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The Use of Digital Media in Empowering Students Digital Literacy and Critical Thinking in Biology Learning

M. Imam Fauzi, State University of Malang, Indonesia
Mimien Henie Irawati Al Muhdhar, State University of Malang, Indonesia
Hendra Susanto, State University of Malang, Indonesia

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Abstract
This research is qualitative and aims to find out how digital media is used to empower students' digital literacy and critical thinking in biology learning. The methods used were filling out questionnaires and conducting interviews. Seventy-six eleventh grade students of SMA Negeri 1 Kesesi, Indonesia, and two biology teachers were selected as the research sample in this study. The research results showed the following aspects: Firstly, the student's digital literacy questionnaire is 71%, which is classified as moderate in digital literacy indicators including finding, using sources, selecting, evaluating, considering sources, message effects, and using data to produce work; secondly, students critical thinking skills is 65% which is classified as relatively low, not yet able to assess evidence, compare and contrast various objects with actual conditions and cannot examine them objectively; thirdly, some of the things that teachers do to train these two skills are by inviting students to search for information via Google/search engines and video searches to support the teacher's explanations, using Canva to make some presentation and using Google Lens to image any plants around the school. Unfortunately, teachers do not train them on how to search using appropriate keywords and trusted sources. Finally, teachers must be more active and innovative in maximizing the wise use of digital media to improve students' digital literacy and critical thinking skills.

Keywords: Biology Learning, Digital Literacy, Critical Thinking

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Introduction

Education in the 21st century has challenges in the form of VUCA (Volatility, Uncertainty, Complexity, and Ambiguity), a condition that indicates very dynamic and rapid changes, is difficult to predict, difficult to understand the causes and effects of something, and has a variety of results that cannot be explained clearly (Mohanta et al., 2020). These challenges mean that education in the 21st century needs to continuously survive and innovate in the current competitive era. Efforts that can be made are to equip and train students with appropriate skills, such as digital literacy and critical thinking.

In education, especially in biology, digital literacy needs to be trained and studied to form a digitally literate generation of the nation's young people. Increasing digital literacy is able to form self-control as a solution to prevent cases of the circulation of false information (hoaxes) from recurring and increasing in number (Sabrina, 2019). Hoaxes usually contain inaccurate information and hate speech that can incite, corner, and even provoke religious, ideological, and other figures. Hoaxes occurs when non-face-to-face interactions between people on social media encourage courage to express opinions or statements that involve insults, hate speech, and bullying (Jusnita & Ali, 2022).

Critical thinking skills are cognitive activities that are connected to the use of the mind (Cotrell, 2005), or the process of solving problems carefully and thinking clearly. A person with thinking skills will be able to question something appropriately, as well as gather relevant information, obtain logical reasons, and think critically based on existing information to draw a conclusion (Reichenbach, 2002). Critical thinking skills are defined by Greenstain (2012) as a way of thinking about any subject, content, or problem in which a thinker skillfully uses the quality of his thinking and forces his intellectual standards to increase. Thinking skills include cognitive abilities and emotional aspects (disposition). Critical thinking skills include interpretation, inference, explanation, evaluation, self-regulation, analysis, and induction and deduction processes in finding reasons (Profetto-McGrath, 2003). Critical thinking skills require cognitive abilities, a habit of deep inquiry, and a desire to think through different problems. The application of this ability causes a person to feel the need to achieve knowledge in the real world.

Based on the background above, the researcher studied how the use of digital media in high school empowering students' digital literacy and critical thinking skills in biology learning.

Method

The research method is qualitative used mix both quistionaire and interview. The data has taken on 9-10 Oktober 2023 in SMA Negeri 1 Kesesi, Pekalongan, Central Java, Indonesia. Qualitative research is a term with varying meanings in educational research. In example, Borg and Gall (1989) suggest that the term is often used interchangeably with terms such as naturalistic, etnograpic, subjective and pospositivistic. A quistionnaire used to measure students perception about digital literacy and crical thinking skill was used in this research. The initial item bank contained 26 items based on digital literacy and critical thinking skills by Arends (2003). All items were scored on a 5-point Likert Scale. A total 76 eleventh grade students of SMA Negeri 1 Kesesi, Indonesia, completed the quistionnaire. Only those students who completed the full quistionnaire were included in the analyses.

Polit and Beck (2006) defined the interview as a methode of data collection in which one person ask question of another person: interviews are conducted either face to face or by telephone. Two biology teacher of SMA Negeri 1 Kesesi participated in interviews. On average, each interview lasted 40 minutes. All interviews were semi-structured and focused on the three topics included digital literacy, critical thinking skill and digital media. The research questions in this study are following:

- What they know about digital literacy and critical thinking skill?
- What kinds of technolgy do they use before classes?
- What kinds of digital media do they use before classes?
- Do students show digital literacy during classes?
- What kinds method do they use to train digital literacy and critical thinking skill?

Results and Discussion

This study aimed to find out how digital media is used to empower students' digital literacy and critical thinking in biology learning. Student questionnaire results shows that the digital literacy of class XI students at SMA Negeri 1 Kesesi classified as medium with an average yield of 71%, with details of the average for each indicator as follows: The first indicator of digital literacy is skills found that getting a score of 74% was moderate. These results show that students are able to sort through choices and independently find information related to or relevant to the problem.

The second indicator Digital literacy, namely the skill of using sources, gets a score of 69% relatively low, so students are able to access some information, but usually misses the problem keyword. The third indicator of digital literacy, namely chose to get a score of 69%, which is low, indicating that students not yet able to select and make exceptions to the source of information and not being able to make the right choice from a wide range of options. The fourth indicator for digital literacy, namely evaluating, getting a score of 77%, which is classified as moderate, shows that students are able to complete source and author verification but are not yet aware of the bias in the information. The fifth indicator of literacy digital, namely considering the source and effect of the message, gets a score of 77%, classified as moderate, indicating that students are aware that there is persuasive or invitation to the information obtained but unable to explain method used. The sixth indicator of digital literacy is using data to produces work that gets a score of 72%, which is classified as medium, showing that students are skilled at creating new works from the information obtained, however has not used strong analysis and evaluation.

Those result is in line with the results of teacher interviews stated that there were still many students who did not consider the message effect of the information they obtain or use and the information validation process is still minimal, so there are tendencies. Students are easily exposed to biased information and hoaxes.

The student questionnaire shows that the critical thinking skills of the class The indicator of using data to develop critical insight is choosing to get a score of 74%, which is classified as moderate, meaning that students are able to use the selected data to draw conclusions that are in accordance with the facts but are not completely accurate. The analysing indicator gets a score of 53.4%, which is low, meaning that students are able to explain the main problem inaccurately and cannot examine it objectively. The synthesising indicator gets a score of 75%, which is considered moderate, indicating that students are able to identify and compare

the components of an argument but are not yet skilled at combining the components of an argument into one complete piece of new information.

Students' thinking skills are low due to the cognitive training that students are given only around the ability to remember and understand (Saparuddin et al., 2021; Shafira et al., 2023). If critical thinking skills are not trained or developed, a person will continue to be in their initial condition and have an impact on their digital literacy (Delima et al., 2023; Indah et al., 2022).

One of the efforts made by teachers is by creating or using multimedia in learning. Digital multimedia have been proven to be able to increase student motivation and learning outcomes (Nofitasari, 2012; Leow, 2014), as well as improve students' critical thinking skills in science learning (Syawaludin, 2019).

The interview results show that teachers have used digital media in biology learning, for example the use of search engines to add information about the topic being studied, the use of Google Lens to help students naming and classifying plants at school and the use of Canva to make presentations. Unfortunately, this process still lacks teacher supervision, especially in determining reliable sources of information and applying keywords when searching, giving rise to bias and the possibility of misinformation.

Conclusion

Based on the results and discussion of this research, the following conclusions were obtained.

1. Digital media can be use by teacher in biology class to empowering students digital literacy and critical thinking skill.
2. Teacher should choose some leaning model when they use digital media.

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Contact emails: m.imam.2203418@students.um.ac.id
mimien.henie..fmipa@um.ac.id
hendrabio@um.ac.id

Illiteracy Eradication Strategies in Indonesian Rural Schools Using the I Love Reading (SSM) Curriculum

Astina Hotnauli Marpaung, Yogyakarta State University, Indonesia
Hiryanto, Yogyakarta State University, Indonesia

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Abstract
This study examines the implementation of the SSM curriculum in eradicating illiteracy in rural Indonesian schools and identifies contributing factors to illiteracy in these areas. Using a qualitative case study approach, data were collected through in-depth interviews with teachers, school principals, parents, and students, alongside direct observations and document analysis. The findings highlight challenges such as children dropping out to assist with family livelihoods, inadequate teacher training, and the lack of a specialized curriculum. Implementation of the SSM curriculum has shown promising results in enhancing both student and teacher engagement by employing phonics, local wisdom-based media, and adaptable teaching resources. This study underscores the significance of contextually relevant curricula in addressing illiteracy in rural areas and aims to contribute to strategies for improving education quality in similar contexts.

Keywords: Illiteracy Eradication, SSM Curriculum, Rural Education, Indonesia

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Introduction

Education plays a pivotal role in improving the quality of human resources and life. However, in rural Indonesia, education quality remains alarmingly low, hindered by factors such as difficult geographical conditions, lack of educational infrastructure, low teacher quality and welfare, and minimal government attention. These issues contribute to high illiteracy rates, particularly in remote areas.

As of 2021, 9.24% of Indonesians aged 45 and above were illiterate, while 1.50% of those aged 15–59 years remained illiterate in 2022 (BPS, 2022). The productive age group (15–19 years) exhibited the highest illiteracy rates, indicating a missed opportunity for human resource development. Poor literacy and numeracy exacerbate social exclusion and alienation, particularly in disadvantaged communities (Hajaj, 2002).

Factors Contributing to Illiteracy in Rural Indonesia

Various factors contribute to this issue, including lack of motivation, varying intelligence levels, and external influences from family, school, and community environments (Sartina et al., 2020). Economic constraints and limited access to education historically have also played a role (Waziroh, 2021). To address this problem, government and non-formal institutions have implemented literacy programs, though these often face challenges such as inadequate learning hours and low student motivation. Successful interventions have included involving religious leaders to increase learner motivation (Anto, 2020), optimizing literacy activities in early childhood education and elementary schools, and providing reading materials (Sudarwita, 2022).

Implementation of the SSM Curriculum in Rural Schools

Several recent studies have explored innovative approaches to eradicate illiteracy in remote areas of Indonesia. The use of flashcards has shown promising results in improving basic reading and writing skills in Sorong district, West Papua (Kasri et al., 2023). Integrating local culture and activities into literacy instructional design has been effective in improving adult reading skills in disadvantaged areas (Hadianto et al., 2022). In Papua, utilizing folklore and mother tongue materials has been proposed as a culturally appropriate strategy to strengthen literacy programs and preserve local languages (Yektiningtyas-Modouw & Karna, 2013). Environment-based literacy programs have also been implemented, as seen in Owata Village, Gorontalo Province, where the surrounding environment became a learning resource for vocabulary and sentence acquisition, resulting in reduced illiteracy rates and increased awareness of environmental conservation (Supriyadi & Kadir, 2020).

Over three years of living and working in 3T areas (Outermost, Frontier, and Disadvantaged), including Nias (North Sumatra), East Nusa Tenggara, and the Mentawai Islands (West Sumatra), the author observed a persistent issue of illiteracy in rural Indonesian schools, where many students in grades 3–5 still cannot read, write, or perform basic arithmetic. These students are often promoted despite lacking foundational skills, as formal schools struggle to address their needs due to limited teacher resources, inadequate teaching materials, and the absence of a special curriculum. Factors such as students missing school to help their families, the blending of illiterate and literate students in one classroom without differentiated instruction, and teachers focusing only on academically capable students exacerbate the problem. Furthermore, the lack of teacher training, low teacher welfare, and insufficient

learning media contribute to the ongoing challenge of illiteracy eradication in these rural areas.

To address the problem of illiteracy in rural areas, it is necessary to develop an effective literacy curriculum that suits local needs. The SSM (Saya Suka Membaca) curriculum offers a step-by-step approach to teaching children to read, utilising learning media based on local wisdom. Research shows that local context-based approaches can increase participation and success of literacy programmes. For example, research by (Hiryanto, 2009) on the illiteracy eradication programme through Kuliah Kerja Nyata (KKN) in Bantul showed success because it integrated local themes and relevant learning resources. In addition, the social context-based education theory proposed by Freire, (2017) emphasises the importance of education that is relevant to students' life experiences and cultural backgrounds, which can increase their motivation and participation in learning.

The functional curriculum theory described by Kress (2003) is also relevant in this context, where literacy is not only about the ability to read and write, but also about the ability to use these skills in practical situations. The active learning approach proposed by John Dewey (1938), which involves direct experience and active interaction of students with learning materials, has been shown to be effective in improving literacy skills. That literacy curriculum interventions that focus on local needs can reduce illiteracy rates in different community groups, emphasising the importance of curriculum development that is appropriate to students' social and cultural contexts (Dewey, 2022).

The SSM (Saya Suka Membaca) curriculum offers a potential answer. Designed to foster literacy through phonics, interactive media, and local wisdom, the curriculum has demonstrated success in improving literacy rates in diverse contexts across Indonesia. This study explores its implementation in rural schools to identify its impact and potential as a model for addressing illiteracy nationwide. In 2018, SSM Curriculum materials were used in the teaching process for more than 4,500 children in 12 Indonesian provinces, ranging from North Sumatra (Nias) to Papua (Merauke), more than doubling the number compared to the previous year, where we served 1,800 children in 2017. The SSM curriculum has provided more than 6000 reading books to partners, including UNICEF and Room to Read. Therefore, researchers are interested in examining how the strategy of eradicating illiteracy in Indonesian rural schools using the SSM curriculum.

Conclusion

The research method used is qualitative research with a case study approach. According to Creswell, in Sugiyono (2023: 45) a case study is a type of qualitative research, where the author conducts in-depth exploration of programs, events, processes, activities for individuals related to time and activities. Case studies aim to study intensively the background of the problem of the current situation and position of an event, as well as the interaction of certain social environments that are as they are. Data were collected through in-depth interviews with rural teachers (20 people), local teachers (4 people), principals in rural schools (3 people), parents (5 people) and students in grades 3-5 who were still illiterate (25 people) who were the subjects of this study. In addition, direct observation and analysis of related documents were also conducted. All information obtained from the field was verified for accuracy through a data triangulation process.

Based on the results of the analysis conducted by the researcher, several factors were found to influence the presence of illiterate high school students in Indonesian rural schools.

a. Factors Influencing Illiteracy Among High School Students in Rural Indonesia

1. Many students leave school because they have to follow their parents to the plantation or to the forest to harvest or hunt, causing them to miss many lessons and even drop out of school but they can return to the same class or even age-appropriate class whenever they come down from the mountain or return from the forest. This indecisive system creates an imbalance of literacy learning needs in one classroom.
2. Illiterate students and students with good academic abilities are combined in one class and there is no special attention or learning for illiterate children so that illiterate students are only present in the class without being able to participate in learning.
3. Teachers in Indonesia's rural schools have no guidelines, teaching materials, modules and no skills training on how they should eradicate illiteracy in the rural schools where they serve.
4. Teachers' unemployment and students' backgrounds from underprivileged families mean that there is limited access to reading resources and effective learning media for children who cannot read.
5. There are still many teachers who focus only on students whose academic abilities are considered good and ignore students who are difficult to teach calistung since the lower grades.

b. The Stages Undertaken by Rural Teachers in Carrying Out Illiteracy Eradication Strategies Using the SSM Curriculum Are As Follows:

1. Identifying students' reading ability and then grouping students based on SSM curriculum levels, namely letter sound class, syllable class, word and sentence class and independent reading class. So that students in one class can vary in age but almost the same learning needs in literacy.
2. Teaching letter sounds (lL, Kk, Mm, Pp consonant letters and vowels until 26 letters are completed). At this level or stage, letters are not introduced or taught in order A-Z but randomly to prevent students from recognizing letters by memorizing but should remember because of understanding not because of memorization. This stage also learns both lowercase and capital letters at the same time and avoids learning similar letters in close proximity such as nN and Mm. Before starting the lesson, the teacher explains to the students what letters they will learn today. The teacher explains and pronounces several names of objects beginning with the letter L. The teacher invites students to look at several different pictures drawn on the blackboard or pasted on the classroom wall (can be printouts, results drawn by the teacher or can be cutouts from used snack wrappers and then leads students to say together all these objects whether the sound of the initial name of the object is the same or different. For the student activity sheet, there are several activities such as finding and then circling the letter being studied that day among many other letters, collaging letters using origami or other used paper according to the teacher's creativity, sticking letters on dry wooden twigs provided by the teacher (letter trees), games to find letters behind friends' chairs and learning to recognize letters written on leaves. For the letter sound stage, students are invited to sing a letter sound song with the same tone for each letter, only changing the name of the object according to the initial letter being studied at that time. The lyrics of the song are as follows: lL flies flies flies Flies start with L L L L L L That's the letter L.

Figure 1: Origami Letter Collage

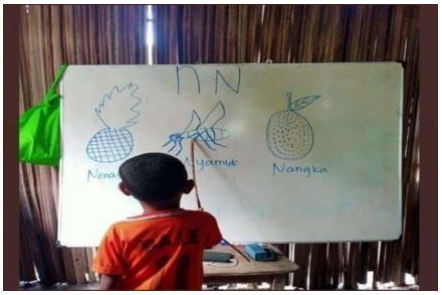

Figure 2: Learning the Letter nN

3. Syllables. At this stage, all students from the letter sound class are expected to recognize and be able to write letters. The teacher teaches students to combine two syllables combining consonant letters and vocal letters such as Sa-Pu. In addition to reading aloud combining 2-3 syllables in front of the blackboard, teachers can also provide learning media in the form of letter cards. Letter cards do not have to be purchased but can also be made by yourself with cardboard written with letters using markers.

Figure 3: Reading Two-Syllable Picture Story Words

4. Words and sentences. The learning objectives at this level are for children to: a. Assemble simple syllables to form new words. b. Explore new varieties of syllables (for example, words ending in the syllable "h", or containing "ng"). c. Follow the reading of simple stories. d. Read simple stories together in class and afterwards individually. e. Read simple questions about the stories they read and write the answers. f. Read stories together in class and afterwards individually.

Figure 4: The Child Reads the Sentence Written on the Leaf

5. Independent reading. This is the final level and the goal of all levels of the SSM curriculum. At this level, the learning objectives are for children to achieve several things, including: a. Practice reading independently to improve their ability to read fluently and understand the content. b. Demonstrate their understanding of the reading

material by writing responses to questions about books they have not read before. c. Understand the proper use of capitalization, as well as punctuation marks such as periods, question marks, and exclamation marks. d. Develop an interest and enjoyment in reading as well as the overall learning process.

The conclusion from the results of this study is that there is an increase in the willingness or participation of high grade students (3-5) to take part in learning because the learning process is adjusted to the agreement with students in the afternoon or evening for students who have to go to the forest to hunt or hunt. Students are also happy in the learning process because in one class all have the same learning objectives so that there are no passive students. The enthusiasm of illiterate students to immediately be able to go to the next stage or level is very high because the motivation is to show everyone that they can read and learning to read is fun. Teachers also feel a positive impact when preparing activity sheets or learning media plans for each level of the SSM curriculum because they can be created with materials provided by nature so that teachers are more happy to be able to teach for good without feeling burdened. Teachers who implemented the SSM Curriculum stated that they benefited from a better understanding of reading teaching methods, felt re-inspired, had a more defined vision for the teaching process, and became more efficient in lesson preparation. They also noted that the children they taught progressed in learning to read more quickly and showed greater interest in reading independently.

Related to the above conclusions, some suggestions for rural schools and the government are that schools need to collaborate with the Tuna Aksara Foundation and the local government or Education Office to provide training on the practice-based SSM curriculum to rural teachers so that in the future classroom teachers for low grades are able to cope with student literacy learning from grade 1 and there are no more illiterate students in high grades (3-5). The SSM curriculum demonstrates significant potential in addressing illiteracy in rural Indonesia by leveraging phonics-based instruction, local wisdom, and adaptable teaching methods. This study highlights the urgent need for targeted literacy programs and specialized teacher training in rural areas. By adopting contextually relevant curricula, Indonesia can make substantial progress toward eradicating illiteracy and improving educational equity.

Future research should explore the long-term impact of the SSM curriculum and its scalability to other rural contexts. Collaborative efforts between policymakers, educators, and communities are essential to ensure sustainable and impactful literacy interventions.

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Contact email: astinahotnauli.2023@student.uny.ac.id

Facilitator's Perception of Module Effectiveness: A Qualitative Review in Ministry of Religious Affairs Teacher CPD Training

Muliyani Olvah, State University of Malang, Indonesia
Muhammad Alfan, State University of Malang, Indonesia
Toto Nusantara, State University of Malang, Indonesia
Shirly Rizki Kusumaningrum, State University of Malang, Indonesia
Radeni Sukma Indra Dewi, State University of Malang, Indonesia

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Abstract
The MEQR Component 3 Project is an activity to strengthen and develop the capacity of supervisors, madrasah heads, teachers, librarians, and laboratory workers through tiered training. Modules are an integral part of this training activity. This qualitative research aims to obtain information on the effectiveness of training modules in CPD Teacher activities. This study involved 6 facilitators who were determined using a simple random sampling technique. Data was taken using interview techniques and document analysis and then analyzed descriptively. The results showed that in the aspect of module readability, facilitators have a good perception. Most of the interview results showed that the modules used had a language that was easy to understand. From the aspect of the module content, most facilitators argue that the content of the CPD Teacher module is still not optimal and requires improvement in the form of curriculum adjustments and clarifying learning stages. Furthermore, in terms of the utilization of modules by participants, facilitators have the opinion that their utilization is still not optimal because most participants still like to read information and materials from PPT compared to modules. Following up on the results of this study, it is recommended that the module revision be made in the form of curriculum adjustments and module design, and further research is needed related to participants' interest in reading the CPD Teacher module.

Keywords: CPD Teachers, Facilitators, Training Modules, Teacher Training

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Introduction

Education is the main foundation for shaping a superior future generation (Presidential Regulation of the Republic of Indonesia Number 87 on Strengthening Character Education, 2017). The quality of education is influenced by various factors, one of which is the success of delivering material to educators. In this context, teacher skills in designing fun learning are indispensable (Sudrajat, 2020). Teachers are expected to participate in professional development activities regularly to improve their professionalism and support their careers. Therefore, the Ministry of Religious Affairs, through the program Madrasah Education Quality Reform (MEQR), initiated Project Component 3: Policy and Continuous Professional Development for Teachers and Education Personnel in Madrasah (Kementerian Agama, 2021).

Project Component 3: Policy and Continuous Professional Development for Teachers, Education Personnel in Madrasah, commonly called CPD Project for Teachers and Educators, is an activity to provide strengthening and capacity building of supervisors, madrasah heads, teachers, librarians, and laboratories through tiered training. This activity involves Working Groups such as KKG, MGMP, MGBK, and KKM as part of its training facilities (Kementerian Agama, 2021). Strengthening and development activities are carried out in stages, starting with module writers, National Instructors, Provincial Facilitators, Regional Facilitators, and teachers.

Facilitators have a crucial role as mediators between training materials and participants in teacher competency-strengthening training (CPD) (Waluyo, 2021). They are not only teachers but also facilitators of learning who connect theory with practice in the field (Imtihanah & Gumati, 2022). CPD Guru facilitators are responsible for ensuring that the material presented is not only understood but also effectively applied by the participants (Milaini et al., 2023). They play an important role in creating an inclusive learning environment, facilitating enriching discussions, and providing in-depth guidance in the learning process (Burhamzah et al., 2023).

CPD facilitators are responsible for understanding the individual needs of participants as companions in teacher professional development (Holiah, 2022). They must be able to adapt the learning approach according to the participants' characteristics and facilitate a results-oriented learning process (Giu, 2021). More than just providing information, CPD facilitators are expected to build teacher skills in applying new knowledge to their teaching context (Adia, 2022). With a responsive and interactive approach, CPD Guru facilitators are not only introducers to information but also mentors who encourage reflection and ongoing professional development for participants (Sugiyono & Setiawati, 2020).

Teacher training modules are teaching materials that are systematically designed and presented to assist teachers in improving their competencies. In the context of education, teacher training modules can serve as operational guidance for education and training institutions (Kementrian Pekerjaan Umum dan Perumahan Rakyat, 2019). The concept of the CPD Teacher module in the MEQR Component 3 Project is designed to contain several Learning Units (UP), with each learning unit having 3 stages, namely In Service Learning 1, On Service Learning, and In-Service Learning *2* (Hairunisah et al., 2020). This module not only contains information but also presents learning materials with an approach that facilitates an interactive, fun, and easy-to-understand teaching-learning process (Putri Kumalasani & Eilmelda, 2022). This teacher's CPD module can also function as a teaching

module because each UP contains examples of learning designs that teachers can apply in madrasah.

Apart from being a guide for participants in attending training, the CPD Guru module also aims to be a reference source that can be reaccessed after completing the training. Good modules are comprehensively designed to include a variety of learning methods, case examples, and activities that support the understanding and application of training materials in the field (Maulinda, 2022). An effective CPD Teacher module can also arouse participants' interest in learning and facilitate the process of reflection and improvement of teacher professionalism (Nadeak et al., 2023).

Unfortunately, no research has examined how effective the CPD Master module is in the MEQR Component 3 Project until now. Information about the effectiveness of modules in this activity is needed, especially by policymakers and module authors, so that they can be input and produce even better teacher training modules.

Various studies regarding module development have been carried out before (Sulistiyono, 2022; Wulandari & Iriani, 2018). Some papers also lead to research to evaluate modules (Firdaus et al., 2023). However, the variables of the study are all teaching modules for students. In line with this information, research examining the effectiveness of training modules has never been conducted. This research needs to be done because it can provide information about how efficiently the use of modules in the CPD Teacher training activities of the MEQR Component 3 Project. In addition, this research can also be the basis for research on the development of teacher training modules. Therefore, the purpose of this study is to see an overview of the effectiveness of the CPD Teacher training module from the perspective of the facilitator.

Method

This research uses a qualitative descriptive approach with data collection methods through interviews and document analysis. The study was conducted from October to December 2023 using interview techniques with several facilitators in data collection. The facilitators selected to be interviewed in this study were 6 people.

In the data collection process, researchers involved Provincial Facilitators and Regional Facilitators as resource persons. Researchers conducted observations and interviews through *WhatsApp media*. Researchers also conduct regulatory analysis and training technical guidelines for CPD Teachers and write modules to gain a deeper understanding of the implementation of teacher CPD and module writing. The instrument used here is an interview guide sheet that contains aspects that want to be researched in general related to the extent of the effectiveness of using the CPD Teacher training module in training activities using general guidelines (Patton, 1990). The leading information to be obtained through interviews included the shortcomings of the training module, its readability, construction, and use by participants during the training. This study used the Miles and Huberman Model for data analysis (Sugiyono, 2022). With data reduction analysis steps, data display, and conclusion drawing/verification.

Result and Discussion

MEQR Component 3 Project Teacher CPD Training Module

The Teacher CPD Training Module Component 3 of the MEQR Project of the Ministry of Religious Affairs is part of the efforts to strengthen the ministry's policies and programs related to Continuing Professional Development (CPD) for Teachers and Education Personnel in Madrasahs. This module is designed to provide strengthening and development through working groups, tiered training, and preparation of prospective madrasah heads and supervisors (Kementerian Agama, 2021). This module is teaching material packaged systematically. It contains a set of planned learning experiences and can be used as an operational guide for institutions that organize education and training (Decree of the Director General of Islamic Education Number 4447 of 2020 Concerning Guidelines for the Preparation of Madrasah Teacher Continuing Professional Development Modules, 2020).

The Component 3 project is one part of the Madrasah Education Quality Reform program initiated by the Ministry of Religious Affairs. This program consists of 4 components, namely: Implementation of the e-RKAM (Electronic-based Madrasah Work and Budget Plan) System Nationally and Provision of Assistance Funds for Madrasahs, Implementation of Learning Outcome Assessment System at Madrasah Ibtidaiyah (MI) level for All Grade 4 Learners Nationally Lack of Training Modules, Policies and Continuous Professional Development for Teachers, Education Personnel in Madrasahs, and System Strengthening to Support Quality Development. (Kementerian Agama, 2020)This project aims to assist the government in achieving its Sustainable Development Goals (SDGs). It is funded by a 50 USD per year World Bank grant.

One of the components of the MEQR program is the Component 3 Policy and Continuing Professional Development Project for Teachers and Education Personnel in Madrasahs. This project aims to provide development and strengthening through working groups, training, learning resources for teachers, and Teacher Competency Assessments, as well as strengthening the capacity of supervisors, madrasah heads, librarians, and laboratorians through tiered training (Kementerian Agama, 2021). This project runs from 2020 to 2024.

The main reasons for teachers' CPD activities are individual teacher needs, government needs, learner needs, madrasah needs, and the needs of educational institutions or foundations. The needs of individual teachers are reflected in the results of teacher assessments through the Teacher Needs Assessment (AKG) and Teacher Performance Assessment (PKG). Furthermore, government needs are based on government program priorities. The needs of educational institutions or foundations are based on the priority programs of the educational institutions or foundations themselves, especially teachers in private schools. So based on these needs, it is necessary to determine the priority programs that must be implemented by teachers in implementing CPD. (Decree of the Director General of Islamic Education Number 6673 of 2019 Concerning Technical Guidelines for Implementing Madrasah Teachers' Continuing Professional Development, 2019).

In training activities organized by MEQR, training modules are required as one of the training teaching materials. A package of teaching materials or teaching materials that contains one learning unit that can be read and studied independently is called a module. Modules are also referred to as media for self-study because they are equipped with instructions for self-study. Modules are designed as a guide for facilitators to help

participants achieve their learning objectives. (Decree of the Director General of Islamic Education Number 4447 of 2020 Concerning Guidelines for the Preparation of Madrasah Teacher Continuing Professional Development Modules, 2020). In general, the module consists of 1) target competencies to be achieved; 2) materials and topics that will be the basis of the teaching and learning process; 3) tools and materials to be used; 4) activity steps; 5) worksheets; 6) additional information; 7) assessment; 8) glossary; and 9) bibliography. By using modules, learning objectives can be achieved effectively and efficiently. Modules also allow participants to learn according to their abilities, methods, and techniques (Najuah et al., 2020). Module characteristics, according to the Module Writing Book, include self-instructional, self-contained, stand-alone, adaptive, and user-friendly (Directorate of Education Personnel Ministry of National Education, 2008). Self-instructional means that trainees can learn by themselves through the module and do not depend on themselves. Self-contained means that the module must contain all the material as a whole so that participants can easily learn the module. Stand-alone means that the module is not connected to other media or does not have to be used together with other media. Adaptive means that the module must adjust to the development of science and technology so that it can adapt to the current conditions of the participants. User-friendly means that the module must be easy to understand and use and follow user needs. Based on these definitions and characteristics, it can be concluded that modules are indispensable and have an important role in the training process. The function of the module is as a substitute for facilitators, teaching materials, evaluation tools, and reference materials.

The structure of the MEQR Component 3 Project Teacher CPD module consists of a module introduction, introduction, learning objectives and outcomes, learning flow, learning activities, glossary, PowerPoint slides (PPT), and bibliography (Decree of the Director General of Islamic Education Number 4447 of 2020 Concerning Guidelines for the Preparation of Madrasah Teacher Continuing Professional Development Modules, 2020). The introductory section explains the module's background, summarizes it in several Units of Learning (UPs), explains the module's interrelationship between UPs, explains the training approach used and provides guidelines for using the module.

Furthermore, the introduction explains the content of the UP and the reason why the material is part of the module. The objectives and learning outcomes focus on the teacher competency targets that will be developed in the UP following Permendiknas No. 16 of 2007 concerning Teacher Qualification and Competency Standards. Teacher competency targets are coupled with student competency targets consisting of knowledge, skills, and attitudes, each of which includes KI and KD according to Permendikbud No. 37 of 2018 concerning Amendments to Regulation of the Minister of Education and Culture No. 24 of 2016 concerning Core Competencies and Basic Competencies in the 2013 Curriculum in Primary Education and Secondary Education. In addition, the learning flow section contains a summary in flowchart form of the training process and time allocation through the stages of In-Service Learning 1 (IN1), On Job Learning (ON), and In-Service Learning 2 (IN2).

Learning Activities are the most crucial part of this module. This section contains the activity steps as well as the methods, approaches, materials sources, and techniques used to achieve the competencies expected in the module. In each activity step, there are Worksheets (LK) in the form of assignments or assessments and Additional Information (IT) which aims to expand knowledge of the concepts given or as a reference for further assignments. The learning activities consist of three main activities, namely the In-Service Learning (IN1) activity step, where in this activity participants will get material from the facilitator, work on

tasks in groups, and then create a learning design to be applied at the On-Service Learning (ON) stage. Furthermore, in On Service Learning (ON) activities, participants return to their respective madrasahs to implement the learning designs they have made in IN1. Then, in In Service Learning 2 (IN2), participants return together with the facilitator to reflect on what they have done in the madrasah.

The Glossary section contains concepts and terms that are new to participants. The PowerPoint slides (PPT) section is displayed during the training. This section contains text, relevant images, diagrams, tables, graphs, and more. The last section is the Bibliography, which contains a list of reference sources used in the module.

Module Readability

Module readability refers to the ability of the module to be presented in a clear, understandable, and accessible manner by the reader or trainee. Readability is not only limited to the ease of reading the words but also to the ability of participants to understand the information presented without significant difficulty (McLaughlin, 1969). This includes using simple language, a structured layout, and supportive visual elements to clarify the concepts being taught.

The importance of readability in training modules is that trainees can access information easily and effectively, improve their understanding of the material, and minimize barriers or confusion when learning the content presented in the module. Thus, a module that has good readability will support the purpose of the training itself, which is to provide knowledge and skills to participants efficiently and effectively.

Based on the results of interviews with 6 facilitators regarding the readability of the Teacher ESC training module, the following data were obtained:

Table 1: Interview Transcript Related to Module Readability

Interviewer	Interview Transcript
1st Facilitator	For the student section of the module, the language is light and easy to understand by students.
2nd Facilitator	There is some language that is not neatly arranged, and the appearance of the module is not attractive.
3rd Facilitator	Overall, the module is easy to understand, especially in the learning design section.
4th Facilitator	The language used is clear and easy to understand, and the display is less colorful.
5th Facilitator	For the facilitator's part, the parts that must be done are clear. In terms of teachers, there are no clear steps, so teachers have to interpret their steps to the madrasah at the time of ON.
6th Facilitator	The module is good and easy to understand.

Based on the data in Table 1, the module's readability is generally good. Most (4 facilitators) said that the language is easy to understand so that the trainees easily accept the information. This is following McLaughlin's opinion that readability is not only limited to words but also to the ease of understanding the information in the module (McLaughlin, 1969). However, there is one facilitator who thinks that the readability is suitable or can be understood during

the learning stage by the facilitator. However, for the learning stages carried out by teachers to students, the readability is still lacking. In addition, 2 facilitators think that the appearance of the module is still not attractive. Therefore, it can be concluded that the perception of facilitators on the readability aspect of the module can be said to be good because, in terms of language, it is easy to understand with light language. As stated in the Technical Guidelines for Writing Teacher CPD Modules, the module must be user-friendly or easy to understand and use by trainees (Decree of the Director General of Islamic Education Number 4447 of 2020 Concerning Guidelines for the Preparation of Madrasah Teacher Continuing Professional Development Modules, 2020).

Module Content

Content in a module refers to information or learning materials that are systematically organized to be delivered to trainees (Sumardjo et al., 2020). The role of content is crucial as it forms the core of the entire module, providing the substance or information to be learned and understood by participants. Good content ensures that the material presented is not only relevant to the learning objectives but also delivered in a clear, structured, and easy-to-understand manner, enabling participants to achieve a deep understanding of the topics taught. Thus, understanding and selecting the right content is an important cornerstone in the construction of a module that is effective in supporting the learning process.

In addition to readability, facilitators were also interviewed to find out their perspectives on the content of the MEQR Component 3 Project Teacher CPD module. The following is a table of interview transcripts for the module construction section:

Table 2: Interview Transcript Related to Module Content

Interviewer	Interview Transcript
1st Facilitator	In the module, teachers seem to be dictated to conduct learning in the same way as the module. Regarding alternative energy materials, the solutions offered are even more expensive and inefficient.
2nd Facilitator	The content is still lacking and needs to be revised.
3rd Facilitator	In general, the content meets the learning needs of students in the classroom related to the material.
4th Facilitator	Not yet paying attention to the diversity of learning, feedback is good with the stimulus at the beginning.
5th Facilitator	The upper-grade module needs to be revised so that the content is more "applicable." The order of material delivery in some sections is still unclear, and it needs to adjust to the new curriculum.
6th Facilitator	For the low-grade module, the stages are less coherent and less clear.

Based on the interview results in Table 2 above, most of the 6 facilitators expressed dissatisfaction with the content of the module. In terms of learning stages, 3 of the 6 facilitators thought that the stages were not clear enough, and 1 facilitator thought that the learning stages were too rigid so that teachers could not innovate when implementing them in madrasah in ON sessions. Furthermore, there is 1 facilitator who believes that the module is not following the Merdeka Belajar curriculum and 1 facilitator who believes that the module content still does not pay attention to student diversity. This is following the Technical

Guidelines for Writing Teacher CPD Modules, that participant modules must be adaptive and self-contained so that participants can study and understand the module as a whole even though there is no facilitator (Decree of the Director General of Islamic Education Number 4447 of 2020 Concerning Guidelines for the Preparation of Madrasah Teacher Continuing Professional Development Modules, 2020). Thus, it can be concluded that the facilitators were dissatisfied with the content and needed improvement.

Module Utilization by Participants During Training

Module utilization by participants refers to the process by which participants use, understand, and apply the material presented in the module during the training process (Muhardini et al., 2023). It involves the way participants learn, understand, and integrate information from the module into their understanding of the subject being studied. Module utilization does not only include reading or accessing materials but also involves activities, discussions, and practical application of the information presented (Najuah et al., 2020). In other words, module utilization is about how participants use this tool to deepen knowledge, develop skills, and apply learned concepts to an authentic context.

Participant engagement is crucial as it has a direct impact on the effectiveness of learning. When participants are actively involved in utilizing the module, they have the opportunity to understand the material more deeply. (Maskur, 2023), strengthening skills, and applying learned concepts to practical situations. This engagement also allows participants to personalize the learning process according to their individual needs and learning styles, thus making the module not only a learning tool but also a resource they rely on to improve their knowledge and skills. Thus, participant engagement in utilizing the module is key to the success of effective training.

On the aspect of module utilization during training activities, the results of interviews with 6 facilitators are as follows:

Table 3: Interview Transcript related to Module Utilization by Participants During Training

Interviewer	Interview Transcript
1st Facilitator	Participants focused more on the PPT and less on the module. In addition, the practicum activities took too much time and did not allow participants to read the module.
2nd Facilitator	Module utilization was not maximized during the training.
3rd Facilitator	Most participants did not use the module during the training. More focus on PPT.
4th Facilitator	Participants did not utilize the module during the training. When asked to make a design, they did not utilize the module but instead searched the internet.
5th Facilitator	Participants preferred to read the PPT over the module because the PPT was simpler.
6th Facilitator	Participants pay more attention to PPT only, while the module is less used during training.

Based on the interview results in Table 3 above based on their experience, all facilitators agree that participants are less than optimal in utilizing the modules provided. This can be seen from the facilitators' answers, who stated that most and almost all participants preferred

to read the PPT rather than the module itself. So, it can be concluded that the aspect of module utilization by participants during training is still not optimal.

Conclusion

In this study, researchers examined the responses or perspectives of facilitators on three aspects of the module, namely readability, content, and module use by participants during training. The results of this study show that in the aspect of module readability, facilitators have a good perception. It can be seen from most of the interview results that the module used has a language that is easy to understand. Furthermore, in terms of module content, most facilitators believed that the content of the CPD Project Teacher Component 3 module is still not optimal and requires improvement. Both improvements in terms of curriculum adjustments, as well as stages must be clarified. Furthermore, in terms of module utilization by participants, facilitators also have the opinion that the utilization is still not optimal because most participants still like to read information and materials from PPTs rather than modules.

Recommendations

Through the findings obtained in this study, the perception of facilitators as teachers in the CPD Teacher Training Component 3 Project is an input that needs to be considered. Revisions and improvements to the CPD teacher training module should be made, especially regarding the learning stages, design, and adaptation to the current curriculum. In addition, further research needs to be conducted on why trainees prefer PPT to get information on training materials compared to reading the module itself.

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Contact email: muliyani.olvah@gmail.com

Moral Disengagement as a Predictor of Bullying Behavior of Adolescent Students

Chrisanta Kezia Yemima, Universitas Negeri Yogyakarta, Indonesia
Diana Septi Purnama, Universitas Negeri Yogyakarta, Indonesia

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Abstract
Moral development in adolescents is crucial for individuals to make behavioral decisions. Moral disengagement involves eight mechanisms considered a form of self-defense in violating ethical standards. The moral release mechanism that teenagers create makes them quickly engage in immoral behavior with peer groups, such as bullying. This research aims to determine whether moral disengagement can predict bullying behavior among teenage students in Surakarta. The method used in this research is quantitative, employing multiple linear regression analysis. The sample in this study consisted of 60 adolescent students aged 15 to 17 years. The results of this research indicate that the hypothesis using the F test shows that the-eight Moral Disengagement mechanisms have a value of F = 5.062 and a significance of 0.000. The coefficient of determination value R2 is 0.34, and the Adjusted R Square is 35.6%. The results of the multiple linear regression analysis show that the Moral Disengagement mechanisms of bullying behavior as predictors are the variables (X3) Advantageous comparison, (X5) Diffusion of responsibility, (X6) Distorting consequences, and (X8) Attribution of blame.

Keywords: Moral Disengagement, Bullying, Students, Teenager

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Introduction

Morals originate from the etymological terms "mos," which means habit, and "ethos," which means habit or custom in behavior, expressing it with excellent and suitable expressions. According to (Wantah, 2005), morals are related to a person's ability to determine right or wrong, good or bad behavior, and make decisions. Good and bad behavior can be observed from early life when an individual is treated in an environment, which becomes part of the factors of moral formation. Moral values have specific benchmarks and roles in determining whether someone's behavior is right or wrong and what limits exist. Morals are a societal standard regarding what can be considered reasonable and healthy. Morality is an essential foundation in guiding human behavior. However, in some cases, individuals may disregard their moral principles to engage in unethical behavior, such as bullying. Humans should have moral principles in social life as guidelines to help them make decisions before acting and feeling. Morals consist of three essential parts: moral knowledge, feelings, and behavior. Feeling morals involves conscience, trust, empathy, self-control, and humility. Meanwhile, moral behavior is the intention, desire, and habit of doing something (Sarbini et al., 2019).

Individuals with strong moral values can be wise in responding to all events within them. Values in social morals contain goodness and healthy behavior to determine good and bad behavior in society. The guidelines that individuals adhere to will refrain from selfish behavior and prevent manipulation, cheating, stealing, and lying (Elliemiers, Toorn, Paunov & Leuwen, 2019). Morals play a significant role in a person's life in society. Still, several researchers discovered deviant behavior carried out by several individuals who were caught based on CNN data from the 19 December 2018 edition by carrying out a tier operation to see 28 cases with a total of 108 suspects. Based on data from the 2019 edition of the 14th edition of the Mind of the People, it is shown that the number of two-wheeled motorbike riders who violate traffic in Cimahi is 12,679, and 3,276 of them are students. This data shows quite a large number of immoral cases. For example, a child's experience at school with his friends over the years helps the student develop social skills, self-confidence, and experiences that strengthen his social life. On the other hand, students who fail to develop social competence will be rejected by their peers and potentially have problematic developmental impacts on their adult behavior (Parkier & Ashier, 1993). Moral disengagement is the ability to control behavior that allows someone to engage in unhealthy behavior. Bandura (2016) identified several ways individuals justify or rationalize their behavior that violates moral norms. These include dehumanization, where the victim is considered an object or non-human, and denial of personal responsibility. They blame situations or external factors for lousy behavior and reduce sensitivity to acts of violence or downplay their negative impacts. Bandura et al. (2006) Explain that there are eight mechanisms in moral disengagement to maintain behavior without intentionally looking at responsibility, namely Moral Justification, Euphemistic Labeling, Advantageous Comparison, Displacement of Responsibility, Diffusion of Responsibility, Distortion of Consequences, Dehumanization, and Attribution of Blame.

There are various mechanisms used to maintain unhealthy behavior, namely redefining a behavior and individuals taking responsibility beyond their abilities by behaving as if the behavior is considered correct with defense (Feist & Robert, 2017). The comparison is calming to benefit the behavior, which is justified by softening the reprehensible behavior to appear friendly and harmless. According to research (Siregar, 2020), it has been studied that the influence of moral disengagement plays a vital role in providing space for unhealthy adolescent behavior, such as bullying behavior. Malfunctioning self-regulation in the sense of moral disengagement in decision-making has an influence that tends to be unethical. A

student needs good standards or principles in their development to support excellent and wrong, a moral compass that can be used as a guide so that student development can run in a balanced manner. This means that cognitive development that is not running in balance has the potential to give rise to deviant behavior, hurtful actions, and involvement in unhealthy peer relationships, one of which is bullying.

Bullying is a phenomenon that often occurs in adolescence. This phenomenon has been proven to be prevalent among adolescents (Nansel et al., 2004). According to Due and colleagues (2005), 123,227 students aged 13-15 years in Western Europe were found to have a relationship with bullying, leading to psychological symptoms such as nervousness, low self-esteem, and loneliness. Research conducted on students aged 13-16 years in England Smith et al. (2004) revealed that the perpetrators of bullying were students who struggled to adjust well, had low self-understanding, and uncertain moral standards. The influence of unhealthy peer relationships becomes crucial during early adolescence, where developmental tasks, adjustment, and positive peer relationships take precedence over individualism (Hurlock, 1991). Adolescents may feel supported by the group when engaging in bullying behavior, disregarding morals for conformity, and unhealthy group behavior. Slonje (2013) discovered that there were more bullying perpetrators aged 15-18 years compared to those aged 20 years and older, indicating that individuals in this age group may feel emboldened by group relationships with friends at school, providing a sense of protection. Meter and Bauman (2018) explain that moral disengagement creates a space for individuals to engage in harmful actions, increasing hurtful behavior. Conversely, low moral disengagement suggests that individuals who can regulate themselves effectively are less likely to engage in bullying behavior.

Based on the explanation mentioned above, this research aims to determine whether bullying behavior carried out by teenagers affects the eight mechanisms of moral disengagement. This research seeks to combine empirical and recent evidence about bullying behavior towards adolescents, which is influenced by moral disengagement. This research hypothesizes that bullying behavior carried out by teenagers influences morals. It is important to note that moral disengagement is only one factor influencing bullying behavior. However, understanding this concept can provide valuable insight into efforts to prevent and intervene against bullying behavior among adolescent students.

Method

This research is quantitative research with a multiple linear regression model to find additional information or data for researchers. The sampling technique used by researchers for the targeted sample is purposive sampling. The researcher first determines the shape and characteristics of the sample. The characteristics of the sample in this study were teenagers aged between 15 and 17 years. This study included a total of 60 subjects aged 15-17 years. Analysis with more than one independent variable is called multiple linear regression. The multiple linear regression technique determines whether there is an influence between two or more independent variables (multicollinearity and normality test). The hypothesis in this research was carried out using the F and T-test.

The data results were obtained by distributing scale instruments to students, and the assessment used a Likert scale. Two scales are used: the Bullying Behavior Scale and the Moral Disengagement Scale. The Bullying Scale is based on the Olweus Bully/Victim Questionnaire (OBVQ) scale, which identifies bullying by perpetrators and has been adapted

into Indonesian. Bandura (2002) created a moral disengagement scale. This instrument was assessed using a Likert scale. The Cronbach Alpha (α) reliability test measures this scale. If the intercept value is reliable, the level is considered trustworthy.

Results and Discussion

1. Normality Test

The normality test results using the Kolmogorov Smirnov one sample statistical method are as follows.

Table 1: Normality Test Results

		Unstandardized Residuals
N		61
Normal Parameters [a, b]	Mean	.0000000
	Std. Deviation	7.30990264
Most Extreme Differences	Absolute	,070
	Positive	,065
	Negative	-.070
Statistical Tests		,070
Asymp. Sig. (2-tailed)		,200 [c,d]

a. Test distribution is Normal.
b. Calculated from data.

Table 1 shows that the output results have a significance value of 0.20. The data is standard because the significance is more than 0.05 (0.20>0.05). The regression model is suitable for use because it meets the normality assumption.

2. Simultaneous Test (F Test)

To determine the test by creating a hypothesis formula as follows:
H0: βi = means variable (X1) Moral Justification, (X2) Euphemistic language, (X3) Advantageous comparison, (X4) Displacement of responsibility, (X5) Diffusion of responsibility, (X6) Distorting consequences, (X7) Dehumanization and (X8) Attribution of blame. It does not have a joint significant influence on the Bullying variable (Y).

H0: βi ≠ means variable (X1) Moral Justification, (X2) Euphemistic language, (X3) Advantageous comparison, (X4) Displacement of responsibility, (X5) Diffusion of responsibility, (X6) Distorting consequences, (X7) Dehumanization and (X8) Attribution of blame. It has a significant influence on the bullying variable (Y).

In determining significance:
- The significance value (*PValue*)<0.05 means H0 is rejected and H1 is accepted
- The significance value (*Pvalue*)>0.05 means H0 is accepted and H1 is rejected

So it can be concluded if:
- (*Pvalue*)<0.05 then H0 is rejected and H1 is accepted. This means that the independent variables simultaneously influence the dependent variable.
- (*Pvalue*)>0.05 then H0 is accepted and H1 is rejected. This means that the independent variable simultaneously does not influence the dependent variable.

The F Test results in Table 2 are as follows:

Table 2: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1024.066	8	128,008	5,062	,000 [b]
	Residual	1315.016	52	25,289		
	Total	2339.082	60			

a. Dependent Variable: Bullying
b. Predictors: (Constant), Attribution of blame, Diffusion of responsibility, Distorting consequences, Moral Justification, Advantageous comparison, Dehumanization, Displacement of responsibility, Euphemistic language

Based on the F-test results above, it can be seen that the calculated F-value is 5.062 with a significance level of 0.00. The significance level is 95% (α=0.05), 0.00<0.05 for this comparison. Therefore, H0 is rejected, which means the variables (X1) Moral Justification, (X2) Euphemistic language, (X3) Advantageous comparison, (X4) Displacement of responsibility, (X5) Diffusion of responsibility, (X6) Distorting consequences, (X7) Dehumanization, and (X8) Attribution of blame have a jointly significant influence on the Bullying variable (Y) with the equation:

$$Y= 35{,}130-0{,}391\ X_1- 0{,}203\ X_2- 0{,}706\ X_3- 0{,}447\ X_4+0{,}740\ X_5+ 1{,}132\ X_6+0{,}041\ X_7+ 1{,}482X_8$$

3. t-Test Results

Table 3. t-Test Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	35,130	4,685		7,499	,000
	Moral Justification	-.396	,346	-.152	-1,142	,259
	Euphemistic language	-.203	,387	-.072	-.524	,603
	Advantageous comparison	-.706	,324	-.272	-2,179	,034
	Displacement of responsibility	-.447	,354	-.162	-1,262	,213
	Diffusion of responsibility	,740	,332	,309	2,228	,030
	Distorting consequences	1,132	,359	,409	3,150	,003
	Dehumanization	.041	,388	.013	.105	,917
	Attribution of blame	1,482	,435	,501	3,407	,001

a. Dependent Variable: Bullying

Based on the results in Table 3, it can be explained from the t-test results:

1. Moral Justification (X1)
   The Moral Justification Hypothesis is:
   H0: βi = 0, meaning that the variable (X1) Moral Justification does not have a joint significant influence on Bullying behavior.
   H0: βi ≠ 0, meaning that variable (X1) Moral justification, has a significant influence on bullying behavior.

The test results obtained variable X1 with a calculated t value = 1.142 with a significance of 0.259 and a significance limit of 0.05, meaning that it is rejected that moral justification does not influence to be a predictor of bullying behavior.

2. Euphemistic language (X2)

   Hypothesis as follows:
   H0: βi = 0, meaning that the Euphemistic language variable (X2) does not have a joint significant influence on bullying behavior.
   H0: βi ≠ 0, meaning that the Euphemistic language variable (X2) has a significant influence on bullying behavior.

The test results obtained variable X2 had a calculated t value of 0.63 and a significance of 0.05, meaning that euphemistic language has no influence as a predictor of bullying behavior.

3. Advantageous comparison (X3)

   Hypothesis as follows:
   H0: βi = 0, meaning that the Advantageous comparison variable (X3) does not have a joint significant influence on Bullying behavior.
   H0: βi ≠ 0, meaning that the Advantageous comparison variable (X3) has a significant influence on Bullying behavior.

The test results obtained variable X3 with a calculated t value = 2.17 with a significance of 0.034, a significance limit of 0.05, meaning that H0 is rejected and H1 is accepted. Advantageous comparison has an influence to be a predictor of bullying behavior.

4. Displacement of responsibility (X4)

   Hypothesis as follows:
   H0: βi = 0, meaning that the Displacement of responsibility variable (X4) does not have a jointly significant influence on Bullying behavior.
   H0: βi ≠ 0, meaning that the Displacement of responsibility (X4) variable has a significant influence on bullying behavior.

The test results obtained variable X4 with a calculated t value = 1.26 with a significance of 0.21, a significance limit of 0.05, meaning that H0 is accepted and H1 is rejected. Displacement of responsibility has no influence as a predictor of bullying behavior.

5. Diffusion of responsibility (X5)

Hypothesis as follows:

H0: βi = 0, meaning that the Diffusion of responsibility variable (X5) does not have a joint significant influence on Bullying behavior.

H0: βi ≠ 0, meaning that the Diffusion of responsibility (X5) variable significantly influences Bullying behavior.

The test results obtained variable X5 with a calculated t value = 2.22 with a significance of 0.030, the significance limit is 0.05, meaning that H0 is rejected and H1 is accepted. Diffusion of responsibility has an influence to be a predictor of bullying behavior.

6. Distorting consequences (X6)

Hypothesis as follows:

H0: βi = 0, meaning that the Distorting consequences variable (X6) does not have a jointly significant influence on Bullying behavior.

H0: βi ≠ 0, meaning that the Distorting consequences (X6) variable significantly influences Bullying behavior.

The test results obtained variable X6 with a calculated t value = 3.15 with a significance of 0.003, a significance limit of 0.05, meaning that H0 is rejected and H1 is accepted. Distorting consequences have an influence to become a predictor of bullying behavior.

7. Dehumanization (X7)

Hypothesis as follows:

H0: βi = 0, meaning that the Dehumanization variable (X7) does not have a joint significant influence on bullying behavior.

H0: βi ≠ 0, meaning that the Dehumanization variable (X7) significantly influences bullying behavior.

The test results obtained variable X7 with a t-value of 0.10 with a significance of 0.91, a significance limit of 0.05, meaning that H0 is accepted and H1 is rejected. Dehumanization has no influence as a predictor of bullying behavior.

8. Attribution of blame (X8)

Hypothesis as follows:

H0: βi = 0, meaning that the Attribution of Blame (X8) variable does not have a joint significant influence on bullying behavior.

H0: βi ≠ 0, meaning that the Attribution of Blame (X8) variable significantly influences bullying behavior.

The test results obtained variable X6 with a calculated t value = 3.40 with a significance of 0.001, a significance limit of 0.05, meaning that H0 is rejected and H1 is accepted. Attribution of blame has an influence to become a predictor of bullying behavior.

4. Multiple Linear Regression Analysis

Based on the regression results with SPSS, the regression coefficient in Table 4 can be seen as follows:

Table 4: Regression Test Results (Regression Coefficient)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	31,759	3,852		8,245	,000
	X3	.728	,320	.280	2,276	,027
	X5	,552	,263	,231	2,100	,040
	X6	1,017	,318	,368	3,198	,002
	X8	1,121	,374	,379	3,000	,004
a. Dependent Variable: Y						

Based on Table 4 In the SPSS results above, the multiple linear regression equation can be seen as follows:

$$Y = 31.759 + 0.728\ X_3 + 0.552\ X_5 + 1.017\ X_6 + 1.121 X_8$$

The results of the equation above are explained as follows:

1. If a student's Advantageous Comparison (X3) level increases by one, bullying will increase by 0.728.
2. If a student's Diffusion of responsibility (X5) increases by one, Bullying behavior will increase by 0.552.
3. If a student's Distorting Consequences (X6) increases by one, Bullying behavior will increase by 1.017.
4. If a student's Attribution of Blame (X8) increases by one, bullying behavior will increase by 1.121.

Meanwhile, the results of the coefficient of determination from the table equation above are:

Table 5: Coefficient of Determination Test Results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.632 [a]	,399	,356	5.00892

a. Predictors: (Constant), X8, X5, X6, X3
b. Dependent Variable Y

The adjusted R Square value is 35.6% based on the data results above.

$$Y = 31.759 + 0.728\ X_3 + 0.552\ X_5 + 1.017\ X_6 + 1.121 X_8$$

Looking at the results of the statistical data analysis above, it can be concluded that the hypothesis in this research using the F test is that the variables (X1) Moral Justification, (X2) Euphemistic language, (X3) Advantageous comparison, (X4) Displacement of responsibility, (X5) Diffusion of responsibility, (X6) Distorting consequences, (X7) Dehumanization and (X8) Attribution of blame have a significant influence together on the Bullying variable (Y) with the equation. With a value of F = 5.062 and a significance figure of 0.000. The coefficient of determination value is 0.399, and the Adjusted R Square is 0.356 or 35.6%.

The results of the multiple linear regression analysis indicate that the variables that significantly predict bullying behavior are (X3) Advantageous Comparison, (X5) Diffusion of Responsibility, (X6) Distorting Consequences, and (X8) Attribution of Blame, with the following equation:

$$Y = 31.759 + 0.728\ X_3 + 0.552\ X_5 + 1.017\ X_6 + 1.121 X_8$$

The results of this research align with (Istiqomah & Madiun, 2023) that moral disengagement with its eight aspects can make an individual easily justify maladaptive behavior such as bullying as normal behavior. Bandura's social-cognitive theory regarding the concept of Moral disengagement leads to a psychological scheme regarding immoral behavior and bullying as detrimental behavior by changing the bullying behavior with self-defense mechanisms to justify bullying as acceptable behavior. This research has shown that eight moral disengagement mechanisms can predict bullying behavior: advantageous comparison, Diffusion of responsibility, distortion of consequences, and Attribution of blame.

Bandura (1997) describes the psychological concept that moral values can be separated from immoral behavior, making others feel disadvantaged by accepting harmful behavior and allowing aggressive and immoral behavior to be carried out. With the help of this process, a person can engage in self-serving behavior inconsistent with their moral principles. They can continue to use these defenses as principles without causing cognitive self-evaluation (such as cognitive dissonance) or emotional reactions (such as guilt and shame), which in their partners can help them avoid making mistakes. Understanding moral disengagement is essential for designing bullying prevention strategies. Intervening at the level at which individuals use these mechanisms can help reduce levels of bullying behavior. This can be done through strong moral education, anti-bullying programs that involve awareness of the consequences of these actions, and fostering a school environment that supports and encourages positive norms. The results of this research emphasize the importance of paying attention to the role of each mechanism of Moral disengagement in understanding and preventing bullying behavior. Using this mechanism is a strong indicator of a person's likelihood of being involved in bullying.

Based on the results of the data above show that moral disengagement, such as Advantageous comparison, Diffusion of responsibility, Distorting consequences, and Attribution of blame, tend to influence teenagers involved in bullying behavior significantly. This can be explained as:

a. Advantageous comparison: Bullies may compare their actions with actions considered worse to make their behavior more acceptable. For example, a student might think, "At least I didn't hit him, just made fun of him."
b. Diffusion of Responsibility: Bullies may feel less responsible if the actions are carried out in a group. They may think responsibility is distributed among all group members, so they feel less guilty. For example, students might think, "We're all in this together, so it's not just my fault."
c. Distorting Consequences: Bullies may minimize or ignore the negative impacts of their actions. They may assume that the victim was not truly hurt or that their actions were not as bad as they were. For example, a student might think, "It was just a joke, he wasn't hurt."
d. Attribution of Blame: Bullies may blame the victim for their actions, assuming that the victim deserves terrible treatment. They may think that the victim has provoked or

deserved the treatment. For example, a student might think, "He deserves it because he always acts weird."

Understanding these mechanisms can help in developing more effective interventions to prevent and address bullying among adolescent students. By identifying and addressing how bullies disable their moral constraints, educators and counselors can work to strengthen moral norms and empathy among students.

Conclusion

Based on the results of the statistical data analysis above, it can be concluded that the hypothesis in this research using the F-test is that the variables (X1) Moral Justification, (X2) Euphemistic language, (X3) Advantageous comparison, (X4) Displacement of responsibility, (X5) Diffusion of responsibility, (X6) Distorting consequences, (X7) Dehumanization, and (X8) Attribution of blame have a significant influence together on the Bullying variable (Y) with the equation. The F-value is 5.062, with a significance level of 0.000. The coefficient of determination value shows 0.34, and the Adjusted R Square is 0.356, representing 35.6% of multiple linear analysis. Regression analysis showed that the variable.

$$Y= 31.759 + 0.728\ X_3 + 0.552\ X_5 + 1.017\ X_6 + 1.121 X_8$$

It can be concluded that there are moral disengagement mechanisms, namely Advantageous comparison, Displacement of responsibility, Diffusion of responsibility, Distorted consequences, Dehumanization, and Attribution of Blame, which are predictors of student bullying behavior by as much as 35.6%. And 64.4% comes from other factors.

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Contact emails: Yemimakezia001@gmail.com
chrisantakezia.2022@student.uny.ac.id

Analysis of Student Difficulties in Determining the Main Idea and Supporting Ideas of Paragraphs

Umi Nahdhiah, State University of Malang, Indonesia
Sri Untari, State University of Malang, Indonesia
Ratna Ekawati, State University of Malang, Indonesia
Shirly Rizki Kusumaningrum, State University of Malang, Indonesia
Radeni Sukma Indra Dewi, State University of Malang, Indonesia

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Abstract
This research was motivated by a problem about the learning difficulties of grade IV students of Sumbersari III Elementary School Malang, Indonesia in determining the main ideas and supporting ideas of paragraphs. This study aims to understand the process of student learning difficulties in identifying the main ideas and supporting ideas of a paragraph and find out the factors that cause students' learning difficulties. The research approach used is a qualitative approach. While the method used is a descriptive research method. The sample in this study was 26 grade IV students of Sumbersari III Elementary School Malang, Indonesia. Data in this study was collected through interviews, documentation, and observations related to the research problem studied. Interviews were conducted with four students and homeroom teachers of grade IV. The results of the analysis show that students have good abilities in determining the main sentence, but most students still have low abilities in the main idea, supporting ideas, and type of paragraph. Internal factors that causes students learning difficulties are low interest in reading, low learning motivation, limited reading ability, lack of confidence, and dislike of Indonesian subject. External factors that causes students learning difficulties are family environment factors and classroom management. It is hoped that these difficulties can be overcome by using appropriate and supportive learning strategies, and students' understanding of the structure and content of Indonesian text can be improved.

Keywords: Student Difficulty, Main Idea, Paragraph

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Introduction

Learning difficulties refer to the hurdles or obstacles that individuals face in attaining knowledge or skills. Learning difficulties are conditions in learning when there are obstacles in obtaining learning outcomes (Cahyono, 2019). Students experience obstacles in receiving lessons from teachers (Nurhaliza et al., 2019). These difficulties can manifest in a variety of ways, such as difficulty completing tasks, difficulty in reading, writing, spelling, reasoning, or remembering information (Firdous et al., 2019). It is very important to pay special attention to children who face learning difficulties because they are the future human resources of the nation (Norman et al., 2021). One of the learning difficulties faced by students is the difficulty in determining the main idea of a paragraph.

The main idea material is one of the materials studied in subjects Indonesian elementary school. The main idea is the essence of a reading or paragraph to find out the point or essence of the reading (Oktafiani & Irawan, 2021). While supporting ideas are sentences in paragraphs that contain explanations of the main topic discussed. A paragraph consists of a series of sentences that support one main idea (Lo et al., 2013). The main idea can be found at the beginning, middle, or end of a paragraph and sometimes throughout a paragraph (Nasution, 2020). The main idea material will be learned by students again at the next level and become an important skill in life.

Students must read the reading first in order to find the main idea. The main idea is obtained through the main sentence and the developer's idea is in the supporting sentence (Irwan et al., 2021). The reader should take several steps to determine the main idea, including reading the passage carefully and understanding its content; formulate questions in the mind related to "what is this paragraph about?"; write down the main idea based on the conclusions that have been thought out; Pay attention to keywords to find key concepts (Hasana & Mukhlishina, 2020). Finding key ideas in Indonesian learning can be a challenging task for students. In this case students have difficulty in identifying key concepts and overarching themes in the text being read.

Based on the results of interviews with the homeroom teachers of grade IV students of Sumbersari III State Elementary School Malang City, it shows that grade IV students have difficulty identifying the main idea of a paragraph. Low interest in reading students make students unable to identify the main idea of the paragraph. This is in line with the results of observations and interviews that have been carried out by Hasana and Mukhlishina (2020) in the homeroom teacher of grade III of Al-Falah Islamic Elementary School, which shows that the ability to determine the main ideas of grade III students of Al-Falah Islamic Elementary School is categorized as low. The inability to determine the main idea can hinder students' understanding and critical thinking skills, because the ability to determine the main idea is essential to summarize and analyze information effectively.

Previous research relevant to this study was conducted by Shansabilah and colleagues (2023) entitled "Analysis of the Difficulty of Class V Students in Determining a Paragraph Main Idea in Subject Indonesian". The relevance of this research is the object of research, learning difficulties. Based on the results of the study shows that there are still many students who have low ability in finding the main idea. Further, research by Nurhaliza and colleagues (2019) entitled "Analysis of Student Difficulties in Determining the Main Idea of a Paragraph in Class V Indonesian Lesson SDN Pondok Jagung 01 Serpong Utara" reveals internal factors that cause students to have difficulty in determining the main idea of a paragraph

including psychological and motivational factors. External factors that cause students learning difficulties are inadequate classroom conditions, as well as monotonous teaching methods and strategies by teachers.

This study aims to understand the process of student learning difficulties in identifying the main ideas and supporting ideas of a paragraph, see the results of the analysis of student learning difficulties in identifying the main ideas and supporting ideas of paragraphs, and find out the factors that cause student learning difficulties in determining the main ideas and supporting ideas of a paragraph.

Method

The research method used in this study is qualitative descriptive. The implementation of in-depth research requires qualitative research (Gungor et al., 2023). Qualitative research can be interpreted as studies that use natural language data to understand variations in individual experiences and their meanings (Sevilla-liu, 2023).

Data in this study was collected through interviews, documentation, and observations related to the research problem studied. Data in descriptive qualitative research is analyzed through three stages, those are data reduction, data presentation, and conclusion drawing (Fithriyana, 2020). The sample in this study was 26 grade IV students of Sumbersari III State Elementary School Malang City. The interview sampling technique uses the technique purposive sampling, which is the technique of deciding on samples with certain considerations (Shintya et al., 2021). Interviews were conducted on four grade IV students and homeroom teacher of grade IV.

The research was conducted from October 12 to November 21, 2023. The research procedure includes the pre-field stage, the fieldwork stage, and the data analysis stage. This study used two data, primary and secondary data. Primary data are obtained internally, such as through direct observation, and so on (Siregar et al., 2022). The primary data in this study were obtained through observation, documentation, and interviews with grade IV students and grade IV teachers of Sumbersari III State Elementary School Malang City. Meanwhile, secondary data are obtained through references related to the variables studied.

Results and Discussion

Based on the findings of the study, researchers discussed the difficulties of students in determining the main ideas and supporting ideas more deeply, as well as the factors that cause student difficulties.

Students' Difficulties in Determining Main Ideas and Supporting Ideas

The results of the study were based on tests determining the main idea and supporting material—including the main sentence, paragraph type, and supporting ideas—which was carried out on grade IV students of Sumbersari III State Elementary School. Researchers gave seven questions to students, including six multiple-choice questions and one description question related to determining the main idea, determining the main sentence, determining the type of paragraph, and supporting ideas. Questions were given to 26 grade IV students. After the test was carried out, researchers found that the ability of grade IV students at Sumbersari III State Elementary School in finding the main idea was still low. This is

evidenced by the results obtained by the average percentage of students' ability to determine the main idea is only 36.5% or nine out of 26 students. In line with the results of observations and interviews by Tiyas and colleagues (2023) in grade IVA students of Sendangmulyo 02 State Elementary School Semarang, which shows that students' ability to distinguish between the main idea and the main sentence is still low. So does what is done by Najiyah et al. (2019) which shows that grade IV students at Polehan 4 State Elementary School Malang often experience confusion in identifying the main idea and main sentence.

Based on the results of the tests that have been conducted, in the first, fifth, and sixth questions related to the main idea, there are 12, one, and 10 out of 26 students who can answer correctly. While on the description questions related to the main idea, there were 15 out of 26 students who could answer correctly. So if presented, there are more than half of students who still have difficulty in finding the main idea. Furthermore, in the question related to determining the type of paragraph, 15 out of 26 or 58% of students can answer correctly the type of paragraph contained in the reading. While on questions related to determining the main sentence, 23 out of 26 students can answer correctly, or if the percentage is 88%. On the question related to determining supporting ideas, only 8 out of 26 students could answer correctly, or 30%. From the test results, the highest score was 71.4 and the lowest score was zero.

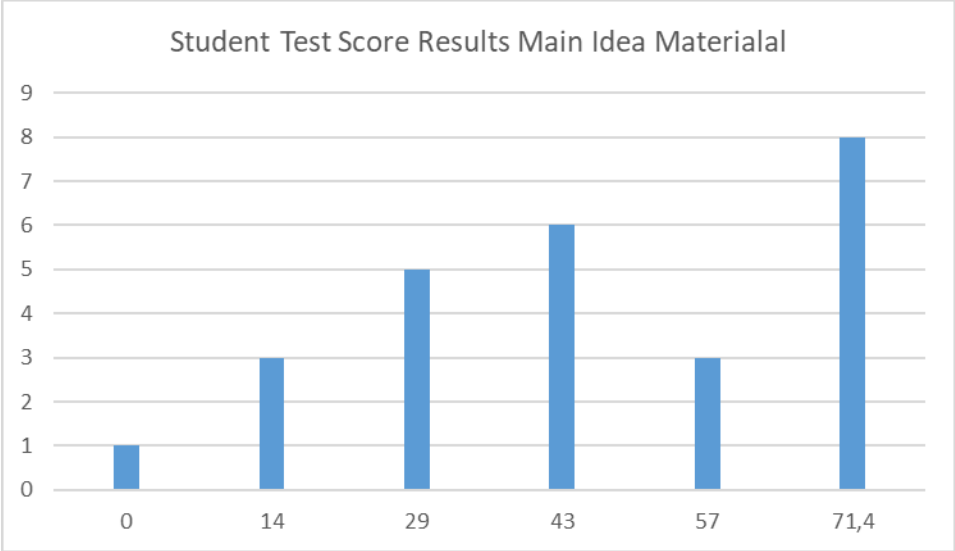

Figure 1: Student Test Score Results Main Idea Material

The average result of the students' test score is 44. This proves that students' ability to determine the main idea is still not good. The results of the analysis can be concluded that students have good abilities in determining the main sentence, but most students still have low abilities in determining the main idea and supporting ideas, and determining the type of paragraph. Interviews were conducted on four grade IV students and homeroom IV students to explore the factors that cause students' difficulties in learning the main idea material. Four of the 26 students were interviewed about their learning difficulties.

Factors Influencing Students' Difficulty in Determining Main and Supporting Ideas

Based on the results of interviews conducted on homeroom teachers and grade IV students of Sumbersari III State Elementary School showed that there are several factors causing students' learning difficulties in determining the main ideas and supporting ideas of

paragraph. These factors include internal factors and external factors. Internal factors refer to circumstances arising from within the student himself, while external factors include things or situations that come from outside the student.

Internal factors that cause student difficulties are that students have low interest in reading, so they tend to be lazy in reading. Low student enthusiasm in reading can be influenced by several factors, namely internal factors such as intelligence, age, gender, literacy skills, attitudes, and psychological needs, as well as external factors such as subject matter, level of complexity in the text, and material format which can also affect student reading motivation (Ningrum et al., 2023). Lack of interest in reading can make it difficult for students to understand the main and supporting ideas in the text, so students cannot understand the reading well. In line with research conducted by Nurhaliza and colleagues (2019) revealed that the difficulty of grade 5 students of Pondok Jagung 01 State Elementary School in determining the main idea was due to lack of interest in reading, resulting in an inability to understand the content and extract the main idea. Research conducted by Marlini et al., (2021) shows the factors that cause the difficulty of Grade IV students of 49 State Elementary School Banda Aceh in determining the main sentence are low interest in reading and learning motivation. This is in line with the research conducted Rahmadhani and Masfiah (2023) which shows that there is an influence of learning motivation on learning outcomes, which is 30.5%.

Based on the results of interviews with students, it was also found that there were still students who were not fluent in reading. The inability to read fluently can also be a major obstacle. Students who do not have good reading skills will have difficulty decoding texts, identifying important information, and understanding the relationship between main and supporting ideas. Research conducted by Safitri (2022) shows that one of the factors causing difficulty in finding the main idea is the factor of not being able to read well (dyslexia), which affects the brain's information processing (Safitri et al., 2022).

The next factor that causes student difficulties is that students have low self-confidence. Low self-confidence can prevent students from actively participating in Indonesian learning. Fear of making mistakes or inability to determine the main idea can affect students' ability to analyze the text effectively. This is in line with research conducted by Akbari & Sahibzada (2020) which explains that the level of self-confidence has a significant impact on the learning process of students, including their participation, achievement of goals, interest in the subject, level of anxiety, comfort with teachers and classmates, and sharing opinions in class. Research results by Septiani & Purwanto (2020) It also shows that there is a positive relationship between self-confidence and student learning outcomes.

Another internal factor that makes it difficult for students to determine the main idea and related material is that students do not like Indonesian subject. Students assume that Indonesian subject is a difficult subject. Lack of interest or disinterest in Indonesian subject can reduce the motivation of students to strive to understand the text fully. This can have an impact on students' level of attention and mental investment in learning the structure and content of the text. This is in harmony with what was revealed by Oktafiani and Irawan (2021), that the factor causing students' learning difficulties in paragraph material is psychological factors, spesigically their low interest or willingness to learn Indonesian. Students who have learning difficulties will Indonesian have difficulty understanding content related to the subject.

The results of interviews with grade IV homeroom teachers of Sumbersari III State Elementary School showed external factors behind students' difficulties is the family environment. Parents pay little attention to the development of the student's educational process. The educational process of a person is influenced not only by factors in school, but also by the family environment. Support from family is very important in supporting the learning process of students. There are several factors that contribute to low academic achievement, including the surrounding environment, peers, school, psychological disorders, and family problems (Al-Qadri et al., 2021). This is in line with research conducted by Oktafiani and Irawan (2021) which shows that external factors that affect students' difficulties in learning are environmental factors. Arumsari (2021) It also reveals external factors that influence is the family environment, especially the role of parents who have low concern for the development of their children. Recognition of students' academic achievement also plays an important role in increasing their confidence in identifying key ideas and supporting details.

Based on the results of observations and interviews, another external factor that causes students' difficulties in determining the main idea is suboptimal classroom management, spesifically the placement of inappropriate student seats. Students who have low ability in learning are placed near students who also have low ability. Research conducted by Mansur et al. (2023), stating that the placement of student seating is not appropriate in grade V 45 State Elementary School Ternate is one of the causes of students' learning difficulties in determining the main idea. Therefore, it is important to note that classroom management must be adjusted to consider many things related to the learning process.

Conclusion

Learning difficulties faced by students include difficulties in determining the main idea, supporting ideas, and paragraph types. Overall, the ability of grade IV students of Sumbersari III State Elementary School Malang City to determine the main idea, supporting ideas, and paragraph types is still relatively low. The difficulties students face in determining the main idea and supporting ideas in Indonesian texts can be influenced by internal factors and external factors. Internal factors, namely low interest in reading, low learning motivation, limited reading ability, lack of confidence, and dislike of Indonesian subject. The external factors that cause student difficulties in learning are family environment factors and classroom management management. By using appropriate and supportive learning strategies, it is hoped that these difficulties can be overcome, and students' understanding of the structure and content of Indonesian text can be improved.

Recommendations

Based on the conclusion above the researcher would like to offer some recommendations to be considered by primary teachers, students, and for the next researchers.

1. For primary teacher
Teachers can organize fun learning activities to increase student motivation and use a variety of learning media, so that students' understanding of the structure and content of Indonesian texts can be improved. Teachers are also expected to be able to manage classes in a balanced manner.

2. For the students
The results of this study are expected to increase student motivation in learning, so as to improve the ability to understand the structure and content of Indonesian text.

3. For next researcher
The researcher aims for this study's findings to serve as a valuable reference for future researchers interested in the Indonesian language and those seeking to explore the about the student difficulties in learning main idea of paragraph.

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Contact emails: umi.nahdhiah.2321038@students.um.ac.id
sri.untari.fis@um.ac.id
ratna.ekawati.pasca@um.ac.id
shirly.rizki.pasca@um.ac.id
radenisukmaindradewi.pasca@um.ac.id

International Projects: Tracing the Journey From Design to Community Use

Inês Araújo, Polytechnic University of Tomar, Portugal
Célio Gonçalo Marques, Polytechnic University of Tomar, Portugal
Hélder Pestana, Polytechnic University of Tomar, Portugal

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Abstract
Nowadays, we are witnessing a gender gap in ICT caused by stereotypes and misconceptions that need to be reversed. To this end, a group of European partners has developed a two-year project to involve girls aged between 14 and 16 in STEM subjects. Empower Girls Creativity Through Use of Digital Technologies (SparkDigiGirls) is an ERASMUS+ project that culminated in the creation of an online course. This course consists of 16 challenges spread across different types of technologies (Augmented Reality, Virtual Reality, Artificial Intelligence, Internet of Things, Robotics, Online Security). Students are challenged to learn about technology, apply it to real everyday situations or needs and present evidence. At a later stage, the course was converted into a MOOC for mentors and integrated into the Chair4Future platform, specifically designed to disseminate knowledge to IPT students and teachers, partner institutions and the community in general. This platform includes courses that can promote the main competences identified as lacking in the IPT's target population. As an institution with courses in the ICT area, capturing the interest of the female gender is increasingly important. In this article we will present how the work produced within the scope of SparkDigiGirls and its main results were integrated into the Chair4Future platform, in order to allow the community to access the knowledge developed. This resulted in the original materials being made available in Portuguese and English and a MOOC for mentors in Portuguese.

Keywords: International Projects, SparkDigiGirls, MOOC, Mentoring

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Introduction

Careers in technology and engineering are associated with gender stereotypes and misconceptions that persist and contribute to the gender gap in ICT. This is a reality experienced by companies in the sector but also by higher education institutions. It is believed that teachers and educators have a crucial role to play in redefining this perspective, providing guidance and opportunities for girls to make informed decisions (Marques et al., 2022; Marques et al., 2023).

The SparkDigiGirls project, co-funded by the Erasmus+ program, was developed between 2021 and 2023 to address the under-representation of girls in the digital technologies sector. It involved partners from four European countries: Lithuania, Portugal, Slovenia and Greece (Marques et. al., 2023). The aim was first to identify ways of reversing the current situation and then to produce digital content to help teachers and educators with this demand.

The SparkDigiGirls project produced content of relevance to the community, and the pilot study revealed very positive results with the students involved (Marques et al., 2024). It was considered imperative to find a solution that would allow it to continue beyond the project. Continuity in terms of maintaining the platform and open access to interested parties. To this end, a fourth phase was added to the project, which enabled the development of a Massive Open Online Course (MOOC) for mentors and the availability of the content produced on an open access platform.

In this paper, we will first recap the resources produced as part of SparkDigiGirls, followed by how they were integrated into the Chaire4Future platform through the fourth phase (community use), which was created after the end of the project. This will allow the content produced to be made available for use by students, as well as a version for mentors who wish to implement it.

SparkDigiGirls Project

SparkDigiGirls “Empower Girls Creativity Through the Use of Digital Technologies” is an international project that was born from the partnership of institutions from different EU countries Lithuania, Portugal, Slovenia and Greece. It lasted two years and was co-funded by the Erasmus+ strategic partnership in the field of youth. The main aim of the project was to create a way to inspire girls between the ages of 14 and 18 to explore digital technologies by generating new and innovative ideas, taking advantage of their newly acquired digital knowledge to contribute creatively to the traditionally male-dominated STEM industry (Marques et al., 2023).

The SparkDigiGirls initiative unfolded in three main phases: 1) Diagnostic and Curriculum Definition; 2) Content Development; and 3) Pilot Study and Dissemination (Marques, Araújo, et al., 2024).

The first phase involved identifying barriers to girls' participation in ICT and collecting insights through focus groups conducted in the participating countries. The analysis highlighted key factors, such as:

- Visible female leaders in ICT inspire girls to imagine themselves in similar roles.
- Providing practical exposure to digital tools and technologies fosters interest and confidence.

- Persistent biases dissuade girls from pursuing careers in STEM fields.
- Educators can play a critical role by actively encouraging girls to explore ICT.

These findings helped the definition of a curriculum to be designed to address these barriers through interactive and engaging methods.

During the second phase a course program, titled Unleash Your CreativITy with Technology, was developed. It consisted of 16 challenges delivered via a Moodle-based platform. These challenges covered various technologies, including Artificial Intelligence (AI), Augmented Reality (AR), Internet of Things (IoT), programming, 3D modeling, and blockchain. Each module (figure 1) included:

- Instructional videos explaining the technology and its applications.
- Tutorials with step-by-step guides for hands-on activities.
- Quizzes to test knowledge and reinforce learning.
- Tasks requiring evidence of completion, such as images, videos, or links.
- Participants earned certificates upon completing individual challenges. By completing challenges across six technology categories, they unlocked a Grand Certificate, symbolizing comprehensive mastery of the program.

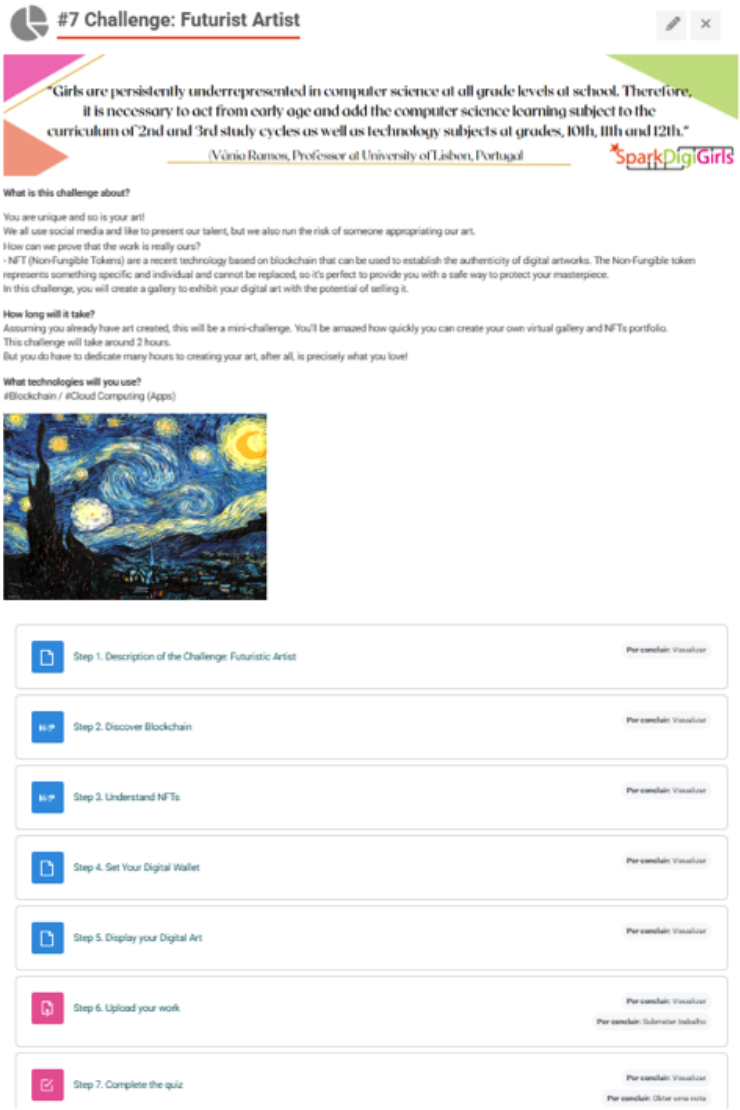

Figure 1: Challenge Example: Futurist Artist

To further inspire participants, the project incorporated testimonials from female ICT professionals and leaders, shared via the project's YouTube channel (Figure 2). These role models provided relatable examples of success in the tech industry, motivating girls to pursue similar paths.

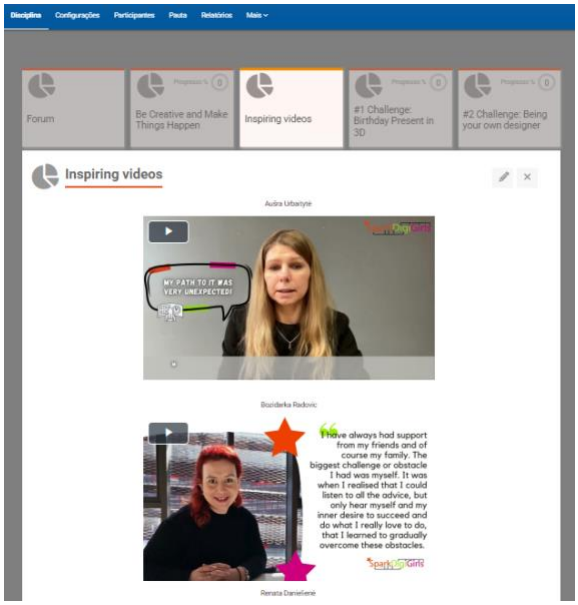

Figure 2: Inspiring Videos Module

The pilot phase involved 279 girls from the four partner countries participating in the program over two months (Marques, et. al., 2023). While initially designed for online delivery, some partners adapted the methodology to include face-to-face sessions, creating a blended learning experience. This approach proved effective in motivating participants and fostering collaboration. It verified that the program promoted high levels of engagement and enthusiasm among participants. The variability in challenge completion rates highlighted the areas for content refinement. Was verified that the blended learning formats combining online modules with in-person support was the most valuable approach.

Based on these findings, the project produced an e-guidebook to assist educators and youth workers in replicating and sustaining the program (Marques, Araújo, et al., 2024). The guidebook includes:

- Strategies for mentoring and empowering girls in digital technologies.
- Best practices from the pilot study.
- Resources and toolkits to enhance teaching and learning activities.
- Outcomes and Impact

The SparkDigiGirls project achieved success in its mission to empower girls through digital technologies, by enhancing interest in ICT, creating capacity building methodologies for educators and providing a sustainable model. The participants demonstrated increased curiosity and confidence in using digital tools, with many expressing a newfound interest in pursuing technology-related careers (Marques et al., 2023). The e-guidebook equips educators with practical tools and strategies to support girls' creativity and engagement in ICT (Marques, Araújo, et al., 2024). The project's resources and blended learning approach provide a scalable framework for future initiatives targeting gender diversity in STEM.

The need to promote the free use of content by the community after funding led to a fourth phase of the project (Community Use). In this way, we expect to attract more female students to the field of technology.

Methodology

Upon the completion of the SparkDigiGirls project, a fourth phase (Community Use) was introduced to ensure broader accessibility to the resources developed during its implementation. The primary goal of this phase was to facilitate community access to the content while also engaging potential mentors who could deliver the activities to groups of students. While the E-guidebook proved to be a valuable resource that sparked significant interest among educators and mentors, it became clear that creating a MOOC for mentors could provide an even more engaging and scalable solution.

The fourth phase of the project was meticulously designed and executed to achieve these objectives. First, a suitable platform was identified to host the MOOC, ensuring ease of access and user-friendliness for the target audience.

There is a process in place for the transformation of courses into MOOCs, which is in line with the Agile Methodology. This approach is increasingly being used in online education because of its emphasis on flexibility, collaboration and incremental progress. It is ideal for creating adaptable online courses that meet the evolving needs of students. (Salza et al., 2019). A five-phase process was designed for the creation and implementation of courses using Agile principles:

1. Analysis: A multidisciplinary team, including trainers, instructional designers, and content specialists, created video templates with institutional branding. These templates were validated by the coordinators responsible for digital content production.
2. Design: A course design workshop was conducted with teachers to support the preparation of MOOC content. The design model for all courses was developed and approved by the team.
3. Development: A media production workshop was held to assist teachers in creating multimedia content. Feedback was provided by instructional designers and content specialists.
4. Implementation: Pilot courses were tested with a student group to gather performance data and refine the content based on identified challenges. Final courses will then be launched.
5. Assessment: Final feedback and performance data will be collected to measure course success and ensure continuous improvement.

This structured approach ensures that the courses are responsive, effective, and tailored to students' needs.

Following this, a specialized module for mentors was developed using Agile Methodology. This iterative approach allowed for continuous refinement of the module, ensuring it met the needs of mentors effectively. The module content was tailored to equip mentors with the necessary skills and knowledge to implement the project activities confidently and successfully.

To validate the MOOC and identify areas for improvement, a pilot test was conducted with four carefully selected participants who met the project's requirements. These participants provided valuable feedback on the structure, content, and usability of the MOOC. Based on their input, further enhancements will be implemented to optimize the course's effectiveness and user experience.

The phase will culminate with the MOOC being made available online. This resource not only extends the reach of the SparkDigiGirls initiative but also empowers mentors to contribute to its mission of fostering student engagement and learning through innovative methodologies.

MOOC for mentors was developed in the second half of 2024 and a pilot test was carried out with a small group of trainees. The aim was to evaluate the content produced and detect possible improvements.

Results

The first step was to identify a platform with the necessary characteristics to facilitate widespread community use and engagement. After careful consideration, the Chair4Future platform (Figure 3) was selected. This platform was developed as part of the STRONG (Resilient Skills and Teachers Focused on the Next Generations) project, it is specifically designed to host digital resources and MOOCs that are accessible to the general community (Marques, Mateus & Araújo, 2024; Marques, Mateus, Araújo, Nata, et al., 2024). The creation of MOOCs on this platform follows the five-phase process using the agile principles mentioned above. By choosing this platform, we ensured that the SparkDigiGirls project aligned with a robust and user-friendly solution.

The Chair4Future platform is built on Moodle (Modular Object-Oriented Dynamic Learning Environment), an open-source learning management system (LMS) that is widely recognized and utilized for educational purposes. Moodle's reputation for flexibility and versatility made it an ideal choice for this initiative. Its core features allow for the creation, organization, and management of courses, providing a range of tools for developing interactive resources such as quizzes, forums, and assignments.

To further enhance the platform's functionality, it was integrated extensions such as H5P, a content creation tool that supports the development of interactive and visually appealing learning materials. Additionally, the medal gamification tool was activated to make the learning experience more dynamic and engaging. This gamification feature encourages user participation by allowing trainees to earn feedback and medals as they progress through their activities, fostering motivation and a sense of achievement.

By leveraging these features, the Chair4Future platform not only meets the project's technical requirements but also creates an interactive and supportive learning environment. This ensures that both mentors and students can benefit from an accessible, engaging, and effective educational experience, reinforcing the platform's role as a key enabler for the project's success.

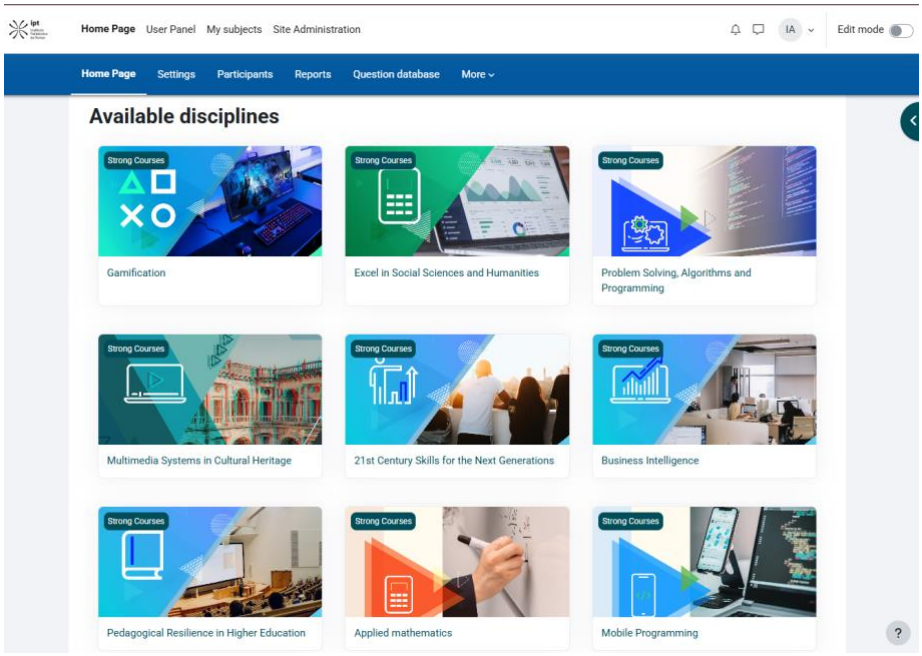

Figure 3: Chair4Future Platform

Three additional courses have been added to the set of MOOCs available on the Chair4Future platform as part of the ongoing process. The MOOCs included are:

1. Unleash Your CreativITy with Technology - Portuguese version;
2. Unleash Your CreativITy with Technology - Mentor Version (available only in Portuguese);
3. Unleash Your CreativITy with Technology - English version.

The Mentor's MOOC aims to provide educators with comprehensive explanatory content to help them better implement and present the challenges to groups of young learners. In addition to providing this content, our platform also serves as a tool for educators to effectively present the SparkDigiGirls challenges to students.

Unleash Your CreativITy With Technology – Mentor Version

In its original version, the set of challenges created as part of SparkDigiGirls only has material for young people who want to discover new technologies. As mentioned above, an e-guidebook has been created for educators who want to put this set of challenges into practice (Marques, Araújo, et al., 2024).

In the mentor version made available through Chair4Future, we decided to use the Agile methodology to create a specific module for educators, tutors or mentors who want to apply the proposed challenges with young people.

The module created to help the mentors is based on the e-guidebook created by the project and is subdivided into the following topics:

- Introduction to the project - explaining the origins of the project, the main results achieved and how the digital content created for the girls is structured. The participants have access to all content of the project, including the e-guidebook produced.

- The mentor/tutor role - where mentors are invited to better understand their role by presenting examples achieved during the project and some testimonies. This topic also describes the learning approaches tested during the project, so that the mentor can choose the one that best suits their context, though a final reflection.
- Digital resources - These include tutorials on how to use some of the tools available during the challenges, such as H5P. This is to enable mentors to adapt the resources if they detect any outdated content or want to adapt to a specific context.
- Final challenge - where mentors are invited to carry out the challenges created, and can see examples already created by participants in the project and ask the instructors any questions they may have.

After the pilot test at the end of 2024, we are still analyzing the information gathered. This will be followed by the implementation of improvements. In this way, we can make the content created available for the community to use. By having access to these resources, we expect that educators, tutors and mentors will be able to inspire and guide students through innovative and technological challenges, contributing to a more dynamic learning environment.

Conclusion

The SparkDigiGirls project represents a significant step toward bridging the gender gap in ICT by providing young girls with the skills, knowledge, and inspiration needed to explore their creative potential in the digital world. Through its innovative learning program, mentorship initiatives, and practical resources, the project empowers girls to become creators and innovators, not just consumers of technology. As a model for future efforts, SparkDigiGirls highlights the importance of inclusive education and diversity in shaping the future of technology (Marques, Araújo, et al., 2024).

Once the project's funding ended, it was considered important to include the resources created on a platform for the Portuguese community. To this end, the Portuguese team added a fourth phase to the initial project, by creating a MOOC for mentors that was made available through Chair4Future. This is an LMS platform based on Moodle for making content available to participants outside the institution. In this way, we have contributed to the development of courses that can be attended by students wishing to apply to the institution, but also by anyone else who is interested.

Thus, three versions of the original course were added, the original version in English and the one in Portuguese, as well a new version for mentors in Portuguese.

Through the Chair4Future platform it is possible for anyone who is interested to access the courses, without having to be an internal student of the institution. This provides the necessary conditions for the community to benefit from content created by the IPT.

With its strong emphasis on empowerment, collaboration, and creativity, SparkDigiGirls has set the stage for a more equitable and inclusive ICT industry, fostering a generation of talented young women ready to lead in the digital age. In this way, IPT aims to maintain its relationship with the community by promoting essential skills for the labour market. We believe that this case exemplifies this commitment to the community, promoting open access to content that can develop essential skills for the region's economic development.

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Contact email: inesaraujo.lied@ipt.pt

Arab EFL Learners' Collocational Competence: Errors, Challenges, and Teaching Implications

Pakenam Shiha, Effat University, Saudi Arabia
Nadine Emirey Lacsina, Al Yamamah University, Saudi Arabia

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Abstract
This study investigates the collocational competence of Arab foundation program students, addressing the lack of systematic analysis of ESL learners' lexical and collocation errors. Understanding how ESL learners construct fixed expressions is crucial for achieving native-like proficiency, a key goal of foundation programs. A cohort of 38 foundation learners took a 60-item collocation test focused on verb-noun and adjective-noun structures to assess their collocational competence and identify specific errors. Results indicated that students were more familiar with verb-noun combinations but struggled with adjective-noun collocations. A significant disparity in scores between these two structures was observed. The primary challenges stemmed from the influence of the learners' first language (L1), particularly in their selection of collocates, as many answers reflected their inability to differentiate between synonyms absent in their L1. Additionally, non-exposure to certain collocations and the degree of L1-L2 differences were highlighted in surveys. Instructor interviews corroborated these findings, emphasizing the students' limited exposure to collocations and insufficient English proficiency, alongside L1-L2 discrepancies. The thematic analysis revealed that enhancing students' exposure to collocations and addressing their linguistic challenges could improve their performance. Overall, the study's findings contribute valuable insights for language pedagogy, suggesting effective strategies for teaching collocations to ESL learners.

Keywords: Collocational Competence, EFL Learners, Collocations, Language Learning, Saudi Arabia

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Introduction

Proficient use of collocations is seen as a defining characteristic of advanced English fluency and communicative competence for language learners. A student's collocational knowledge plays a pivotal role in determining their academic and professional success and acquiring vocabulary in phrasal units, rather than in isolation, may accelerate the second language learning process. Mastery of collocations is viewed as a critical indicator of overall language proficiency and a strong predictor of positive outcomes for students seeking to reach a higher level of English language skills (Hill, 2000; Howarth, 1998).

The investigation of EFL learners' interlanguage could greatly contribute to the teaching of English as a foreign language and the development of teaching materials. Despite the importance of collocations in language proficiency, collocational competence is one of the most neglected areas in language studies, especially second language teaching. Acquiring collocations is quite challenging and problematic to non-native English speakers. Nevertheless, it is widely noticed that collocations are still underestimated in different EFL contexts, which may hinder English learners' fluency in speaking and writing.

The present study aimed to raise awareness of the most common errors and challenges Arabs face when they learn collocations. In addition, this study investigated the collocational competence and knowledge of English learners with Arabic L1 backgrounds and different proficiency levels. The first part of the study deals with the types of collocations and the most common errors Arabs face while using collocations. The study then presents the challenges Arab students and EFL instructors face while teaching collocations. The last part includes a number of recommended activities that English language instructors can implement in their classroom. The paper is thus helpful to both researchers and language instructors as it sheds light on pertinent areas for research and recommends useful activities for teaching collocations.

Definition and Types of Collocations

The term collocation has been defined by different scholars. Collocation was first introduced by Firth (1957) to refer to a combination of words associated with each other. Meanwhile, Sinclair (1991) defines collocations as "items that occur physically together or have strong chances of being mentioned together". Furthermore, according to Lewis (1997), collocation was defined as "the readily observable phenomenon whereby certain words co-occur in natural text with greater than random frequency". In addition, collocation is defined as a predictable combination of two or more words which produce a specific meaning (Cowie, 1999; Hill, 2000). Benson, Benson, and Ilson (1997) categorized collocations into two types which are grammatical collocations and lexical collocations. Grammatical collocations consist of a dominant word and a grammatical word, whereas lexical collocations do not include function words. For this study, lexical collocations which are categorized into six types were used: adverb + adjective; adjective + noun; noun + noun; noun + verb; verb + noun; verb + adverb.

Although it may not be common to use these combinations of words, it will be highly effective in conveying messages in a more appropriate sense. Even though it is possible to use other word combinations, understanding collocations will definitely help English learners improve their fluency and communication skills (Hill, 2000).

Challenges in Using Collocations

Several past studies investigating second language acquisition of English collocations have shown that EFL learners' problems are due to different factors (Fan, 2009; Huang, 2001). One of the major reasons for collocational errors is the native language influence (Bahns, 1993; Koya, 2003; Nesselhauf, 2003). Learners' native language (L1) has an impact on their subsequent learning of L2 collocations (Nesselhauf, 2003, 2005). Learners' reliance upon their L1 collocational knowledge may represent their assumption that there is a one-to-one correspondence between L1 and L2 collocational choices. Fortunately, where there is an exactly identical match between collocations in both languages, transfer from learners' mother tongue could result in positive, satisfactory production (Ellis, 2008). For instance, the combination in reality appears to be possible in both Arabic and English. As a result, it is very likely that Arab learners will become successful in transferring this particular collocation from L1 Arabic to L2 English. On the other hand, some researchers have also found that learners depend on certain learning strategies, such as synonyms (Farghal & Obiedat, 1995; Mongkolchai, 2008), repetition and overgeneralization (Granger, 1998; Howarth, 1998).

Earlier Studies on Collocations

Mahmoud (2005), revealed in his study that EFL learners produce 'unnatural' word combinations. 61% of the incorrect combinations could be due to negative transfer from Arabic. The fact that post-intermediate and advanced students of EFL have a relatively large stock of vocabulary might have motivated interlingual transfer in the belief that it would be easy to find the EFL equivalents of the Arabic lexical items.

In a study conducted by Shammas (2013) on the assessment of comprehension and production of collocations of MA students from four Arab universities, the results of the study showed that the overall performance of the students was unsatisfactory and below what was expected from MA students. Four factors were mentioned that influenced students' weakness in understanding and using collocation which are: 1) the lack of knowledge of the collocations in question 2) shortage of dictionaries that include collocations 3) lack of consciousness of the role of collocations in expressing meaning as intended in context and 4) lack of concentration on collocations in EFL classes at Arab universities.

Another study by El Dakhs (2015) examined the collocational competence of Arab undergraduate students who study English in a foreign language (EFL) environment. The study focused on lexical collocations. The study showed that the collocational competence of learners was notably unsatisfactory despite the fact that English is the medium of instruction at the University. It was also found that collocational competence improves with increased language exposure but at a slow rate.

Likewise, Alsulayyi (2015) analyzed grammatical collocations through students' essays to examine their production of collocations. Examining the writing of 10 Saudi undergraduate students majoring in English, he found out that the learners studying in the United Kingdom produced fewer grammatical collocation errors than those studying in Saudi Arabia despite their similar IELTS score ranging between 5.5 and 6.

Consequently, Habtoor (2019) examined the familiarity of English as a Foreign Language (EFL) learners at Najran University with English collocations and the strategies being used when translating them into Arabic. The participants' familiarity with English collocations was

measured by means of a two-part test adopted from Gyllstad (2007). The study concluded that EFL learners' knowledge of collocations was unsatisfactory and below what was expected from them as English language major students. The results of the Pearson correlation test indicated a positive relationship between the learners' familiarity with English collocations and their ability to translate them into Arabic using different translation strategies.

Similarly, Osman (2019) investigated English language postgraduates' knowledge in using English collocations by examining M.A English language students' awareness of using English collocations in both lexical and grammatical forms. The descriptive analysis showed that M.A students were not sufficiently aware of using English collocations because university syllabi do not sufficiently cover English collocation. It was recommended that collocations should be integrated in university syllabus to raise students' awareness in using collocations and that students should practice collocations seriously to master the language.

Collocational Competence and English Proficiency

Several studies linked students' collocational competence with proficiency levels. Hua and Azmi's (2021) study supports this idea and exclaims that high language proficiency level can be reflected through collocational competence. In the same way, Bagherzadeh Hosseini and Akbarian (2007) whose study delved on language proficiency and collocational competence underscored that there is a correlation between a student's general proficiency and collocational competence. Furthermore, he mentioned that collocational knowledge is 25% of a person's general proficiency, exclaiming that rest include "vocabulary knowledge, grammatical knowledge, knowledge of discourse, an understanding of how texts are organized, skill in reading, writing, etc., and fluency" (p. 15).

Most of the previous research studies mentioned above focused on one single group of EFL learners, particularly those with high proficiency. Hardly do such studies reflect a true picture of how learners' collocational knowledge has been developed through time. To put it another way, there has been little research to date examining learners' errors in the total interlanguage system with respect to collocation learning. It is for this reason that the present study was undertaken to bridge the gap, i.e. to scrutinize the collocational competence of high-proficiency and low-proficiency Arab learners of English.

Statement of the Problem

Given the EFL context in Saudi Arabia and the importance of collocations in achieving native-like proficiency among students, this research aimed to investigate the overall collocational competence of Arab foundation students in Saudi Arabia. This objective was further explained and explored through the following questions:

1) What are the lexical errors that students make?
2) What are the challenges that students encounter when they form collocations?
3) What is the overall collocational competence of the students?
4) Does students' collocational competence progress with proficiency?

Significance of the Study

Results of this study shed light on the existing challenges that Arab ESL learners face as they use collocations. Furthermore, this study shall help instructors in designing activities that

help students strengthen their collocational competence, as having strong collocational competence is highly associated with native-like proficiency. In this way, students' oral and written skills using the target language may be improved (Alotaibi & Alotaibi, 2015). Lastly, this study will benefit syllabus designers because this research will guide them on the extent in which collocations have to be included in the syllabus and the frequency in which collocations have to be introduced in an English course.

Method

Research Design

This study utilized both quantitative and qualitative designs. For the qualitative end, this research used descriptive qualitative research as reflected through the thematic analysis that was used to get the recurring patterns from both the questionnaires and semi-structured interviews.

For the quantitative end of the research, statistical treatment was used to interpret the scores from the collocational test. Students were given a 60-item test in order to determine their overall collocational competence. Scores of the test underwent statistical treatment to identify whether the students' collocational thresholds are acceptable.

Participants

The participants of the study were a total of 38 foundation program students from the Effat English Academy. These students were chosen through purposive sampling. The criteria in choosing the students were based on the following: 1) students should be part of the foundation program 2) students should be studying collocations in their respective levels 3) students should be at least from the intermediate level. Students who are part of the foundation program undergo intensive English courses in order to improve their language skills prior to entering college. Of the 38 chosen students, 19 were upper intermediate level students, while 19 were intermediate level students. The students' levels were determined by the university's placement test, Cambridge's Linguaskill test.

Data Collection

The study used the triangulation method to collect data in order to cover many aspects, such as tests, interviews, and surveys to arrive at more grounded answers. The primary data for this study came from the Collex and Collmatch collocation tests which were adopted from Gyllstad (2005). A total of 60-items were administered to students, 20 items from the Collex test, while the other 20 items were taken from the Collmatch test. 12 items prompted students to combine words to form collocations, whereas the remaining 8 items were part of a fill-in-the blank test.

The test was administered once since the aim of this research was to know the collocational competence of students along with the challenges they face as they use collocations. The instructors who proctored the students during the administration of the test were the same instructors who were interviewed.

The secondary data came from the survey that was administered to students. The survey focused on the challenges that students face when dealing with collocations and the

frequency of their exposure to collocations which can serve as support to the results of their collocation test. The survey was administered a day after the test, so students can have ample time to reflect about their overall performance and feedback about the test.

Meanwhile, additional secondary data in the form semi-structured interview was administered to the instructors handling the students. Gathered data from the interview supported the findings of the test. In addition, instructors' perspective proved important in improving pedagogical practices and syllabus revisions that would benefit students in the future. The semi-structured interview was done two days after the administration of the test to give instructors time to gather their thoughts in terms of teaching collocations in the classroom context and their observations while proctoring the students during the administration of the test.

Data Analysis

To arrive at a more comprehensive answer to each of the research questions raised in the earlier section of this paper, the data analysis will comprise four stages as shown in Figure 1. The first stage of data analysis focused on the statistical treatment of the collocation test scores. Since the tests were administered to two different levels, B1 and B2 respectively, unpaired t-Test was utilized to compare the means from the two levels. Meanwhile, taking the average of both levels would prove sufficient to know the collocational competence of the students. The second stage deals with the identification of common errors made by the students when they took the collocation test. This proved effective in determining the words they chose to pair with a collocate. In addition, examining students' choice of collocates gave justification as to how their L1 influences their word choice in L2. The third stage centered on the analysis of the raw data from the survey guided by the Likert scale. Finally, in order to support the results of the test and students' answers from the survey, qualitative coding was used to get the common patterns or themes present in the interview transcripts of the instructors teaching these students.

Figure 1: Stages of Data Analysis

Results

1. What are the lexical collocation errors that students make?

Analysis of the collocation test revealed that students had difficulties with lexical collocations. For the specific collocation structures, students were only tested with verb+noun structure in the form of Collex and Collmatch tests, and adjective+noun structure in the form of a matching type test and fill-in-the-blank test. Based on the overall performance of the students in the test, they scored higher in the verb+noun structure than in the adjective+noun structure. Several mistakes were observed in the adjective+noun structure, hence students got the lowest scores in the matching type, which required them to pick a word from each box to form collocations.

To illustrate, Table 1 shows the common mistakes that students made when they formed the adjective+noun structure. Only the most frequent combinations were included in the table below.

Table 1: Common Lexical Errors of Students Test 3

Unusual Combinations (formed by the students)	Expected Combinations
effective version	effective treatment; online version
close issue	close relationship; global issue
high information	high standard; basic information
classic achievement	classic example; academic achievement
active relationship	active participation; close relationship

Looking at the common lexical errors made by students from Test 3, it can be seen that students chose inappropriate adjectives to pair with their preferred nouns. For instance, instead of combining the adjective “effective” with treatment, most students chose to pair it with the noun version. On the other hand, the adjective “close” was paired with the noun “issue” instead of pairing it with the adjective “global”. Another unusual pair of collocation that emerged from the test was “high information”. Although high is not used with information, students might have chosen this adjective to mean that the information is important. Classic achievement was also formed by a number of students. Classic from the options must be paired with example, while achievement should have been paired with academic. However, this unusual combination may be interpreted to mean a type of achievement that most people accomplish (e.g. finishing high school and obtaining a college diploma). Lastly, instead of forming “close relationship” some students answered “active relationship” which to them could mean in constant communication with a friend or a relative. Overall, occurrences of unusual collocation combinations were due to the fact that students needed to depend on their actual collocational knowledge unlike the Collex and Collmatch tests which already provided students with two collocations that they have to choose from.

Table 2: Common Lexical Errors of Students From Test 4

Unusual Combinations (formed by the students)	Expected Combinations
heavy tire	flat tire
flat coffee	instant coffee
fair insurance	medical insurance
fair traffic	heavy traffic

Unlike Test 3, which prompted students to choose an adjective and a noun to form a collocation, Test 4 only required students to choose an adjective to pair with an existing word in each number. Regardless, the students still faced difficulties choosing the correct collocates. These combinations are common in books, movies, and even everyday conversations, however, very few students got these expected combinations correctly.

2. What are the challenges that students encounter when they form collocations?

One of the major aims of this study is to identify the challenges that Arab EFL students face as they use collocations. Through the questionnaires administered, the participants mentioned five major challenges which are: 1) unfamiliarity to words 2) level of difficulty of word combinations 3) inability to use collocations in communication (writing and speaking) 4) correct combinations of collocates and 5) influence of L1 on L2.

Unfamiliarity to Words

Students' inability to recognize words was one of the recurring answers from the questionnaire. To be specific, S1 mentioned that “I don’t know a lot of words”, while S37 wrote “I don’t know which words to use.” Students unfamiliarity with words could be heavily influenced by their limited vocabulary repertoire which is vital in using collocations. Limited vocabulary leads to poor usage and understanding of collocations. In addition, students' inability to understand word meanings contributed to their difficulty in using collocations. Several students mentioned that they do not understand the meaning of words, hence their poor usage of collocations.

Difficulty of Collocations

Another challenge that emerged from the thematic analysis of the questionnaire was the level of difficulty that students encounter when dealing with collocations. This finding is parallel to a number of studies done previously which stated that students found word combinations extremely challenging and confusing. S8, for instance, said that collocations are “difficult and we must understand it more”. Another participant, S30, wrote “it is very difficult to understand”.

Inability to Use Collocations in Communication (Writing and Speaking)

The third challenge of using collocations in sentences is related to the students’ productive and receptive knowledge of lexical collocations. This answer is supported by the result of the collocation test. Students scored better when they were given two collocations and only had to choose which the appropriate combination was. However, students struggled with the tests which required them to combine words themselves. Given their difficulty in combining possible word combinations, it will significantly impact their ability to produce collocations

on their own when writing sentences. In addition, aside from students having difficulty producing collocations when they write, they also struggle using collocations when communicating with others. In fact, several students mentioned that even pronouncing collocations was a problem for them.

Correct Combinations of Collocations

Correct combinations of collocations require good proficiency in English. Hence, collocational competence, as revealed by recent studies, has been linked to English proficiency. With the current study, students mentioned that one of the challenges they face is the way words collocate and added that it was difficult for them to choose which word is the correct collocate of another. This was due to not having been exposed to many activities in class and not having enough avenues for exposing oneself to practice using collocations, as some students mentioned that they rarely use collocations because their family and friends always speak Arabic.

Influence of Students' of L1 on Their L2

Another major challenge that students face is the influence of their first language on their ability to understand the meaning of words. Through the questionnaire administered, students mentioned that it was difficult for them to figure out the meanings of the words and their combinations because there are certain words in English that do not have a direct counterpart in Arabic. Furthermore, the students' L1 was revealed to have influenced their ability to choose the correct words because Arabic, unlike English, does not use several synonyms. Hence, words like "fast" and "quick" only have one counterpart in Arabic which is " سريع".

3. What is the overall collocational competence of the students?

Collocational competence has always been deemed important in improving one's language skills, as one's ability to use collocations and understand collocations promise not only native-like proficiency level, but also a more effective way to communicate with others. After a rigorous analysis of the data, the study reveals that students from both levels have poor collocational competence. In fact, the overall performance of the students was below average. Table 3 shows a detailed representation of the average of both levels in each of the tests.

Table 3: Overall Performance of All Students

Participants	Test 1	Test 2	Test 3	Test 4	Overall Average
L3 and L4 students	48%	58%	25%	42%	45%

Looking at the overall performance of all the students across all tests, the highest average obtained was 58% from the Collmatch test, followed by 48% from the Collex test, then 42% from the fill-in-the-blank test, and 25% from combining collocates. In a more detailed representation, Table 4 and 5 show students' performance in each test including the percentage, mean, and standard deviation.

Table 4: Detailed Performance of Students in Tests 1 and 2

Participants	Collex			Collmatch			Overall Percentage
	P	M	SD	P	M	SD	
L3 and L4 students	48%	10	2.5618	58%	12	1.929	53%

Table 5: Detailed Performance of Students in Tests 3 and 4

Participants	Matching type			Fill in the blank type			Overall Percentage
	P	M	SD	P	M	SD	
L3 and L4 students	25%	3	1.6214	42%	3	1.3677	33.5%

Based on Tables 2 and 3, it can be seen that among the tests administered, the highest performance was observed from the Collmatch test with an overall performance of 58% and a mean of 12 out of 20, which is still below average. For the Collex test, students' overall performance was 48% with a mean of 10 out of 20. 2 points lower than the Collmatch test which indicates below average as well. However, students' performance in both tests 1 and 2 may be considered better when compared to their performance in tests 3 and 4, which required them to form the most appropriate collocations from boxes containing adjectives and nouns and fill in the correct collocates by choosing an adjective from a series of adjectives inside a box, respectively. These results show that the collocational competence of the students is below average because they performed better in tests (1 and 2) which already provided them with collocations and all they had to do was to choose which was the appropriate one. Meanwhile, in tests that required students to form collocations on their own, they got much lower scores that indicate the students' difficulty using collocations on their own. Hence, matching type test and fill-in-the-blank type test proved to be very challenging.

4. Does students' collocational competence progress with proficiency?

As earlier studies revealed, collocational competence was strongly linked with proficiency. Based on the data that underwent statistical treatment, the findings reveal that the collocational competence of students from levels three and four do not progress with proficiency. Table 6 shows the overall performance of each group in the collocation test.

Table 6: Overall Performance of Students Based on Proficiency Levels

Level of Students	**Overall Average**
Intermediate Students (L3)	48%
Upper Intermediate Students (L4)	43%

Looking closely at the overall performance, L3 students performed better when considering the overall average of the tests. Ideally, L3 students' entry score is 140, while L4 students' entry score is 155. With the big difference between the two entry scores, it was expected that L4 students should score higher than L3. However, the difference between the two levels was not that much to be able to show a significant difference between their performances using the t-test.

Table 7: t-Test Result Comparing the Performance of L4 and L3 Students

Participants	Mean	Variance	Standard Deviation	T-Value	Critical Value
Intermediate Students (L3)	28.5789	19.6122	4.4286	1.7063	2.028
Upper Intermediate Students (L4)	26	23.7895	4.8774		

Based on the results of the t-test in Table 7, the calculated t-value is lower than the critical value (1.7063<2.028), hence the means are not significantly different. To put simply, the means of Group 1 and Group 2 are not significantly different at $p < 0.05$. This finding reveals that given the variation in terms of levels and target CEFR scores, there is no significant difference between how both levels performed in the collocation test. This result opposes results of some earlier studies that show students' collocational competence progresses with their proficiency level.

Discussion

Developing students' collocational competence is crucial for language learning, as exposure to recurring word combinations significantly impacts second language acquisition (Snoder, 2019). This study addressed the challenges English learners face, emphasizing the need to help them achieve native-like proficiency.

Analysis revealed that students were more familiar with verb+noun combinations, supported by significant score differences in the Collex and Collmatch tests. This finding aligns with El-Dakh's (2015) study, which showed that students demonstrated less command of adjective+noun patterns.Errors in unusual word combinations were common, particularly due to students' reliance on their mother tongue when selecting adjectives for nouns. Habtoor (2019) noted that such unnatural combinations often result from this reliance. Instructor interviews confirmed that confusion over synonyms was a major issue, particularly in reading and speaking contexts.

The study also identified several challenges students encounter with collocations, including unfamiliarity with words, difficulty with combinations, and the influence of their first language (L1) on their second language (L2) use. Students' vocabulary repertoire and exposure to correct collocations play significant roles in their understanding and usage, paralleling Shammas's (2013) findings regarding master's students' lack of awareness of collocation usage in context.

Collocations containing unfamiliar words hinder students' ability to distinguish correct combinations, impacting their overall proficiency. This aligns with Shammas's (2013) research on master's students and the claims of Farrokh (2012) and Zughoul (1991) that collocates vary by language, complicating comprehension for Arabic speakers.

Textbook limitations were also noted, as they often lack sufficient scaffolding and practice with collocations. Although they cover eight topics, many chapters provide only a few collocations, insufficient for enhancing students' lexical repertoire. Rogosic (2023) found considerable inconsistencies in the coverage of collocations across textbooks, echoing Suarez and Natal (2017) and Eid and Al-Jamal (2023)'s observations that single words are prioritized over collocations. Regarding the influence of L1, 56% of participants acknowledged that Arabic affects their collocational use. This aligns with Sun and Park (2023), who emphasized that L1 transfer can impede L2 collocational acquisition.

Overall, students' collocational competence was below average, with the highest average score of 12 out of 20 (58%) on the Collmatch test, indicating challenges with productive use compared to recognition. This reflects findings from El-Dakhs (2015) and Gaballa and Al-Khayri (2014), which noted poor collocational knowledge among Arab learners. Interestingly, while there was no direct link between collocational competence and proficiency, intermediate learners outperformed upper-intermediate peers, contrasting with studies suggesting advanced learners achieve near-native collocational use (Abdullah and Noor, 2013). Overall, the study supports Halim and Kuiper (2018), who found that students across proficiency levels struggle with producing appropriate multi-word units.

Conclusion

This study aimed to examine foundation year students' collocation errors, investigate challenges that students face when using collocations, and identify the collocational competence. Findings reveal that students had difficulties with lexical collocations and scored unsatisfactorily in both tests. Between the verb+noun and adjective+noun structure, students scored better when tested the former. Having said this, the overall collocational performance of students was below average given the overall performance of 45% combining the results of upper intermediate and intermediate students. However, one key finding from this study is that the intermediate students scored better than the upper-intermediate ones. Looking deeply into the challenges that students face when dealing with collocations, unfamiliarity with words, difficulty of collocations, inability to use collocation in communication, correct combination of collocations, and the influence of L1 on L2 have emerged through the interviews and surveys conducted. These challenges affected the students' collocational competence and their ability to use collocations inside and outside the classroom setting, some of which support earlier studies. In this study, interestingly, the proficiency levels of the learners do not progress with their proficiency levels. The result of the t-test revealed that there is no significant difference between the means of both upper intermediate and intermediate students. Therefore, although there is a huge difference in their proficiency levels, their scores in both tests did not show any.

Recommendations

This study is limited to upper intermediate and intermediate students, focusing only on verb+noun and adjective+noun structures. Future research should include all proficiency levels, from beginner to advanced, to provide a fuller picture of Arab students' collocational

competence, encompassing both lexical and grammatical collocations. Additionally, exploring the impact of translanguaging on teaching collocations could enhance understanding, as pedagogical practices significantly influence students' development in this area.

Given the specific challenges identified, it's crucial to emphasize early exposure to collocations to raise awareness among students. The findings suggest a greater focus on developing collocational competence in language instruction, including direct teaching, bilingual glossaries in EFL textbooks, and bilingual collocation dictionaries.

Current textbooks often inadequately cover collocations, so more explicit, scaffolded teaching is necessary to address learners' specific challenges. This should include a broader range of collocational patterns and tackle issues like synonym confusion and first language reliance. Furthermore, collocation instruction should be tailored to proficiency levels, as intermediate learners sometimes outperform upper-intermediate students. Addressing both receptive and productive collocational knowledge is essential. Integrating these elements into language curricula could significantly enhance students' overall collocational competence.

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Tangled Timelines: A Qualitative Exploration of ESL Challenges in Acquiring the English Past Tense

Ewana Mohamad Yusop, Maktab Duli Pengiran Muda Al-Muhtadee Billah, Brunei Darussalam
Nur Qistin Mohd Harunthmarin, Maktab Duli Pengiran Muda Al-Muhtadee Billah, Brunei Darussalam

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Abstract
This paper aims to discover and identify the challenges encountered by ESL (English as a Second Language) learners in their pursuit of mastering the English past tense. The acquisition of this grammatical aspect constitutes a crucial step in achieving language proficiency, yet it remains a challenge for many non-native speakers. Most ESL students in Brunei sit for the English Cambridge O Levels at the end of their secondary school education and to obtain the highest band in the Writing paper, students must demonstrate highly accurate use of complex spelling, punctuation, and grammar. Despite having been taught the past tense rule over their 12 years of studying English, some ESL students in Brunei still face difficulties in applying the past tense during assessments. Hence, the main objective of this research was to identify the underlying causes hindering students' application of this grammatical concept, especially during assessments. This exploratory case study uncovered twelve ESL students' challenges in applying the past tense through a self-reflective activity. The students' responses were analyzed using thematic analysis to identify common, recurring themes and patterns. The themes derived from the data were: time limitations, confusion of irregular verb spelling, lack of practice, and translating of mother tongue to English. The findings have implications for educators, curriculum designers, and policymakers, aiming to inform the development of targeted interventions that can empower ESL learners to navigate the complexities of the English past tense more effectively.

Keywords: ESL Learners, Grammar Past Tense, Qualitative Case Study

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Introduction

One of the assessment objectives of the Brunei-Cambridge English Language O-level is for students to be able to communicate successfully and show language competency. To obtain the highest band in the Cambridge O Level Paper 1 (the Writing paper), students are required to use highly accurate use of complex spelling, punctuation, and grammar. However, despite having been taught the past tense rule over their years of studying English, O-level students in Year 12 are still facing difficulties in applying the past tense during assessments. The main objective of this research was to identify the underlying causes hindering their application of this grammatical concept.

Background of Research

English language education in Brunei has undergone substantial development over the years. The context of ESL education in Brunei is unique due to the nation's bilingual status, with Malay as the official language and English as a second language. It is essential for Brunei's ESL students to achieve a high level of proficiency because this country's bilingual environment has made English a vital tool for communication, education, and economic development. For instance, in the field of education, most of the subjects learned in Bruneian schools are communicated in English, thus English as ESL proficiency is strongly encouraged in Bruneian primary, secondary, and tertiary education.

English language proficiency is not limited to these 12 years of education; in order to continue their education, students must obtain at least a Credit in English Language at O Level, further emphasizing the importance of English proficiency. The O Levels exam gives significant weight to evaluating students' language proficiency, including their mastery of intricate spelling, punctuation, and grammar. The highest band on the writing portion of the exam requires a high level of grammatical accuracy, which includes using the past tense correctly.

Indeed, the English Language in Brunei now plays the role of ‘gatekeeper’ whereby with a good grasp of the target language, one would almost be likely guaranteed a secure future. This ‘gatekeeper’ role largely explains the dire need for the Ministry of Education to find ways of heightening students’ proficiency level in English. Without credit in their GCE English O-level examinations, students will find it almost impossible to obtain places to study at the local universities or any of the higher institutions. The past tense in English is particularly significant because it is important for communicating past actions and events. Understanding the past tense is crucial for clear communication and is frequently necessary for success in academics.

However, many ESL students in Brunei continue to have difficulty correctly applying this grammatical concept despite receiving rigorous instruction and exposure to it throughout their schooling years, particularly in high-stakes exams like the O Levels. These issues call for a deeper look because they are symptomatic of a larger problem with Brunei's ESL classrooms. Therefore, the main goal of this study is to investigate the root causes that make it difficult for Bruneian ESL students to use the past tense correctly, especially when it comes to assessment situations. To achieve this, an exploratory case study approach was employed, involving twelve ESL students. This study sought to learn more about the specific difficulties these learners have in correctly using the past tense through a self-reflective activity.

The results of this study will have important ramifications for many stakeholders involved in Brunei's ESL education system, such as teachers, curriculum designers, and policymakers. Targeted interventions can be created to effectively address these issues by understanding the difficulties ESL students have learning the past tense. In the end, this study enhances ESL instruction in Brunei by giving students the skills and confidence they need to successfully negotiate the complexities of English grammar, particularly the past tense.

Aims and Objectives

The aim of this research is to uncover underlying factors and causes that contribute to ESL learners' challenges in effectively using the past tense, especially during assessments. The ultimate objective is to inform pedagogy implications such as effective interventions that empower ESL learners to overcome challenges of the English past tense with greater success and confidence.

Research Questions

Hence the following research question this paper seeks to answer:

RQ: What are the recurring themes that emerge from the self-reflective responses on ESL challenges with the English Past Tense?

Literature Review

The acquisition of grammatical aspects, such as verb tenses, is a fundamental component of language proficiency for ESL (English as a Second Language) learners. Among these aspects, the English past tense plays a pivotal role in conveying actions and events that occurred in the past. However, mastering the past tense remains a formidable challenge for many non-native speakers, including ESL students in Brunei. Despite years of English language education, these learners continue to struggle with the accurate application of the past tense, especially during assessments. This literature review explores the challenges faced by ESL learners in mastering the English past tense, provides insights into the causes of these challenges, and highlights the implications for education in Brunei.

Significance of the English Past Tense

The English past tense is a cornerstone of effective communication and language proficiency. It enables learners to express actions and events in relation to time, allowing for the clear and accurate conveyance of narratives and descriptions. In academic settings, mastery of the past tense is essential for writing, comprehension, and overall language competence (Hinkel, 2002). Achieving precision in its usage is vital for ESL students aiming to excel in English language assessments, including the Cambridge O Levels.

Challenges Faced by ESL Learners

Studies into the challenges of the learning of English Past tense have been documented well in the literature. Common issues faced by ESL students in learning the concept are due to English verb inflections and irregularities. One prominent challenge lies in the inflection of regular and irregular verbs in the past tense. ESL learners often struggle with the diverse patterns of verb conjugation, particularly the irregular forms (Eckman, 2004). The inconsistent spelling and pronunciation of irregular verbs can lead to confusion and errors.

Studies conducted in similar contexts to Brunei, such as Malaysia, show ESL students are continuously facing difficulties in past tense, such as a study by Manokaran, Ramalingam & Adriana (2013), with students often making errors in tense shifts and misconceptions of the past tense of the auxiliary verb 'be'. Similary, Jabeen, Kazemian and Shahbaz (2015) claim that incorrect usage of verb tenses are the most common errors found in Iranian ESL students.

The influence of a learner's native language on the acquisition of the past tense is a well-documented phenomenon (Dulay & Burt, 1974; Guo, Liu & Chen, 2014). Often due to the differences in language mechanics, there is an existence of negative transfer which will cause ESL learners to commit errors when they attempt to either speak or write sentences in the second language (Munchen. Arsad, & Razali, 2021). Furthermore, the frequency of negative language transfer occurs higher in low level language learners as they rely on their native language in terms of certain language rules and structures, for example they tend to over-generalise the target language rules during sentence constructions (Febriyanti & Sundari, 2016). This is the case in Brunei, whereby learners may transfer Malay language structures and tenses to English, resulting in incorrect usage (Deterding & Sharbawi, 2013; Deterding & Suhaimi, 2021).

Furthermore, effective language acquisition requires regular practice, especially in applying complex grammatical rules like the past tense. ESL students may not receive adequate opportunities to practice and reinforce their understanding of this aspect (Lightbown & Spada, 2013). Finally, ESL learners often face time constraints when completing written tasks. This can add pressure and hinder their ability to accurately apply the past tense (Hamp-Lyons & Heasly, 2006), especially during high-stakes assessments like the Cambridge O Levels.

Significance of Study

As the status of the English Language continues to take hold, it becomes necessary to understand the needs of ESL learners in order to assist their learning and for teachers to better inform their teaching pedagogy. The contribution of this study to the body of knowledge of ESL teaching of English past tense is believed to be valuable. Understanding ESL challenges in acquiring the English past tense will allow for the following contributions:

a. ESL educators in Brunei and ESL learners would be able to identify the challenges related to the English past tense and provide targeted instruction that addresses these difficulties.
b. Curriculum designers would be able to incorporate more opportunities for ESL learners to practice and reinforce their understanding of the past tense, both in written and spoken contexts based on the findings of this study.
c. Policymakers and educators could consider adaptations in assessment formats to promote accurate application of the past tense in assessments.

Hence, recognizing the challenges of ESL learners and the underlying causes of their inability to grasp the past tense is essential for improving language education in Brunei.

Method

This study utilizes an exploratory case study design. This research was conducted over a two-week period, involving a group of Year 12 ESL students, that consists of 7 boys and 5 girls. The study was constrained by the fact that the researchers had access to only one English O

Level class, and coincidentally it was one of the researchers' own classes, resulting in a limited pool of subjects available for the research.

Students' Task: Reflection Task

The reflection task was designed to help teachers understand the student's understanding of past tense and the difficulties they faced in applying it during tests and exams. The task involved asking students to write short paragraphs explaining their understanding of past tense and the challenges they faced using it. The Table 1 shows the questions asked:

Table 1: Self Reflective Questions

No	Self-reflective questions
1	What do you understand about past tense?
2	Why do you think it was difficult for you to grasp past tense before this, especially during tests?
3	What are the steps that you have learned to improve your knowledge in past tense?

Findings and Discussion

The students' responses were analyzed using thematic analysis to identify common, recurring themes and patterns of students' challenges of learning and applying the English past tense. The constant comparative method was used in the data analysis and the refinement of open codes to axial codes and eventually into themes and sub-themes. The first step of this process is the reduction of data into manageable units and codes (Miles & Huberman, 1994). Data reduction involves the selection, simplification, abstraction, and transformation of the raw data. By the process of data reduction, pieces of information from the data can be combined into categories and themes.

The themes that were derived from the data were as follows:

1) Time limitations during examinations
   Most students said they had a basic understanding of past tense but struggled to apply it correctly during tests and exams due to time constraints and feeling pressured to complete the tasks within the time limits. Students also mentioned due to time constraints they were not able to check and recheck their writing to spot for errors in their use of tenses.
2) Confusions of irregular verbs spelling
   Students reported their confusion in terms of the spellings of irregular verbs such as 'buyed' and 'bought'. Regular verbs in English typically form their past tense by adding "-ed" to the base form (e.g, walk-walked), whereas irregular verbs change their base form entirely (e.g., go-went).
3) Lack of practice
   Students admitted that they lacked writing or grammar practice and did not read widely to be more familiar with the English language grammar.
4) Translating Malay to English
   Others stated that they needed time to translate from their mother tongue language when writing, which caused them to rush to finish their tasks and not have any remaining time to check their work.

To address the challenges faced by students as identified through the analysis, teachers can provide more targeted instructions to address time constraints and students' lack of practise. Interventions could be done to address confusion of irregular verbs spelling. Research on verb conjugation on second language acquisition has shown that distinguishing between regular and irregular verbs is a crucial step in learning the past tense (Lightbrown & Spada, 2013). Additionally, classroom instruction should include contextual learning. Studies have emphasized the importance of using context, such as storytelling or dialogues to help learners understand the practical application of past tense forms (Nation & Chung, 2009).

Furthermore, fostering bilingualism by encouraging students to integrate their mother tongue, Malay, with English can substantially enhance language learning. It is important to change the perspective from viewing the native language as an interference to identifying its potential as a valuable educational tool. This approach aims to raise students' awareness of how they might transfer linguistic structures from Malay into English. By understanding these influences, students can make more knowledgeable language choices, avoid common errors, and ultimately become more proficient in both languages. This linguistic awareness represents the first step in overcoming language challenges, empowering students to navigate the complexities of language acquisition with greater confidence and effectiveness.

Conclusion

In conclusion, the research provided valuable insight into identifying the challenges, issues, and gaps of learning of second language learners, in particular Year 12 English O Level students in Brunei Darussalam, in grasping the concept of past tense. It is important to note that this research was conducted under a limited scope, thus, future studies are recommended to include a larger and more varied sample of ESL learners as participants. A greater and more diverse participant pool will provide a more wide-ranging understanding of the challenges associated with the English past tense in Brunei's educational context. Expanding the participant pool in future research will improve the generalizability of findings and allow for a deeper examination of the challenges related to the English past tense. This will contribute to the development of more effective strategies and interventions for ESL education in Brunei.

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Contact emails: ewana.yusop@teacher.maktabduli.edu.moe.bn
nur.harunthmarin@teacher.maktabduli.edu.moe.bn

Environmental Empathy Through the Paradigm of Postmodernism Based on Indigenous Peoples' Local Wisdom

Piki Setri Pernantah, Universitas Pendidikan Indonesia, Indonesia
Nana Supriatna, Universitas Pendidikan Indonesia, Indonesia
Kokom Komalasari, Universitas Pendidikan Indonesia, Indonesia
Siti Nurbayani K, Universitas Pendidikan Indonesia, Indonesia

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Abstract
Environmental empathy can be viewed as a moral movement that aims to increase awareness and concern for various environmental problems and issues. This movement encourages changes in the behavior of people who were previously antipathic or indifferent to the environment to empathize with the environment. The purpose of this study is to know and analyze the reality of society in empathizing with the environment and the implementation of environmental empathy through local wisdom in Indonesia in the perspective of postmodernism which can also be a source of learning. This research uses a post-qualitative approach by conducting field research to various indigenous peoples. The results of this study can be understood as follows: (1) the reality of the community being able to maintain and empathize with the environment through the values of local wisdom that are still believed and carried out in everyday life so as to minimize problems or damage to the environment; (2) The implementation of environmental empathy through local wisdom in the perspective of postmodernism is carried out in various activities or traditions while still maintaining the previous culture that has an impact on environmental conservation. This view emphasizes the plurality of values and diverse views of society about the environment, but with a good goal of maintaining a balance of relations between humans and the environment (nature).

Keywords: Environmental Empathy, Local Wisdom, Postmodernism

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Introduction

Human behavior and perspectives on the natural world are key factors influencing environmental damage. In 2023, the Indonesian Ministry of Environment and Forestry (https://www.menlhk.go.id) highlighted the "triple planetary crisis" of climate change, pollution, and biodiversity loss. In response, the Indonesian government has focused on environmental protection and sustainable development, including initiatives like Asia-Africa climate change cooperation, tackling plastic pollution, and combating illegal wildlife trade (Kementerian Lingkungan Hidup dan Kehutanan, 2023). These environmental problems are also experienced by everyday communities, particularly those whose livelihoods depend on nature. Environmental degradation is evident in the form of damaged agricultural land and forests, pollution, loss of biodiversity, waste and clean water crises, global warming, and climate change, among other issues. Many of these problems are caused, at least in part, by human activities, which are significant contributors to environmental destruction (Bilqisti et al., 2023; Haris et al., 2016; Pranadji, 2005; Uar et al., 2016;). Environmental sustainability becomes threatened when human needs are driven by the concept of modernity, reducing nature to a mere material object to fulfill those demands (Marfai, 2019).

Given that various environmental issues are closely linked to human activities, addressing these problems requires fundamental changes in how humans think about and interact with the environment, as well as in their behaviors toward it (Keraf, 2010). Cause, the active role of humans is closely linked to the existence, capacity, and quality of social and community organizations that focus on environmental issues, as well as the level of public knowledge and awareness regarding environmental sustainability (Chandra, 2020). Nature must be viewed as something valuable, which in turn fosters positive behavior in interacting with the environment. A Minangkabau proverb states, "Alam Takambang Manjadi Guru" (nature expands to become a teacher), emphasizing that the environment should be regarded as a teacher, offering meaning and lessons for humanity, thus deserving of respect, proper care, preservation, and the ability to draw life wisdom from natural signs. In the study of environmental philosophy or ecosophy from a postmodern perspective, it is also understood that it is essential to interpret and explore the wisdom inherent in the environment, recognizing that it should not merely be seen as a tool to fulfill human needs, but that the environment holds intrinsic value and wisdom (Keraf, 2014). This is expected to educate humans and foster a relationship between humanity and the environment that is more ethical and empathetic, supporting sustainable living and ensuring the continuity of life on Earth.

The importance of empathy toward various environmental issues undoubtedly involves knowledge, attention, and responsibility for the condition and sustainability of the environment to address and overcome these problems. This concern is not overlooked in the field of education, where fostering empathy can serve as a key strategy to enhance educational success in Indonesia. By integrating empathy into the curriculum, it is possible to cultivate a more environmentally conscious and responsible generation, thereby contributing to both individual development and broader societal goals (Sumiati et al., 2021). Producing outstanding individuals by considering the continuity of human life and environmental preservation can be supported by creative pedagogy as "the way of thinking" (Supriatna et al., 2020). This study examines societal realities of environmental empathy and its implementation through local wisdom in Indonesia, viewed from a postmodernist perspective. It explores how indigenous communities empathize with the environment and develop unique paradigms, while also investigating societal behaviors that support

sustainable environmental practices, aiming to cultivate individuals attuned to environmental sustainability for the well-being of future generations.

Method

This study employs a post-qualitative approach, conducting field research within various indigenous communities. Data collection techniques include observation, interviews, and documentation from various references. The study attempts to observe the views and activities of several indigenous communities in Indonesia, particularly the Baduy community in Lebak Banten, the Sinar Resmi community in Sukabumi, West Java, and the Kampung Naga community in Tasikmalaya, West Java.

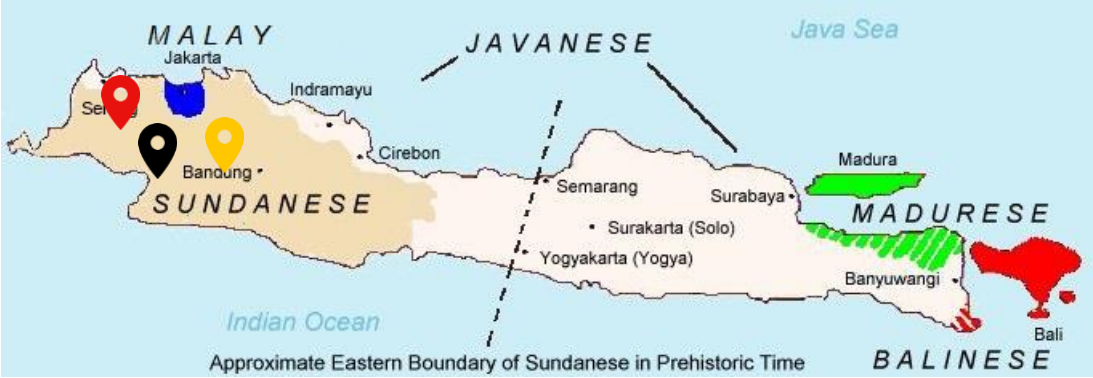

Figure 1: Research Location

Details:

- The Baduy village in Lebak Banten, Banten Province
- The Sinar Resmi village in Sukabumi, West Java Province
- The Kampung Naga village Tasikmalaya, West Java Province

Interviews were conducted with traditional leaders or community figures, as well as local residence, to obtain relevant data for the topic under discussion. The data is further supported by various sources, including books, journals, websites, and other documentation. Subsequently, the data is analyzed using qualitative data analysis, following stages of data collection, data reduction, data display, and conclusion. Within the tradition of post-qualitative research, the procedure focuses on the researcher's style, which is regarded as critical, idealistic, and postmodern/pragmatic. As a result, it is difficult to avoid subjectivity in the development of the research (Bungin, 2020).

Results and Discussion

Indonesia's indigenous communities, numbering in the millions, are key custodians of unique cultural traditions and ways of interacting with the environment. The United Nations highlights their importance globally, as these communities maintain distinct social, cultural, economic, and political characteristics that set them apart from dominant societies (United Nation, 2023). According to data from the Data Indonesia website (https://dataindonesia.id), based on information from the Alliance of Indigenous Peoples of the Archipelago (AMAN) as of August 9, 2023, Indonesia has 4.57 million indigenous people, with the largest populations in Kalimantan (1.40 million), Sumatra (1.27 million), and Sulawesi (1.05 million). Other regions include Bali-Nusa Tenggara (302,799), Maluku (285,728), Java (250,115), and Papua (10,543). Of the total, 2.34 million are male and 2.23 million are female.

Indigenous territories are crucial in understanding environmental empathy, as they reflect the attitudes of communities toward the environment. These areas highlight how indigenous peoples' empathy, rooted in local wisdom and values, influences their relationship with nature. According to data from the Kompas website (https://www.kompas.id), as of August 2023, As of August 2023, Indonesia's indigenous territories cover 26.9 million hectares, with 1,336 maps registered across 155 districts. This is an increase of 1.8 million hectares from March 2023. Of these, 219 territories are officially recognized, covering 3.73 million hectares. Additionally, 123 indigenous forests span 221,648 hectares, with 12.9 million hectares of primary forest and 5.37 million hectares of secondary forest identified. A more detailed depiction of this can be seen in the image below:

	Sumatera		Kalimantan		Sulawesi		JawaBaliNusra		Maluku		Papua	
	Peta	Luas (Ha)	Peta	Luas (Ha)	Peta	Luas (Ha)	Peta	Luas (Ha)	Peta	Luas (Ha)	Peta	Luas (Ha)
Total Peta Wilayah Adat	298	2.397.733	515	10.181.668	174	1.707.282	118	540.050	19	277.247	212	11.864.876
Status Registrasi BRWA												
Sertifikasi	6	19.189	17	638.909	19	163.407	10	23.691	-	-	7	104.253
Verifikasi	39	178.390	27	1.569.585	81	719.600	17	64.321	5	69.679	17	824.566
Registrasi	247	2.172.843	444	7.074.070	67	753.144	72	433.468	11	196.210	142	5.174.940
Tercatat	6	27.311	27	899.105	7	71.130	19	18.571	3	11.359	46	5.761.118
Status Pengakuan												
Penetapan	82	309.545	56	2.148.607	45	600.875	17	51.081	4	58.876	15	564.370
Pengaturan	117	1.563.418	418	6.610.727	62	572.058	61	186.839	7	125.911	197	11.300.506
Status Hutan Adat (Hektar)												
Penetapan	22.995		126.912		22.108		9.411		157		40.096	
Potensi	1.202.967		7.238.935		971.744		283.195		151.698		11.008.204	

Figure 2: Status of Indigenous Territory Recognition in Indonesia as of August 2023 From the Indigenous Territories Registration Agency (BRWA)

The Indonesian Constitution guarantees the existence of indigenous communities, as outlined in Article 18B (2) and reinforced by Article 28I (3), ensuring the respect for their cultural identity and rights. Indigenous communities continue to uphold and practice their local wisdom, customs, and traditions (Sekartaji et al., 2021). Among the many indigenous communities in Indonesia, this study will focus on analyzing several specific indigenous groups. It aims to observe the perspectives and activities of indigenous communities in Indonesia, particularly the Baduy community, the Sinar Resmi community, and the Kampung Naga community.

The Baduy indigenous community, living at the foot of the Kendeng Mountains in Banten Province, is divided into Baduy Luar (Outer) and Baduy Dalam (Inner). They maintain ancestral values centered on environmental preservation, rejecting modern developments and upholding *Sunda Wiwitan* teachings to protect the environment from external influences. The values upheld by the Baduy community (referred to as *pikukuh*) are categorized into four main areas: the value of life, the value of tradition and belief, the value of maintaining balance with nature, and the value of togetherness and cooperation (*gotong royong*) (Ardiyansah et al., 2023). The Baduy community has two groups with distinct lifestyles. The

Baduy Luar (Outer) is more open, using modern items like nails, iron, and instant noodles in their diet. They allow documentation and have more diverse practices. In contrast, the *Baduy Dalam* (Inner) maintain a traditional, nature-based lifestyle, avoiding modern conveniences and documentation. They rely on wooden and bamboo items and live without modern bathing facilities, using the river instead. Despite these differences, both groups share a common belief in preserving nature as the source of life for future generations.

Figure 3: Environmentally Friendly Bridge in Baduy (Personal Documentation, 2023)

Figure 4: House of the *Baduy Luar* Community (Personal Documentation, 2023)

The Baduy indigenous community serves as an exemplary model for the management and utilization of natural resources, demonstrating a balance between the well-being of the community and the preservation of forest ecosystems (Jasmine et al., 2023). The local wisdom of the Baduy community, which upholds traditions to protect nature, reflects the belief that the environment plays a crucial role in human life. Nature provides essential resources for daily needs, including economic, social, and cultural values. This deep respect for the environment has contributed to the preservation of the natural state of the region, including its forests (Mirajiani et al., 2022; Fitri, 2023). The indigenous forests in the Baduy region can be divided into three categories: (1) *Titipan* Forests, which include protected

forests and restricted forests, (2) *Tutupan* or Cultivated Forests, which consist of fields and gardens, and (3) Village Forests or *Dudungusan*, which are located within the settlements (Jasmine et al., 2023). The diagram of indigenous forests in the Baduy region is shown in the image below:

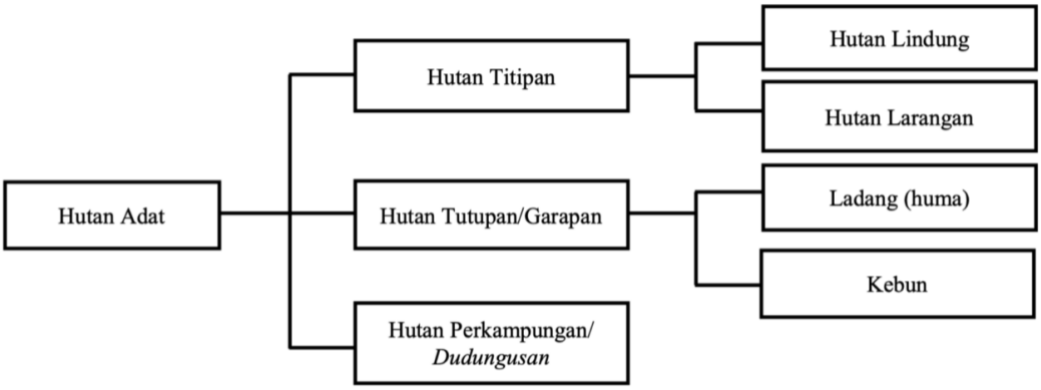

Figure 5: Division of Indigenous Forests in the Baduy Region
Source: Jasmine et al. (2023)

In managing agriculture, the Baduy indigenous community always adheres to the *pikukuh* (customary rules) that have been established. As a result, their farming practices are simple and traditional. They do not plow the land, do not create terraces, and instead use a method called *tugal*, which involves planting seeds using a sharpened piece of bamboo (Mirajiani et al., 2022). The use of pesticides is prohibited, and it is replaced with traditional remedies made from a mixture of various types of leaves combined with palm sap water (*nirah*) (Fitri, 2023). The Baduy community uses agricultural harvests efficiently for food, rituals, and reserves in rice barns (*leuit*). Surplus crops like durian, bananas, and cassava are sold for extra income. Their agricultural practices aim to preserve the environment, avoiding land alterations that could cause degradation. This environmental empathy aligns with postmodern ecocentrism. This theory emphasizes that ethical and moral responsibility applies equally to all aspects of the environment, asserting that human actions should align with the broader ecosystem rather than dominating or exploiting it (Keraf, 2010). The study conducted by Jasmine et al. (2023) also concluded that the management of natural resources in the forest ecosystem by the Baduy indigenous community is considered to be effective.

Figure 6: Village of the *Baduy Luar* Community (Personal Documentation, 2023)
*The village of the *Baduy Dalam* community is prohibited from being documented.

For the next, Sinar Resmi indigenous community led by Abah Asep Nugraha, is in the Cisolok District, Sukabumi, and is part of the Kasepuhan Banten Kidul, a region known for its efforts to preserve its cultural heritage. This community is situated within the Ciletuh Geopark, an area monitored by UNESCO. Sinar Resmi Village spans 4,917 hectares, with 2,950 hectares dedicated to forest and 275 hectares allocated for agriculture. Unlike other Kasepuhan communities, Sinar Resmi has adopted a more modern and open approach to interacting with the government and broader society. The community remains deeply committed to promoting food security without compromising environmental sustainability, a commitment that earned them the prestigious "Adhikarya Pangan Nusantara Award" in 2016 for their role in food security, presented by President Joko Widodo. The traditional agricultural practices that promote food security demonstrated by the Kasepuhan community are closely intertwined with agricultural practices, social institutions, belief systems, and natural elements such as soil, water, air, sunlight, weather, and others (Rahmawati et al., 2008). The tangible manifestation of the values, thoughts, and practices of the Sinar Resmi community is reflected in their agricultural activities, which are regarded as a form of worship. As such, these activities are inseparable from ritual ceremonies, sacredness, and myths (Supriatin et al., 2022).

Figure 7: Agricultural Tools and Irrigation of the Sinar Resmi Indigenous Community (Personal Documentation, 2023)

Figure 8: Agricultural Land of the Sinar Resmi Indigenous Community (Personal Documentation, 2023)

The life principles governing the relationship between humans and the environment in the Sinar Resmi community are encapsulated in the philosophy of "Ibu Bumi, Bapak Langit, and Guru Mangsa." This philosophy can be interpreted as follows: The Earth, regarded as a living entity, is symbolized as a mother. Consequently, the community engages in agricultural activities only once a year as a form of reverence for "Ibu Bumi" (Mother Earth). The phrase "Masa, Ibu" reflects the cultural belief that a mother should not be forced to give birth twice a year, which informs the community's agricultural rhythm. Prior to cultivating the land, the community conducts rituals to seek permission and offer prayers to the Earth, demonstrating respect for the natural world. The concept of "Bapak Langit" embodies the local knowledge derived from celestial events (the sky) that influence agricultural practices. Meanwhile, "Guru Mangsa" refers to the practice of learning from the universe to determine the optimal times for planting and harvesting. This worldview is closely aligned with the postmodern perspective in the theory of biocentrism, which emphasizes that both humans and nature possess intrinsic value. According to this theory, humans have a moral responsibility toward the environment, which is regarded as a living entity. Therefore, all elements of nature, including the Earth, are endowed with inherent dignity and value, contributing to the broader ecological and ethical considerations of life on Earth (Keraf, 2010).

The community expresses gratitude for the agricultural harvest through the annual "Syukuran Seren Taun," a ritual imbued with philosophical significance. This ceremony is a way of giving thanks for the blessings of nature and the Earth's abundance, acknowledging the sustainable harvests that can be enjoyed by current and future generations. The harvested crops are utilized for consumption within the community, shared as alms with neighbors, offered during ritual ceremonies, and stored in rice barns called *leuit* as a food reserve for the family. In addition to its agricultural traditions, the Sinar Resmi indigenous community places a strong emphasis on environmental conservation, particularly in the protection of forests. The community divides its forest areas, known as *leuweung*, into three zones: "hutan titipan" (entrusted forest), "hutan tutupan" (protected forest), and "hutan garapan" (cultivated forest). This division ensures that the environment is sustainably managed, with each zone designated for specific purposes to maintain the balance and conservation of the ecosystem (Prabowo et al., 2021).

Furthermore, it can also be observed how the Naga Village indigenous community demonstrates empathy and maintains a relationship with the environment. The term "Naga" or "Nagawir," meaning cliff, signifies that this indigenous village is in a cliffside area. The Naga Village is situated in the village of Neglasari, Salawu District, Tasikmalaya Regency, West Java. The total land area of Naga Village is 1.5 hectares, with most of it being used for housing in the form of triangular roofed homes made of palm fiber, yards, ponds, and the remaining area used for rice field agriculture, which is harvested twice a year. In building its relationship and empathy with the environment, Naga Village also has a forbidden forest (*hutan larangan*) designated as a protected forest to maintain the natural balance in the surrounding area (Purnama, 2021). All agricultural activities in Naga Village are still carried out using traditional tools, such as when plowing rice fields, planting, repelling pests, and harvesting, with the reason being to avoid damaging the environment (Nurislaminingsih et al., 2022). The indigenous community of Naga Village utilizes their agricultural produce not only to fulfill their daily needs but also to share with neighbors, support ritual ceremonies, and store in rice barns (*leuit*) to ensure food security. The settlement pattern in Naga Village is characterized by stilt houses made of wood, strategically constructed to adapt to the terrain. This design helps mitigate the risks of landslides and earthquakes, reflecting a thoughtful integration of environmental considerations. Such practices are part of a broader strategy to

create a sustainable relationship between humans and the environment, promoting resilience to environmental changes while preserving the community's social and cultural integrity without causing harm to the surrounding ecosystem (Nurdin et al., 2023).

The indigenous community of Naga Village also teaches environmental preservation through a guiding philosophy that states, "It is better not to cut down trees than not to plant them." This implies that before the community can cut down a tree, they must first plant one. This principle reflects a deep concern for and empathy towards environmental sustainability. From a postmodernist perspective, this philosophy aligns with the concept of deep ecology, which emphasizes the need for environmental ethics to be translated into tangible, concrete actions. In this context, the community's practices embody a commitment to ecological responsibility, ensuring that their actions contribute to the long-term well-being of the environment (Keraf, 2010). Indeed, the tangible actions and practices undertaken by the community are inherently tied to broader concerns that involve the collective interests of the entire ecosystem. These practices are not merely driven by individual or isolated motivations but are deeply embedded in a communal responsibility for environmental stewardship. They underscore the interdependent relationship between human needs and ecological balance, reinforcing a commitment to environmental sustainability. The community's efforts reflect a conscientious approach to safeguarding the environment, ensuring that the preservation of natural resources aligns with the welfare of both present and future generations.

Figure 9: The Traditional Village of Kampung Naga Community
(Personal Documentation, 2023)

The actions undertaken by the three indigenous communities discussed above underscore a fundamental alignment with the principles of environmental preservation and sustainability. When specific values or regulations become ingrained within a social group, they essentially institutionalize, and individual behavior is subject to the influence of these norms. Violators of these collective agreements face customary sanctions that have been mutually established by the community. For more detailed understanding can be obtained through the following table:

Table 1: Analyzes the Perspectives and Activities of Three Local Wisdom Communities

Kampung Baduy communities	Sinar Resmi communities	Kampung Naga communities
1. The Baduy community lives by traditional values, keep away modern physical development and utilizing nature sustainably. 2. Within this community, there are two subgroups: *Baduy Luar*, which is more open to interactions with outside societies, and *Baduy Dalam*, which is more closely connected to tradition and nature. 3. Environmental empathy in this community is reflected in their values, such as practicing mutual assistance, and constructing residence without using iron nails. 4. Members of this community engage in simple and environmentally friendly farming, make us of traditional methods and natural fertilizers for pest and disease management. 5. This community manages customary forests by categorizing into three zone to protect environmental sustainability.	1. The Sinar Resmi community sustains its commitment to local cultural values while adapting to modern elements. 2. This community shows excellence in maintaining food security without harming the environment and has received recognition as a sustainable food village. 3. They embrace the philosophy of "Mother Earth, Father Sky, and Teacher of Seasons" (*Ibu Bumi, Bapak Langit, dan Guru Mangsa*), which underscores their respect for nature as a living entity. 4. Agricultural practices in this community that involves rituals and respects for nature, in line with principles of biocentrism in the relationship between humans and the environment. This perspective explains that humans have a moral responsibility to preserve nature as a vital component of life.	1. The Kampung Naga community also sustains its commitment to local cultural values while adapting to modern elements. 2. This community roundly preserves traditional agricultural practices to mitigate environmental degradation. 3. They manage a forbidden forest that serves to protect the ecological balance, reflecting their commitment to environmental conservation. 4. The architectural structure is consists of stilt houses made of wood, designed to adapt to the land conditions to prevent landslides and seismic impacts, thereby to create a balanced system between humans and the environment. 5. This community practices environmental preservation through the philosophy: "It's better not to cut down trees than not to plant them," meaning that if they want to cut down a tree, they must first plant a new one.

Source: Researcher (2024)

The table above illustrates how the cultural realities within indigenous communities frequently reflect local wisdom in understanding and preserving ecosystem balance. This relationship often manifests as a deep empathy toward the surrounding natural environment. These communities do not merely exhibit ethical responsibility and concern for the environment; they also empathize with nature, perceiving themselves as an integral part of

the ecosystem. This represents a form of ecological wisdom grounded in local cultural practices. Such ecological wisdom reflects the community's careful approach to managing and treating nature, ensuring its protection from environmental degradation (Julaeha et al., 2019). The presence of environmental empathy within indigenous communities is frequently the outcome of local wisdom, shaped by years of experience and a deep understanding of the human-environment relationship. Recognizing and valuing these principles of local wisdom can serve as a source of inspiration for advancing environmental preservation and sustainability initiatives. The application of sustainable development principles that are relevant to the environment can be implemented through the approach of ecopedagogy (Supriatna et al., 2018). This approach highlights the importance of incorporating environmental awareness, sustainable practices, and ethical responsibilities into educational systems, encouraging a greater understanding of the relationship between humans and the natural environment. By adopting ecopedagogy, communities can cultivate more sustainable practices and raise ecological awareness among individuals and groups. Sustainable development also requires ecological intelligence to design and implement policies, strategies, and sustainable practices. To this end, the form of ecological intelligence in understanding, realizing, and actualizing the importance of living in harmony with nature can be supported by two pedagogical approaches: ecopedagogy and ethnopedagogy (Supriatna, 2016).

In the context of Cultural Ecology, this theory can also be understood as an approach within postmodernism, which examines the dynamic relationship between human culture and the environment. It highlights the crucial role of culture in shaping how societies engage with and manage their surroundings, particularly in terms of environmental preservation and the sustainable use of natural resources. The implementation of Ecological Wisdom, Ecopedagogy, and Postmodernism can generate three important ideas, namely: 1) the three communities exhibit ecological wisdom embedded in their cultural practices and traditions, where environmental empathy emerges as a result of long-standing experiences that foster a harmonious relationship with nature; 2) the principles of sustainable development can be effectively implemented through the lens of ecopedagogy, which strengthens ecological awareness and emphasizes the importance of living in harmony with the natural world. This approach cultivates a deeper understanding of the interconnectedness between culture, humanity, and the environment, aiming to promote environmental conservation; and 3) the theory of cultural ecology, viewed through a postmodern framework, allows for an exploration of the intricate relationships between culture, humanity, and the environment, emphasizing how local wisdom shapes awareness and attitudes toward environmental stewardship. It can be concluded that the integration of ecological wisdom, ecopedagogy, and postmodern perspectives provides a comprehensive understanding of how communities can maintain a balance between culture and the environment. Through a deeper understanding of the relationship between humans and nature, more sustainable approaches to natural resource management and environmental preservation can be developed. By valuing and implementing local wisdom and strengthening ecological consciousness, we can create a future where harmony between humanity and nature prevails, with sustainability serving as the foundation for all aspects of life.

Conclusion

The study, viewed through the lens of Postmodernism, underscores the pluralism of perspectives, and rejects the notion of a singular narrative or universal truth. In this regard, environmental empathy grounded in the local wisdom of indigenous communities can be

interpreted as a form of subjective truth, one that is recognized and actively lived by these communities. Such an understanding emphasizes the importance of appreciating diverse perspectives on the human-environment relationship, all of which are informed by moral ethics and empathy aimed at preserving and safeguarding the environment in the pursuit of sustainable development, without causing harm to nature. Moreover, this includes the recognition that experiences and empathy toward the environment can vary according to social identity, cultural background, and the local context of an indigenous community. Considering this, the study is of considerable significance, contributing valuable insights into how humans relate empathetically to the environments they inhabit. Furthermore, the research holds potential for expansion and could be more widely implemented in educational settings to further enrich the discourse.

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Contact emails: piki.pernantah@upi.edu
nanasup@upi.edu

Higher Order Thinking Skills (HOTS) of Elementary School Teacher Education Students in Indonesia: A Systematic Literature Review

Iyoh Maspiroh, Yogyakarta State University, Indonesia
Zuhdan Kun Prasetyo, Yogyakarta State University, Indonesia
Hermanto Hermanto, Yogyakarta State University, Indonesia

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Abstract
As prospective teachers, HOTS among elementary school teacher education students is very important to develop. Teaching and learning problems require HOTS to solve them. This literature review aims to determine the profile of HOTS among primary school teacher education students in Indonesia and the efforts that have been made by academics to optimize students' HOTS. The method used in this study is the Preferred Reporting Item for Systematic Reviews and Meta-Analyses (PRISMA). We conducted an extensive review of 997 articles obtained from the Google Scholar database using Harzing's Publish and Perish on the HOTS proficiency profile of primary school teacher education students in Indonesia published in the period 2017–2023. This research was conducted in five stages: 1) determining eligibility criteria; 2) determining information sources; 3) study selection; 4) data collection; and 5) data item selection. As a result, we identified that 77% of articles describing the HOTS of elementary school teacher education students were in the low category, and 22% of articles were in the good or optimal category. Efforts have been made by academics to improve the HOTS of elementary school teacher education students by developing HOTS-oriented learning strategies. This study underlines the importance of improving the HOTS of prospective elementary school teachers and suggests the use of a more comprehensive lecture program to bridge the gap between the skills possessed by prospective elementary school teachers and the skills required by a teacher in the 21st century.

Keywords: HOTS, Elementary School Teacher Education Students

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Introduction

One of the education programs that plays a major role in improving the quality of education in Indonesia is the primary school teacher education program. The primary school teacher education program is one of the educational programs in higher education that has the task of educating and producing prospective elementary school teachers following what is needed in the field. In the formulation of the Indonesian Primary School Teacher Education Program Lecturer Association, it is stated that prospective teachers printed by universities are expected to be able to train and develop high-level thinking skills, scientific attitudes, and creativity as early as possible in elementary school students by what students get while studying in college (Julianto et al., 2018).

Elementary school teachers have a very important responsibility in laying the foundation for future student success, shaping student development, and understanding the learning process (Dahlqvist, 2023). Future generations must be equipped with higher-order thinking skills to compete and survive in the face of global challenges (Zivitere et al., 2015). It is believed that it is important to explicitly train students to think at a higher level in the learning process, as it cannot be assumed that students will automatically become good thinkers. Therefore, teachers are expected to stimulate students to engage in higher-order thinking (Wijnen et al., 2021).

However, HOTS-oriented teaching practices are not optimal (Miedijensky et al., 2021). The learning process still tends to be oriented towards memorization and understanding, not reaching the level of analysis, so students have not made meaning of the material they have learned (Usmaedi, 2017).

The low level of higher-order thinking skills is also shown by the PISA (Program for International Students Assessment) results in 2022. PISA is a study conducted by the Organization for Economic Co-Operation and Development (OECD). The 2022 PISA results showed that Indonesia ranked in the bottom 13 out of 81 participating countries. The average reading, math, and science skills of Indonesian students are below the average of ASEAN students (OECD, 2022). The tests given by PISA are tests that require higher-order thinking skills. Thus, it can be seen that most students are not optimal in solving HOTS (high-order thinking skills) type questions.

The above problems have triggered educators, especially at the university level, to try to find strategies or solutions to improve the quality of learning. Improving the quality of learning is directed at developing the skills to think, communicate, and collaborate in solving problems and being able to make decisions appropriately (Djufri et al., 2022).

There have been many analyses of students' higher-order thinking skills, but no studies have reviewed and detailed the results of previous research on the thinking skills of primary school teacher education students over the past five years. Moreover, some studies show that the thinking skills of elementary teacher education students are not always low, some studies show the results that the high thinking skills of elementary teacher education students are optimal. Therefore, it is important to analyze and detail the results of previous research and synthesize and review them systematically.

Given the importance of the achievement of thinking skills of elementary school teacher education students based on the results of previous research to know the comparison between

HOTS and LOTS that have been achieved by students to be followed up with further research. This research is a preliminary study that aims to conduct a literature review on the results of previous research on higher-order thinking skills of students majoring in Elementary Teacher Education over the past five years.

Methods

This systematic review used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines to guide the review process. Based on these guidelines, there were several steps in this study:

- Step 1, determine eligibility criteria. The inclusion criteria set for this review guideline were: a) original research written in Indonesian and English; b) research aimed at investigating the higher-order thinking profile of Primary School Teacher Education students in Indonesian universities. The latter criteria were included to answer the research questions. Figure 1 describes the steps in conducting a systematic review.
- Step 2, determining sources of information. Online database search through Google Scholar database using Harzing's Publish and Perish.
- Step 3, study selection. Study selection was conducted in the following four phases: a) keyword searches were selected according to the research interest in reviewing higher-order thinking profiles. The search strings were related to "HOTS profile", "higher order thinking skills", "higher order thinking skills profile", "higher order thinking skills", "higher order thinking skills of PGSD students", b) exploration of the selection of titles, abstracts, and keywords of identified articles was carried out based on eligibility criteria, c) reading of provisions that were not eliminated in the previous stage was carried out in full to determine whether or not they were included in the review, according to the eligibility criteria, d) the article reference list was scanned to find related research.
- Step 4, data collection process. Data collection is done manually using a data extraction form consisting of content, article type, journal name, year, and topic. The assessment consists of reading the full text and extracted data.
- Step 5, data item selection. The information extracted from each data article consisted of the purpose of the study, the type of study and the results of the study. This data is used to determine the profile of PGSD students' high-level thinking skills and the things that influence them.

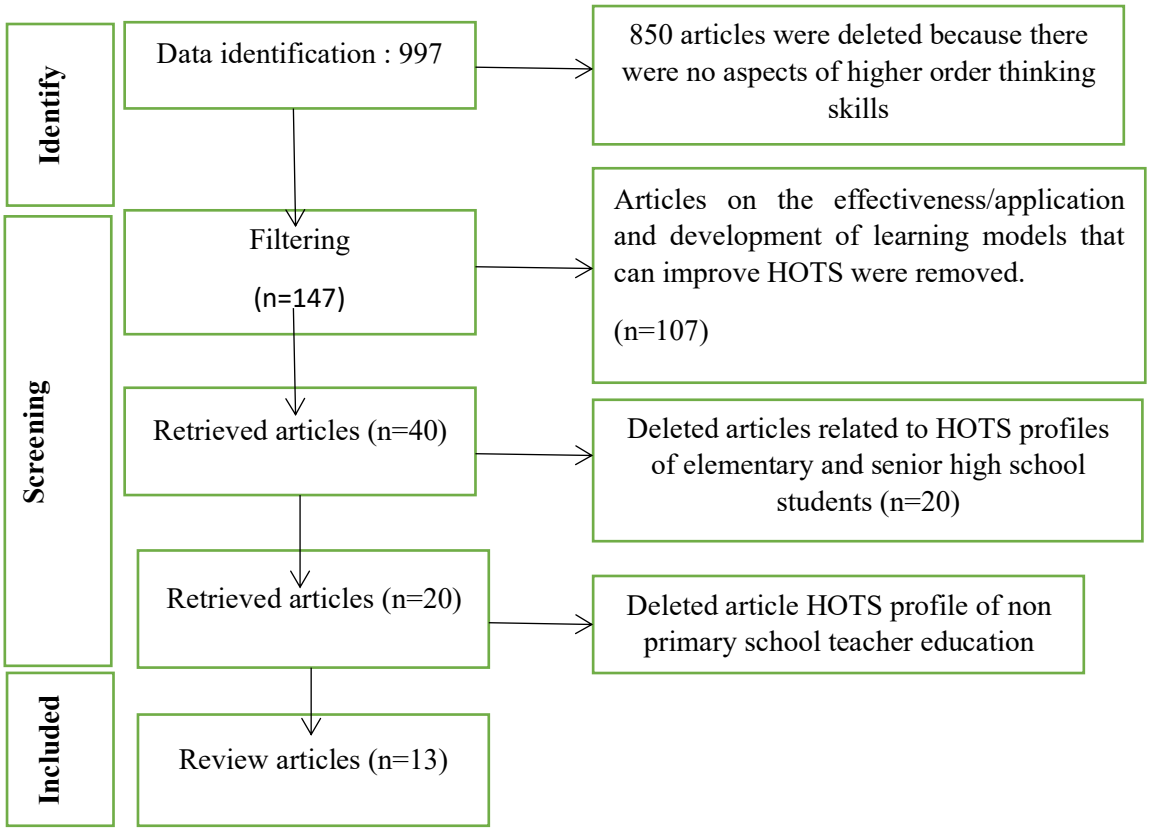

Figure 1: PRISMA Flow Chart

Results and Discussion

The search results on the selected databases provided a total of 997 articles written in English and Bahasa Indonesia studies published from 2015 to April 2023. Of the 997 articles generated from the first study and after the papers were removed before screening; 850 articles were removed because there were no aspects of higher order thinking skills, and 107 articles were removed because they were effectiveness/application and development of learning models that can improve HOTS. 40 articles were selected based on title and abstract, and then the synthesis papers were checked for eligibility by reading the full text. Some articles did not include HOTS profiles of students from elementary to high school (n=20), HOTS profiles of science education students (n=7). Finally, 13 articles were included in this study.

The research topics in the articles that have been screened and deemed appropriate are then reviewed and extracted and analyzed. The extraction results can be seen in Table 1.

Table 1: Extracted Articles

No.	Authors	Aim of study	Method	Result
1	Wiyoko, Tri., & Aprizan. (2020).	Describe the results of the analysis of the skills of the cognitive level of Elementary School Teacher Education students in learning basic natural science.	Qualitative descriptive	Shows that the skills of primary school teacher education STKIP MMB students are still at the Low order thinking skills (LOTS) level.)
2	Djufri, E., Septiani, D., & Hidayatullah, A. S. (2022).	Describing the skills of elementary school teacher education students in critical thinking in science concept courses.	Qualitative descriptive	The results showed that only 6.25% of students had good critical thinking skills, so most students still had low critical thinking skills.
3	Purwanti, Siwi. (2020).	Describe the results of the analysis of students' thinking skills in solving HOTS model science tests in advanced science learning.	Qualitative descriptive	The results showed that students' skills in analyze (C4) were quite good, but at the evaluation (C5) and creation (C6) levels it still had to be improved (Purwanti, 2020).
4	Jusuf, R., Sopandi, W., Ratnawulan, A., & Sa'ud, U. S. (2018).	Describe the results of the analysis of the distribution of National Science Examination questions in 2007-2016 based on the cognitive process dimension and the dimension of student thinking.	Analytic descriptive with a qualitative approach	The results showed that overall the questions made by the central and regional UN organizers in the cognitive process dimension with an average aspect of remembering (C1) 1%, understanding (C2) 13%, application (C3) 35%, analysis (C4) 41%, evaluation (C5) 9%, and creating (C6) 2% while the average basic thinking category was 48% and the high-level thinking category was 52% (Jusuf et al., 2020).
5	Indriani, I. (2021).	To describe students' skills to think at a high level on HOTS questions in the form of problem solving about environmental damage.	Qualitative descriptive	The results showed that students' higher-level thinking skills were optimal (Indriani, 2021).

No.	Authors	Aim of study	Method	Result
6	Nurhayati & Anggraeni (2017).	Describing students' skills to think at a high level on optics material	Qualitative descriptive	The results showed that students' skills to think at a high level was in the moderate category (Nurhayati & Anggraeni, 2017).
7	Wiyoko, Tri., & Aprizan. (2019).	Describe the results of analyzing the profile of critical thinking skills of primary school teacher educationstudents using graded response models in science learning.	Qualitative descriptive	The results showed that critical thinking skills that reached high criteria were only 11.6%. This article presents an example of data collection techniques with written test techniques with description questions. Scoring written tests in this study using Graded Response Models.
8	Rahmawati, S., Hariyadi, S., & Febrianto, F. (2020).	Describe the profile of the cognitive skills of primary school teacher education students in the Teaching and Learning Strategy course.	Qualitative descriptive	The results showed that the skills of school teacher education students at Muhammadiyah Kudus University in the LOTS (Low Order Thinking Skill) cognitive process was higher than the skills of the HOTS cognitive process (Rahmawati, Hariyadi & Febrianto, 2020).
9	Arda. (2020).	Describing the profile of students' cognitive skills levels in learning basic science concepts	Qualitative descriptive	The results showed that the level of thinking skills of students was still at the LOTS level (Arda, 2020).
10	Julianto, Wasis, & Agustini, R. (2018).	Describe the creative thinking skills of students	Qualitative descriptive	The results showed that students' creative thinking skills were in the low category (Julianto et al., 2018).
11	Saila, Nurul. (2022).	describe the results of the analysis of the skills level of students of the Faculty of Teacher Training and Education in solving HOTS (high order thinking skills) questions in statistics courses.	Qualitative descriptive	The results showed that students of the Faculty of Teacher Training and Education of Panca Marga University had mastery of HOTS aspects in solving statistical problems but were uneven, so efforts were needed to improve them (Saila, 2022).
12	Firmansyah, Arif., & Rizal. (2019).	Describe critical thinking skills and student	Qualitative descriptive	The results showed that elementary school teacher education students at STKIP

No.	Authors	Aim of study	Method	Result
		achievement motivation.		Tadulako University had critical thinking skills at low criteria (Firmansyah & Rizal, 2019).
13	Sulistyaningrum, H., Winata, A., & Cacik, Sri. 2019.	To determine the initial skills of 21st century skills so that it can be used to improve the quality of learning.	Qualitative descriptive	The results showed that the initial skills of 21st century skills of Unirow elementary school teacher education students still showed low results. These results are shown from the average skills to think critically students show average results of less than 30%, communicative skills are less than 50%, collaborative skills and creative thinking are less than 45% (Sulistyaningrum et al., 2019).

Based on data extraction, the results show that there are three articles that show the results that the higher-level thinking skills of elementary school teacher education students are in the good category, while ten articles show that they are in the low category. The comparison is described in Figure 2.

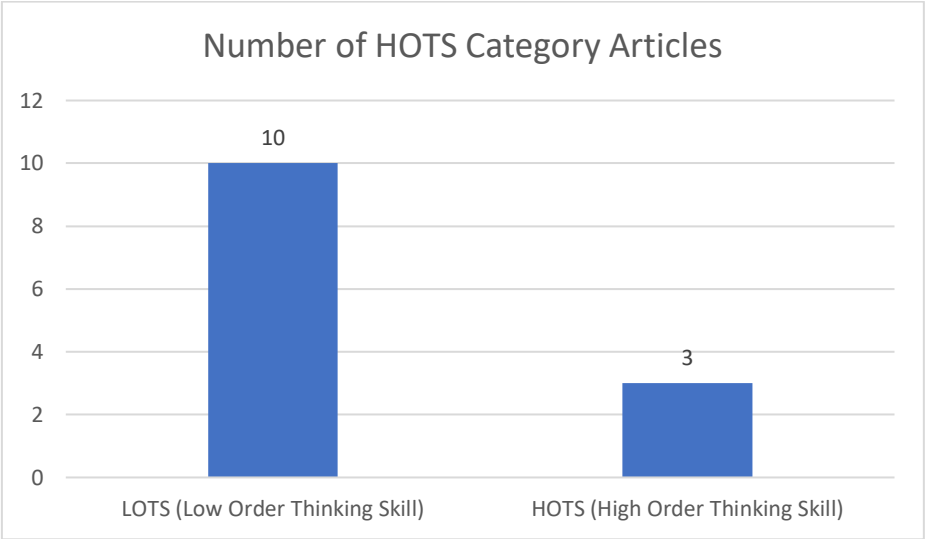

Figure 2: Comparison Diagram of Extracted Articles

Based on the analysis of articles related to level thinking skills, the results show that 3 articles (23%) describe student HOTS at a good or optimal level. Meanwhile, 10 articles (77%) describe the HOTS of PGSD students are still at a low level or Low Order Thinking Skill (LOTS) level, namely at the C1, C2, and C3 levels. This means that the cognitive skills of most PGSD students are still at the LOTS (Low Order Thinking Skill) level.

HOTS is one of the student skills that must be developed through teaching and learning. Teachers' knowledge of HOTS and their teaching and learning tactics are key to successful

education (Retnawati et al., 2018). The low HOTS of students can be caused by several factors including: a) HOTS-oriented learning has not been optimally used, even though students know a concept, they do not necessarily know how to apply it (Wiyoko, 2019), b) student-centered learning (Ichsan et al., 2019), c) the biggest obstacle in teaching and learning higher order thinking is the lack of teacher training and learning time (Davies & Willing, 2023), d) the learning strategies used are less effective in creating and improving HOTS (Misrom et al., 2020).

Strategies that can be done to improve students' HOTS are to design HOTS-oriented learning, including a) using learning models that can improve HOTS can be one of the solutions in improving the quality of learning and of course improving the quality of graduates ((Dewi et al., 2021; Handayani et al., 2019; Wiyoko & Aprizan, 2020), b) creating a smart classroom environment, namely using digital technology or online learning applications (Letchumanan et al., 2022; Lu et al., 2021; Nadarajan et al., 2023; Prahani et al., 2020; Venkatraman et al., 2022), c) using HOTS-oriented assessments (Hadzhikolev et al., 2020; Rintayati et al., 2020), d) implementing collaborative systems in the learning process (Zaid et al., 2018).

Conclusion

The thinking skills of most elementary school teacher education (PGSD) students is still at a low level, namely still at the C1, C2 and C3 levels. This is due to many factors including the skills of lecturers to design learning. HOTS-oriented learning has not been optimally used, so this can be used as a foothold for further research, namely developing learning or lecture programs oriented towards increasing the HOTS of elementary school teacher education students.

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Contact emails: iyohmaspiroh@gmail.com
zuhdan@uny.ac.id
hermansp@uny.ac.id

Self-Efficacy and Self-Regulation in Mathematics Learning: Validity and Reliability of Instruments in Private Junior High School Students

Ovan, Universitas Negeri Surabaya, Indonesia
Yusuf Fuad, Universitas Negeri Surabaya, Indonesia
Mega Teguh Budiarto, Universitas Negeri Surabaya, Indonesia

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Abstract
Measuring junior high school students' self-efficacy and self-regulation in mathematics requires valid and reliable measuring instruments. This study aimed to test the validity and reliability of the instrument of the Self-Efficacy Questionnaire (SEQ) and Self-Regulation Questionnaire (SRQ) of junior high school students in mathematics. This research method uses a quantitative approach. Before being given to students, the SEQ and SRQ were empirically validated by three senior lecturers in mathematics education with average scores of 4.60 > 3.50 and 4.50 > 5.50 respectively. SEQ and SRQ was given to 9th-grade students of SMP Muhammadiyah 4 Malang City for 30 minutes, and the researcher directly supervised the implementation. The results of SEQ declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.976 > 0.70, meanwhile the results of SRQ declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.971 > 0.70. The 20 valid SEQ and SRQ statements can be used to evaluate junior high school students' self-efficacy and self-regulation in mathematics. It is suggested that future researchers test the instrument on a larger population because the students involved in this study were too few, namely nine students, and the number of statements in the questionnaire should also be considered to be compiled in large numbers.

Keywords: Self-Efficacy, Self-Regulation, Mathematics, Validity, Reliability

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Introduction

Research investigations, scientific discoveries, and contemporary discoveries all rely on mathematics, which is a subject that is pertinent to modern schooling (Batiibwe et al., 2020; Mozahem et al., 2021). Mathematics is regarded as the most crucial topic in the secondary school curriculum, connecting algebra, geometry, and trigonometry. It can also be utilised to solve difficulties in daily life (Laranang & Bondoc, 2020). Due to its ability to impact mathematical comprehension and learning, self-efficacy has been extensively described in earlier study (Bandura et al., 1997; Yuksel & Alci, 2012). In the process of learning mathematics, this suggests that students' self-efficacy is crucial (Mumcu & Aktas, 2015; Rittmayer & Beier, 2008). The belief in one's capacity to acquire and excel in mathematics classes is known as self-efficacy in mathematics (Kumar, 2022; Kundu & Ghose, 2016). A conviction that success in maths class will follow from doing particular behaviours. These beliefs, however, have been demonstrated to predict mathematical performance more accurately than other belief structures linked to mathematics (Mumcu & Aktas, 2015; Yuksel & Alci, 2012).

Students with High self-efficacy indicate strong motivation to improve their learning achievement, while students with low self-efficacy tend to find it difficult to improve their learning achievement (Ilgün et al., 2012; Özgen & Bindak, 2011). Student self-efficacy can be measured through three components, namely magnitude, strength, and general (Bandura et al., 1997; Laranang & Bondoc, 2020). Magnitude relates to a person's level of confidence that it can be completed. Strength relates to the level of strength or weakness of a person's beliefs regarding their perceived abilities or individual expectations of their abilities. Generally related to self-efficacy that occurs in certain domains or applies to various activities and situations.

Self-efficacy and mathematics are a complete study to reveal student behavior in solving mathematical problems. The research results show that student self-efficacy influences students' mathematics performance and thanks to good self (Bandura, 1982; Kumar, 2022; Mukhtar et al., 2021). Other research also shows that students' poor self (Görgün & Tican, 2020; Recber et al., 2017; Schukajlow et al., 2022). Thus, self-efficacy in Mathematics is a determining factor in student success.

Similar to self-efficacy, the concept of self-regulation is also rooted in the social cognitive theory proposed by Bandura (Bandura et al., 1997). Self-regulation can be done if students can control themselves in solving problems then evaluating and planning during the learning process (Li et al., 2020). Self-regulation is a process in which students deliberately pursue predetermined goals by controlling, monitoring, and regulating cognitive/metacognitive processes and student learning behavior (Zimmerman, 2000).

According to Zimmerman (2000), pupils must be able to control themselves during the learning process in order to attain the desired outcomes, which include achievement in mathematics. In the classroom, students have the power to guide themselves to affect their own behavioural reactions in addition to being influenced by outside forces. When given learning tasks, students can use cognitive, metacognitive, and behavioural learning strategies to exert control over their activities.

Math learning outcomes can be enhanced by students who exhibit strong self-regulation and vice versa. Students who possess strong self-regulation are able to solve geometry problems

and enhance their learning outcomes. For instance, they are able to concentrate, differentiate between important and irrelevant information, and employ efficient techniques to retain information in long-term memory and retrieve it when required (Arora et al., 2020). On the other hand, pupils who struggle with self-control perform poorly when it comes to solving mathematical problems (Marchis, 2012). This suggests that studies on self-regulation in math problem solving are necessary.

In relation to evaluating student self-efficacy and self-regulation in mathematics, it needs to be supported by capable tools, one of which is a valid instrument. This research aims to measure instruments that are suitable for measuring student self-efficacy and self-regulation in mathematics classes. A valid instrument is very useful for measuring student self-efficacy and self-regulation. Research on the validity and reliability of self-efficacy and self-regulation instruments has been conducted by previous researchers (Anderson & Betz, 2001; Britner & Pajares, 2006; Hampton & Mason, 2003; Lent et al., 1991; Lopez & Lent, 1992; Usher & Pajares, 2007), but it is still rarely done in Indonesia, especially self-efficacy in junior high school students' mathematics classes.

Method

This research uses a quantitative research design. Data collection was carried out in 2022 at Muhammadiyah 4 Middle School, Malang City. The sample size for class 9 at this school consists of one group, 6 boys students and 3 girls students. The researcher chose this research location because he had made observations regarding the problems faced by students, namely low mathematics scores student, self-efficacy, and self-regulation. The Self-Efficacy Questionnaire (SEQ) and Self-Regulation Questionnaire (SRQ) instrument consists of 20 statements in the form of a 1-5 Likert scale. Based on the indicators compiled, the classification of SEQ statements can be divided into three dimensions, namely the first is magnitude which includes statements number 1-5. Second, strength includes statements number 6-13. Third, generally includes statements number 14-20. Meanwhile, the SRQ statement classification consists of indicators, namely planning which includes statements number 1-6, implementation which includes statements number 7-14, and reflection which includes statements number 15-20.

SEQ was adapted from Laranang & Bondoc (2020) about students' self-efficacy in mathematics, meanwhile SRQ was adapted from Brown and colleagues., (1999) about students' self-regulation in mathematics. Before being given to students, the SEQ and SRQ were empirically validated by three senior lecturers in mathematics education with average scores of $4.60 > 3.50$ and $4.50 > 5.50$ respectively. SEQ and SRQ was given to 9 grade 9 students of SMP Muhammadiyah 4 Malang City for 30 minutes, and the researcher carried out direct supervision and was assisted by a mathematics teacher in its implementation. SEQ and SRQ aims to obtain appropriate responses from students for the purposes of this research.

After getting students' answers, SEQ and SRQ validity and reliability were tested. Apart from differences in statement items in the questionnaire, researchers also took into account the situation, conditions, learning location, facilities, and abilities of the students. Test the validity and reliability of SEQ and SRQ using product moment person correlation and Cronbach's alpha.

Results

The results of the validity and reliability tests started from the SEQ, then followed by the SRQ. Both instruments were subjected to descriptive statistical tests with the help of SPSS software version 29.0. The results of the SEQ validity and reliability test show that students' self-efficacy varies. The original SEQ and the translated results into Indonesian can be seen in appendix 1.

The self-efficacy questionnaire (appendix 1), adapted and developed according to the needs of junior high school students in Indonesia. The development of the self-efficacy questionnaire can be seen in Table 1 below.

Table 1: Validity Value of the Self-Efficacy Questionnaire (SEQ)

No	SEQ Statement	WM	VD	Indication	Sig. 2-Tailed
1	I feel confident enough to ask questions in my math class	3.11	Neutral	Moderately high	0.019
2	I am confident that I can do well on the math test.	3.33	Neutral	Moderately high	0.001
3	I believe that I complete math assignments of varying difficulty	3.56	Agree	High	0.005
4	I am confident that I am able to understand and complete mathematics assignments	3.44	Agree	High	0.007
5	I am confident that I am able to choose strategies well in completing mathematics assignments	3.00	Neutral	Moderately high	0.011
6	I believe that I am the type of person who is good at mathematics.	3.22	Neutral	Moderately high	0.004
7	I am confident that I can understand the content in mathematics assignments	3.44	Agree	High	0.001
8	I am confident that I can get an “A” when I study mathematics.	3.44	Agree	High	0.005
9	I am confident that I am able to persist in my efforts to face tasks and challenges	3.22	Neutral	Moderately high	0.017
10	I am confident that I can learn well when given mathematics assignments.	3.22	Neutral	Moderately high	0.001
11	I feel confident when taking math tests.	3.22	Neutral	Moderately high	0.009
12	I still try to complete math assignments even though the assignments are difficult to do	3.44	Agree	High	0.001
13	I believe that I am the type of person who can do math	3.22	Neutral	Moderately high	0.001
14	I feel that I will be able to do well in future math assignments	3.44	Agree	High	0.001

No	SEQ Statement	WM	VD	Indication	Sig. 2-Tailed
15	I am confident that I can do mathematics when I am given a mathematics assignment	3.44	Agree	High	0.013
16	I believe that I can think like a mathematician.	3.22	Neutral	Moderately high	0.009
17	I feel confident when using mathematics outside of school.	3.11	Neutral	Moderately high	0.001
18	I am confident that I can complete math assignments using various methods	3.33	Neutral	Moderately high	0.013
19	I am confident that I can solve math tasks that I have never encountered before	3.00	Neutral	Moderately high	0.009
20	I am sure that mathematics will be useful for my future	3.78	Agree	High	0.011
Overal Weighted Mean		**3.31**	**Neutral**	**Moderately high**	**0.007**

Legend: Range	Verbal Description	Indication
5.00 - 4.21	Strongly Agree (SA)	Very high
4.20 - 3.41	Agree (A)	High
3.40 - 2.61	Neutral (N)	Moderately high
2.60 - 1.81	Disagree (D)	Low
1.80 - 1.00	Strongly Disagree (SD)	Very low

Based on Table 1, the mean is 3.31, the verbal description is declared neutral and it is identified that SEQ is in the moderately high category. Then 20 statements were declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.976 > 0.70, meaning that the data is concluded to be reliable. Based on the three indicators of self-efficacy measured in the SEQ instrument, satisfactory results were obtained, where 20 SEQ statements were declared valid and reliable. This means that this instrument can be used to measure students' self-efficacy at the junior high school level.

Meanwhile, the results of the validity and reliability tests for the SRQ obtained different results for each item of the SRQ statement. The original SRQ and the translated results in Indonesian can be seen in appendix 2. The self-regulation questionnaire (appendix 2), adapted and developed according to the needs of junior high school students in Indonesia. The development of the self-regulation questionnaire can be seen in Table 2 below.

Table 2: Validity Value of the Self-Regulation Questionnaire (SEQ)

No	SRQ Statement	WM	VD	Indication	Sig. 2-Tailed
1	I am able to make plans for myself.	3.56	Agree	High	0.001
2	I am able to carry out plans that I have made myself.	3.56	Agree	High	0.002
3	I have so many plans that it's hard for me to focus on any one of them.	4.11	Agree	High	0.038
4	I can stick to plans that are working well.	3.11	Neutral	Moderately high	0.001
5	I have no trouble making plans to help me achieve my goals.	3.89	Agree	High	0.001
6	Minor problems or distractions won't throw me off my plan.	3.56	Agree	High	0.001
7	I can usually solve problems that I have planned in advance.	2.89	Neutral	Moderately high	0.020
8	Once I see things that are not right then I immediately do something about it to fix it.	3.33	Neutral	Moderately high	0.019
9	I call others for help when I need it.	3.56	Agree	High	0.006
10	I am able to manage the environment in which I play/study.	3.44	Agree	High	0.005
11	As soon as I see a problem or challenge, I start trying to find a solution and solve it quickly.	3.78	Agree	High	0.033
12	I am good at finding information to solve the problems I face.	3.11	Neutral	Moderately high	0.006
13	When I experience obstacles/challenges, I usually look for the information I need.	3.11	Neutral	Moderately high	0.012
14	When I want to make a decision, I connect it with knowledge and experience that is in line with my understanding.	3.56	Agree	High	0.020
15	I usually double check my math work before submitting it to the teacher.	3.44	Agree	High	0.008
16	When I get a bad grade in math, I keep studying to improve in the future.	3.56	Agree	High	0.005
17	If I want to change, I keep improving myself.	3.67	Agree	High	0.017
18	I learned from my previous mistakes.	3.22	Neutral	Moderately high	0.033
19	I usually evaluate what I have done	3.89	Agree	High	0.023
20	I am the type of person who doesn't give up easily.	3.67	Agree	High	0.001
Overal Weighted Mean		**3.50**	**Agree**	**High**	**0.013**

Legend: Range	Verbal Description	Indication
5.00 - 4.21	Strongly Agree (SA)	Very high
4.20 - 3.41	Agree (A)	High
3.40 - 2.61	Neutral (N)	Moderately high
2.60 - 1.81	Disagree (D)	Low
1.80 - 1.00	Strongly Disagree (SD)	Very low

Based on Table 2, The mean is 3.31, the verbal description is declared agree and it is identified that SRQ is in the high category. Then 20 statements were declared valid with sig. (2-tailed) < 0.05 and Cronbach alpha reliability of 0.971 > 0.70, meaning that the data is concluded to be reliable.

Based on the three indicators of self-regulation measured in the SRQ instrument, satisfactory results were obtained, the same as the SEQ, where 20 SRQ statements were declared valid and reliable. This means that this instrument can be used to measure students' self-regulation at the junior high school level. The SEQ and SRQ instruments that are valid and reliable, each of which is indicated as Moderately high and high, of course have a long process. Starting from obtaining the creation of both instruments, obtaining data from students, analyzing data, and thinking about the usefulness of these two instruments. In Indonesia, research that is relevant to the results of this study is still lacking, so researchers need to adapt to the results of previous studies such as research conducted by Laranang & Bondonc (2020) which validated the self-efficacy instrument and the work of Brown and colleagues., (1999) who compiled a self-regulation questionnaire.

Discussion

A five-point Likert scale is used in the SEQ and SRQ. Most self-efficacy questionnaires use an adapted version of the Sources of Mathematics Self-Efficacy Scale (SMES) developed by Lent and colleagues., (1991). A number of its components have been modified for usage in academic and social contexts after being initially created to evaluate students' sources of mathematical self-efficacy (Anderson & Betz, 2001; Britner & Pajares, 2006; Lopez & Lent, 1992; Usher & Pajares, 2007). A scale to gauge students' sources of mathematical self-efficacy was also created by Matsui and colleagues., (1990) and modified for use with younger pupils (Klassen, 2004). The Sources of Academic Self-Efficacy Scale was created by Hampton and Mason (2003), verified, and then utilised with students who struggled academically in high school and college. Other researchers have employed alternative measures as stand-ins for one or more sources (Chin & Kameoka, 2002; Johnson, 2005) or have depended on unpublished source items (Bates & Khasawneh, 2007; Stevens & Jr, 2006).

Regarding the sources of self-efficacy, there are two key reasons why accurate and trustworthy measuring tools are required. First, self-efficacy plays an important role in students' academic and career choices (Hackett, 2017). Bandura's social cognitive theory, which holds that self-efficacy cannot be adequately assessed without evaluation, is another significant factor supporting the need for psychometrically valid measures of the origins of self-efficacy (Locke, 1987). Researchers must use valid and reliable metrics that accurately reflect their hypothesised sources and their place in the larger social structure if they hope to comprehend the composition of students' self-efficacy. In the field of academic motivation, where the sources of self-efficacy have frequently been operationalised and assessed in ways

that are very different from how Bandura (1997) hypothesised them, this cognitive theory is especially significant.

Several previous studies have shown that self-efficacy instruments can be used and declared valid and reliable, whether collecting self-efficacy instruments for students in tertiary institutions or high schools (Anderson & Betz, 2001; Britner & Pajares, 2006; Hampton & Mason, 2003; Lent et al., 1991; Lopez & Lent, 1992; Usher & Pajares, 2007). The self-efficacy instrument for junior high school students in Indonesia is still under-researched, so the SEQ in this study can be recommended for measuring student self-efficacy, especially at the junior high school level. The SEQ was adapted from Laranang & Bondoc (2020) which consisted of 14 items, then we added 6 statement items, so that the SEQ in this study became 20 statement items, all of which were declared valid and reliable.

Then the self-regulation questionnaire has been developed by several researchers in various countries such as research conducted by Pichardo and colleagues., (2014) who validated the self-regulation questionnaire for students in Spain. Where 50% (n = 417) of students have been confirmed and suggested that the measurement is more efficient to do. SRQ is also adapted from Brown and colleagues., (1999). We adjust to the conditions of students in mathematics classes in Indonesia, so we adjust several sentences related to students in mathematics classes. As the statistical test that has been explained that 20 SRQ items are declared valid and reliable. This study is related to Bagçeci & Kanadli (2014) report on a similar study reporting the validation of a student self-regulation questionnaire at the junior high school level in Turkey. A total of 762 middle school students in Gaziantep were involved in this study, specifically students in grades 5, 6, 7, and 8 in the 2012-2013 academic year. The values obtained were 0.477 and 0.818 respectively and the total correlation was between 0.24 and 0.47. The results of the Pearson correlation of the questionnaire test-retest were obtained at 0.85 and the Cronbach Alpha reliability was 0.78, so the ASRQ adapted into Turkish is valid and reliable. Likewise, the adapted SRQ was obtained valid and reliable into Indonesian.

Conclusion

This research is useful for future students in mathematics classes because the 20 self-efficacy and self-regulation questionnaire statements were declared valid and reliable. The impact of this research is that the SEQ and SRQ which is declared valid can be used to measure students' self-efficacy and self-regulation in mathematics classes, especially at the junior high school level. It is advised that students put in more study time in order to raise their maths proficiency. By actively participating in study sessions with peers, having conversations in math classes, and feeling confident when handed arithmetic homework, they should cultivate a positive attitude towards the topic. By boosting their self-confidence, students can work harder to change their attitudes towards mathematics and become more driven to learn the subject. This research can be supported by similar studies conducted in other cities.

Recommendations

The factors that influence self-efficacy and self-regulation in mathematics can be identified through additional research investigations on larger populations. In order to provide a secure learning environment for kids, educators can uphold a favourable school atmosphere. Teachers can use innovative teaching and learning tactics to increase students' interest in studying mathematical concepts and theories while also helping them build high self-efficacy

and self-regulation to succeed in mathematics. In addition to helping their children who struggle with maths, parents can also assist them understand why their children have a bad attitude towards maths. In order to promote greater academic performance by raising and bolstering higher levels of student success and motivation, schools might suggest ways to enhance their mathematics programs that are specific to the needs, interests, and issues of their students.

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Contact emails: ovan.21029@mhs.unesa.ac.id
yusuffuad@unesa.ac.id
megatbudiarto@unesa.ac.id

ORCID: https://orcid.org/0000-0002-7325-7830
https://orcid.org/0000-0002-9589-7839
https://orcid.org/0000-0002-9052-3141

Appendices

Appendix 1. Adapted Self-Efficacy Questionnaire

No	SEQ From Laranang & Bondoc (2020)	Translate in Indonesia
1	I feel confident enough to ask questions in my mathematics class	Saya percaya diri untuk mengajukan pertanyaan pada pelajaran matematika
2	I believe I can do well on a mathematics test.	Saya yakin selalu dapat mengerjakan tes matematika dengan baik.
3	I believe I can complete all the assignments in a mathematicscourse.	Saya yakin mampu memahami dan menyelesaikan tugas pada pembelajaran matematika
4	I believe I am the kind of person who is good at mathematics	Saya adalah tipe siswa yang pandai matematika.
5	I believe I will be able to use mathematics in my future careerwhen needed.	Saya yakin bahwa matematika akan berguna untuk masa depan saya ketika dibutuhkan
6	I believe I can understand the content in a mathematics course.	Saya yakin dapat memahami materi pada pelajaran matematika
7	I believe I can get an “A” when I am in a mathematics course.	Saya yakin bisa mendapatkan nilai “A” untuk mata pelajaran matematika.
8	I believe I can learn well in a mathematics course.	Saya yakin mampu bertahan dalam menghadapi tugas dan tantangan dalam kehidupan sehari-hari
9	I feel confident when taking a mathematics test.	Saya percaya diri saat mengikuti tes matematika.
10	I believe I am the type of person who can do mathematics.	Saya yakin bahwa saya tipe siswa yang bisa mengerjakan matematika
11	I feel that I will be able to do well in future mathematics courses.	Saya dapat mengerjakan tugas matematika dengan baik di masa depan
12	I believe I can do the mathematics in a mathematics course	Saya yakin dapat mengerjakan matematika ketika saya diberi tugas matematika
13	I believe I can think like a mathematician.	Saya yakin bahwa saya bisa berpikir seperti ahli matematika.
14	I feel confident when using mathematics outside of school.	Saya percaya diri ketika menggunakan matematika pada kegiatan luar sekolah.

Appendix 2. Adapted Self-Regulation Questionnaire

No	**SRQ From Brown et al., (1999)**	**Translate in Indonesia**
1	I usually keep track of my progress toward my goals.	Saya biasanya melacak kemajuan saya untuk mencapai tujuan saya.
2	My behavior is not that different from other people's.	Perilaku saya tidak jauh berbeda dengan orang lain.
3	Others tell me that I keep on with things too long.	Orang lain mengatakan saya terlalu lama melakukan sesuatu.
4	I doubt I could change even if I wanted to.	Saya ragu bahwa saya bisa berubah, sekalipun saya mau.
5	I have trouble making up my mind about things	Saya kesulitan mengambil keputusan tentang berbagai hal
6	I get easily distracted from my plans.	Saya mudah teralihkan dari rencana saya.
7	I reward myself for progress toward my goals.	Saya memberi penghargaan pada diri sendiri atas kemajuan menuju tujuan saya.
8	I don't notice the effects of my actions until it's too late.	Saya tidak menyadari dampak tindakan saya sampai semuanya terlambat.
9	My behavior is similar to that of my friends.	Perilaku saya mirip dengan teman-teman saya.
10	It's hard for me to see anything helpful about changing my ways.	Sulit bagi saya untuk melihat adanya manfaat dari perubahan kebiasaan saya.
11	I am able to accomplish goals I set for myself.	Saya mampu mencapai tujuan yang saya tetapkan untuk diri saya sendiri.
12	I put off making decisions.	Saya menunda pengambilan keputusan.
13	I have so many plans that it's hard for me to focus on any one of them.	Saya mempunyai begitu banyak rencana sehingga sulit bagi saya untuk fokus pada satu saja.
14	I change the way I do things when I see a problem with how things are going.	Saya mengubah cara saya untuk melakukan sesuatu ketika saya melihat masalah bagaimana sesuatu berjalan.
15	It's hard for me to notice when I've “had enough” (alcohol, food, sweets).	Sulit bagi saya untuk menyadari kapan saya sudah “cukup” (alkohol, makanan, permen).
16	I think a lot about what other people think of me.	Saya banyak berpikir tentang apa yang orang lain pikirkan tentang saya.
17	I am willing to consider other ways of doing things.	Saya bersedia mempertimbangkan cara lain dalam melakukan sesuatu.
18	If I wanted to change, I am confident that I could do it.	Jika saya mau berubah, saya yakin saya bisa melakukannya.
19	When it comes to deciding about a change, I feel overwhelmed by the choices	Ketika harus memutuskan untuk melakukan perubahan, saya merasa kewalahan dengan banyaknya pilihan.
20	I have trouble following through with things once I've made up my mind to do something.	Saya kesulitan menindaklanjuti sesuatu yang sudah saya putuskan untuk dilakukan.
21	I don't seem to learn from my mistakes.	Saya tampaknya tidak belajar dari kesalahan saya.
22	I'm usually careful not to overdo it when working, eating, drinking.	Saya biasanya hati-hati untuk tidak terlalu berlebihan ketika bekerja, makan, minum.

No	**SRQ From Brown et al., (1999)**	**Translate in Indonesia**
23	I tend to compare myself with other people.	Saya cenderung membandingkan diri saya sendiri dengan orang lain.
24	I enjoy a routine, and like things to stay the same.	Saya menikmati rutinitas, dan ingin segala sesuatunya tetap sama.
25	I have sought out advice or information about changing.	Saya telah mencari saran atau informasi tentang perubahan.
26	I can come up with lots of ways to change, but it's hard for me to decide which one to use.	Saya dapat menemukan banyak cara untuk berubah, tetapi sulit bagi saya untuk memutuskan cara mana yang harus digunakan.
27	I can stick to a plan that's working well.	Saya dapat berpegang pada rencana saya yang berjalan dengan baik.
28	I usually only have to make a mistake one time in order to learn from it.	Saya biasanya hanya perlu membuat kesalahan satu kali untuk dapat belajar darinya.
29	I don't learn well from punishment.	Saya tidak belajar dengan baik dari hukuman.
30	I have personal standards, and try to live up to them.	Saya mempunyai standar pribadi dan berusaha untuk memenuhinya.
31	I am set in my ways.	Saya sudah mantap dengan cara-caraku.
32	As soon as I see a problem or challenge, I start looking for possible solutions.	Begitu saya melihat masalah atau tantangan, saya mulai mencari kemungkinan solusinya.
33	I have a hard time setting goals for myself.	Saya kesulitan menetapkan tujuan untuk diri saya sendiri.
34	I have a lot of willpower.	Saya memiliki banyak tekad.
35	When I'm trying to change something, I pay a lot of attention to how I'm doing.	Ketika saya mencoba mengubah sesuatu, saya banyak memerhatikan bagaimana saya melakukannya.
36	I usually judge what I'm doing by the consequences of my actions.	Saya biasanya menilai apa yang saya lakukan berdasarkan konsekuensi tindakan saya.
37	I don't care if I'm different from most people.	Saya tidak peduli jika saya berbeda dari kebanyakan orang.
38	As soon as I see things aren't going right I want to do something about it.	Begitu saya melihat sesuatu tidak berjalan dengan baik, saya ingin melakukan sesuatu.
39	There is usually more than one way to accomplish something.	Biasanya ada lebih dari satu cara untuk mencapai sesuatu.
40	I have trouble making plans to help me reach my goals.	Saya kesulitan membuat rencana untuk membantu saya mencapai tujuan saya.
41	I am able to resist temptation.	Saya mampu menahan godaan.
42	I set goals for myself and keep track of my progress.	Saya menetapkan tujuan untuk diri saya sendiri dan melacak kemajuan saya.
43	Most of the time I don't pay attention to what I'm doing.	Seringkali saya tidak memperhatikan apa yang saya lakukan.
44	I try to be like people around me.	Saya mencoba untuk menjadi seperti orang-orang di sekitar saya.

No	SRQ From Brown et al., (1999)	Translate in Indonesia
45	I tend to keep doing the same thing, even when it doesn't work.	Saya cenderung terus melakukan hal yang sama, bahkan ketika itu tidak berhasil.
46	I can usually find several different possibilities when I want to change something.	Saya biasanya dapat menemukan beberapa kemungkinan berbeda ketika saya ingin mengubah sesuatu.
47	Once I have a goal, I can usually plan how to reach it.	Begitu saya punya tujuan, biasanya saya bisa merencanakan cara mencapainya.
48	I have rules that I stick by no matter what.	Saya memiliki aturan yang saya patuhi, apa pun yang terjadi.
49	If I make a resolution to change something, I pay a lot of attention to how I'm doing.	Jika saya bertekad untuk mengubah sesuatu, saya akan memberi banyak perhatian bagaimana saya melakukannya.
50	Often I don't notice what I'm doing until someone calls it to my attention.	Sering kali saya tidak menyadari apa yang saya lakukan sampai seseorang memberitahu saya.
51	I think a lot about how I'm doing.	Saya banyak berpikir tentang apa yang sedang saya lakukan.
52	Usually I see the need to change before others do.	Biasanya saya melihat perlunya perubahan sebelum orang lain melakukannya.
53	I'm good at finding different ways to get what I want.	Saya pandai menemukan berbagai cara untuk mendapatkan apa yang saya inginkan.
54	I usually think before I act.	Saya biasanya berpikir sebelum bertindak.
55	Little problems or distractions throw me off course.	Masalah-masalah kecil membuat saya keluar jalur rencana saya.
56	I feel bad when I don't meet my goals.	Saya merasa buruk jika saya tidak mencapai tujuan saya.
57	I learn from my mistakes.	Saya belajar dari kesalahan saya.
58	I know how I want to be.	Saya tahu bagaimana saya ingin menjadi.
59	It bothers me when things aren't the way I want them.	Saya merasa terganggu ketika segala sesuatunya tidak berjalan sesuai keinginan saya.
60	I call in others for help when I need it.	Saya meminta bantuan orang lain ketika saya membutuhkannya.
61	Before making a decision, I consider what is likely to happen if I do one thing or another.	Sebelum mengambil keputusan, saya mempertimbangkan apa yang mungkin terjadi jika saya melakukan sesuatu.
62	I give up quickly.	Saya cepat menyerah.
63	I usually decide to change and hope for the best.	Saya biasanya memutuskan untuk berubah dan berharap yang terbaik.

Improving Nutrition Education and Physical Fitness in High School Through a Community-Based Haheho Apps Intervention

Ropik Hidayat, University of Semarang, Indonesia
Syahrizal Islam, University of Semarang, Indonesia
Heny Setiawaty, University of Semarang, Indonesia
Siti Baitul Mukarromah, University of Semarang, Indonesia
Hermawan Pamot Rahardjo, University of Semarang, Indonesia

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Abstract
With the rise of sedentary lifestyles post-COVID-19 pandemic and the adverse effects of handphone use and unhealthy eating habits among high school students, teachers and staff, there is an urgent need for innovative interventions that promote nutrition education and physical activity. So far, several conventional approaches have not shown significant results. This study addresses the need for school communities to initiate active and healthy lifestyle changes by utilizing mobile technology through a school community-based Haheho Apps intervention. Methods: Experimental study with one group pretest-posttest design involving 256 students aged 15-18. 21 teachers and school staff aged 30-58 years old, participants will receive access to community-based Haheho Apps for 8 Weeks focusing on nutrition education and physical activity. Student, teacher and school staff groups receive age-appropriate materials and physical activities. Pre- and post-intervention assessments will measure changes in nutrition knowledge, BMI, and physical fitness. 277 participants consisting of students, teachers, and school staff took the pretest and posttest; participants showed improved nutrition knowledge, BMI, and physical fitness. Statistically significant decreases and increases were recorded overall: a significant reduction in BMI of 42% in the obese group, an increase in BMI of 33% in the less-than-ideal group, and 25% had no change. The Haheho Apps intervention based on the school community is efficacious in improving school community members' knowledge, BMI, and physical fitness.

Keywords: Physical Activity, Knowledge Nutrition, Physical Fitness, Community-Based

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Introduction

Every year, the country spends trillions of rupiah to handle public health and health insurance. In fact, if public health is well maintained, starting with instilling, getting used to, and providing knowledge about how to live an active and healthy life from an early age, then the country will be able to save the health budget and divert health subsidies to the development sector (Kristiyanto, 2021).

The health and fitness of school community after the pandemic experienced a tremendous decline. The results of the 2021 Sports Development Index (SDI) report from the Ministry of Youth and Sports of the Republic of Indonesia, randomly selected in 34 provinces, showed a significant decline in physical fitness. It was found that "the fitness level in the very poor category reached 53.63%, the poor category was 22.68%, and only 5.86% were in the very good and superior categories. There was generally no significant change compared to the 2006 SDI data. Although there was an increase in the good and very good categories, there was an increase in the very poor category." (Mutohir et al., 2022). This shows that physical fitness continues to decline. Based on the results (Ministry of Health, 2018) measurement in Indonesia, 8.7% of children aged 13–15 years are malnourished (1.9% are skinny and 6.8% are thin), while 16% are overweight (11.2% are obese and 4.8% are very obese). Based on the results of a multistage fitness test conducted on students at SMA Negeri 1 Kesesi, involving 277 samples including teachers, staff, and students, it was found that 102 people were in the very poor category, 68 people in the poor category, 76 people in the sufficient category, 31 people in the good category, and 15 people in the very good category. In addition, 56.8% of students' Body Mass Index (BMI) were in the normal category, 36.5% in the underweight category, and 6.7% in the overweight category.

The education sector is important in preventing and providing knowledge to school community so that they can have an active and healthy lifestyle throughout life. In an effort to restore the condition of education services and restore the learning process after the COVID-19 pandemic, the Ministry of Education and Culture instructed policymakers in schools as task implementers in the field to create strategies and plans for the recovery of educational services that are structured, systematic and massive involving various parties who have resources power to encourage learning recovery, encourage school community to maintain health by reducing the risk of diseases such as heart disease, stroke, and diabetes, and equip school community to have knowledge of balanced nutrition and calculate daily calorie needs.

The use of applications in the world of education today could be a solution, considering that currently, everyone cannot be separated from gadgets. A more in-depth application technology approach can assist teachers, administrative staff, and students implement learning and exercise programs to improve physical fitness and health. This statement is in line with what was expressed by Tjandrawina (2016). In The Economist Intelligence Unit, 50% of doctors believe that smartphone application technology empowers patients so that they can play a role in managing their health proactively. Physical fitness can help fight COVID-19. According to the statement (Costa et al., 2022) there is a possibility that someone who does not have good physical fitness will appear and cause complications and problems that will be more serious if someone experiences a COVID-19 infection. Therefore, appropriate training is required to increase physical fitness. According to Helmy (2015), training is a type of physical activity that is planned, structured, and repetitive and aims to increase or enhance the physical fitness's constituent components.

Several studies also show positive results. As per research conducted (Okinarum et al., 2017) "There is an increase in mothers ' knowledge of implementing the consumption of a variety of balanced nutrition food for elementary school children before and after using the (SEHATI) application."

According to Florian and Hurych (2022), high-intensity interval training is a type of exercise regimen characterized by short intervals of time considered strenuous. According to Bauer and colleagues (2022) there are several benefits associated with HIIT training, including more control over training and a more systematic approach since it makes it easier for students to understand their daily progress and increases potential energy more quickly than other conditioning methods. Additionally, the program can be completed almost anywhere and does not require specialized training. Physical exercise is considered the primary means of promoting health and protecting the body from various illnesses (Garber et al., 2011).

These conditions motivated the author to create an innovative work the Haheho Apps. Haheho Apps is an Android-based application that includes sports training guides and fitness monitoring and is able to collect fitness data. Various features can increase the school community's knowledge regarding diet and balanced nutrition. Application technology can more deeply assist teachers, students, and school staff in implementing fitness training programs and learning nutrition education.

Method

Methods used in the study This is an experiment. Research experimental considered their own level of the highest certainty. Sugiyono (2017) explain that method study this is used to look for influence treatment certain to other variables in controlled conditions. Researchers predict the study in accordance with the type of research that was developed, namely study quasi-experimental, with the use of the application Heheho App as variable independent, and physical fitness, knowledge nutrition, and body mass index as variable dependent.

Design used in study this is "one group pretest- posttest design." by specific, design study this involves a pretest before given treatment, and posttest after a given use haheho app for 2 months treatments. Although own potential design this sometimes criticized because its instability, such as lack of group control (Groesz et al., 2002). However, Shek and Sun (2012) explain the design this still often used because its practicality and simplicity in lots methodology study. In addition, research quasi-experimental, including pretest - posttest design, very suitable for evaluate new initiatives and programs in environmental education (Zajić et al., 2022).

Agustianti and colleagues (2022) state that results can be known more accurately because they can be compared before and after treatment. Research This will compare pretest results before the use of the application Haheho and post-test physical fitness, nutrition knowledge at SMAN Kesesi.

Data collection techniques were carried out with stage blended learning, namely online and offline learning, which look at face-to-face and online meetings through the Google Meet application. Researchers explain in a short way the use of the Haheho application, then give task movement to students in the form of 18 treatments or exercises in the Haheho application. Instrument in study this is the Multistage Fitness Test (MFT) tool, also known as a MFT (Fenanlampir & Faruq, 2015). MFT Test was carried out with the request of students

to run back and forth, or shuttle runs between two measured lines using meters and limited by cones that are 20 meters apart. Students must run from cone First to cone second while hearing the "beep" sound at the desired tone of their own bleep test rhythm.

For the measurement of nutrition knowledge, quizzes and questionnaires were used to determine activities carried out by the community school for 18 training sessions, which were collected via Google Forms. Instrument this includes a question with a scale response, namely a question for a general summary from the respondent about contents questionnaire.

The body mass index (BMI) is measured by measuring the weight and height of students. Weight measurement uses a digital scale, while height is measured using a standard height-measuring tool. After the weight and height data are obtained, BMI is calculated using the formula weight (in kilograms) divided by height (in meters) squared. This body mass index is used to determine the nutritional status of students, whether they are included in the thin, normal, or obese categories according to the standards set by WHO.

Treatment

The treatment was carried out 18 times in the form of interval training using the Haheho application media, which must be carried out by the school community 18 times. Some of the features of the Haheho application include: (1) An exercise guide menu that functions to guide users in doing exercises to stay safe in accordance with the FITT and SMART principles; (2) an exercise monitoring menu that functions to monitor sports training programs starting from pre-exercise, 18 exercises, post-exercise, to printing fitness certificates; (3) BMI menu to calculate body mass index. (4) Nutritional material that functions to provide training on nutrition. All of this training is directly connected to the LMS; (5) Quiz is menu functions to evaluate the extent of the school community's understanding of physical fitness and nutritional material; (6) The exhibition menu functions as a tool to harvest learning outcomes by exchanging ideas and experiences while running training programs.

The stages of treatment are as follows:

Table 1: Phase *Treatment*

No.	Phase	W Duration
1	Socialization of Multistage Fitness Test, Balanced Nutrition, Use of Haheho Apps	1 session
2	*Pretest*	1 session
3	The treatment was given 18 sessions of movement task training and learning nutrition on LMS	18 sessions practice through project assignments and fill in practice progress
4	*Post Test*	1 session

Giving treatment of 18 exercises of movement tasks to be carried out by school citizens for 2 months in the media Haheho App.

Results and Discussion

Pre Test Results

Before starting treatment, a pretest is carried out to see the student's initial physical fitness level using the Multistage Fitness instrument. Then, the following data is obtained:

Table 2: Statistic Data Description *Pre-test*

Variables	N	Min	Max	mean	Standard deviation
Physical fitness	277	26.4	69.5	44.4	11.1
Knowledge nutrition	277	30	87	60.3	10.2
BMI	277	13	34.6	20.2	3.6

Source: SPSS 26.0 *for Windows*

Table 3: Statistic Data Description *Post-test*

Variables	N	Min	Max	mean	Standard deviation
Physical fitness	277	33.3	69	51.9	11.1
Knowledge nutrition	277	49	100	85.5	7.4
BMI	277	14	34	20.1	3.1

Source: SPSS 26.0 *for Windows*

Based on the results of the statistical data analysis descriptive in the pre-test and post-test, there was a significant change in physical fitness on knowledge of nutrition and body mass index (BMI) of respondents after the intervention. In the pre-test, the physical fitness participant's own range mark is between 26.4 and 69.5, with an average of 44.4 and a standard deviation of 11.1, which indicates the existence of variation between participants. After the intervention, in the post-test, the physical fitness increased with a range mark between 33.3 and 69, and the average increased to 51.9, while the standard deviation remained at 11.1. This shows that improvement in the physical fitness happens to every participant, especially for those with the lowest mark.

Knowledge of nutrition also experienced significant improvement. In the pre-test, the nutrition knowledge score ranged between 30 and 87, with an average of 60.3 and a standard deviation of 10.2. After intervention, on post-test, the value knowledge of nutrition increased in the range of 49 to 100, with an average of 85.5 and a standard deviation decrease to 7.4. The decreased standard deviation indicates that improved nutrition knowledge is more evenly distributed among participants.

For BMI, changes are not too significant. In the pre-test, the BMI value ranged from 13 to 34.6, with an average of 20.2 and a standard deviation of 3.6. After intervention, span BMI values range from 14 to 34, with a slightly higher average. Decreased to 20.1, and the standard deviation decreased to 3.1. Although BMI changes are insignificant, the decreased standard deviation shows that BMI variation between participants is slightly reduced after the intervention. Overall, intervention Is effective in increasing physical fitness and knowledge of nutrition, although the impact on BMI tends to be minimal.

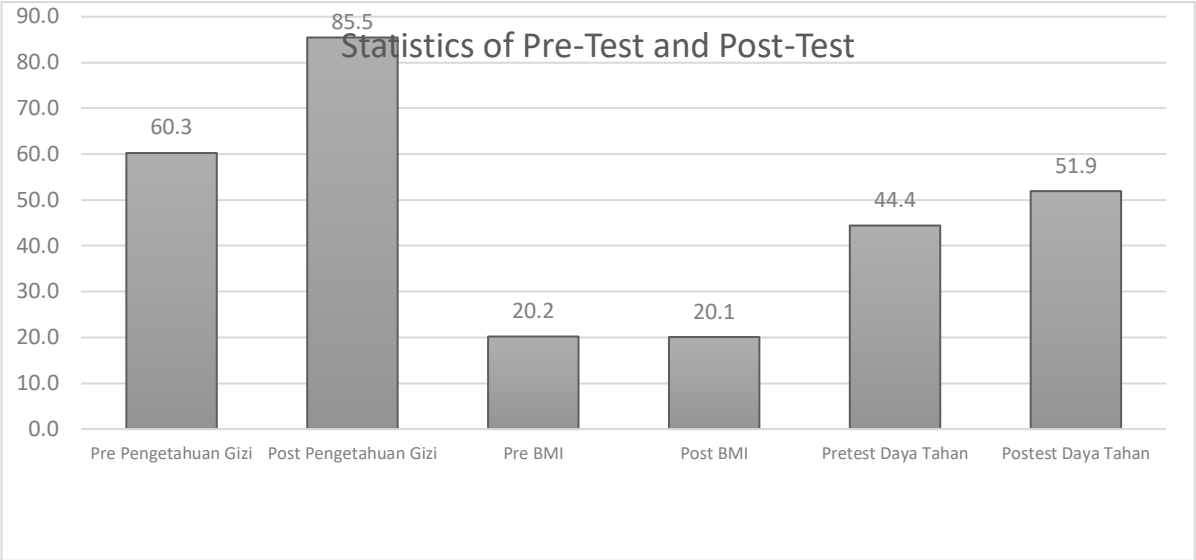

Figure 1: Statistics of Pre-test and Post-test

Table 4: Normality Kolmogorov-Smirnov [a]

Variables		Statistics	Sig
Physical Fitness	Pre	.121	.000
	Post	.173	.000
Knowledge	Pre	.048	.200 *
	Post	.095	.000
BMI	Pre	.163	.000
	Post	.380	.000

A non-parametric normality test using the Kolmogorov-Smirnov Test showed that most of the data was not normally distributed. For the physical fitness variable, both in the " Pre " condition (before intervention) with a statistical value of .121 and significance of .000, and " Post " (after intervention) with a statistical value of .173 and significance of .000, the data were not normally distributed. Likewise, the BMI variable showed abnormality both in the " Pre " condition, with a statistical value of .163 and significance of .000, and " Post " with a statistical value of .380 and significance of .000. Meanwhile, the knowledge variable only showed a normal distribution in the " Pre " condition with a statistical value of .048 and significance of .200. In contrast, in the " Post " condition it was not normally distributed with a statistical value of .095 and significance of .000.

Hypothesis Testing

Table 5: Wilcoxon Non-parametric Paired Test Table (Sample 277 students)

Variables	Z	Asymp. Sig. (2-tailed)
BMI	-3.048 [b]	.002
Knowledge Nutrition	-14.663 [b]	.000
Physical Fitness	-16.643 [b]	.000

Wilcoxon test results Signed Rank The test showed that the treatment had a significant effect on the variables BMI, knowledge, and physical fitness.

1. BMI

Based on the test results conducted on the BMI variable, a Z value of -3.048 was obtained. This Z value indicates how much the average difference between two data sets (for example, before and after the intervention) is from the mean of zero in a normal distribution unit. In this use, a negative Z value indicates a decrease in BMI after the intervention is applied. This means that after receiving the intervention, participants tend to have a lower BMI compared to before the intervention. Furthermore, the significance value obtained from this analysis is 0.002. In statistical research, this significance value is often compared to the commonly used significance level, which is 0.05 or 5%. If the p-value (significance value) is less than 0.05, then the results are considered statistically significant. Thus, these results indicate that the decrease in BMI after the intervention is statistically significant especially for obese group.

2. Nutritional knowledge

Based on the test results conducted on nutritional knowledge, the Z value obtained for the knowledge variable is -14.663. This number reflects a very significant change in the data; a negative Z value indicates that after the intervention, the participants' knowledge scores increased compared to before the intervention. The greater the absolute value of Z, the greater the difference between the two sets of data being compared. In this case, a high and negative Z value confirms that the intervention has succeeded in substantially increasing participants' knowledge. The significance value obtained from this result is 0.000. When the p-value is 0.000, this indicates that there is very strong evidence to reject the null hypothesis; in other words, the results obtained are very unlikely to occur by chance. In this use, a significance value of 0.000 is far below the general threshold of 0.05, which means that the change in participants' knowledge after the intervention is very statistically significant.

3. Physical fitness

Based on the results of the test conducted on the physical fitness variable, a Z value of -16.643 was obtained. This Z value shows how much the average difference between two data sets (for example, before and after the intervention) is from the mean of zero in normal distribution units. In this use, a negative Z value indicates a significant increase in student physical fitness after the intervention is applied. This means that after receiving the intervention, participants tend to have better physical fitness compared to before the intervention. Furthermore, the significance value obtained from this analysis is 0.000. In statistical research, this significance value is often compared to the general significance level, which is 0.05 or 5%. If the p-value (significance value) is less than 0.05, then the results are considered statistically significant. Thus, these results indicate that the increase in physical fitness after the intervention is statistically significant, which means that the intervention carried out has a real impact on increasing students' physical fitness.

Discussion

1. The Haheho Application on BMI (Body Mass Index)

Haheho application has been proven to have a significant effect on reducing the body mass index (BMI) of obese group participants after following a training program through this application. In the digital era like today, technology plays an increasingly important role in personal health monitoring, and Haheho is one of the innovations that has succeeded in utilizing this development. With a combination of tracking physical activity features, nutritional knowledge, and community support, this application offers a comprehensive approach to help users achieve their health goals.

These results align with several previous studies that have shown that digital application-based interventions effectively reduce BMI and improve overall health. research conducted by Granado-Font and colleagues (2015) Found that the use of health applications that provide guidance and monitoring of physical exercise significantly increases physical activity and helps in weight loss. In the study, digital applications were shown to be able to motivate users to participate in fitness programs, improve exercise patterns, and ultimately reduce BMI.

Another study by Carter and colleagues (2013) It also supports these findings, where technology-based interventions, including the use of apps, were effective in helping participants manage their weight through regular exercise and nutrition monitoring. Apps that combine training features and real-time BMI measurement provide users with the opportunity to manage their progress, which in turn improves fitness outcomes.

In the use of the Haheho application, the intervention provided through structured interval training for 18 sessions had a significant impact on reducing participants' BMI. The application provides key features such as user-tailored exercise guidance, progress monitoring, and BMI calculation, all of which play a role in helping participants achieve their fitness goals. These findings strengthen the conclusion that application-based interventions, including Haheho app, help reduce BMI and contribute to healthier lifestyle changes. The success of the Haheho application in this study adds to the evidence that digital technology can be an effective tool in facilitating fitness and health programs.

2. Haheho Application on Nutritional Knowledge

Haheho application has a significant impact on increasing participants' nutritional knowledge after the intervention. This application is equipped with nutritional education features integrated into the physical training program, such as a nutrition module that provides information about balanced food intake, calorie needs, and the importance of proper nutritional consumption for physical fitness. The quiz feature in the application also allows participants to evaluate their understanding of the nutritional material that has been presented, thus ensuring that the information is well absorbed. Key features of the app include a nutrition module that provides practical guidance on proper food intake, information on daily calorie requirements, and an explanation of the role of each food group in supporting physical fitness.

This feature directly supports previous research that confirms that structured nutrition education through application-based technology can improve participants' understanding of the relationship between diet and health. Research by Ulfa and colleagues (2022) Showed

that a mobile application equipped with interactive nutrition modules significantly increased awareness of the importance of nutritional balance among fitness program participants. Technology-based interventions, including mobile applications, are effective in improving nutrition knowledge and promoting healthy behavior change (Chueh et al., 2024). The Haheho application, with a similar approach, successfully leverages technology to provide relevant and informative nutrition education, thereby encouraging participants to pay more attention to students' diets.

In addition to the information module, this application also has an interactive quiz feature that functions as an evaluation tool for participants. This feature allows users to evaluate their understanding of the material that has been studied, as well as provide direct feedback on their level of understanding. This type of evaluation mechanism refers to research by Tandiono (2024), which found that interactive evaluation tools, such as quizzes, can increase information retention by up to 40% better than passive learning methods. Overall, the Haheho application not only acts as an educational tool but also as an evaluation platform that facilitates in-depth and sustainable improvement of nutritional knowledge.

3. Haheho Application on Physical Fitness

The Haheho app has become a significant tool in improving users' physical fitness, especially in this digital era. One of the main features of Haheho is its ability to offer personalized training programs, which have been shown to increase individuals' motivation and adherence to exercise routines, as explained in a study by Nowosielski and colleagues (2016). The app analyzes user data to recommend appropriate exercise types and intensities, allowing users to gradually increase their physical capacity. In addition, the progress tracking feature provided by Haheho allows users to see their progress in terms of time, distance, and intensity of exercise.

One of the key aspects of Haheho is the personalization of training programs. Research by Almutari and colleagues (2024) Shows that programs tailored to individual needs can increase motivation and engagement in physical activity. By analyzing user data, Haheho is able to recommend exercises that are appropriate to each individual's fitness level and goals. This approach not only helps users achieve their fitness goals but also reduces the risk of injury due to exercises that are not appropriate for the student's physical abilities.

In addition to personalization, the progress tracking feature provided by Haheho also contributes greatly to increasing physical fitness. Research by Bhawankar (2024) Confirms that real-time progress tracking can provide a deep sense of accomplishment, thus encouraging individuals to stay committed to their exercise routine. In this application, users can monitor various metrics such as exercise time, distance traveled, and activity intensity. By seeing real progress, users feel more motivated to continue exercising and overcome students' physical limitations.

Variety in training programs is essential to maintain user interest. Research by Swank (2013) Shows that variety in training can reduce boredom and increase compliance. Haheho offers a variety of training types, from cardio to strength and flexibility, which makes the training experience more interesting and enjoyable. Thus, users are not only focused on one type of training but can explore various activities that can improve overall physical fitness.

In conclusion, the Haheho app functions not only as a training tool but also as a holistic platform that combines personalization, progress tracking, social support, and program variations to improve user physical fitness. By leveraging the scientific research underlying each feature, Haheho is able to provide a significant positive impact on the user's physical abilities, making it an invaluable tool on the journey to better health and fitness. As technology advances and the understanding of fitness improves, apps like Haheho can continue to adapt and evolve to meet the needs of future users.

Conclusion

The program to increase the physical fitness and nutrition knowledge of school community with the Haheho Apps application can increase motivation for undergoing exercise programs and learning balanced nutrition material; This application can also provide more experience for school community in getting to know various variations of movement and intensity of exercise. Through the use of the Haheho apps, fitness training becomes more attractive, increasing motivation to carry out exercise programs. Through the use of this application, the learning material taught becomes clear and meaningful. So it can improve physical fitness and enrich the movement experience. This is proven by the results obtained after being given treatment; there was an increase in physical fitness.

The initial abilities measurement (pre test) showed that the physical fitness level was 37% with the category of very poor, 24% in the poor category, 27 in the sufficient category, 11% in the good category, and 5% in the very good category, meanwhile, for nutrition knowledge, the average score was 60. After carrying out treatment via the Haheho Apps application and carrying out a final ability test (post test), the physical fitness level was obtained at 2% with the category very poor, 7% in the poor category, 60% in the sufficient category, 22% in the good category and 9% in the aspect Nutritional knowledge has increased, as proven by the average score of 85. So it can be concluded that using is a significant influence of using Haheho Apps on improving students ' physical fitness and nutrition knowledge.

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Contact email: sitibaitul@mail.unnes.ac.id

Performance Measurements of Community-Friendly Schools in Hong Kong

Kwun-hang Lau, East Bridge University, France

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Abstract
This research evaluates the performance of community-friendly schools in Hong Kong, a new educational model introduced by CCC Tam Lee Lai Fun Memorial Secondary School since 2016. Community-friendly schools, though few in number, aim to balance resource utilization while fulfilling both educational and social needs. The study adopts a descriptive mixed research method, utilizing questionnaires and interviews as data gathering instruments. The sample consists of 86 students, 19 teachers, and 30 community stakeholders for the questionnaires, while interviews were conducted with a total of 38 participants, including students, teachers, and community stakeholders. The performance of these schools is assessed in terms of their impact on school reputation, students' learning attitudes, academic performance, and community engagement. These aspects are evaluated through three levels of activities - community learning activities, the activities cooperated with community organizations and community services organized by the school. Data analysis includes descriptive statistics, Analyses of Variance, and linear regression models, showcasing the significant effects of these institutions. The study examines changes in students' behavior before and after enrollment, revealing positive correlations between student engagement in community activities and improvements in academic performance, community awareness, and willingness to serve the community. This comprehensive evaluation framework aims to provide insights into the effectiveness of community-friendly schools in achieving educational and social objectives, and their overall reputation within the Hong Kong community.

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1. Introduction

1.1. Background of the Study

Despite various educational reforms, Hong Kong's education system remains dominated by an examination-driven culture, with a strong emphasis on public examinations like the Hong Kong Diploma of Secondary Education Examination. The New Senior Secondary (NSS) curriculum aimed to ease examination pressure by consolidating public exams and incorporating school-based assessments. However, research by Fok and Yu (2014, 2018) and Lam, Yu & Li (2019) shows that students, parents, and schools continue to prioritize examination results, often at the expense of non-academic learning experiences. This focus has shaped teaching methods, with traditional exam-centric strategies remaining prevalent (Lam, Ho, & Tsang, 2020). Dou and Shek (2022) also found that schools often allocate excessive time to core subjects, limiting opportunities for diverse and enriching learning experiences. These challenges highlight the need for a shift toward more inclusive educational practices that address the varied growth needs of students. At the same time, the reforms open up opportunities to adopt creative teaching approaches, such as community-friendly schools, which integrate learning with local environments and communities to promote holistic student development beyond traditional academics.

Table 1: Hierarchy of Community-Friendly Schools

Level	Focus	Determinants	Level of Engagement
First Level: Community-Based Learning Activities (About the Community)	Connection between students' life environment and learning	The school: 1) includes community elements in the curriculum. 2) identifies suitable topics and resources during curriculum design. 3) organizes learning activities within the local community.	Teacher Level
Second Level: Learning Activities in Collaboration with External Organizations (In the Community)	Partnership between schools and external organizations	The school: 1) collaborates with external organizations to organize learning activities. 2) jointly participate in designing curriculum and activities with external organizations. 3) opens its campus to external organizations for community activities.	Subject/ Committee Level
Third Level: Community Services/Activities Organized by the School (For the Community)	Interaction and mutual benefit between schools and the broader community, using school facilities as a community hub	The school: 1) organizes activities for community residents. 2) invites community residents to participate continuously in school activities. 3) receives support from community residents for its activities. 4) provides solutions or contributes efforts to address social needs or problems in the community	Whole-School Engagement

Community-friendly schools represent an innovative educational model that seeks to integrate academic objectives with societal development. In Hong Kong, schools face increasing pressure to address diverse stakeholder demands, including academic excellence,

student well-being, and community engagement. However, traditional educational frameworks often overlook the potential for schools to serve as hubs of community interaction and development. As illustrated in Table 1: Hierarchy of Community-Friendly Schools, this model is characterized by a progressive engagement structure. The first level, Community-Based Learning Activities (About the Community), focuses on connecting students' life environments with their learning experiences. At this level, schools integrate community elements into the curriculum, select appropriate topics and resources, and organize learning activities within the local community, primarily engaging at the teacher level. The second level, Learning Activities in Collaboration with External Organizations (In the Community), emphasizes partnerships between schools and external entities. Schools collaborate with organizations to co-design curriculum and activities, host joint initiatives, and open their campuses for community-related programs, reflecting engagement at the subject or committee level. The third level, Community Services/Activities Organized by the School (For the Community), fosters interaction and mutual benefit between schools and the broader community. Schools actively organize activities for local residents, invite their participation, receive their support, and address social challenges, representing whole-school engagement. By adopting this hierarchical approach, community-friendly schools not only achieve educational objectives but also enhance societal well-being, serving as pivotal platforms for collaboration and mutual growth (Lau, 2024a).

While prior studies have highlighted the benefits of experiential learning and community-based education, limited research exists on the systematic performance evaluation of community-friendly schools in fostering educational and social outcomes. This research gap underscores the need for a comprehensive framework to assess the dual impacts on students and schools, as well as the broader implications for school development and stakeholder relationships.

The objectives of this study are presented in a complete paragraph to provide clarity and direction. This study aims to evaluate the educational and social performance of community-friendly schools, focusing on how these institutions enhance student engagement, learning motivation, personal growth, and community understanding. Additionally, it seeks to analyze the broader impacts of community-friendly initiatives on schools' roles in education and their relationships with stakeholders, including their reputation and connection with the community. By addressing these objectives, the study provides valuable insights for educators and policymakers to optimize community-friendly school practices.

1.2. Problem Statement

The evolving educational landscape in Hong Kong presents numerous challenges for schools. Stakeholders demand accountability not only in academic performance but also in addressing societal needs. Despite the potential of community-friendly schools to bridge this gap, their effectiveness remains underexplored. Questions persist about how these initiatives impact student development, how engagement in community activities translates into measurable outcomes, and how schools can position themselves as both educational and community leaders. Without a clear understanding of these dynamics, schools may struggle to implement effective strategies that balance educational goals with community contributions.

1.3. Significance of the Study

This study holds significant academic and practical value. Academically, it contributes to the growing body of literature on community-based education by providing a comprehensive evaluation framework for community-friendly schools. The findings offer insights into how experiential and community-based learning activities influence student outcomes and school performance. Practically, the study equips educators, policymakers, and stakeholders with evidence-based strategies to design and implement community-friendly initiatives. By highlighting the dual benefits for students and communities, the study underscores the potential of these schools to transform the educational landscape in Hong Kong and beyond.

1.4. Research Questions

1. How do community-friendly school programs influence students' learning motivation, personal growth, and understanding of their local community?
2. What is the relationship between students' levels of engagement in community activities and their developmental outcomes in terms of motivation, community understanding, and personal growth?
3. How do community-friendly school initiative affects schools' roles in education and their communities, their connections with the community, and their reputation among stakeholders?

2. Methodology

2.1. Research Design and Participants

This exploratory study seeks to fill gaps in understanding schools' performance in educational and social accountability. A mixed-method approach was employed, combining qualitative and quantitative data to provide a comprehensive analysis. According to Creswell and colleagues (2003), mixed-method research involves collecting and analyzing both data types, either concurrently or sequentially, with one often prioritized. This method mitigates the limitations of using only one approach (Creswell & Creswell, 2018).

The research began with a quantitative survey, followed by qualitative interviews with a randomly selected subset of participants to enrich the initial findings. Three paper-and-pencil questionnaires were distributed to students, teachers, and community stakeholders. Comparative analysis highlighted mean differences across these groups, while correlation analysis examined relationships between variables, such as students' involvement in community-school programs and their understanding of and willingness to serve their community.

Semi-structured interviews offered in-depth insights into students' and teachers' experiences with community learning activities, despite the time-intensive nature of data analysis (Marshall & Rossman, 2016). Using a convergent parallel mixed methods approach, the study separately analyzed quantitative and qualitative data before integrating the findings to achieve a comprehensive understanding.

2.2. Population and Sampling

The study targeted three distinct stakeholder groups to ensure diverse perspectives on the performance of community-friendly schools. A total of 86 students from various grade levels were selected through purposive sampling to quantitatively capture a range of experiences with community-friendly initiatives. The teacher sample comprised 19 educators from multiple disciplines, chosen to provide insights into instructional practices and school operations. Additionally, 32 community stakeholders were recruited using stratified sampling to ensure balanced representation of different community roles and levels of engagement with the schools. This sampling strategy facilitated a comprehensive evaluation of the schools' impact from multiple vantage points. Quantitative data were collected through surveys administered to all participants. The surveys assessed the impact of community-friendly schools on student engagement, motivation, community understanding, and personal growth, as well as the schools' role in education, their connection with the community, and their reputation among stakeholders.

To complement the quantitative findings, qualitative data were gathered through interviews with a subset of 28 students, 5 teachers, and 5 community participants. Thematic analysis was employed to identify recurring themes, offering deeper insights into the lived experiences of stakeholders engaged in community-friendly school activities. This mixed-method approach provided a robust and comprehensive evaluation of the schools' multifaceted impact.

2.3. Data Collection Instruments

The study employed two primary instruments for data collection: structured surveys and semi-structured interview guides. The surveys were designed to measure both student and school impacts. For students, the survey incorporated 18 items across four dimensions: engagement (5 items), learning motivation (5 items), community understanding (4 items), and personal growth (4 items), with scores ranging from 1 to 5 (5 indicating the greatest impact, 1 indicating the least impact). For school-level impacts, separate questionnaire items were developed for each stakeholder group to capture their unique perspectives. Teachers assessed the school's role in education (5 items), its connection to the community (4 items), and the school's reputation (4 items). Likert scale responses ranged from 1 (strongly disagree) to 5 (strongly agree). These quantitative measures provided a broad understanding of the impacts on both students and the school as a whole, enabling to identify key trends and patterns.

The qualitative component of the study utilized semi-structured interviews to delve deeper into the experiences and perceptions of various stakeholders. Interview guides were tailored to each group, allowing for a detailed exploration of the impacts of community-friendly school initiatives. Students were asked about how specific activities influenced their engagement, learning motivation, personal growth, and understanding of community issues, often sharing personal anecdotes or moments that stood out. Teachers reflected on the school's role in fostering educational innovation, connecting with the community, and the observed changes in student attitudes and behaviors. Community members and parents provided insights into the perceived benefits of the school's initiatives on the community, its contributions to local well-being, and its influence on the school's reputation. This qualitative data offered nuanced perspectives that enriched the quantitative findings, providing a holistic understanding of the initiatives' impacts.

2.4. Data Processing and Analysis

Quantitative data from the surveys were systematically analyzed using statistical software to ensure precision and reliability in the results. Descriptive statistics, including means, standard deviations, and frequency distributions, provided an overview of stakeholder perceptions across dimensions such as engagement, learning motivation, community understanding, and personal growth. Advanced statistical methods, such as multiple regression analyses, were employed to explore the relationships between community-friendly school activities and specific student and school-level outcomes. For instance, the analysis identified how specific activities influenced factors like engagement and learning motivation. Reliability testing was conducted to validate the internal consistency of survey scales, ensuring robustness and accuracy in the measurements.

Qualitative data from the semi-structured interviews were transcribed verbatim and analyzed using a rigorous thematic analysis approach. This process involved an initial coding phase, where meaningful segments of text were labeled, followed by the identification of recurring themes and patterns. Key themes such as "enhanced community understanding," "improved student confidence," and "strengthened school-community relationships" emerged. To ensure credibility and dependability, the thematic analysis incorporated peer debriefing, where findings were reviewed by colleagues to confirm consistency and relevance. Triangulation was employed by comparing qualitative insights with the quantitative findings, allowing for cross-validation and ensuring validity while reducing potential biases.

The integration of data synthesis further enriched the analysis by combining perspectives from different stakeholders, including students, teachers, parents, and community members. This synthesis facilitated a deeper understanding of the community-friendly school model's multifaceted impacts, providing a comprehensive narrative that captured both measurable outcomes and lived experiences. The mixed-method approach ensured a holistic exploration of the research questions, highlighting the dynamic interplay between theoretical principles and real-world application within community-friendly schools.

3. Results and Discussion

3.1. Impacts on Students

This section presents and discusses the results of the study, focusing on the perceptions of students and teachers toward community-based learning activities, collaborative activities with external organizations, and school-organized community services. Key aspects such as engagement, learning motivation, community understanding, and personal growth are analyzed.

Table 2: Overall Scores of Community Learning Activities on Students' Engagement, Learning Motivation, Community Understanding, and Personal Growth

	Community-based learning activities		Learning activities cooperated with external organizations		Community services/ activities organized by the school		Combined	
	Students N=86	Teachers N=19	Students N=86	Teachers N=19	Students N=86	Teachers N=19	Students N=86	Teachers N=19
Engagement and satisfaction	*3.88*	*4.18*	*3.87*	*4.08*	*3.81*	*4.05*	*3.87*	*4.11*
Learning motivation and attitude	*3.71*	*4.09*	*3.76*	*4.02*	*3.81*	*4.07*	*3.76*	*4.06*
Community understanding and engagement	*3.79*	*4.23*	*3.84*	*4.23*	*3.79*	*4.12*	*3.81*	*4.19*
Personal growth	*3.78*	*4.16*	*3.88*	*4.26*	*3.78*	*4.13*	*3.81*	*4.19*

3.1.1. Engagement and Satisfaction

Table 2 illustrates that all three types of activities significantly contribute to engagement and satisfaction, with average ratings of 3.87 for students and 4.11 for teachers. Among the activities, teachers rated community-based learning activities the highest (M=4.18), indicating a strong belief in their effectiveness in fostering engagement. Students showed a slightly higher engagement with activities organized in cooperation with external organizations (M=3.87), which suggests that exposure to external expertise and resources may be particularly stimulating for them.

A Secondary 5 student reflecting on economics learning activities in the community:

> *Through the economics learning activities in our community, I gained a deeper understanding of issues like negative externalities. At Hung Kiu Bus Stop, I observed how crowded traffic creates problems such as noise and air pollution, which affect the well-being of nearby residents.*

A Secondary 5 student highlights how learning in the community bridges theory and practice in economics:

> *Exploring market structures and addressing air pollution in Hung Kiu sparked our interest in economics. These hands-on experiences revealed how deeply economics is embedded in everyday life—something we rarely get to witness firsthand. No textbook, no matter how detailed, can compare to the insights gained through real-world application.*

Teachers frequently noted the transformative impact of these experiences on students. As Teacher T1 stated:

> *Activities like the food guide in Hung Kiu allow students to explore the community actively, enabling deeper engagement beyond daily interactions.*

3.1.2. Learning Motivation and Attitude

Learning activities also positively influenced students' motivation and attitudes toward learning, with students' ratings averaging 3.76 and teachers' ratings 4.06. School-organized activities received the highest score from students (M=3.81), suggesting that familiar settings with structured guidance from schools can encourage positive learning attitudes. Teachers, however, rated external collaborations more favorably (M=4.02), reflecting their appreciation of the broader perspectives these partnerships bring to educational experiences.

A secondary 5 student emphasizes the importance of experiential learning on motivation:

> *Experiencing it personally is better than just learning from books. Learning on the spot brings more reflection, emotions, and meaningful experiences.*

A Secondary 5 student underscores the value of applying economics to everyday life to foster enthusiasm for learning:

> *By applying economics knowledge to real-life situations, we gained a better understanding of our surroundings, seamlessly integrated what we learned into daily life, and developed a greater enthusiasm for studying the subject.*

3.1.3 Community Understanding and Engagement

Both students and teachers highlighted the role of community learning activities in improving understanding of community dynamics and stakeholders. Teachers gave consistently high ratings across all activities, averaging 4.19, with community-based and externally supported activities receiving identical ratings of 4.23. Students also rated externally supported activities the highest (M=3.84), underscoring their effectiveness in exposing learners to diverse perspectives.

Student S2 reflected on the value of such activities:

> *Visiting the elderly increased my confidence in communicating with people I wouldn't normally interact with, enhancing my understanding of community life.*

A secondary 2 student demonstrates her willingness to serve her community and contribute to its betterment:

> *Some elderly people have issues in their home, so we would talk to the social workers in the community. Then our volunteer team has a home maintenance class. We've gone out to help the elderly with repairs, so there are some activities like that. Participating in the environmental activities let me know that we need to protect the environment where we live better.*

As Secondary Five student S3 remarked after participating in beach clean-ups:

> *These activities increased my awareness of environmental issues, motivating me to adopt sustainable practices in daily life.*

Student S4 noted how their perspective shifted after engaging in community service:

> *I realized there are many areas in the community that need improvement, inspiring me to contribute more to society in the future.*

3.1.4. Personal Growth

Personal growth emerged as a key outcome of the activities, with mean ratings of 3.81 for students and 4.19 for teachers. Teachers perceived activities involving external organizations as the most impactful (M=4.26), while students valued these activities equally with school-organized services (M=3.78). The findings suggest that engagement with community stakeholders and real-world challenges fosters self-awareness and confidence in students.

A secondary 5 student reveals his improvement attitudes toward personal growth:

> *At this school, we care for the elderly and learn from them, such as Chinese painting and calligraphy. Seeing how spirited and optimistic they are has inspired me to overcome my own negativity.*

A secondary 5 student also reveals his improvement attitudes toward interpersonal skills:

> *Through various activities, I have greatly enhanced my interpersonal skills. For instance, volunteering to assist the elderly during community events taught me how to communicate with respect and empathy. Organizing arts workshops as part of a team also helped me develop collaboration skills and the ability to value diverse perspectives. These experiences have boosted my confidence and enabled me to build stronger, more meaningful relationships with others.*

A teacher echoes these activities contribute to facilitating students' personal growth:

> *Initially, some students might be hesitant or shy to engage. However, after participating in volunteer work or small tasks a few times, they gradually take on leadership roles and become more proactive. They may go from simple visits to leading activities at community centres, demonstrating initiative and responsibility. Even though they're not directly involved in organizing, some activities allow them to shine and showcase their talents.*

Overall, the results indicate that the combined impact of all three activity types is highly favorable, with teachers rating them at 4.19 on average and students at 3.81. Teachers' consistently higher ratings reflect their broader appreciation of the strategic goals and outcomes of community learning initiatives. For students, the variation in scores suggests that while activities effectively promote engagement and understanding, there is room to enhance their motivation and willingness to serve the community. The findings reaffirm the effectiveness of community-friendly school model in enriching students' learning experiences and strengthening their connection to the community. Learning activities, especially those

involving external organizations, play a crucial role in fostering personal growth and promoting civic engagement. Future initiatives should aim to expand such collaborations and design activities that further inspire students' willingness to contribute actively to their communities.

3.2. The Relationship Between Students' Engagement and Its Impacts

Table 2 illustrates the relationship between students' involvement in different community activities and their understanding of the community. Three key areas were examined: learning activities within the community, learning activities in cooperation with external organizations, and community services organized by the school. The analysis of students' engagement in community activities reveals significant relationships with their developmental outcomes.

Table 3: The Relationship Between Students' Engagement and Its Impacts

	Multiple R	R Square	t Stat	P-value
First tier: Community-based learning activities				
Learning motivation and attitude	0.8944	0.8001	4.3391	0.0000396**
Community understanding and engagement	0.8389	0.7037	2.9694	0.00389**
Personal growth	0.8345	0.6964	2.99688	0.00390**
Secondary tier: Learning activities cooperated with external organizations				
Learning motivation and attitude	0.8843	0.7820	4.5160	0.00002**
Community understanding and engagement	0.9003	0.8107	3.281	0.0015**
Personal growth	0.9018	0.8132	1.9121	0.0592
Third tier: Community services/activities organized by the school				
Learning motivation and attitude	0.8688	0.7548	3.34911	0.0012**
Community understanding and engagement	0.8867	0.7863	3.2622	0.0016**
Personal growth	0.8913	0.7944	3.2060	0.0019**

Note. Statistical significance at the $p<0.05$ level indicated by * and $p<0.01$ level indicated by **

The analysis of students' engagement in community activities reveals significant relationships with their developmental outcomes. Community-based learning activities demonstrated the highest influence, with a Multiple R value of 0.8944 and an R Square value of 0.8001, indicating that 80.01% of the variance in learning motivation could be attributed to these activities. Similarly, these activities had a strong correlation with community understanding ($R = 0.8389$, $R^2 = 0.7037$) and personal growth ($R = 0.8345$, $R^2 = 0.6964$), both statistically significant at $p < 0.01$. Learning activities with external organizations also showed positive effects on learning motivation ($R = 0.8843$, $R^2 = 0.7820$, $p < 0.01$) and community understanding ($R = 0.9003$, $R^2 = 0.8107$, $p < 0.01$). However, the impact of learning activities with external organizations on personal growth ($R = 0.9018$, $R^2 = 0.8132$, $p = 0.0592$) is not statistically significant since the p-value exceeds 0.05. However, it shows a positive trend, suggesting further investigation may be warranted. Community services organized by schools further highlighted substantial contributions to learning motivation ($R = 0.8688$, $R^2 = 0.7548$, $p < 0.01$), community understanding ($R = 0.8867$, $R^2 = 0.7863$, $p < 0.01$), and personal growth ($R = 0.8913$, $R^2 = 0.7944$, $p < 0.01$). The statistical insignificance observed in the external organization's activities' impact on personal growth suggests variability in how these programs influence student development.

This analysis underscores the critical role of engagement in community activities, demonstrating that greater participation fosters motivation, understanding, and growth. Moreover, the findings highlight the potential for refining external collaborative efforts to ensure consistent benefits across all developmental dimensions.

3.3 Impacts on Schools

The role of community-friendly schools extends beyond the confines of traditional education, serving as vital bridges between academic environments and the broader community. By organizing community services and fostering active collaboration with stakeholders, these schools aim to create a twofold impact: enhancing the educational experience while addressing social needs. This section examines how community-friendly schools influence key areas such as educational roles and responsibilities, their ability to strengthen community connections, and their reputation among stakeholders. Drawing from quantitative and qualitative analyses, the findings highlight the multifaceted contributions these schools make to societal development and the perceptions of students, teachers, and community members.

3.3.1 Roles in Education and Communities

Table 4: Perceptions of Students, Teachers, and Community Stakeholders on the Purpose and Impact of Community Services and Activities Organized by the School

	Students (N=86)		Teachers (N=19)		Community Stakeholders (N=32)	
Survey Items	M	SD	M	SD	M	SD
The community services/activities organized by the school are for educational purposes.	3.91	0.94	4.21	1.03	4.44	0.88
The community services/activities organized by the school create positive impacts on bot h students and community.	3.97	0.94	4.26	0.99	4.47	0.84
The school has responsibilities to serve the c ommunity.	3.83	1.05	4.05	1.18	3.88	0.98
The community services/activities organized by the school are unique from the services fr om other organizations in the community.					4.19	0.90
The community services/activities organized by the school make my life more fulfilling.					4.00	0.92

A community stakeholder emphasizes the uniqueness of these activities:

> *The school's programs are different from other community services because they bring a fresh perspective. For example, having students monitor air quality and discuss their findings with the community not only educates the students but also empowers local residents to think about their environment differently.*

A student highlights the dual benefits of the activities:

I didn't realize how much I could learn by helping others. At first, I thought it was just about volunteering, but I've gained new skills and even found ways to apply what I've learned in class to real-life situations.

Table 4 underscores the perceptions of students, teachers, and community stakeholders regarding the dual purpose of community services and activities organized by the school in addressing educational and community needs. Teachers rated the educational significance of this initiative the highest (M = 4.21, SD = 1.03), closely followed by community stakeholders (M = 4.44, SD = 0.88), while students rated them slightly lower (M = 3.91, SD = 0.94). Similarly, the positive impacts on both students and the community were acknowledged across all groups, with community stakeholders providing the highest mean score (M = 4.47, SD = 0.84), followed by teachers (M = 4.26, SD = 0.99), and students (M = 3.97, SD = 0.94). These findings suggest that although all groups recognize the value of these activities, students may benefit from a deeper understanding of their broader impact. Additionally, stakeholders emphasized the unique nature of the school's programs, which not only enhances learning but also empowers the community. As one student reflected, these activities provide opportunities to apply classroom knowledge in real-life contexts, fostering both skill development and a sense of fulfillment.

3.3.2 Connection With Communities

Table 5: Perceptions of Students, Teachers, and Community Stakeholders on How Community Services and Activities Strengthen Connections With the Community

	Students (N=86)		Teachers (N=19)		Community Stakeholders (N=32)	
Survey Items	M	SD	M	SD	M	SD
The community services/activities improves the school's ties with the community.	3.84	0.97	4.37	1.01	4.38	0.87
Participating community services/activities organized by the school help me to understand more about teenagers.					4.03	0.90
The community services/activities improved my understanding on the school.					4.06	0.95
Participating in community services/activities organized by the school broadens my social network.					4.03	0.90

A teacher discusses how these activities build stronger ties with the community:

These services allow the school to act as a bridge. By involving local residents in events or discussions, we've seen a mutual understanding grow. Community members start seeing the school not just as a place of learning but as an active part of their lives.

A community stakeholder notes the broadening impact of school-organized activities:

Before participating in these programs, I didn't know much about the younger generation or what schools were doing. Now, I feel more connected, and I've even made friends through these activities. It's a win-win for everyone involved.

Table 5 highlights the significant role of school-organized activities in strengthening connections with the community. Teachers (M = 4.37, SD = 1.01) and community stakeholders (M = 4.38, SD = 0.87) rated these efforts highly, underscoring their positive impact. However, students provided a comparatively lower mean score of 3.84 (SD = 0.97), suggesting room for improvement in engaging students with the community-oriented objectives of these activities. Community stakeholders also reported that participating in this initiative enhanced their understanding of the school (M = 4.06, SD = 0.95) and expanded their social networks (M = 4.03, SD = 0.90). These findings emphasize the school's role as a bridge between students and the community, fostering mutual understanding and collaboration. As one teacher observed, these activities position the school as an integral part of the community by creating opportunities for interaction and shared learning. A community stakeholder further noted how these programs not only deepen their connection with the younger generation but also provide platforms for building meaningful relationships, making the initiative mutually beneficial. While the school's efforts are highly effective among external stakeholders, there is potential to enhance students' appreciation and engagement with the community-building initiative.

3.3.3 Reputation Among Stakeholders

Table 6: Perceptions of Students, Teachers, and Community Stakeholders on the Impact of Community Services and Activities on the School's Reputation

	Students (N=86)		Teachers (N=19)		Community Stakeholders (N=32)	
Survey Items	M	SD	M	SD	M	SD
The community services/activities makes the school differenetiates it from other schools.	3.91	0.98	4.11	1.05	4.09	0.96
The community services/activities improves reputation in the community.	3.88	0.94	4.37	0.90	4.19	0.93
I will recommend the community-friendly schools to other people I know.					4.19	0.86
More schools should work as community-friendly schools.					4.22	0.91

A community stakeholder shares their confidence in recommending the school:

I've spoken with friends and family about the school's programs, and they're always impressed. I tell them it's not just about academics here; it's about preparing the next generation to make a real difference.

A student comments on the school's unique approach:

Our school is different because it doesn't just focus on tests and grades. It's about how we can contribute to the community and learn from it too. It's something I'm proud of, and I think other schools should try it too.

Table 6 illustrates the positive impact of community-friendly schools on their reputation among various stakeholders. Teachers rated the school's ability to differentiate itself from others with a mean score of 4.11 (SD = 1.05), followed closely by community stakeholders (M = 4.09, SD = 0.96) and students (M = 3.91, SD = 0.98). Regarding the school's reputation within the community, teachers provided the highest rating (M = 4.37, SD = 0.90), with community stakeholders giving a similarly strong score (M = 4.19, SD = 0.93), while students offered a lower rating of 3.88 (SD = 0.94). Community stakeholders also showed strong confidence in recommending community-friendly schools to others (M = 4.19, SD = 0.86) and advocated for the expansion of this educational model (M = 4.22, SD = 0.91). These findings highlight how teachers and community stakeholders, in particular, recognize the school's efforts to build social relationships and improve standing in a competitive environment, significantly enhancing its reputation and social capital (Lau, 2024b). As noted by one stakeholder, the school's focus extends beyond academics to preparing students to contribute meaningfully to the community, a quality they are proud to share with others. Similarly, a student expressed pride in the school's unique approach, emphasizing the integration of community engagement with learning. While the school's reputation is highly regarded by teachers and stakeholders, there is an opportunity to further enhance students' awareness and appreciation of the initiative.

4. Conclusions

The study highlights the effectiveness of community-friendly school initiative in enhancing educational outcomes and societal contributions. These programs enrich students' learning experiences, foster personal growth, and strengthen schools' roles as community hubs. By addressing diverse stakeholder needs, these schools have the potential to redefine education in Hong Kong and beyond.

4.1. Key Findings

Community-friendly school activities significantly enhance all-round development in students, equipping them with essential skills to cope with future challenges while boosting engagement, learning motivation, community understanding, and personal growth. The initiative align with experiential learning theories like Kolb's Learning Cycle, emphasizing active participation in real-world contexts for deeper learning and skill development (Kolb & Kolb, 2017; Kong, 2021). By fostering holistic development, they help students build resilience, adaptability, and problem-solving skills, preparing them to navigate complex, uncertain environments. Activities involving external organizations broaden students' perspectives, fostering critical thinking, self-reflection, and flexibility in learning, as Eyler and Giles (2002) argue that service learning is particularly effective for understanding complex issues within larger systems through repeated application of concepts in realistic settings. Survey results reinforce these principles, with students rating personal growth (M=3.81) and engagement and satisfaction (M=3.87) highly, while teachers also valued activities with external organizations (M=4.26), consistent with findings by Krug (1994) that such programs improve self-esteem and attitudes toward school and community. This aligns with the role of community-friendly schools in fostering all-round development as a core function of their educational contributions. Moreover, these initiative cultivates practical skills and emotional intelligence, promoting self-regulation, teamwork, and leadership abilities. Conrad and Hedin's (1989) research highlights service learning's role in enhancing self-esteem, fostering social responsibility, and promoting complex thinking, while Voukelatou (2019) emphasizes the importance of mental, emotional, and social interactions in

creating dynamic learning environments. By integrating theory with practice, community-friendly schools fulfill their educational role by providing a holistic approach that prepares students for life beyond the classroom, making them active contributors to their communities while enhancing their self-awareness, critical thinking, and readiness to face future challenges.

Motivation, as a critical driver of learning, is shaped by various factors, including the learner, the educator, course content, teaching methods, and the learning environment (D'Souza and Maheshwari, 2010). Community-based activities provide authentic contexts for students to exercise autonomy and achieve competence, accounting for 80.01% of the variance in learning motivation ($R=0.8944$). Gelona (2011) and Kosgeroglu et al. (2009) highlight motivation as essential for goal-oriented behavior and educational success. However, variability in personal growth observed in external collaborations ($p=0.0592$) suggests the need for refinements to ensure consistent alignment with theoretical principles and practical goals. Community-friendly school initiative embodies Robert Blum's (1995) vision of evolving educational goals, emphasizing critical thinking, collaboration, and real-world problem-solving. By integrating real-world applications and fostering collaboration, these programs cultivate self-awareness and lifelong learning abilities, enabling students to connect theoretical knowledge with real-world challenges effectively (Guo et al., 2016). These contributions underscore the pivotal role of community-friendly schools in building stronger connections between education and community, as the initiative integrates real-world problem-solving with educational excellence.

Community-friendly initiative has elevated the role of schools as vital learning hubs that serve not only students but also their communities, creating mutual benefits for all three major stakeholders—schools, students, and the community. This initiative fosters deeper connections with stakeholders, with teachers highly valuing their role in relationship-building and community engagement ($M=4.37$). Students' moderate appreciation suggests room for enhancing alignment with their interests, underscoring the importance of evolving this initiative to better meet their needs. The OECD's Future of Schooling report envisions schools as dynamic hubs where diversity, experimentation, and community integration drive learning, civic engagement, and social innovation (OECD, 2020). As hubs of community connection, community-friendly schools actively bridge the gap between education and real-world application, helping students and communities address shared challenges. Community-friendly schools embody this vision by implementing hands-on learning experiences that transcend traditional classroom boundaries—such as monitoring river water quality, analyzing air pollution, and solving local challenges through humanities projects. These activities not only enrich students' learning and personal growth but also empower communities by fostering collaboration and addressing local concerns. Research highlights that such initiative enhances school reputation by showcasing adaptability and societal contributions (Brown et al., 2006; Gilpin, 2010; Helm, 2011). By embracing diversity, experiential learning, and community involvement, community-friendly schools strengthen their role as centers of mutual benefit—empowering students with critical skills, enhancing community well-being, and establishing schools as pivotal agents of civic engagement, social innovation, and sustainable development.

4.2. Recommendations

In light of the findings and limitations identified in this study, we propose several key recommendations for future research aimed at enhancing the understanding and effectiveness

of community-friendly schools. These recommendations focus on addressing the challenges of sampling, measurement, data collection, and cultural context, as well as mitigating the impact of time, resource constraints, and subjectivity in self-evaluation.

To evaluate the lasting effects of community-friendly school initiative, future research should consider conducting longitudinal studies. These studies could track students over several years to assess changes in personal growth, academic performance, career development, and social responsibility. By examining how early exposure to community engagement influences life-long learning and societal contributions, researcher can provide a more comprehensive understanding of the sustained benefits of these programs. Incorporating more robust score scales with additional questions targeting areas such as personal growth, civic awareness, and critical thinking can help uncover deeper insights into students' developmental trajectories.

Future research should expand its scope to encompass a diverse range of schools from various regions and educational systems. Including schools of different sizes, types, and cultural settings through random sampling methods can enhance the generalizability of findings. Comparative studies across different contexts would provide valuable insights into the patterns, variations, and challenges in implementing community-friendly initiative. By broadening the research scope, it becomes possible to identify best practices and tailor strategies to suit different community and educational needs.

Improving the precision and reliability of measurement tools is essential for advancing research on community-friendly schools. Questionnaires and interview protocols should be refined through pilot testing to ensure clarity and effectiveness, while triangulation methods—such as combining qualitative interviews, quantitative surveys, and observational data—can help reduce bias and validate findings. To enable a more nuanced evaluation, future research should introduce comprehensive score scales that assess the overall performance of schools as community-friendly hubs. These scales can integrate various dimensions, including academic outcomes, stakeholder satisfaction, community engagement, resource efficiency, reputation, connection with the community, and the role of education within the community. Additionally, more detailed score scales tailored to evaluating the impact on students should be developed, incorporating indicators for personal and social development, problem-solving abilities, and adaptability. Including metrics to measure broader benefits such as community cohesion, resource utilization, and societal contributions would provide deeper insights and guide schools in refining their initiatives. By systematically measuring these areas, researcher can identify strengths and areas for improvement, ensure accountability, and support the continued development of community-friendly schools.

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Using Case Studies to Develop Policymaking Competencies in Continuing Education: Integrating Practice and Experience

June Gwee, Civil Service College, Singapore

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Abstract
This paper presents findings on the use of case studies in practitioner-based, continuing education public policy programmes. Unlike academic programmes that lead to a degree or certificate, continuing education programmes are normally shorter in duration and comprise stackable segments to cater to the needs of working adults. Adult learners of foundation-level public policy programmes want to develop policymaking skills to solve everyday policy problems. Learning with case studies serve a dual function in the development of foundational policymaking skills through two instructional methods: learning through inquiry and learning through practitioner stories. They can develop critical thinking, systems thinking, creative thinking and communications skills. At the same time, they can contain a rich source of policy domain knowledge, tacit knowledge and practitioner-based experience which are integral to policymaking. Case study praxis in adult education is varied and extends beyond the case method.

Keywords: Case Studies, Policy in Practice, Adult Continuing Education

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Introduction

Policymaking can be defined as a purposeful course of action taken to deal with a problem or issue for a specific outcome (Anderson, 1997). It is a complex task that involves policy domain knowledge, sense-making, critical thinking, systems analysis and creative thinking. Often, it is an iterative rather than a linear and sequential event. Some have referred to policy and policymaking as a chaos of purposes and accidents (Sutton, 1999). Neither can any policy be truly novel because every idea, person and event is connected—"In modern days, policymaking never occurs in greenfield sites, as there is always a preexisting policy that must be modified or overturned, leading to friction between existing and proposed policies" (Manazir, 2023, p. 4).[1]

Competencies are a set of interrelated knowledge, skills and attitudes that represents a job role and which can be measured against well-established standards, as well as reinforced through training and development (Parry, 1996). The report on Competencies for Policymaking (Schwendinger et al., 2022) identified 36 competencies for innovative policymaking organised into seven clusters: Advise the Political Level, Innovate, Work with Evidence, Be Futures Literate, Engage with Citizens and Stakeholders, Collaborate and Communicate. Many of these skills cannot be taught but learnt. Case studies, as part of the case method for inductive learning, have been effective for acquiring the praxis of policymaking because they provide a real-world context for critical thinking and decision-making.

The case method is among the oldest form of experiential and flipped learning where learners interact with one another to discuss issues and problems set within a story that has several variables interacting with one another. When used as part of the case method, learners analyze data to discover the problem and solve it themselves (Prince & Felder, 2006). In academic programmes, students analyse theory and apply theoretical models to real-world situations (Brooke, 2006). This approach enables students to (a) develop generic skills required for policy practice, (b) gain a deeper understanding of policy theory, acquire knowledge about policy theory and policy practice in the context of practice, and (c) demonstrate an ability to apply theory to analyse policy problems (Walker, 2009). Students are required to demonstrate these abilities either through assessments in the form of graded written examinations or class discussions with marks given for participation.

Beyond the academic setting, especially in non-degree programmes where the goal of learners is to obtain specific real-world skills and knowledge to supplement existing education, the objective of this research is to examine the use of case studies in the development of policymaking competencies in continuing education. This research presents the findings from how case studies were used in two foundation-level policy programmes: the Policy in Practice (PIP) Programme and the Foundation Policy Programme: Thinking and Writing Clearly (FPP) at the Civil Service College Singapore.

The Three-Stage Learning Process

Since policymaking is an interaction with the past and present, while involving multiple players (individuals, agencies, groups) within a given system and domain, the narrative

[1] Manazir, S. H. Reimagining public policy formulation and analysis: a comprehensive theoretical framework for public policy. *Discov glob soc* 1, 16(2023). https://doi/org/10.1007/s44282-023-00018-4

situated in the case study offers a well-conceptualised setting for learners to interpret, analyse and make decisions about issues and problems within a specific context.

The traditional case method strategy is done through a three-stage learning process that requires individual preparation, small group discussion and large group discussion (Wood et al., 2023). This is similar to flipped learning methodology where learners actively read or watch lectures and analyse them before participating in group problem-solving activities (Baig & Yadegaridehkordi, 2023). During individual preparation, learners are given the case study before the start of the programme to be familiar with the contents of the case study. Individual preparation requires discipline and motivation because "there has to be hunger and commitment behind this search for the right analysis, solution and implementation" (Maufette-Leenders et al., 2001, p. 20–21).[2]

After individual preparation, learners discuss the case study in small groups to "check insights; assumptions and preparation against those of others; clarify understanding; listen attentively and critically to others; and argue for positions based on convictions developed during the individual preparation stage" (Maufette-Leenders et al., 2001, p. 22).[3] Both individual preparation and small group discussions take place outside of curriculum time (i.e. class) and are lead-ups to the large group discussion. Large group discussion is the finale where learners gather in a single large group, in class, to engage in deep discussions centred on a case study. The goal of the large group discussion is to push the learning beyond what could be achieved individually and in small groups.

Public Policy Programmes

Learners from the PIP and FPP programmes comprised policy officers with one to two years of policy work experience. They were nominated to attend the programmes to improve their policymaking competencies required in their job roles. A challenge for those relatively new to policymaking is the lack of work experience, policy experience and exposure to the workings within government. To plug this gap, foundational policy programmes were designed for learners to participate in deep learning where they would apply models and complete tasks and while doing so, be sufficiently engaged with the learning content and process of learning to discover insights about policy practice. The main elements of the PIP and FPP programmes are summarised in Table 1.

[2] Maufette-Leenders, M., Erskine, J. A., Leenders, M. R (2001). Learning with Cases. Ontario, Canada: Ivey Publishing, p. 20-21.
[3] Maufette-Leenders, M., Erskine, J. A., Leenders, M. R (2001). Learning with Cases. Ontario, Canada: Ivey Publishing, p. 20.

Table 1: Overview of Foundation Policy Programmes PIP and FPP

	Policy in Practice Programme (PIP)	**Foundation Policy Programme: Thinking and Writing Clearly (FPP)**
Learning outcomes	1. Describe the policy development and evaluation cycle 2. Analyse the common challenges faced at each stage of the cycle 3. Propose factors that help you make effective public policies	1. Define policy problems 2. Analyse common challenges in the policymaking process 3. Write and convey policies concisely and clearly
Target learners	Policy officers involved in policy operations	Policy officers involved in policy design and review
Duration of programme	2 days	2 days
Topics covered	Structure of Government, Policy Development and Implementation Cycle, Principles of Governance, Public Service Values	Structure of Government, Problem Definition, Policy Development and Evaluation Cycle, Principles of Governance, Policy Writing, Structuring Arguments
Number of case study discussions	2	1
Duration of case study session	90 mins	60 mins
Format of Programme	Synchronous Virtual	Synchronous Face-to-Face
Average number of learners per session	50	30 (based on 8 sessions)
Assessment Requirement	Nil (Formative Assessment)	Nil (Formative Assessment)
Course Completion Requirement	85% of Attendance	85% of Attendance
Total number of Programmes from Jan 2023 to Oct 2024	11	8

Methodology

Research was conducted by triangulating data from three sources: programme evaluation questionnaires of learners who attended the programmes, in-depth interviews with instructors who used case studies for discussions in the PIP and FPP programmes, and in-class observation of the case study discussions. This methodology enabled data to be collected

from three independent yet related sources which helped reduce potential biases and improve data reliability and validity.

From January 2023 to June 2024, there were a total of 19 PIP and FPP programmes with 774 learners from more than 60 public agencies across the Singapore Public Service. These programmes were conducted by four instructors who could choose two out of a selection of five case studies for their programmes. The case studies used in the programmes typically comprised 10-page structured cases that described policy issues and challenges. With a small sample size of instructors and case studies, this research aimed to minimise distraction from other variables such as trainer dispositions, facilitation styles, case study topics, and narrative styles of case studies which could affect the engagement of learners. The consistent use of only five case study topics and a common terminology by instructors helped to define for learners what is a case study and what learning with case studies entail. The programme evaluation questionnaire of all participants in the 19 runs of the programmes formed the full sample for the quantitative survey of this research.

A factor that might affect research reliability is the different platform in which case study discussions took place: virtually in PIP and face-to-face in FPP. Learner engagements could vary when case study discussions took place in different learning spaces. Bearing in mind that the data collected under different conditions could affect data reliability, this variable was accounted for during data analysis.

Programme Evaluation Questionnaire

The programme evaluation questionnaire (Table 2) comprised multiple choice (questions 1 to 11) and open-ended questions (questions 12 to 13). This was a standard questionnaire that was applied across both PIP and FPP programmes, as well as other programmes within the College. Overall, the effectiveness of the programme was based on scores received in the areas of learner engagement, acquisition of knowledge/skills/insights, and application of learning. Questions that targeted the effectiveness of learning through case studies are found in close-ended questions 5, 6, 7 and 8. Open-ended questions 12 and 13 allowed learners to provide additional feedback in verbatim. The response rate from the questionnaire survey was 87%.

Table 2: Programme Evaluation Questionnaire

1. I believe that the intended outcome(s) of this learning experience has been met.
2. I was engaged during the learning experience.
3. I acquired useful knowledge/skills/insights that will support me in my work.
4. I am able to apply what I have learnt.
5. My learning has been enhanced by the use of this case study.
6. I am satisfied that the content for the case study was presented in a concise and coherent manner.
7. I am willing to recommend this case study to others who are interested in this topic.
8. My learning has been enhanced by the use of this case study.
9. I felt that the instructor was effective in helping me learn.
10. I am satisfied with the administrative and logistical support.
11. On the whole, I am satisfied with the learning experience.
12. What were the best features of the learning experience?
13. How could the learning experience be improved?

In-Depth Interviews

The interview questions for instructors were designed around three areas: the background & experience of the instructors which gave context to their approach in using case studies for learning, their instructional design process in preparing and conducting case study discussions to achieve the desired outcomes, and their views on the effectiveness of case studies to achieve policymaking competencies.

The qualitative interviews were semi-structured to allow follow-up questions, clarifying questions or the fine-tuning of questions during the interview process. A first interview was conducted with an instructor with similar sample profile to test the interview questions for phrasing, sequencing and probes, as well as conduct a trial run of the data collection procedure and interview process. From the feedback received, the interview questions were simplified and shortened. Some questions were modified to distinguish responses between knowledge development versus skill development. The final interview guide is presented in Table 3.

Table 3: In-Depth Interview Guide

1. How did you prepare and conduct these case study discussions?
2. On average, what proportion of learners had read the case study before class?
3. To what extent were learners able to identify the problems/issues presented in the case study?
4. How did learners apply policy concepts, frameworks and tools to the problem/issues outlined in the case study?
5. How did learners understand the complexities of policy practice?
6. How effective were learners in identifying and explaining the operating contexts and policy principles presented through the case study?
7. To what extent do learners bring their experience into the discussions?
8. What worked or didn't work in allowing learners to demonstrate policymaking competencies when analysing the policy issues?
9. How effective was the case study in enabling you to facilitate a good learning experience? What worked or didn't work?
10. In your view, how can we improve the effectiveness of case studies for learning?

Direct Observation

Direct observation of the case study discussion enabled the author to observe and assess how learners demonstrate policymaking competencies in the areas of critical thinking, systems thinking, decision-making, communication skills and creative thinking. These competencies were identified when mapping FPP and PIP learning outcomes to case instructors' instructional design strategies, while referencing the report on competencies for policymaking by Schwendinger and colleagues (2022). Bloom's Taxonomy framework was used to gauge the level of complexity demonstrated by learners when trying to achieve the learning objectives (Bloom et al., 1956). During direct observation of the case study discussions in the programmes, a checklist was used to assess the extent (Always, Sometimes, Limited) in which each item was demonstrated in the checklist (Table 4). The checklist was mapped to the questions in the in-depth interviews and programme evaluation questionnaire. Observer bias was reduced by focusing on long-term observable behaviours rather than short term impressions.

Table 4: Checklist for Observation of Case Discussion

Item	Mapping to:		Degree of Evidence (Always, Sometimes, Limited)
	In-depth Interview Questions	**Programme Evaluation Questionnaire**	
Lesson Design			
1. Learners read and prepared the case study before class	Q2	Q12, Q13	
2. Instructor set context and provided a clear introduction to the case study and learning objectives	Q1	Q6, Q9	
3. Learners were actively engaged and participated freely in the discussion	Q1	Q2, Q9, Q12, Q13	
4. Instructor summarised the key points and takeaways from the discussion	Q1	Q1, Q9	
5. The learning objectives for the session were met	Q1	Q1, Q3, Q12, Q13	
Critical Thinking Skills			
6. Learners examined the situation from multiple and different viewpoints	Q3, Q6, Q7, Q8, Q9	Q3, Q4	
7. Learners evaluated ideas, arguments, or methods with sound reasoning	Q4, Q5, Q7, Q8	-	
8. Learners identified the problem and its root cause	Q3, Q4, Q5, Q6, Q8	-	
Systems Thinking Skills			
9. Learners were able to understand and describe key aspects of the system as part of the operating environment	Q3, Q5, Q6, Q7, Q8	-	
10. Learners evaluated impacts within the sector/industry and explained the significance of various cause and effects	Q3, Q5, Q7, Q8	Q11, Q12, Q13	
11. Learners explained the behaviour of the system within the operating environment	Q3, Q5, Q6, Q7, Q8	Q3, Q4	
Communication Skills			
12. Learners composed arguments and present logical reasoning based on evidence from the case study to support their arguments	Q5, Q7, Q8	Q3, Q4	
13. Learners applied and referenced relevant frameworks and concepts in explaining their arguments	Q4, Q6	Q3, Q4	
Creative Thinking Skills			
14. Learners suggested new ideas that were not previously used in the domain	Q7, Q9	-	

Findings

The qualitative data from interview transcripts and open-ended questionnaire feedback were scrutinised through ground-up coding by labelling and clustering data. The labels were then analysed systematically and used to identify themes and sub-themes. These were later cross-referenced and compared against quantitative data of learners' ratings of the programmes.

Using content and thematic analysis, three themes emerged: "Syndicate-based Learning", "Contextualised Policymaking" and "Practitioner Insights and Tacit Knowledge".

Syndicate-Based Learning

Syndicate-based learning was more suitable for adult learners of the programmes. Syndicate learning can be described as cooperative peer learning involving small groups of 5 and 10 learners working to find answers for a common task within a fixed timeframe (McKerlie, 2018). There were two main differences between Wood's three-step learning approach and the syndicate approach. First, individual preparation and small group discussion in the syndicate approach were conducted in class rather than before class. Second, large group discussion in a single conversation was replaced by groups presentations on their assigned questions.

Although learners were given the case studies for pre-reading at least two weeks before the start of the programme, most did not spend much time on the materials. Being in the initial years of their career, many were deeply entrenched in their day-to-day work and could not devote time to read the pre-programme materials. With busy work schedules, it was challenging for adult learners to read the case studies before class, much less form small groups to discuss them before class. Beyond work, they would rather devote time to family commitments and other personal activities.

> "Many of us have our Business-As-Usual work to do and would only glance through the pre-course materials."(Respondent)

> "This is where I think adult learning is very different. Most of the learners would say 'No time, because I've got so much work to do.' They are busy. There is no protected time for them to read. They were taking work time to carry out learning activities required by the programme. Then there were other reasons— 'I also have family things to do.' Most feel that 'I have work pressure, I have family pressure. So, I skim through the case study. I don't really have a good sense of the case study, or I haven't read it." (Instructor A)

As adult learners were often less prepared when entering a case study discussion, instructors unanimously used syndicate learning approach because it helped to level up learners who might not have read or analysed the case study to do so at the small group discussions. Furthermore, completion of the programmes was based on 85% of attendance and no grades were awarded for formative assessment. Hence, instructors also found the syndicate approach best suited for adult learners, compared to the three-stage learning approach (Table 5).

Table 5: A Comparison of Three-Stage Learning Process and Syndicate Learning Approach

	Three-Stage Learning Process by Wood et. al	**Syndicate Learning Approach**
Individual Learning	Learners read case studies prior to class	Learners read case studies in class
Small Group learning	Small groups discuss and analyse case studies prior to class	Small groups are formed in class and given a specific question to discuss and answer
Large Group Discussion	Instructor facilitates large group discussion in a single conversation	Groups take turn to present their answers to the assigned question

For both programmes, ratings specific to case study discussions were consistent at a mean of 4.3 out of 5, regardless of class size (30 learners versus 50 learners) and mode of delivery (face-to-face versus virtual programmes). However, overall scores for all other categories, including engagement during the learning experience, effectiveness of instructor, and programme learning outcomes were all higher for FPP which was conducted face-to-face and had an average class size of 30 learners. Qualitative feedback from PIP learners highlighted that the Zoom platform was less conducive for case study discussions of complex issues, and it was difficult to sustain attention.

Contextualised Policymaking

Through questioning techniques that centred on 'how', 'what' and 'why' that corresponded with levels 2 to 5 of the Bloom's Taxonomy (Bloom et al., 1956), instructors probed learners to analyse the information provided in the case study to identify policy issues, apply policy frameworks, present their policy ideas and solve policy problems, i.e. the performance goals of competencies required of policymakers. Observations of large group discussions and in-class presentations revealed that adult learners in these programmes were highly articulate and could present their ideas clearly and convincingly to a high extent. However, they were only able to sense-make issues based on the information provided in the case study, demonstrate critical thinking, systems thinking and creative thinking to a moderate extent when making policy decisions (Table 6).

Table 6: Demonstration of Policymaking Competencies

Competencies	**Description of Competencies**
To a high extent	
Communications	Ability to explain with evidence and empathy
To a moderate extent	
Critical Thinking	Ability to sense-make, analyse complex problems, evaluate options and make decisions based on logic and evidence
Systems Thinking	Ability to connect issues with the larger system and its interdependencies
Creative Thinking	Ability to suggest different and new ideas previously not used in the policy domain
Domain Knowledge	Understanding of policy context, operating context, policy domain

Learners' analyses were limited by their own policy and work experience because they were at the early stages of their career. While effective in analysing policy issues and presenting well thought-through issues based on the information provided in the case study, they had limited knowledge of their own policy domains, other policy domains and the inter-dependencies within the larger system.

Learners could only apply critical thinking based on what could be gleaned from the case study but could not deepen discussions. Some had provided feedback that they would prefer case studies situated in their own policy domains so that they could better analyse policy problems within the context of their work.

> "It is hard to formulate policy analysis for content areas we are not familiar with, and within such a short period of time." (Respondent)

> "The quality of discussion depended a lot on group members' contribution." (Respondent)

> "For this group of younger policymakers, we need to have a case study that is situated in their domain because ultimately, they are making policies within their domains. This is very different from if you are using a case study in say, a leadership programme where you can use a case study from any domain to learn leadership lessons. In a policy programme, it is about the practice of policymaking within a very specific domain. I need to keep coming back to ask them how is this relevant to them in their current job role, in their current context." (Instructor B)

Still, adult learners were hungry for knowledge about how to navigate the operating environment within their policy domains (e.g., social, economics, health and education).

Practitioner Insights & Tacit Knowledge

Learners were keen to discover authentic, behind-the-scenes, domain-specific policy insights and tacit knowledge from past and current policymakers, which make these stories quite unlike case studies used for inquiry-based learning where certain facts may be hidden or contained in the teaching note. They wanted to know how experienced and veteran policymakers identified root causes of policy issues, made decisions about trade-offs and dealt with dilemmas faced during policymaking. These case studies also contained policy fundamentals, policy principles, policy vision, and operating context which were needed for young policymakers to develop sensibilities, ethos and evaluative judgement in policymaking.

> "In terms of storytelling, it is really powerful. It's not just about skills. It is powerful at imparting knowledge. 'Oh, is this what happened?' 'Is this how government works together?' 'I didn't know this back-story?' Learners find this interesting but it may not directly lead to them acquiring policymaking skills. It is beyond inductive learning. It inspires ethos, a sense of belonging, which is very powerful." (Instructor B)

> "The case studies were really interesting and enlightening, so more sample case studies (as optional reading, maybe)." (Respondent)

A consistent idea that emerged was the use of shorter structured stories in learning. Conciseness and format were as important as the substance of the content itself. Learners were also drawn to shorter and more concise case studies with some degree of interaction.

> "Length has become something of a concern. Patience for case studies is very thin. The length is something that people don't have patience for anymore. They are not doing a degree programme and they don't have patience for a long case study. Case studies have evolved. They don't have to be written down. They can be videos, podcasts, etc." (Instructor B)

The three themes are linked by two instructional strategies—learning through Inquiry and learning through practitioner stories. The former enables policymakers to develop critical thinking skills while the latter develops policy domain knowledge and policy sensibilities.

Both are essential competencies for policymakers to integrate policy theories with practitioner experience (Figure 1).

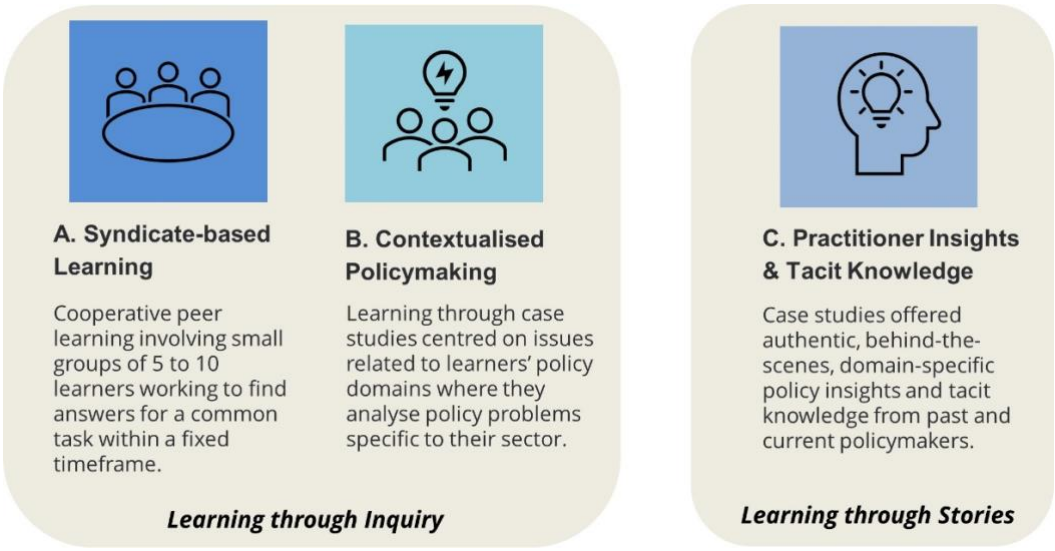

Figure 1: Overview of Research Findings

Conclusion

From this research, it can be concluded that learning with case studies is useful and relevant to the development of policymaking competencies, but they serve different functions in continuing education of policymakers. First, policy domain knowledge is integral to policymaking, alongside other policy skills such as critical thinking, sense-making, communication, etc. At the core of understanding the praxis of policymaking lies the tacit and practical knowledge of policy veterans. All of which are essential to the development of policy-related competencies. Second, case studies serve a dual function in the development of foundational policymaking competencies. They are used for inquiry-based learning and story-based learning. Both types of learning are needed for competency development of policymakers (Figure 2).

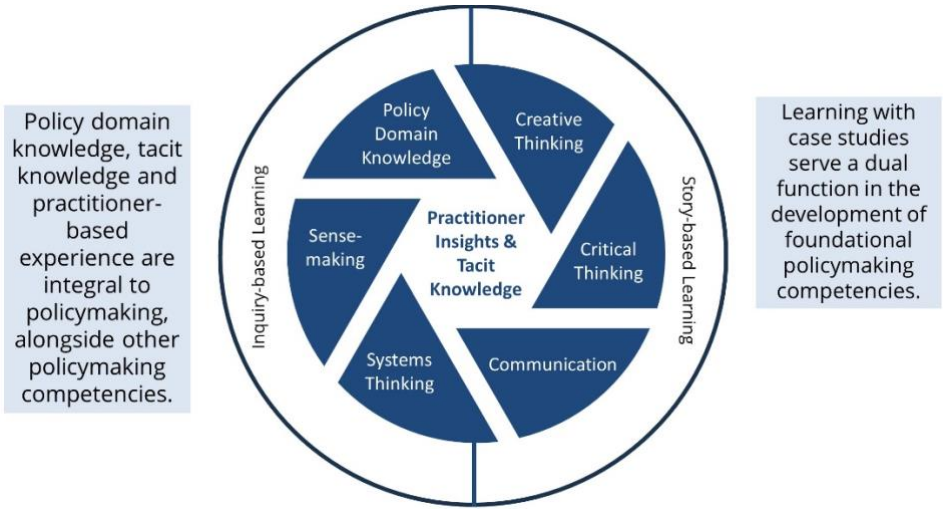

Figure 2: Overview of Research Findings

The composition, design and usage of case studies in both forms are dependent on the learning goals, learner motivations and learning preferences. For adult learners in continuing

education programmes, learning with case studies for policymaking is more effective if case studies are situated in the learners' policy domains. Simply because policy is not developed in a vacuum and is situated within specific operating contexts with social, political and economic stimuli, the context in which policy is made and the understanding of the policy domain and the context in which policy is made is part of policymaking and a much-needed competency. This echoes the research by Collins, Green and Hunter (Collins et al., 1999) which emphasised the importance of linking policy context with policy process to strengthen policy analysis. Clearly, there are benefits of using domain-specific case studies in foundational policy programmes. However, it may be challenging to implement. Policy classes would have to be customised to specific groups of learners which may be resource-intensive and difficult to scale.

In foundational policy programmes where learners could benefit from deeper learning from the knowledge and experience of veteran policymakers, a variety of case studies in different modalities could be designed and curated to meet different learning needs, as well as offer a wider array of learning experiences. Programme design could vary to include a combination of teaching cases for facilitated, inquiry-based learning and story-based cases for self-directed learning.

Whether for inquiry-based or self-directed story-based learning, case studies are effective in the development of policymaking competencies because they provide "a focal point around which analysis, experiences, expertise, and observations can be exchanged" (Harling and Akridge, 1998, p. 3).[4] According to Barnes, "a good case is not just a history; it relates an event—or sequence of events—that contains enough perplexities to inspire a rich educational discussion. The goal of a good case is to present rich data coherently" (Barnes et al., 1994, p. 71–72).[5]

There are differences in writing and designing a case study for facilitated learning in a classroom setting or for self-directed, self-paced learning by adult learners. Learning with cases is effective only if there are purposefully designed, well-crafted narratives and engaged learners. The way the case study narrative is structured, sequenced, presented and distributed could be vastly different depending on how it is used. There is scope for further research on how to design a good case study to achieve different learning goals that are useful to adult learners in developing policymaking competencies.

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Virtual Linguistic Landscape of Saudi Arabia's Language Policy in Higher Educational Institutions' Websites

Nadine Emirey Lacsina, Al Yamamah University, Saudi Arabia

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Abstract
This study aims at examining Saudi Arabia's language policy through the virtual linguistic landscape (VLL) of the kingdom's higher educational institutions' websites. The study sought to reveal the languages evident in the university websites, their informational and symbolic functions, and the current language situation of the Kingdom. Results reveal that there are four available languages; English, Arabic, Spanish and French. However, most of the university websites only offered English and Arabic. Hence, multilingual accessibility was not strongly observed. The informational function reveals the speech communities present mainly spoke English and Arabic. Also, it is revealed that highly populous non-Arabic speaking expatriate nationalities were not recognized in terms of language inclusion in the websites, proving the value that the institutions assign to English and Arabic. On the other hand, English was deemed to be a tool to disseminate information to non-Arabic speaking users. In terms of language dominance, English emerged to be valued more than Arabic as reflected through most university websites' preference for English as their default language. The use of English was driven by international collaborations, global ranking efforts, benchmarking curriculums, preparation for Vision 2030, spread of Islamic faith, and better international representation. Considering all the findings vis-à-vis the Kingdom's language policy, the study reveals that the observed bilingual nature of university websites' VLL reflected the country's current language policy.

Keywords: Virtual Linguistic Landscape, Language Prestige, Informational and Symbolic Functions, Websites, Saudi Arabia

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Introduction

Studies on language use in public spaces have spurred research in semiotics, sociolinguistics, applied linguistics, and discourse analysis. Landry and Bourhis (1997) introduced the concept of 'linguistic landscape' (LL), focusing on language in public signs. Recent research has expanded to the 'virtual linguistic landscape' (VLL), as noted by Ivkovic and Lotherington (2009), which examines language use in digital environments. VLL mirrors LL by exploring language hegemony, policy, learning, and multilingualism. Biro (2018) emphasized that virtual signages enhance LL studies by examining community language practices. Despite its growing popularity, VLL remains a newer field requiring further research across various online platforms.

As countries adapt to an expanding global trade environment, the interplay between government policies and their sociocultural effects becomes increasingly important. One significant aspect of this is language policy, which encompasses the rules and laws that directly impact a nation. Language policy is defined as the outcome of a planning process aligned with national goals, including national language planning (Jernudd & Das Gupta, 1971). Governments exert influence over institutions, particularly education systems, to perpetuate language policies at various levels for diverse purposes. Shohamy (2006) emphasizes that authorities implement language policies not only directly but also through agents like schools and universities, which help disseminate both official and de facto policies. This highlights the mechanisms through which policies are executed and their implications.

In the context of virtual linguistic landscapes (VLL), the analysis of university websites reveals how language policy is manifested. Gomaa (2020) points out that the visibility and presence of language on these websites contribute to a perceived hierarchy of language within a specific context.

Symbolic and Informational Functions of LL and VLL

Linguistic landscape has two functions which are informational and symbolic (Landry & Bourhis, 1997). The informational function of LL serves as an attributive marker of the language community which lives in a geographical territory. Because of this, LL helps to make apparent the territorial restrictions of the specific language group staying in adjoined territories, through clear-cut language boundaries. On the other hand, the symbolic function of LL serves as an indicator of ideology due to the fact that languages have their own value and status, hence the prevalence of a particular language on public signs can symbolize the strength of a certain language community in a certain location. Not only does it show the vitality of the in-group's language, but it also shows how that particular language community can have control on key sectors, such as economy, media, education, and civil administration (Landry & Bourhis, 1997). On a different note, Ivkovic and Lotherington (2009) exclaims that the informational function is to state a fact and inform people of events and can be measured by the successful delivery of information and the relevance of the content presentation. On the other hand, symbolic function goes beyond the objective of informing and stating a fact, rather it involves the analysis language choice and its use to present the content.

Multilingualism and Virtual Linguistic Landscape

VLL, as an extension of linguistic landscape, also addresses questions about multilingualism, which is a given since VLL is delocalized, hence the languages available in the virtual space can cater to as many users as possible. According to Ivkovic and Lotherington (2009), multilingual options and choices have increased significantly due to the fact that the web is continuously evolving hence increase in multilingual capabilities through computer-mediated communication can be evidently seen.

Studies on multilingualism open more opportunities to look into language choice and provide a safe space for minority languages. For instance, in a study conducted by Thorne and Ivkovic (2015) who looked into plurilingual interaction on Youtube, their study revealed that the commentsection of Youtube and other social media platforms open opportunities to study multilingual processes. Although cyberspace propagates the use of many languages as in the case of Sperlich (2005) who underscored that although English is the lingua franca in virtual space, other languages have been increasingly visible and that multiple language access and exchanges have been made possible through multilingual pages, some research also exclaims that the use of English in cyberspace hinders the propagation of other languages online.

Language Policy and Planning and Virtual Linguistic Landscape

VLL can also provide substantial insights about language policy and planning. In fact, languagepolicy and planning has a key role in linguistic landscape (Hult, 2018), which is the physical counterpart of VLL. For instance, the relationship between LL and language policy can be seen inthe studies of both Cenoz and Gorter (2006) who investigated multilingualism in the Netherlandsand Spain. Their study revealed that public signs in Spain were dominated by the minority language as compared to the signs in the Netherlands, hence, reveals the stronger language policyin Spain which was aimed at protecting and propagating the use of Spain's minority language. In another study by Rosendal (2009) on Rwanda-French bilingualism and Rwanda-French-English trilingualism, his study revealed that the positioning of languages on signs in markets andnewspaper affects not only the people's usage of both the national and official language, but alsothe status of non-African languages.

Linguistic Landscape and Language Situation in Saudi Arabia

Saudi Vision 2030 was announced in April 2016 by the Crown Prince Mohammed bin Salman as an introduction to the country's shift in its strategy to better achieve global status as an economic force. Despite the country's rich natural reserves of oil, the decrease of international use for this resource is central to the government's tactic to shift its investments towards cultivating the manpower that is its youth. Hence, one of the more significant ways to carefully develop its humancapital is through the crafting of an educational sector that caters to adaptability in an ever- changing market (Alzahrani, 2017). With these, the scarce linguistic landscape studies done in the kingdom reflects the country's efforts to embrace multiculturalism which is manifested through bilingual public signs in both the physical world and the virtual space.

Language Policy and Planning in Saudi Arabia

Saudi Arabia's national and official language is Arabic which can be classified into three: Classical Arabic, Standard Arabic, and Modern Standard Arabic (Alhaider, 2018). There are

about 220,000,000 Arabic speakers in the world and Arabic is one of the most used languages on the internet as revealed in the research conducted by Benaida and colleagues (2018). Based on the official educational policies as stated by the Ministry of Education, Arabic is the medium of instruction in all subjects; however, students are taught at least one foreign language which is English. Students, especially in the public schools are strongly encouraged to read, write, and speak Arabic in order to maintain students' mother tongue and avoid code-switching which may impair their proficiency in Arabic (Payne & Almansour, 2014). Furthermore, Arabic is a major subject and is taught at all levels regardless of the type of school--public or private.

Despite the important and beneficial results of the earlier research on virtual linguistic landscape, further investigation on language choice, language representation and language policy are needed because cyberspace offers varied, complex network of information. In addition, majority of the research done using these networks focused their data analysis using either government-run websites and portals or social media platforms. Hence, little research is done in order to examine the linguistic phenomena in privately- owned websites across different genres.

Statement of the Problem

The study generally aimed to examine the language policy of Saudi Arabia as manifested in the virtual linguistic landscape of both the government and private universities. Specifically, this study will answer following research questions:

1) What languages are evident in the websites of public and private universities?
2) What informational and symbolic functions do the languages in the websites reveal?
3) How do the languages used reflect the language policy and the language situation in the Kingdom?

Theoretical Frameworks

The first framework is Ivkovic and Lotherington's (2009) informational and symbolic functions of VLL. The informational function conveys facts and events, measured by effective communication and content relevance. The symbolic function analyzes language choice and its presentation.

The second framework is Spolsky and Cooper's (1991) three-conditional model, which offers insights into language choice through three conditions: 1) the sign-writer's skill, 2) the presumed reader, and 3) the symbolic language condition.

The third framework is Fasold's language prestige (2006), which explains that language prestige encompasses not only the dominant language but also the preferred languages within speech communities.

Method

This research aimed to examine the language policy of the Kingdom of Saudi Arabia as reflected in the virtual linguistic landscape of educational institutions, utilizing a descriptive qualitative design. This approach facilitated the analysis of the languages used, available, preferred, and the target audience of the websites studied. Due to the information overload on

websites, not all content was analyzed; instead, selective focus was applied, a process described by Guest and colleagues (2012) as "winnowing data."

Corpora of the Study

The study's corpora consisted of public and private Saudi university websites accessible via search engines like Google, including 18 sites from six provinces: Makkah, Riyadh, Eastern, Madinah, Asir, and Al-Qassim. Purposive sampling was employed to select these provinces, allowing the researcher to effectively address the research question (Creswell, 2014). The provinces were chosen based on factors like population, location, and the presence of at least one public and one private university.

Data Analysis

First, each website was analyzed for the languages used on the front page and in the language tab, with a frequency count identifying the most common language across the sites. Second, this frequency data allowed for an analysis of the informational function of VLL, revealing different speech communities. Third, language dominance and preference were assessed using the frequency count, designating the most frequent language as dominant. The order of languages in the translation lists was also recorded. Fourth, Spolsky's and Cooper's (1991) three-conditional model was applied to examine language choice in depth. Fifth, the symbolic function of VLL was analyzed to uncover the reasons behind language dominance and preference. Next, the value assigned to each language by the university websites was examined to determine which languages held more prestige among local speech communities. Finally, the initial interpretations and analyses were compiled to assess whether the VLL of the university websites accurately reflect these findings.

Results and Discussion

Evident Languages in the Websites of Public and Private Universities

A key aspect of linguistic landscape studies is the collection of languages in public spaces, with sign counting being a primary focus (Barni & Bagna, 2015). Similarly, virtual linguistic landscape studies gather data on languages used online, providing insight into linguistic communities and territorial boundaries.

To identify the prominent languages, frequency counts recorded the languages available on the websites. The analysis categorized the websites into three groups: 1) monolingual, 2) bilingual, and 3) multilingual. Of the websites analyzed, 11% (2) were monolingual, 83% (15) were bilingual, and 6% (1) was multilingual. The available languages included English, Arabic, French, and Spanish.

Table 1: Languages Available in the University Websites

Languages Available	Number of Universities	Percentage
English	18	100%
Arabic	16	89%
French	1	6%
Spanish	1	6%

Table 1 outlines the languages available on university websites. All universities provided English, often as the default language on their landing pages. However, only 89% (16 universities) included Arabic, with King Fahd University of Petroleum and Minerals and Prince Mohammad bin Fahd University offering only English.

Regarding French, only King Abdulaziz University provides this option, reflecting the decline in French teaching in the kingdom since its removal in 1970 (Barnawi & Al-Hawsawi, 2016; Hudhayri, 2021). King Abdulaziz University also offers Spanish, which accounts for 6% of the total options across the 18 universities. These findings align with Korpela's (2003) research on the prominence of multiple languages in international communication.

In terms of multilingualism, only King Abdulaziz University offers accessibility to English, Arabic, French, and Spanish, allowing users to select their preferred language on its website (see Figure 1).

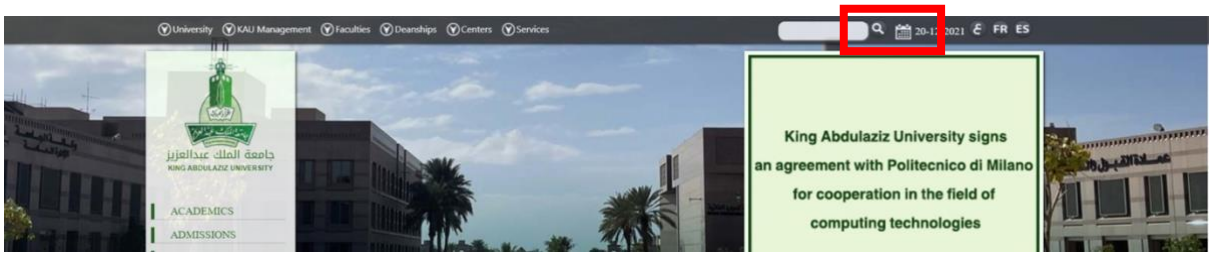

Figure 1: King Abdulaziz University's Multilingual Accessibility Option

Table 2: Number of University Websites With English and Arabic Options

Default Language	No. of Universities	Percentage
Universities with both English and Arabic as available languages	16	89%
Universities with only English as the available language	2	11%
Total	18	100%

Most universities provide a bilingual option, allowing users to choose between Arabic and English, which enhances user comfort while browsing for information. This aligns with

Farivar's (2011) study, which found that website audiences feel more at ease when information is presented in their language rather than merely translated.

The current study found that 89% (16 universities) utilized both languages on their websites, while 11% (2 universities) exclusively used English: King Fahd University of Petroleum and Minerals and Prince Mohammad bin Fahd University. King Fahd University was a pioneer in using English as a medium of instruction (EMI) for courses like medicine and engineering, highlighting its strong emphasis on the English language (Barnawi & Al-Hawsawi, 2016).

Table 3: University Websites and Their Default Languages

University Websites	No. of Universities	Percentage
University websites using English as their default language	10	56%
University websites using Arabic as their default language	8	44%
Total	18	100%

Table 3 shows that most university websites, including King Saud University, Al Imam Muhammad Ibn Saud University, and others, use English as their default language. This facilitates access to information for foreign visitors, while Arabic speakers must locate the language option to switch to Arabic.

Specifically, 56% of the websites default to English, while 44% (8 universities) use Arabic, including King Faisal University and King Khalid University. This setup aids Arabic speakers, making navigation easier, but non-Arabic speakers must convert the page to English.

These findings align with Payne and Mansour's (2014) study, which indicated that English competes significantly with Arabic, posing a potential threat to national identity and local beliefs in favor of Western influences.

The Informational and Symbolic Functions of the Languages Used in the Websites

Informational Functions of the University Websites

The languages documented on the websites indicate that: (1) Saudi Arabia has non-Arabic speaking communities; (2) minority languages representing small linguistic communities are absent; (3) both Arabic and English serve as communication mediums. Additionally, following Ivkovic and Lotherington's (2009) definition of informational function, (4) the primary purpose of university websites is to deliver essential information.

The Presence of Non-Arabic Speaking Nationalities in Saudi Arabia

The informational function reflects the language community in a territory (Bourhis, 1992). The virtual linguistic landscape of university websites reveals both the speech communities and territorial restrictions in the study regions. Results show that the population is nearly split between Saudis (56%) and foreigners (44%). Among foreigners, Indians, Syrians, and

Pakistanis are the predominant nationalities, as noted by Global Media Insight (2022) and the United Nations (2019).

This cultural and linguistic diversity has created competitiveness among speech communities (Holmes, 2013). Habtoor (2012) highlighted that nearly half of Saudi Arabia's population consists of non-Saudis from various geographical backgrounds, contributing to a rich cultural and linguistic environment. Table 4 presents the population of Saudis and non-Saudis in each province of Saudi Arabia as recorded by the General Authority for Statistics in 2017.

Table 4: Population of Saudi and Non-Saudi in the Major Provinces in Saudi Arabia

Province	Population				Total
	Saudi	Percentage	Non-Saudi	Percentage	
Riyadh	4,583,751	57%	3,430,927	43%	8,014,678
Makkah	4,516,577	53%	4,041,189	47%	8,557,766
Eastern	3,090,272	65%	1,697,103	35%	4,787,375
Asir	1,750,131	79%	461,744	21%	2,211,875
Madinah	1,376,244	65%	756,435	35%	2,132,679
Qassim	1,009,543	71%	414,392	29%	1,423,935

The population data indicates that more than half of residents in the provinces are Saudis, reflecting the government's efforts to enhance education, trade, and technology, which encourage Saudis to remain in the kingdom. Additionally, the Vision 2030 initiative attracts foreigners, aiming to position Saudi Arabia as a leading global country by boosting tourism and business.

Notably, in populous provinces like Riyadh and Makkah, the populations of Saudis and non-Saudis are nearly equal, suggesting a rich diversity of speech communities and increased language interaction. In contrast, provinces like Eastern, Asir, Madinah, and Qassim show a significant disparity between Saudis and non-Saudis.

Analyzing the specific populations and available languages reveals distinct speech communities in different provinces. For instance, in Qassim and Madinah, universities further apart tend to reflect differing language preferences; while the closer universities default to Arabic, the more isolated university opts for English.

Absence of Minority Languages

Analysis reveals that while university websites reflect existing linguistic communities, they lack representation for minority languages spoken by foreign nationals whose primary language is not Arabic. According to Table 4, although 16 nationalities are noted—8 of which were listed by the United Nations in 2019—none of the languages spoken by non-Arabic speakers appear on the websites. While Yemenis, Egyptians, and others speak Arabic, nationalities like Indians, Pakistanis, and Filipinos use languages not represented.

This absence highlights that, despite their significant populations, these languages are not recognized on university websites, reflecting the dominance of Arabic and English. This situation aligns with Kelly-Holmes and Pietikainen's (2013) observation that minority languages can be overlooked even when they form a sizable demographic. This contrasts with findings from Ivkovic and Lotherington (2009) and Kelly-Holmes and Pietikainen (2013), which advocate for multilingualism and the acknowledgment of minor languages on websites.

English as a Medium of Communication

The absence of minority languages on the websites indicates that English not only represents a major linguistic community but also serves as a lingua franca for non-Arabic speakers. This suggests that both Arabic and English are used by university website creators to communicate with their audiences.

Analysis of language presence shows that four languages are available (as noted in Table 1), with only one university offering French and Spanish; the rest provide only Arabic and English. English is the default language for 56% of the websites (10 out of 18), while Arabic accounts for 44% (8 out of 18). This highlights that the lack of representation for minor languages necessitates the use of English to reach non-Arabic speakers.

These findings align with Gomaa's (2020) study on Bahrain's government e-portal, where Arabic targets Arabic speakers and English addresses non-Arabic communities, emphasizing linguistic rights despite the exclusion of other languages.

University Websites as a Means to Deliver Information

In addition to territorial restrictions and the representation of linguistic communities, the study examined the informational function of university websites, focusing on their ability to convey facts and reference events (Ivkovic & Lotherington, 2009). This analysis revealed that the primary purpose of these websites is to provide vital information about the universities, emphasizing the efficiency and relevance of their content.

For Riyadh province, all universities included sections like "About Us," colleges, research, faculty, student life, news, e-services, and social media links. Important updates are found in the main content area as users scroll. In Makkah, common tabs include "About the University," research, student experience, admissions, and social media. News and announcements are prominently displayed on the landing page. In the Eastern province, universities feature sections on background, faculty, student life, and research, with facts and figures available in the website body. Asir province websites provide links for languages, contact details, and colleges, along with news and announcements in the body. Qassim universities offer links like language options, university background, admissions, and e-services, while also featuring news and employee portals. Lastly, in Madinah, common links include language options, student and staff information, research, admissions, and services, with news and statistics presented in the body.

Symbolic Functions of the University Websites

The languages featured on the university websites reveal several symbolic functions: (1) the rapid spread of English; (2) its status as a prestigious language to attract students and faculty;

(3) its importance as a language to learn; (4) its role as a gateway to global growth; and (5) the influence of location on language choice.

The symbolic function of these websites reflects underlying ideologies linked to language preferences. As Landry and Bourhis (1997) noted, this function indicates the importance certain communities assign to specific languages, highlighting their strength and control over sectors like education. The status and prestige associated with particular languages further explain their prevalence.

Three key theories guide this examination of the websites' symbolic functions: Spolsky and Cooper's (1991) three-conditional model for language choice, which incorporates the presumed reader condition and symbolic language condition, and Ivkovic and Lotherington's (2009) insights. Additionally, the status and prestige attributed to specific languages are underscored by Fasold's (2006) concept of language prestige.

The Fast Spread of English

The data in Table 1 shows that all 18 universities (100%) offer English for website navigation, while 16 universities (89%) provide Arabic alongside English. According to Table 3, 56% of the universities use English as their default language, compared to 44% that default to Arabic.

Despite Arabic being the official language of Saudi Arabia, English has become the dominant language on these websites, reflecting its role in disseminating information in the kingdom. This trend mirrors findings by Giannakoulopoulos and colleagues (2020), which noted English's prevalence across various EU websites, including monolingual sites that sometimes use English instead of the national language. Similarly, Nunes-da-Cunha and colleagues (2019) highlighted how institutions strive for global reach through English, which has become the common language in Europe. Additionally, Mongeon and Paul-Hus (2016) found that English is the most-used language in academic journals, indicating a preference among non-native authors to publish in English.

Websites' Utilization of English as a Means to Attract Students and Faculty

The emergence of English as the dominant language on university websites prompted the use of Spolsky and Cooper's (1991) three-conditional model to analyze language choice motivations. The first condition, regarding the sign-writer's proficiency, underscores the need for accurate information dissemination. While many websites underwent proofreading, some errors in spelling, grammar, and punctuation were evident, indicating varying proficiency levels. For instance, typographical errors included misspellings like "univeristy" and unnecessary capitalization in titles.

The second condition, the presumed reader condition, focuses on the language users are expected to understand. All websites offered both Arabic and English, targeting local and international audiences. English is employed to appeal to a broader audience, as noted in Giannakoulopoulos and colleagues (2020). Universities using English as the default language also aim to attract international collaborations.

The third condition, the symbolic value condition, connects to Ivkovic and Lotherington's symbolic function. Websites were categorized into three types: (1) English-only, (2) English

as the default language with Arabic options, and (3) Arabic as the default with English options. King Fahd University and Prince Mohammad bin Fahd University exemplify English-only sites, indicating a preference for a global audience. Most universities used English as the default, reflecting a desire for international recognition, while Arabic-default sites aimed to attract Arabic-speaking visitors.

The prioritization of Arabic underscores its cultural significance, especially given Saudi Arabia's status as a center for Islamic teachings. Initiatives to promote Arabic in education and business further reinforce its importance. While some universities provide English options, key content often remains in Arabic, indicating a focus on local Arabic-speaking populations. Overall, these findings reflect a balance between global aspirations and local cultural identity.

English as an Important Language to Learn

The dominance of English on university websites aligns with findings from various studies (Kelly-Holmes & Pietikainen, 2013; Ivkovic & Lotherington, 2009; Berezkina, 2018; Koskinen, 2013) that highlight English as a lingua franca and the most utilized language online. In Saudi Arabia, where English is the official foreign language, its strong presence on university websites, alongside Arabic, reflects its significance. This mirrors Huhtala and colleagues (2021), who noted English as a neutral choice online, and Lee (2016), who emphasized its prevalence on social media, even among those with lower proficiency.

These findings support earlier claims by Burchfield (1985) and Coupland and Bishop (2007) about the international prestige of English, which can lead to feelings of deprivation for those who do not speak it.

To further validate these conclusions, Fasold's (2006) concept of language prestige illustrates how academic communities assign value to languages. Analysis shows that 10 out of 18 university websites use English as their default language, with 2 using it exclusively. This dominance reflects the high regard for English within the universities and their communities, as evidenced by the order of language presentation on some websites.

The high prestige associated with English indicates its importance as a language to learn, serving as a gateway to scientific knowledge and the propagation of Islamic faith (Elyas & Badawood, 2016). English's status is further reinforced by its inclusion in educational curricula and scholarship programs that promote study in English-speaking countries (Alshahrani, 2016).

English as a Gateway to Global Growth

The findings align with Saudi Arabia's current socio-political and economic context as it seeks to thrive on the global stage. The prestige that academic communities assign to English reflects its importance in the global market, supported by analytical data. Learning English benefits Saudis and enhances the country's economic capacity for global relations (Alrashidi & Phan, 2015). Politically, English aids the Saudi government in expanding its military capabilities (Cordesman, 2002).

This aligns with the economic goals outlined in Vision 2030, as universities recognize the need for linguistic adaptation through international collaborations, faculty diversification, and

partnerships with prestigious institutions. For example, KFUPM has been a pioneer in using English as a medium of instruction (Barnawi & Al-Hawsawi, 2016). Higher education institutions are also focusing on improving students' English proficiency, as it is essential for engaging in international scientific and trade activities, reflecting this in their missions and objectives.

Influence of Location on Language Choice

A significant finding from the analysis reveals a connection between language preference and location. In three of the six provinces—Asir, Qassim, and Madinah—Arabic is prioritized on university websites, reflecting their demographics: 79%, 65%, and 71% Saudi populations, respectively. This suggests that language choice is influenced by the dominant speech communities in these areas. This aligns with Giannakoulopouluos and colleagues (2020), who noted that culture, geography, and population shape language use on websites. Similarly, Hippala and colleagues (2019) and Loikkanen (2020) found that location heavily influences language choices on social media.

However, Sulaiman Al Rajhi University and University of Prince Mugrin differ from this trend; both use English as their default language despite being in Qassim and Madinah. Their choice is driven by collaborations with international entities, which enhance the credibility of their academic programs.

Language Policy and Language Situation in the Kingdom As Reflected by the Virtual Linguistic Landscape of the Websites

The analysis reveals a strong connection between language preference and location, highlighting three key points about bilingualism in Saudi Arabia: (1) alignment of virtual linguistic landscape (VLL) with local languages (LL), (2) emphasis on English, and (3) bilingualism in cyberspace, with English serving as a lingua franca for minor linguistic groups.

Bilingualism is evident, as 15 out of 18 university websites offer both Arabic and English. Despite English being the dominant language, some universities in Saudi-majority areas still use Arabic as their default. This finding supports prior studies (Blum, 2014; Alhaider, 2018; Alfaifi, 2015) that consider Saudi Arabia bilingual based on linguistic landscape analyses.

The prevalence of English on university websites reflects its growing significance in the kingdom, especially for communication with the increasing foreign population (Al-Tamimi, 2019). The government recognizes the need for English in science and technology and aligns its language policies with global economic integration.

Although Arabic remains the official language, the dominance of English on these websites challenges previous claims of a heavily multilingual virtual landscape (Almoaily, 2019; Ivkovic & Lotherington, 2009), as only Arabic and English are primarily used. Notably, this trend underscores the limited recognition of other foreign languages, emphasizing English as a common ground for non-Arabic speakers. This aligns with Kelly-Holmes and Pietikainen (2013), who noted that English is often used to address diverse audiences.

The current language situation reflects the country’s language policy, where both English and Arabic are officially recognized. English holds a prominent role, supported by historical

policies to teach English as a foreign language (Al Haider, 2018). The shift towards English in education and the economy illustrates the government's efforts to modernize and adapt to globalization (Barnawi & Al-Hawsawi, 2016; Al-Tamimi, 2019).

The focus on English also arises from socio-political motivations, as language policy evolves alongside trade and modernization efforts. The emphasis on English, especially post-9/11, reflects a desire to foster cultural acceptance and promote a peaceful image of Islam (Barnawi & Al-Hawsawi, 2016; Payne & Mansour, 2013). The Ministry of Education's policies aim to prepare students to engage globally while maintaining cultural integrity (Elyas & Badawood, 2016).

Conclusion

The study examined the virtual linguistic landscape of higher education institutions in Saudi Arabia to analyze the government's language policy as reflected on their websites. A sample of 18 university websites from the most populated provinces was analyzed using the informational and symbolic functions (Ivkovic & Lotherington, 2009; Landry & Bourhis, 1997).

The analysis revealed that 15 out of 18 universities offered bilingual options in English and Arabic, reflecting the speech communities in their regions. However, minor linguistic communities of migrants and foreigners were largely unrecognized on these websites, indicating a lack of inclusivity. English was primarily used to present important information to foreign users, while Arabic dominated in areas with a higher Saudi population.

The study also highlighted that the dominance of English as the default language was a strategic choice to cater to international audiences, aligning with the kingdom's efforts to globalize its education system. The use of English signifies its prestige and importance for information dissemination, especially in academic contexts.

Applying Spolsky and Cooper's (1991) three-condition model, the study found some websites contained language errors, impacting the sign-writer's skill condition. The presumed reader condition underscored that universities in mixed-population areas targeted foreigners, while those in Saudi-dominant areas focused on local Arabic speakers.

Furthermore, the websites' preference for English reflects a broader trend towards embracing globalization, consistent with the kingdom's Vision 2030 initiative aimed at attracting foreign investment and talent. Partnerships and collaborations with internationally recognized universities were crucial factors influencing the language choice, enabling these institutions to leverage global academic standards and enhance their credibility. Additionally, the analysis pointed to a growing recognition of the role of English in scientific and technological fields, illustrating how language policy is shaped by economic and educational imperatives. This shift not only aims to improve the proficiency of Saudi students but also positions the kingdom as an emerging hub for international education and commerce. Overall, the findings underscore the complex interplay between language use, cultural identity, and globalization in Saudi Arabia's academic landscape.

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Contact email: nadinel@interlink.edu

Promoting Workplace Comprehension Through Situated Interactive Simulation of Recruitment Mobile Game

Pei-Ching Ngu, National Taiwan University of Science and Technology, Taiwan
Mei-Chiung Fu, Sijhih Cathay General Hospital, Taiwan
Chih-Chung Chien, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
"Recruitment" is an important key and strategic tool for businesses to gain competitive capital and advantages. Businesses should disclose more accurate information about internal conditions and real job previews in recruitment activities to help job applicants understand the work environment and make the right decision to seek employment. This study used the *thinglink* digital platform to design an educational game that simulates the working environment of a hospital nursing station. The learning objectives of the game are: Players take on the role of a new nurse who is soon to enter the workplace, and visit the wards of a hospital for a workplace visit. The game utilizes *Google Forms'* highly interactive situated questions and answers to allow the player to explore the salary and benefits as well as the realistic work environment. The study involved 22 nursing students over 18 years of age in Taiwan, and the results showed that the learners' mean scores on flow, game elements, and game feedback were significantly higher than the median (i.e., 3) on the five-point Likert scale, and activity anxiety scores were lower than 3. In addition, the qualitative feedback indicated that the recruitment through situated interactive simulation games is vivid and interesting, and it gives the player a feeling of being in the real world and a more comprehensive understanding of the workplace environment. The information obtained from the interactive feedback can enhance the player's memory of important information, especially salary bonuses, annual leave, etc., which allows the player to consider in-depth the willingness to enter the hospital. Compared with the traditional campus recruitment, it can help the applicants to understand the hospital's salary and benefit information. Therefore, the results of this study suggest that the "recruiting game" through the situated interactive simulation mechanism is more effective in enhancing the applicants' comprehension of the salary and benefits and the working environment.

Keywords: Situated Simulation, Situated Learning, Digital Games, Workplace Competency Training, Workplace Comprehension

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Introduction

Recruitment is a pain point for many organizations, business leaders, and human resource professionals, and a critical key to competitive capital and advantage (Morgan, 2023). According to The Resilience Revolution: PwC's Global Crisis and Resilience Survey 2023, which explored the results of 1,812 business leaders around the world, the impact events they are most worried about in the next two years include employee retention and recruitment difficulties, according to Taiwan Union of Nurses Association (TUNA) statistics show that the number of first-time registered nurse practitioners has been declining year after year, and the percentage of those actually practicing in hospitals has hit a nine-year low, indicating that attracting talent is particularly difficult as new generations enter the workforce and job seekers' values about work and organizations evolve (Kalleberg & Marsden, 2019).

In the past, nursing careers were mostly recruited through campus recruiting or hospital websites, and traditional oral, graphic, or video presentations were used to introduce the hospital's working environment and benefits and salaries (Morgan, 2023). Such a lack of interactive presentation fails to present the hospital's internal strengths and characteristics.

When applicants are unable to fully understand the actual working environment of the hospital, they are prone to have high and unrealistic expectations, which may result in the recruitment of talents that do not meet the needs of the organization, which in turn increases the turnover rate (Baur et al., 2014) and affects the team's stability and work efficiency. However, Realistic job previews (RJP), which refers to the provision of a preview of what the job will really be like during the recruitment process, can have a significant impact on improving job retention, reducing turnover, and increasing job satisfaction (Morgan, 2023).

When companies are willing to provide more real information about the organization and the job during the recruiting process, especially important information that is difficult for applicants to access during the job search process (e.g., salary and benefits), it is more likely to help them make more informed job search decisions (Connelly et al., 2011).

Morgan (2023) states that real job previews can include digital interactive simulations of work situations, allowing applicants to take part in an immersive gaming experience prior to an interview is considered to be one of the most effective predictive tools in the recruitment process, and that all learning processes involve 'role-playing', therefore gamification mechanisms demonstrate how participants can be invested in new identities or roles, and that this engagement can be a powerful motivation to promote classroom and workplace deeper learning (Gee, 2003), whilst triggering a sense of engagement, motivation and achievement (Hassan et al., 2021), as well as reducing learning anxiety (Coffland & Huff, 2022).

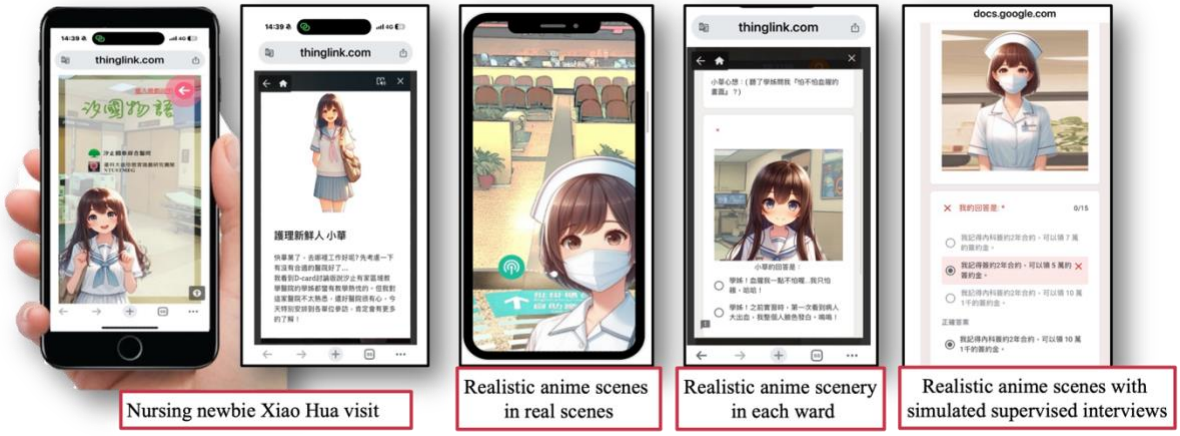


Figure 1: Combination of *Thinglink's* Simulated Situation and *Google Forms'* Highly Interactive Simulation for Role-Playing to Enhance the Understanding of the Workplace

This study utilized the *Thinglink* digital platform to design "The Hospital Story", a contextual educational game that simulates the working environment of a hospital nursing station as shown in Fig. 1. The learning objective of the game is to allow the player to take on the role of a new nursing recruit and conduct environmental visits to hospital wards such as the emergency room, the operating room, the intensive care unit (ICU), the gynaecology and Paediatrics Ward, the medical Ward, and the surgical ward, as shown in Fig. 2. Through the highly interactive simulation provided by *Google Forms*, the player was asked questions to strengthen the memory of important information that the player had explored, such as benefits, vacations, further education, and accommodation costs, as shown in Figure 3, and finally, through the game's "Supervisory Interviews", the player was able to confirm his/her willingness to join the company and his/her level of understanding of the information, so that he/she could understand the work environment more closely with the real situation.

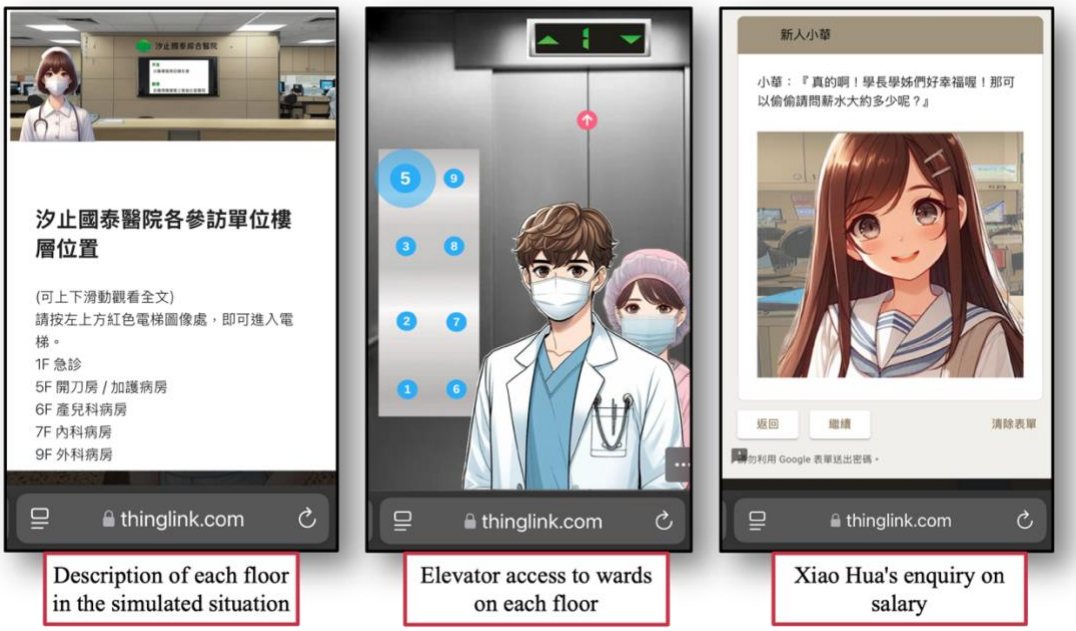
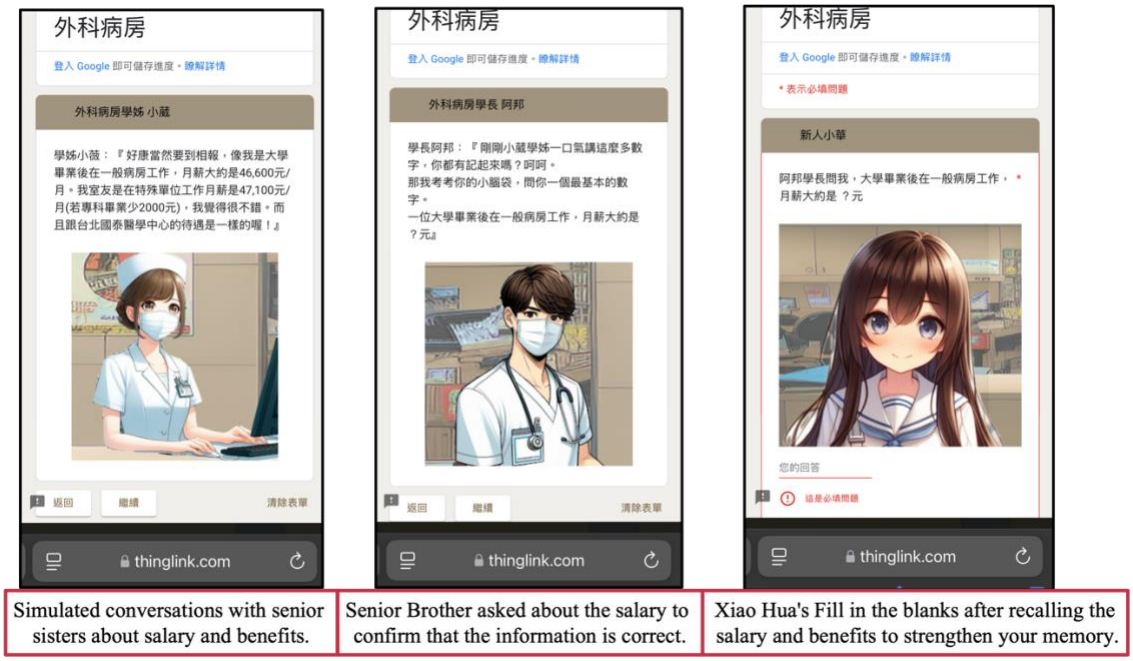


Figure 2: Highly Interactive Simulated Scene Through *Thinglink* and *Google Forms*



Simulated conversations with senior sisters about salary and benefits.	Senior Brother asked about the salary to confirm that the information is correct.	Xiao Hua's Fill in the blanks after recalling the salary and benefits to strengthen your memory.

Figure 3: Simulation of a Highly Interactive and Realistic Salary Question and Answer Mechanism Through *Thinglink* and *Google Forms*

Methods

This study is a pilot research study, the participants were 22 nursing students over the age of 18 in Taiwan, the way of conducting was 5 minutes of introduction of the game platform and rules, 20 minutes of game time, and 10 minutes of questionnaire survey, this study investigated the flows experiences scale, the activity anxiety scale, the game feedback (perceived usefulness, perceived ease of use), and the game elements. The other part of the questionnaire consisted of 4 semi-structured questions focusing on whether the game mechanism of this study could enhance the learners' understanding of the hospital's welfare policies and increase their understanding of the hospital's working environment.

Results and Discussions

According to the single-sample Wilcoxon Singed-Rank analyses as in Table 1, on the flow experience scale, overall flow (M=4.45, SD=0.46), flow antecedents (M=4.53, SD=0.45), and flow experience (M=4.38, SD=0.53) participants all scored significantly above the median (ie.3). Mean activity anxiety (M=1.93, SD=0.98) scores on the activity anxiety scale were all below the median (i.e., 3). Table 2 scores for participants in game feedback (M=4.49, SD=0.40), game usefulness (M=4.57, SD=0.50), game ease of use (M=4.39, SD=0.35), game elements (M=4.39, SD=0.57), and sense of achievement (M=4.45, SD=0.67) were all significantly higher than the median (ie.3). Through the qualitative analysis, the participants indicated that the game was simple to play, the interactive question-and-answer format could deepen their memory and understanding of the content, it gave them a sense of being in the real world, they could understand the working environment of each department before entering the workplace, they had to memorize the content of the questions and answers, and they could think about their willingness to work in the hospital more deeply.

Table 1: The Mean and Standard Deviation of Learners' Flow and Learning Anxiety (*N*=22)

	M	*SD*	*Z*	*Sig.*
Overall Flow	4.45	0.46	4.11***	0.000
Flow antecedents	4.53	0.45	4.12***	0.000
Flow experience	4.38	0.53	4.11***	0.000
Learning anxiety	1.93	0.98	-3.58***	0.000

***p <0.001

Table 2: The Mean and Standard Deviation of Learners' Game Feedback and Game Elements (*N*=22)

	M	*SD*	*Z*	*Sig.*
Game Feedback	4.49	0.40	4.16***	0.000
Game Usefulness	4.57	0.50	4.18***	0.000
Game Ease of Use	4.39	0.35	4.23***	0.000
Game elements	4.39	0.57	4.13***	0.000
Accomplishment	4.45	0.67	4.05***	0.000

***p <0.001

Conclusions and Limitations

This study developed a digital contextual role-playing educational game, "The Hospital Story", to enhance the understanding of the work environment. Through the personalized game process, it can effectively enhance the player's engagement, participation, and sense of achievement, and there is not too much anxiety about the activity, and the player also feels that the operation is simple and immersive, which is suitable for mastering the work environment before joining the company to increase the understanding of the work environment. Morgan (2023) pointed out that the immersive game experience that applicants participate in before the interview can be used as one of the tools to predict retention in the recruitment process, so it is suggested that the future research design can be added to the experimental group and the control group, to explore the effectiveness of the recruitment process in depth, and also can be added to the interactive scaffolding of the GenAI in order to increase the interactivity and fidelity of the game situation.

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Contact email: hthou@mail.ntust.edu.tw

Development of Print Media for Learning Motivation Using Creative Designs in Printing, Decorating, and Book Making

Tanapon Tangpanyavareekul, King Mongkut's University of Technology Thonburi, Thailand
Suchapa Netpradit, King Mongkut's University of Technology Thonburi, Thailand
Wannarat Wirachkul, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
The print media are currently focused on impressive design, creative graphic, and special production techniques to stand out among electronic media. The objective of this study was to create a motivated book sample to promote print media for learning enhancement by using creative design of printing, decorating, and book making. The graphic arts were designed to choose by learners in 3 themes: carnival, underwater, retro through online questionnaires, and the carnival theme was the most interesting. The mock-up of hard cover book sized of 10.63 x 12.28 inches was made by using 350-g art card paper for cover and 260-g art card paper for text with 10 die-cutting pages. The colorful graphic arts were printed on the paper with a wide color gamut of 7-color digital press. The die-cutting pages and pop-up 3D paper art was made using a digital cutter. The content in a book was included of printing systems, printing materials, product samples, special techniques of printing, production process and coating methods. The qualities of the book were evaluated by 3 experts in a printing house. The satisfactions were evaluated by the learners, staffs in the printing house and consumer samples using online questionnaire of 5-level rating scale. The qualities of content, illustration, character, and composition were very good level. The satisfaction regarding to the effectiveness, motivation and book format was very high level. Therefore, the print media using various creative designs could be applied for learning motivation and at the same time promotion of print media production.

Keywords: Print Media, Learning, Design, Book

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Introduction

Advances in technology and digital media are playing an increasingly important role today. To stand out among electronic media, the print media must be improved by focusing on impressive design, creative graphics, and special techniques. To promote print media and provide graduates with practical skills and knowledge about printing technology. Four-year undergraduate programs focusing on printing techniques, materials, and processes, including hands-on experience through projects and practical sessions have been developed at many educational institutions.

There are several techniques to make and decorate the books in the post-press which is the final stage of the printing process which turns the printed materials into printed products such as coating, lamination, die-cutting, folding, binding, trimming, etc. The die-cutting is a technique giving your book a completely unique look and makes it stand out from any other product. The process is used to cut shapes out of the material rather than straight trimming. Die cutting is often used for art books allowing the reader to interested in the decorative designs, bullet holes, and many shape edges. The coating or lamination significantly improved color accuracy and increased contrast, making the printed material more visually appealing, enhance the print quality and the durability. There are two primary types of coatings frequently used in the industry; matte and glossy, each offering distinct advantages based on the desired visual effect and functionality.

Many instructors are looking for ways to get their students hands-on in the post-press course and excited to attend the practice class. As an educational developer and a teacher assistant for undergraduate students at the department of Printing and Packaging Technology, King Mongkut's University of Technology Thonburi (KMUTT), the real example of print media was made to enhance learning and understanding of book making with various decoration techniques. The objectives of study were to design and produce a motivated book sample to promote print media for learning enhancement by using creative design of printing and decorating, to evaluate the qualities of print media by experts, and to assess the satisfaction of instructors and learners sample group. This teaching technique not only helps the students to have more skills, experience, and inspiration for print media production and value adding, but also fostering their self-learning in printing technology.

Methodology

The requirement of instructors for suitable methods of book as a print media production were surveyed using the questionnaire with a Google Form. The Adobe Illustrator was used for graphic design and the Adobe Acrobat Pro was used for book layout and imposition. The appropriate graphic design was selected through three team as follows:

Theme 1: Underwater that is cool tone blue
Theme 2: Carnival that is warm tone red color
Theme 3: Retro that is grey color

The structure and format of book mockup) was created on the real blank paper and the die-cut work with a digital cutting machine was tested for approval. After decision, the PDF file of graphics designed by the Adobe Acrobat Pro was sent to print with the Hp Indigo 12000 Digital Press which can create special hi-fi color printing with 7-color printing: Cyan, Magenta, Yellow, Black, Orange, Violet, and Green for eye-catching. The printed sheet was then laminated with the gloss and matte film before making the die-cut edges with innovative

shape design using ZUND G3 L2500 machine. The book was assembled into a butterfly-style binding with glue spray to make a special book.

The qualities in the format structure and graphics of the book were evaluated by three experts in printing technology. The satisfaction assessment was performed by five instructors and a sample group of thirty persons including graduated students, alumni, and others involved in printing through an online questionnaire of Google Form with 5-point scale, as shown in Table 1.

Table 1: The Criteria of 5-Point Rating Scale for Evaluation

Scale	Scale Interval	Opinion for Quality	Description for Satisfaction
5	4.50-5.00	Excellent	Very Satisfied
4	3.50-4.49	Good	Satisfied
3	2.50-3.49	Average	Neutral
2	1.50-2.49	Poor	Dissatisfied
1	1.00-1.49	Very Poor	Very Dissatisfied

Results and Discussion

After requirement analysis, the mock-up of hard cover book sized of 10.63 x 12.28 inches was then made by using 350-g art card paper for cover and 260-g art card paper for text with 10 die-cutting pages, as shown in Figure 1. The pop-up pages inside the book were made of 260 gsm Silk Card paper. The sticker samples attached in the book were paper and PP material. The graphic images in the book included of 22% drawing, 37% photography, and 41% cartoon. The desired layout format is Step & Repeat and the selected graphic style is Carnival theme with 89% popular voting, as shown in Figure 2.

Figure 2 shows the book cover made from 350 gsm art card paper printed with the design of Carnival theme that is warm tone red color and die-cut window as pocket flap for easy holding. A matte plastic film lamination technique was applied for protection and enhanced durability. The back cover showed a graphic design continuous strip from the front cover.

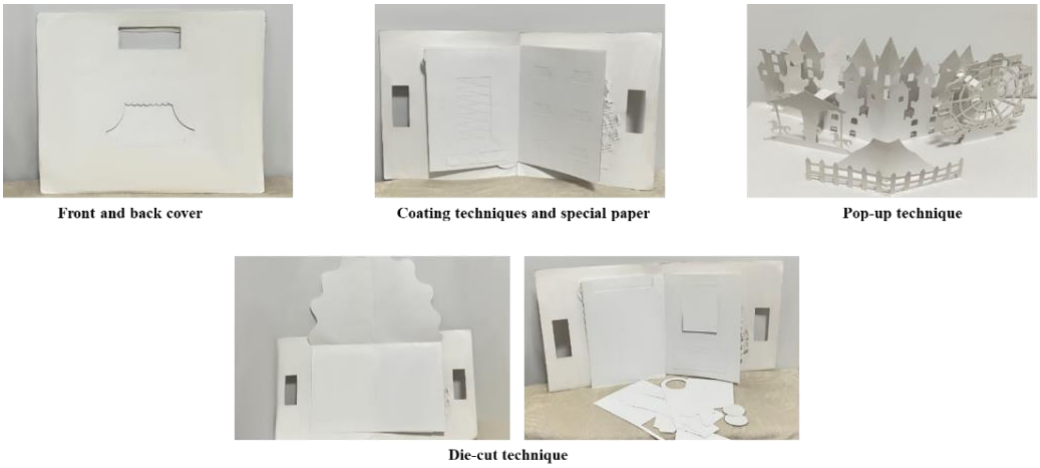

Figure 1: Mockup of Book Creating for Decision Before Real Making

Figure 2: Front and Back Cover of Book

Figure 3: Inside the Book

Figure 3 shows the art card paper of 260 gsm used for book content inside with die-cutting techniques such as window cut, rounded edge cut, or wave-like pattern cut. The book was finished using a butterfly-style binding, making open flat at 180 degrees. The content in book was included of information about printing systems, printing materials, product samples, special techniques of printing, production process, coating methods and plastic film lamination. The book also showed comparison of gloss coating and matte coating. There are various parts to play with or can be slid in and out. The left side of the page includes a business card holder, photo frame, cup sleeve, and door hanger while the right side of the page includes post-it notes size of 3.14 x 4.44 inches and stickers size of 1.96 x 1.96 inches, as shown in Figure 4. There was a pop-up of papercut attached to the book which stand up 90◦ and become 3D when the book was unfolded, as shown in Figure 5.

Figure 4: Examples of Various Techniques

Figure 5: Pop-Up Technique

The 3D Paper Arts are designed in a Carnival theme, consisting of a castle, carousel, swing and fence. Assembling the pop-up design involves applying glue to the die-cut pieces and

attaching them to the base of the book. The qualities of book were assessed by 3 experts in print media relating to content, visual aspect, character side, and components in book.

Table 2: Content Quality Assessment by 3 Experts

Topics for Evaluation	Mean score	S.D.	Level
1. Clarity and conciseness of presented content	4.75	0.50	Excellent
2. Continuity of content used in presentation	4.50	0.58	Excellent
3. Appropriateness of content for target audience	4.50	0.58	Excellent
4. Alignment of content with objectives and matter	4.75	0.50	Excellent
5. Accuracy of content	4.75	0.50	Excellent
Average score	4.5	0.58	Excellent

Table 3: Illustration Quality Assessment by 3 Experts

Topics for Evaluation	Mean score	S.D.	Level
1. Easy for Application	4.5	0.58	Excellent
2. Quality, Beauty and Colors of Illustrations	5	0	Excellent
3. Clarity in Visual Communication	4.75	0.5	Excellent
4. Stimulating Interest	5	0	Excellent
5. Consistency of Illustrations with Content	4.75	0.5	
6. Appropriateness of Illustrations Quantity	4.5	0.5	Excellent
Average score	4.79	0.35	Excellent

Tables 2 and 3 show the average score results of quality assessment in content and in illustrations which were rate as excellent.

Table 4: Satisfaction Assessment by 5 Instructors Due to Efficiency for Teaching/ Learning

Topics for Evaluation	Mean score	S.D.	Level
1. Beauty of Design	4.6	0.89	Very Satisfied
2. Relationship between Illustrations and Content	4.6	0.89	Very Satisfied
3. Clearly Visible of Text	4.4	1.34	Satisfied
4. Easy for Reading	4.4	0.89	Satisfied
5. Motivation of Book Structure	4.6	0.89	Very Satisfied
Average score	4.52	0.98	Very Satisfied

Table 5: Satisfaction Assessment by 5 Instructors Due to Print Media Format

Topics for Evaluation	Mean score	S.D.	Level
1. Portability of Book	4.4	0.89	Satisfied
2. Appreciation in Book	4.6	0.89	Very Satisfied
3. Easily Understand for Learners	4.4	0.89	Satisfied
4. Promote more Learning	4.4	1.34	Satisfied
Average score	4.45	1.0	Satisfied

Tables 4 and 5 show the average score results of satisfaction assessment by 5 instructors in efficiency for teaching/ learning and print media format which were rated as very satisfied and satisfied, respectively.

Table 6: Satisfaction Assessment by 30 Graduating Students, Alumni, and Involved Person in Printing Due to Efficiency for Teaching/ Learning

Topics for Evaluation	Mean score	S.D.	Level
1. Beauty of Design	4.8	0.89	Very Satisfied
2. Relationship between Illustrations and Content	4.7	0.59	Very Satisfied
3. Clearly Visible of Text	4.27	0.69	Satisfied
4. Easy for Reading	4.4	0.67	Satisfied
5. Motivation of Book Structure	4.8	0.55	Very Satisfied
Average score	4.59	0.60	Very Satisfied

Table 7: Satisfaction Assessment by 30 Graduating Students, Alumni, and Involved Person in Printing Due to Print Media Format

Topics for Evaluation	Mean score	S.D.	Level
1. Content in Printing Technique	4.6	0.49	Very Satisfied
2. Information and Knowledge Gaining	4.67	0.6	Very Satisfied
Average score	4.64	0.55	Very Satisfied

Tables 6 and 7 show the average score results of Satisfaction assessment by 30 graduating students, alumni, and involved person in printing in Efficiency for teaching/learning and print media format which were rated as very satisfied.

Conclusion

The quality evaluation of content and illustrations falls into the “Excellent” category. The satisfaction evaluation from instructors regarding usability and the format of the printed media showed rated as “Very Satisfied”. Additionally, the satisfaction evaluation from the sample group, including graduating students, alumni, and individuals involved in printing, regarding usability and the format of the print media, resulted in “Very Satisfied”. The designers have created innovative print media, highlighting materials and special techniques clearly, meeting the requirements of our instructors. The results achieved the intended objectives and serve as an excellent example for learning motivation in print media production with special technique for value added to overcome the electronic media.

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Contact email: tanapon.tan@kmutt.ac.th

PRIMM Model Towards Malaysian Matriculation Students' Motivation in Learning Programming

Tevya Letchumanan, Sarawak Matriculation College, Malaysia

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Abstract
As computer programming becomes one of the most sought-after skills, novice learners, especially Malaysian Matriculation students, struggle to grasp the ideas of computational thinking. The lack of time in the traditional classroom also inhibits constructive communication. These also cause high stress and low self-efficacy in learning programming languages. This research has been guided by constructivism to design a Predict-Run-Investigate-Modify-Make (PRIMM) module that will allow learners to think at a higher-order level via social constructivism theory, engagement theory, and self-determination theory. The literature has strengthened the role of PRIMM in improving the academic performance of students. However, there is a gap in how the PRIMM model improves motivation, engagement, and academic success among pre-university students in the Malaysian context. This research aims to design a PRIMM module by underpinning the constructivism framework, exploring the role of the PRIMM model in mediating learning motivation, authentic engagement, and reducing stress, and validating the module via a focus group. Phenomenological research was carried out to achieve these objectives, and volunteer participants were subjected to focus group interviews. Five major themes emerged from the focus group interview: Motivated, Engaged, Enjoyable, Efficient, and Collaboration. Research findings state that the PRIMM module developed has improved collaboration, learning interest, learning motivation, and authentic engagement and has reduced stress in learning programming languages among beginners. The findings of this research provide a framework for lecturers to redesign the computer science classrooms in Malaysian matriculation colleges via classroom activities that implement problem-solving before formal instructions.

Keywords: PRIMM Model, Novice Programmers, Malaysian Matriculation

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Introduction

Background of Study

Computational thinking skills such as problem-solving, recursive thinking, and programming knowledge are no longer considered skills exclusively required for computer scientists but for professionals from the engineering, economics, and education analytical fields (Apiola et al., 2010; Song et al., 2021). For novice students, however, the introduction to computational thinking, syntaxes, semantics, and overall structure of programming languages are all complex and overwhelming to learn over a short period. Even after learning the theories, students struggle to apply the content they have learned to build a robust program, which often leads to frustrations and a loss of interest and motivation, resulting in a higher drop rate. It is essential to continuously maintain students' motivation, engagement, passion, and joy to ensure that students successfully master programming. Motivation is often associated with learning via self-regulation, metacognition, and persistence. One way to achieve this is via the use of the PRIMM model. The Predict-Run-Investigate-Modify-Make (PRIMM) approach was built based on the Use-Modify-Create (UMC) model, where students read and predict what a program will do before investigating the actual output and finally build their code based on the comprehension from previous steps. Since student-centered learning has been encouraged in educational institutions to improve student accountability, student engagement, and active learning, the PRIMM model can be implemented to meet the demands of the knowledge and skills learners are expected to obtain at the end of each lesson. Specifically, the approach requires students to predict an output based on prior knowledge or logic, allowing students to learn from the success or failure to guess the outputs and providing them more time to engage in the classroom.

Problem Statements

Students face a lack of constructive communication between peers and the instructor (Garvin-Doxas & Barker, 2004). In the conventional classroom, teachers spend a substantial amount of time delivering the subject matter, resulting in less discussion time. The lack of communication results in students being unable to build knowledge to solve problems and failing to get guidance to solve the problems they could potentially have. Consequently, students also tend not to get any support to fix their misconceptions. This goes in line with Bandura's social cognitive theory that emphasises the occurrence of learning in a social context. While the study by Sentance and colleagues (2019a) on the PRIMM model itself has reported that students taught via the PRIMM model have academically performed better than students in the traditional control group, there is a gap in studies on the implication of the PRIMM model amongst Malaysian Matriculation Students via constructive communication that can improve motivation given the 64 hours allocated per semester to teach computer science, specifically Java Programming in Malaysian Matriculation Program.

Another problem that learners face when learning a programming language is the lack of problem-solving skills in computer science (Cheah, 2020). While students can understand the syntax theoretically, they fail to build high-level analytical thinking that can produce effective solutions to a problem causing a lack of motivation to learn programming. Additionally, applying programming knowledge in different contexts has become a struggle because students tend only to have surface knowledge of content-specific programming. Studies on the UMC model, such as those by Martin and colleagues (2020) and Salac and fellows (2020), have indicated the role of the model in improving computational thinking.

However, there is a gap in studies with these two elements overlapping in teaching programming and a gap in the studies on the role of motivation in improving engagement when studying computer programming. There is also a gap in the studies for these elements with the PRIMM model, especially for the Malaysian Matriculation setting.

Learners have also reported stress in learning computer programming due to low self-efficacy (Rahardjo et al., 2013). According to Figueiredo and Garcia-Penalvo Jr (2020) and Amoloza (2015), independently working on programming subjects leads students to a higher cognitive load. This induces stress, which has a detrimental impact on engaging with lessons and, thus, learning programming as a whole. This negatively affects the retention rate and lowers the students' achievement rate. In addition, learners tend to think of computer science tasks and problems as harder than they actually are. This leads to constant self-criticism, and learners stop engaging with the classroom lessons and activities without any motivation to learn. Low self-efficacy also limits the learners' positive attitudes toward learning programming languages and their cognitive skills. Although studies by Piteira and Costa (2013) and Salguero and colleagues (2021) have pointed out the stress and anxiety faced by students when learning programming, there is a lack of research on how the issue can be approached via the learning engagement caused by the PRIMM model.

Research Questions

1. How to design and develop teaching and learning module based on the PRIMM model for Malaysian matriculation computer science students?
2. What is the role of the PRIMM model in mediating learning motivation when learning computer programming?
3. How does learning motivation improve students' authentic engagement when learning Java programming through the PRIMM model?
4. What is the role of the PRIMM model in reducing the stress faced by students when learning computer programming?

Purpose and Objectives

In response to the challenges faced by novices in learning Java programming, the purpose of the study is to examine the implementation of the PRIMM model in improving Malaysian matriculation computer science students' motivation to learn computer programming. The objectives of the research are:

Main Objective: To design and develop teaching and learning module based on the PRIMM model for Malaysian matriculation computer science students by applying the constructivism elements.

Specific Objectives:

1. To explore the role of the PRIMM model in mediating the learning motivation when learning computer programming.
2. To discover the role of motivation in mediating students' authentic engagement when learning computer programming through the PRIMM model.
3. To understand the role of the PRIMM model in reducing the stress faced by students when learning computer programming.

Literature Review

PRIMM Model

The PRIMM model concentrates on having students discuss how and why computer programs operate before the students edit and write their programs Sentance and colleagues (2019b). This method addresses the issue of beginners developing programs before they are yet able to read them. The model primarily draws from three main areas of research, namely, Tracing and read-before-you-write by Lister and colleagues (2009a), Use-Modify-Create by Lee and colleagues (2011), and Levels of Abstraction by Perrenet and colleagues (2005a). PRIMM encourages self-regulation and metacognition while providing students and teachers with a language to discuss the tactics they are employing. According to Sentence (2021), the PRIMM model focuses on the five principles: read code before you write code, work collaboratively to talk about programs, focus on code comprehension, use existing starter programs, and gradually take ownership of programs. The five stages of the PRIMM are explained based on the study by Sentence and Waite (2017), as shown in Figure 1.

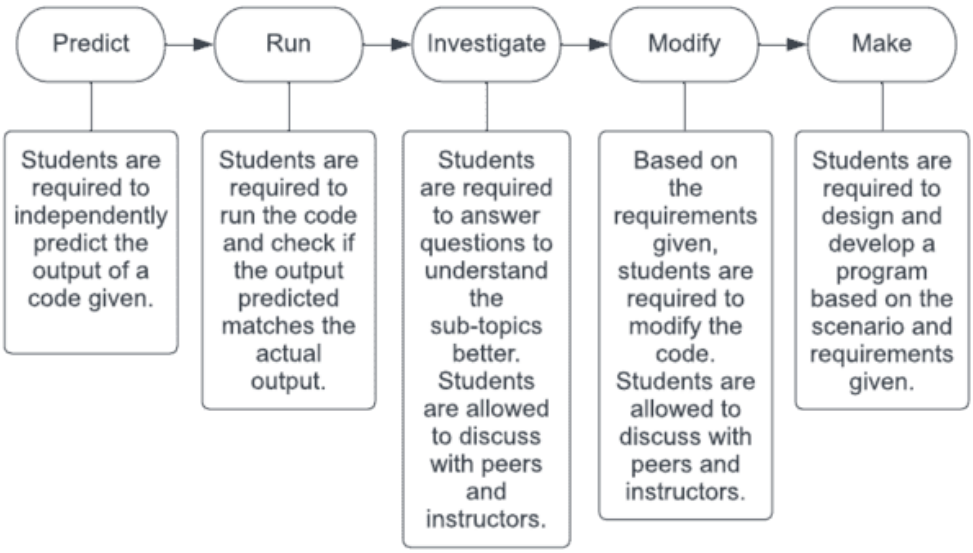

Figure 1: Five Stages of the PRIMM Model

Malaysian Matriculation Programme

The Malaysian Matriculation Programme is a pre-university programme with two and four-semester programs. Learners who have completed Sijil Pelajaran Malaysia (SPM) and are not over 20 years old are eligible to apply for the programme has met the grade requirements. Upon completing the program, learners pursue their degree within local public universities, private educational institutions, or international institutions. Science and accounting streams are available within the two-semester system (SDS), and the four-semester system (SES) offers science, accounting, and engineering streams. The Science stream offers modules for Life Science, Physical Science, and Computer Science. The computer science subject is taught as part of the Physical Science and Computer Science modules. After the first two semesters, the SES students will follow the exact curriculum specifications drafted for SDS. The Curriculum Specification (CS) for the SDS semester 2 Computer Science (SC025) used in this research is attached in Appendix A.

Learning Motivation

Learning motivation acts as the driving force for students to achieve learning goals and to strengthen and improve knowledge acquisition Shabani (2016). It is an essential predictor of the learning success rate (Schnotz et al., 2009). At the initial and bottleneck stages of learning, extrinsic motivation yields better results until learning becomes autonomous, after which students gain fun and a sense of achievement via intrinsic motivation (Lin et al., 2017).

Motivation on the students' side is crucial for successful cumulative learning due to the importance of persistence when learning new concepts. Learning motivation in a classroom implementing the PRIMM model reflects students' engagement and contribution during all five stages of the model. To ensure the effectiveness of the PRIMM model, students are expected to be actively engaged in all class activities, and for this, students must be motivated to participate first. Despite intrinsic motivation being stated to be superior, most human endeavours cannot be intrinsically motivated after childhood because the ability to be intrinsically driven is curtailed by societal expectations. Therefore, in this study, intrinsic and extrinsic motivation are both explored to measure the dimensions of learning motivation in a programming classroom taught using the PRIMM model.

Learning Engagement

Student learning engagement is the involvement of students in their studies and the persistence that the students must have to accomplish desired goals (Saeed & Zyngier, 2012). Students are said to be engaged when they are involved, committed, and attentive in classroom activities despite the obstacles faced in completing the tasks. Motivation and academic engagement are reciprocal, as motivation may affect students' engagement in academic tasks (Singh et al., 2002; Z. Wu, 2019). The levels of engagement are examined based on the five dimensions: authentic, engagement, passive compliance and rebellion (Digamon & Cinches, 2017). In authentic engagement, students have a high level of curiosity and personal significance in their work and do not back down from a difficulty. Saeed and Zyngier (2012) propose an analysis of the type of motivation that has a stronger association with authentic student engagement since students' intrinsic motivation showed authentic engagement while students with extrinsic motivation only showed ritual engagement that may not fully assist learning. As such, this study focuses on the role of intrinsic and extrinsic motivation in mediating the students' authentic engagement when the PRIMM model is implemented in the classroom to teach programming.

Stress in Learning

Stress is when an individual finds a circumstance or challenge that surpasses their ability to solve it (Lindau et al., 2016). As such, the interpretation of the stress level is subjective for each student based on their cognitive capacity. The perception of stress in learning is not solely dependent on the volume of learning tasks but can also be influenced by the nature of the learning expected (Rudland et al., 2020). Challenges can manifest in various forms, including grappling with complex subject matter, mastering a particular skill, or deciphering critical information from intricate patient histories. Both learners and educators have the potential to shape the intensity and nature of the stressors encountered, although often, it is the educator who determines these factors, in addition to the characteristics of the learning environment. The study by Von Hausswolff and colleagues (2020a) states that the decrease in stress associated with hands-on learning could explain the small positive effect on the test

after one week. The connection between cognition and bodily feeling is highlighted, suggesting that emotions play a role in understanding and meaning-making. Therefore, managing students' stress levels is crucial to maximise learning motivation and information retention.

Guided Theory

The study is guided by three theories namely, self-determination theory, engagement theory, and social constructivism theory. These theories are used to support the study in identifying the role of the PRIMM model in improving learning motivation programming skills and reducing stress. Figure 2 shows the incorporation of the theories into developing the PRIMM module.

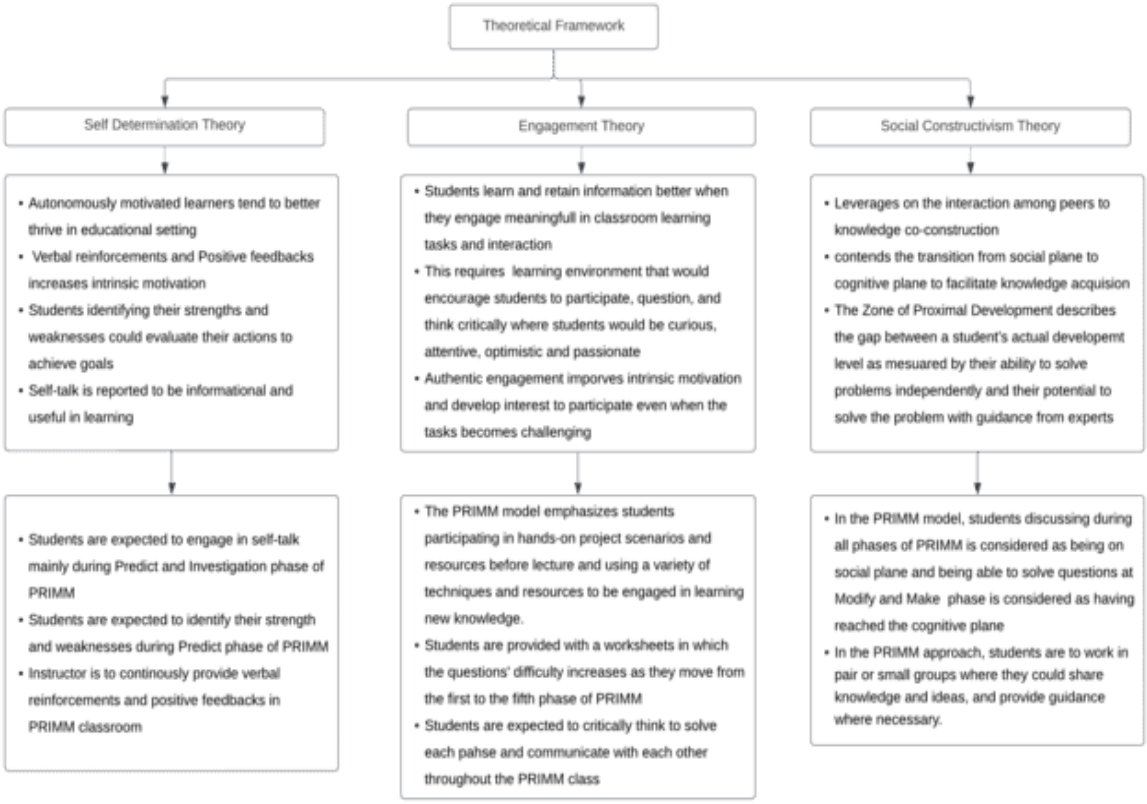

Figure 2: The Guided Theories in Developing the PRIMM Module

Method

Research Design

A phenomenological research design was used as part of the qualitative research approach. The phenomenological design investigates an individual's lived experiences while barring the researcher's preconceived assumptions regarding the topic. In this research, the phenomenological design has been utilised to elicit the lived experience of novice learners who have experienced the PRIMM model to learn computer science. The selection of a phenomenological design enables an in-depth exploration of learners' motivation in learning computer science via the PRIMM model as well as the best techniques of the PRIMM model encountered in the implementation process. Designing a PRIMM module that is best suited for novice learners learning Java programming is also important.

The syllabus of the Matriculation computer science program is divided into four chapters. In the first chapter, Introduction to Programming, students learn about the programming language paradigm and the translator programs. In chapter two, Approach in Problem-Solving, students are taught the five problem-solving steps. In the third and fourth chapters, students learn about the identifiers, variables, constants, expressions, control structures, arrays, and methods of Java Programming Language.

The PRIMM model will be used to teach Chapter Three: Design a Solution involving the introduction to control structures and Chapter Four: Java Language, which includes sub-topics on data types, variables, constants, two-dimensional arrays, and methods. For each subtopic, students must complete a worksheet attached to the Google Classroom. Together, these six worksheets are to form an efficient module to teach SC025 in the Malaysian matriculation program. A total of 10 hours would be spent on each subtopic. While students complete the worksheets, the instructor provides explanations, scaffolding, and guidance toward a better understanding the topic. Verbal reinforcements via positive feedback would be given throughout the classes to leverage self-determination theory. As the students move towards the Modify and Make sections of the worksheets, guidance will be gradually withheld so that students can apply what they have learned. Students are expected to be intrinsically motivated to solve these questions. In each worksheet, five questions are set, each representing a phase of the PRIMM model. Six worksheets have been prepared to cover nine sub-topics. Table 1 in Appendix B shows the worksheet, the subtopics covered in the worksheets, and the learning objectives for each worksheet. The complete module, which consists of Worksheet 1 to Worksheet 6, is attached in Appendix C.

Sample and Sampling Method

The learners are all to be from the science stream, computer science subject in Sarawak Matriculation College to ensure all the participants have experienced the PRIMM classroom directly via the researcher. The context is Computer Science learners in the class for whom it is their first time learning programming for public examination. In this study, 24 learners who were registered in the computer science subject will be recruited. The learners were taught using (Bybee, 2009) 5E instructional model for the first two chapters and the newly developed PRIMM module for chapters three and four. A non-probability sampling was used because the study was qualitative. A purposeful sampling method was used to select study groups. In this context, criterion sampling has been used. In selecting the participants, criteria such as being voluntary, having not studied any programming language for exam purposes prior to entering the Matriculation program, and having attended at least 90% of the classes throughout the semester were sought. Plummer-D'Amato (2013) states that using four to five focus groups is adequate. As such, four focus groups were formed for this study. Six participants were recruited into each focus group to be interviewed for a maximum of 60 minutes as suggested by Giibs (1997). To bar any gender bias and to ensure comfortable focus group interviews, each group was formed to have three male and three female students.

Data Collection Procedures

The data collection process for this study is done after students have been introduced to the complete module via focus group interviews. The data was collected from the participants who have learned Java programming language via the PRIMM module over 16 weeks. Figure 3 shows the flow and timeline of module development and data collection.

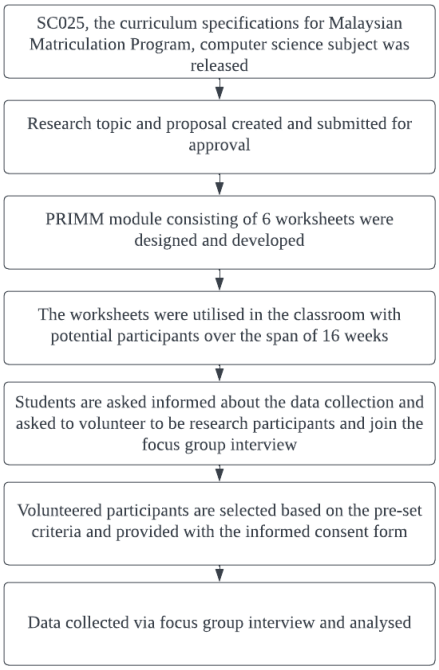

Figure 3: Flow and Timeline of Module Development and Data Collection

Focus group interviews were conducted with the learners to analyse the design of the learning module based on PRIMM and the effectiveness of the new PRIMM module. The focus group interviews have been used to discuss different perspectives on the PRIMM module approach within a limited duration. Based on the study conducted by Fern (1982), Plummer-D'Amato (2013), and Rabiee (2004), the participants were grouped into three groups of six for focus group interviews with a maximum time duration of 60 minutes so that enough input could be derived from the discussion without exhausting the participants. Each interview was conducted online, using Google Meet. The interview was recorded with the participant's permission and stored in Google Drive with a password.

According to Bevan (2014), phenomenological interviewing should focus on collecting data to examine participants' lived experiences. Therefore, in-depth information concerning participants' experiences must be gathered via open questions. The interview protocol for this study starts with asking participants to describe the PRIMM classroom they participated in in detail. Based on the participants' answers, they were questioned on the techniques used to complete the PRIMM worksheets and how they helped them. To answer the research questions, participants were questioned on how the newly developed PRIMM module has helped them to improve communication, learning motivation, and engagement. The interview protocol for the focus group interview with learners is attached in Appendix D.

Data Analysis Procedures

Each focus group interview was immediately transcribed with behavior annotations and phonetic transcription of dialects and filler words. The interview transcription is attached in Appendix E. The transcriptions include annotations for behavior to assist in analysing learners' emotions concerning learners' motivation state as a result of participating in the PRIMM module. Phonetic transcription of dialects and filler words is included since the

research population comprises learners from Sarawak Matriculation College who mixed the local dialect during the focus group interview.

The focus group interviews were analyzed using thematic analysis as this provided flexibility and a comprehensive explanation of data. Thematic analysis was useful when looking for subjective information about learners' experiences and views of the PRIMM model and the newly developed module. Themes were identified using inductive coding to free the research from the researcher's theoretical interest. The researcher then grouped the recurring topics during the data collection and grouped the codes into themes to summarize the data sections in a useful way to achieve research objectives. Next, the researcher looked for common codes to form themes relevant to the research questions, reviewed the selected themes, and then finalized the themes. These steps must be done sequentially to ensure the data are relevant to answer the research questions.

Qualitative data coding is used to create and assign codes to categorize data extracts. The codes are then used to derive themes and patterns for thematic analysis. At this stage, similar data types were labeled and grouped to generate themes and ensure that data analysis was manageable. Inductive coding was used for this research. As such, the researcher developed the codes based on what was found in the data. Inductive coding has been used since the data collection involves interviews, and the direction of the conversation has yet to be known. Inductive coding was also selected for this research since there exists a big gap in research on the PRIMM classroom among pre-university computer science learners.

In the first stage, broad codes were derived from the interview, and structural coding was used to describe the data in a condensed manner. The data is then coded based on the interview transcription so that data can be structured into smaller pieces for further analysis. The researcher then coded line-by-line to add details to the codes. The researcher used the major themes and subthemes for the data to be synthesized. The researcher went through all the transcripts and the codes to conduct quality appraisals and analyze the data and its quality to ensure the accuracy of data for each code.

A total of 24 students participated in four focus group interviews whereby 50% of the participants were male and the other female. In this paper, participants were identified by group number and random participant number within that group, and participants' quotations are indicated in italics. Quotations in languages other than English have been typed in red font and a translation has been provided in parentheses.

Discussion

The complete version of the themes, subthemes, and participant quotes are attached in Appendix F.

The main idea of collaboration that the PRIMM module has allowed is the ability to discuss not only each other's answers but also each other's ideas. Participants pointed out that they could see multiple algorithms for the same question and test each one to find the most optimal solution. Discussions were sometimes also made with the instructor for further understanding. It has also allowed students to study the problem as a group and deduce ideas about each subtopic. Therefore, when completing the worksheets, students learn about the concepts with similar-minded peers. In this situation, students learn and teach their peers,

which, according to the participants, has helped them to remember the concepts better. The findings in accordance with the research questions are discussed in the paragraphs below.

Research Question 1: How to design and develop a teaching and learning module based on the PRIMM model for Malaysian matriculation computer science students?

To address the main objective of the research and the first research question, the design of a PRIMM module to teach programming in the Malaysian Matriculation Program is best when it has scope for students to practice coding in the classroom with peer communication and collaboration as well as a step-by-step increase in terms of difficulty with a relationship between the worksheets such that each worksheet can be used as a reference. The findings also suggest that each worksheet can have more than one question for each phase of PRIMM to allow better exposure. The findings regarding the provision of the module's answer scheme have contradicted. Some participants have found that not having an answer scheme is more motivating since they do not have to focus on getting the exact-worded, correct answers. However, participants have also stated that having an answer scheme would further increase the probability of using the module as revision material. A study by Sinta and colleagues (2019) on students' improvement in learning grammar via Quizziz has found that releasing the answer key to the students improved their ability to identify their strengths and weaknesses, improving their learning. Therefore, it is suggested that an answer scheme is prepared and given to students after the worksheet in the module has been completed.

Research Question 2: What is the role of the PRIMM model in mediating learning motivation when learning computer programming?

This PRIMM model has developed intrinsic motivation amongst the students, where students tend to continue doing the worksheets despite getting the answers wrong in the first round to achieve personal satisfaction. Theories and applications of intrinsic motivation are connected to fostering respectful exchanges and facilitating profound learning. This is partly attributed to individuals channelling their efforts into activities that naturally provide a sense of fulfilment (Ginsberg & Wlodkowski, 2019). The module has also extrinsically motivated students via healthy competition. It has been found that students are motivated to learn and complete the module after seeing their peers complete it. Participants stated that seeing their peers understand the concept and solve the questions encouraged them to continue to learn even when they had gotten the prediction wrong or struggled to solve the questions in the previous worksheets. On the other hand, once they start getting better at solving the questions, the feeling of satisfaction eventually improves learning interest. The module also reassures students that with practice, they will be able to master the content.

Research Question 3: How does learning motivation improve students' authentic engagement when learning Java programming through the PRIMM model?

Learning motivation has been a stepping stone in improving authentic engagement in PRIMM classrooms, consistent with the literature review. The direct impacts of intrinsic or extrinsic motivation on academic performance have been evident through learning engagement (H. Wu et al., 2020). The PRIMM module developed has fostered authentic engagement through high-level curiosity, personal significance, and determination. The engagement was also observed when students actively discussed the questions and answers with each other. All participants stated and agreed that the motivation they developed to complete the module to get the satisfaction of completing it kept them engaged in the

classroom. It has also been found that students have also run the code from Question multiple times after checking their prediction in an attempt to understand the concepts better before attempting Question 3.

Research Question 4: What is the role of the PRIMM model in improving Java programming skills among Malaysian matriculation computer science students?

It has been found that solving all questions correctly without the instructor's intervention during the first worksheet was nearly impossible for all participants. However, participants were able to solve the worksheets, especially Question 5, on either the first attempt or after a short discussion with their peers. This assures that continuous hands-on practice is a form of higher cognitive work as supported by Zainuddin and Halili (2016) which has improved the matriculation students' Java programming skills. The study also found that the PRIMM module paved the way for understanding programming language concepts by doing the programming itself. Understanding the concepts and the curiosity to learn resulted in deeper learning. The Module has also allowed students to detect their weaknesses and learn from their mistakes. This way, students made fewer errors as they progressed through the worksheets and developed better algorithms to solve Question 5 faster. This learning method is also supported by Fischer and colleagues (2006). According to the authors, deriving lessons from mistakes and close calls and individual and systemic accountability are important in promoting knowledge acquisition.

Research Question 5: What is the role of the PRIMM model in reducing the stress faced by students when learning computer programming?

The findings suggest that the PRIMM model improved learning interest and reduced students' learning stress. For students who have continuously heard that programming is difficult and believed in the perception, completing the model has given them the confidence to believe in their abilities. The discussions among peers have tremendously helped when students were stuck with solving the questions and fixing the bugs which alleviated students' stress and is in line with the study conducted by Choi and colleagues (2021). For students who struggled to convert their theoretical knowledge into the application, implementing the module helped them gain hands-on experience in coding while learning the concepts.

Conclusion

The review of literature has exhibited success on the PRIMM model in improving learning performance and at the same time, has pointed out the gap in the mediating role of learning motivation towards academic performance, especially in the scope of the Malaysian matriculation program. There is a huge gap in the implementation of the PRIMM model among pre-university computer science students, especially in the Malaysian context. While studies have been conducted on the success of the PRIMM model towards the academic performance of learners, the impact of the model on motivation and engagement, as well as the impact of the model in pre-university and Malaysian student settings, is still unknown. Underpinning the engagement theory, social constructivism, and self-determination theory, this research aims to design and develop a PRIMM module suitable for computer science learners of the Malaysian matriculation program. Research findings from the focus group interviews and thematic analysis found that the PRIMM module was efficient in learning programming, and students were motivated to learn and enjoyed the PRIMM classroom, where students had the opportunity to collaborate with peers and were engaged throughout

the classroom. The instructors and learners must have a say in understanding the perspective of teaching and learning. This research could act as a guide for instructors who are planning on redesigning the computer science classrooms for lecturers from matriculation colleges around Malaysia to develop new in-class activities. The PRIMM module that was developed can be efficiently used by Malaysian Matriculation colleges to teach programming.

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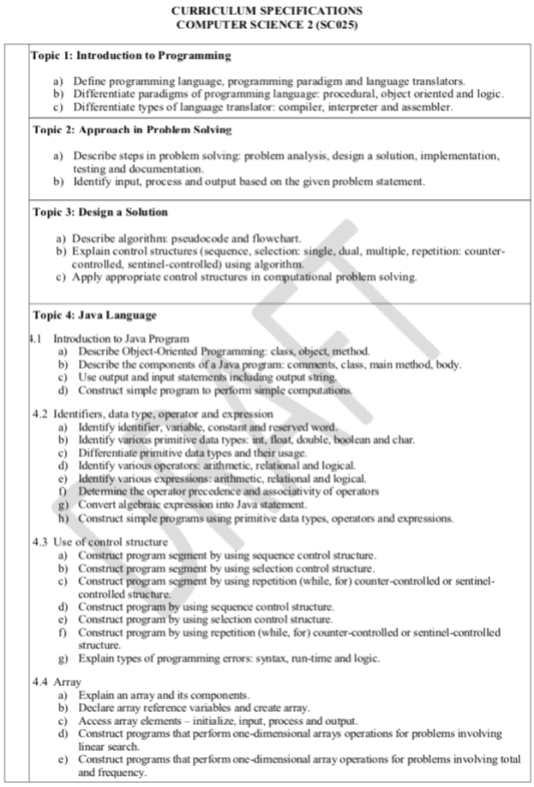
Contact email: tevya.tl@gmail.com

Appendices

Appendix A



CURRICULUM SPECIFICATIONS
COMPUTER SCIENCE 2 (SC025)

Topic 1: Introduction to Programming

a) Define programming language, programming paradigm and language translators.
b) Differentiate paradigms of programming language: procedural, object oriented and logic.
c) Differentiate types of language translator: compiler, interpreter and assembler.

Topic 2: Approach in Problem Solving

a) Describe steps in problem solving: problem analysis, design a solution, implementation, testing and documentation.
b) Identify input, process and output based on the given problem statement.

Topic 3: Design a Solution

a) Describe algorithm: pseudocode and flowchart.
b) Explain control structures (sequence, selection: single, dual, multiple, repetition: counter-controlled, sentinel-controlled) using algorithm.
c) Apply appropriate control structures in computational problem solving.

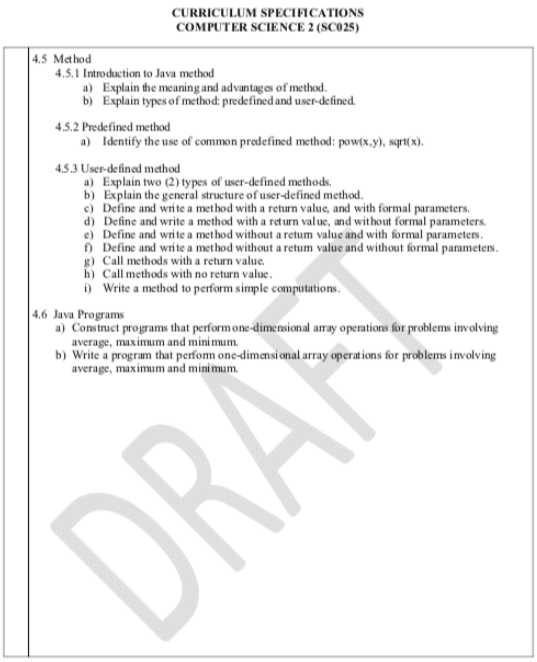
Topic 4: Java Language

4.1 Introduction to Java Program
a) Describe Object-Oriented Programming: class, object, method.
b) Describe the components of a Java program: comments, class, main method, body.
c) Use output and input statements including output string.
d) Construct simple program to perform simple computations.

4.2 Identifiers, data type, operator and expression
a) Identify identifier, variable, constant and reserved word.
b) Identify various primitive data types: int, float, double, boolean and char.
c) Differentiate primitive data types and their usage.
d) Identify various operators: arithmetic, relational and logical.
e) Identify various expressions: arithmetic, relational and logical.
f) Determine the operator precedence and associativity of operators
g) Convert algebraic expression into Java statement.
h) Construct simple programs using primitive data types, operators and expressions.

4.3 Use of control structure
a) Construct program segment by using sequence control structure.
b) Construct program segment by using selection control structure.
c) Construct program segment by using repetition (while, for) counter-controlled or sentinel-controlled structure.
d) Construct program by using sequence control structure.
e) Construct program by using selection control structure.
f) Construct program by using repetition (while, for) counter-controlled or sentinel-controlled structure.
g) Explain types of programming errors: syntax, run-time and logic.

4.4 Array
a) Explain an array and its components.
b) Declare array reference variables and create array.
c) Access array elements – initialize, input, process and output.
d) Construct programs that perform one-dimensional arrays operations for problems involving linear search.
e) Construct programs that perform one-dimensional array operations for problems involving total and frequency.



CURRICULUM SPECIFICATIONS
COMPUTER SCIENCE 2 (SC025)

4.5 Method
4.5.1 Introduction to Java method
a) Explain the meaning and advantages of method.
b) Explain types of method: predefined and user-defined.

4.5.2 Predefined method
a) Identify the use of common predefined method: pow(x,y), sqrt(x).

4.5.3 User-defined method
a) Explain two (2) types of user-defined methods.
b) Explain the general structure of user-defined method.
c) Define and write a method with a return value, and with formal parameters.
d) Define and write a method with a return value, and without formal parameters.
e) Define and write a method without a return value and with formal parameters.
f) Define and write a method without a return value and without formal parameters.
g) Call methods with a return value.
h) Call methods with no return value.
i) Write a method to perform simple computations.

4.6 Java Programs
a) Construct programs that perform one-dimensional array operations for problems involving average, maximum and minimum.
b) Write a program that perform one-dimensional array operations for problems involving average, maximum and minimum.

Appendix B

https://docs.google.com/document/d/1w7M0vtA69dJA4RwPG_D3NHC3GBORpVe_SQfM22UfHdw/edit?usp=sharing

Appendix C

https://docs.google.com/document/d/1yYlUu8BQXxZXAg-Uwrb6mXgeResWWsbL/edit?usp=sharing&ouid=108257376393913038180&rtpof=true&sd=true

Appendix D

Interview Protocol Project	: PRIMM Model towards Malaysian Matriculation Students' Motivation in Learning Programming
Time of Interview	: (To be Confirmed)
Date	: (To be Confirmed)
Place	: Online (Google Meet)
Interviewer	: Researcher - Tevya Letchumanan
Interviewee	: Students
Questions	:

1. Would you be able to describe you experience with the PRIMM module in the computer science classrooms with as much details as possible.
2. You have experienced the traditional classroom approach when learning the first two chapters and the PRIMM approach to learn the other two. Which way do you prefer to learn computer science? – Why?
3. How helpful was PRIMM model to increase your participation in classroom activities?
4. How was the PRIMM module prepared helpful in improving your communication and collaboration amongst your peers?
5. How did the PRIMM module help managing the stress of learning computer science?
6. What are, if any, the challenges of learning computer science in a PRIMM classroom?
7. Overall, in what ways has the PRIMM model that you experienced managed to improve your motivation in learning computer science at matriculation level?

Appendix E

Hyperlink to the transcription of the interview with focus group 1 : https://drive.google.com/file/d/1pxHR6PRESemWJdpVcyy6h9ELy508Tp29/view?usp=sharing

Hyperlink to the transcription of the interview with focus group 2 : https://drive.google.com/file/d/1xfsFYDupS9Zv1emg3OqZtipN-kznIxhI/view?usp=sharing

Hyperlink to the transcription of the interview with focus group 3 : https://drive.google.com/file/d/1lj0euMSHGvGmUSqv4aouAZ7lrEKXAxEm/view?usp=sharing

Hyperlink to the transcription of the interview with focus group 4 : https://drive.google.com/file/d/1V_v5YahTGynkmmtttdsyR1jgZMwnY7jr/view?usp=sharing

Appendix F

https://docs.google.com/document/d/1jponvvlTQ2H4bp14e86IOo-_-JTqWNCjKzsRIlj7-NM/edit?usp=sharing

National-Level Cross-Cluster Rotation Training in Obstetrics and Gynaecology: Through the Looking Glass of Residents

Chun Phoy Cheng Rachel, KK Women's and Children's Hospital, Singapore
Manisha Mathur, KK Women's and Children's Hospital, Singapore
Citra Mattar, National University Hospital, Singapore
Yang Liying, Singapore General Hospital, Singapore
Jill Lee Cheng Sim, KK Women's and Children's Hospital, Singapore

The Asian Conference on Education 2024
Official Conference Proceedings

Abstract
In Singapore, there are 2 sponsoring institutions (SI) under the Obstetrics and Gynaecology (OBGYN) residency program, namely SingHealth and National University Health System. The compulsory cross-cluster rotation training (CCRT) exercise was introduced in 2023 as an additional component to the six-year OBGYN residency program. Thirteen fifth-year residents (R5) in both SI underwent CCRT in the 2023/2024 academic year. This study aims to explore the R5s' perceived views on CCRT experience. Findings from this study will allow opportunity for better curriculum development at national level. R5s were invited to write a reflection essay on their CCRT experience. Resident identities were anonymized. Using a constructivist approach, these essays were analysed and grouped under the six core competencies of the Accreditation Council for Graduate Medical Education (ACGME). Residents reported medical knowledge gains as each SI had a different spectrum of OBGYN patients. The area of greatest gain was in system-based practice. Residents observed different models of care and identified areas to benefit patients' care. Residents recognised that CCRT provided lessons that would revise their practice in their institutions, in keeping with practice-based learning and improvement. Additionally, residents reported improved interpersonal communication across institutions and various faculty members. Whilst all residents expressed anxiety prior to CCRT, host programs offered adequate support through close faculty and peer support. Interestingly, there were different opinions regarding the sufficiency of CCRT duration. Overall, the residents agreed that CCRT exercise was a useful and good experience to enrich their existing residency training and further develop their core skills.

Keywords: ACGME, Residency Training, Obstetrics and Gynaecology, Postgraduate Medical Education

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Introduction

In 2010, the postgraduate medical education in Singapore successfully transitioned from the old United Kingdom-based specialists' accreditation system to the new United States-based residency program under the provision of MOH Holdings (MOHH), the holding company of Singapore's public healthcare clusters. The Obstetrics and Gynaecology (OBGYN) residency program is sponsored by two institutions, namely SingHealth and National University Health System (NUHS).

In the pre-residency era, the specialists' accreditation system was a six-year program, divided equally into two phases - Basic Specialist Training (BST) and Advanced Specialist Training (AST). The trainees did their cross-cluster rotation during AST period for a total of six months. Similarly, the OBGYN residency program consists of a six-year comprehensive training program, which includes four years of junior residency and two years of senior residency.

The BST/AST specialist training program involved skill-based clinical training and a summative examination of three years of BST, followed by three years of AST. Progression in training was time-based with an emphasis on the summative examination, consisting of the specialist Member of the Royal College of Obstetrics and Gynaecology (MRCOG).

The new United States-based residency system was adapted because of its structured training framework and a curriculum based on the six core competencies introduced by the Accreditation Council for Graduate Medical Education (ACGME) which consist of: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice (Figure 1) (Yin et al., 2015; Leach D. C., 2001).

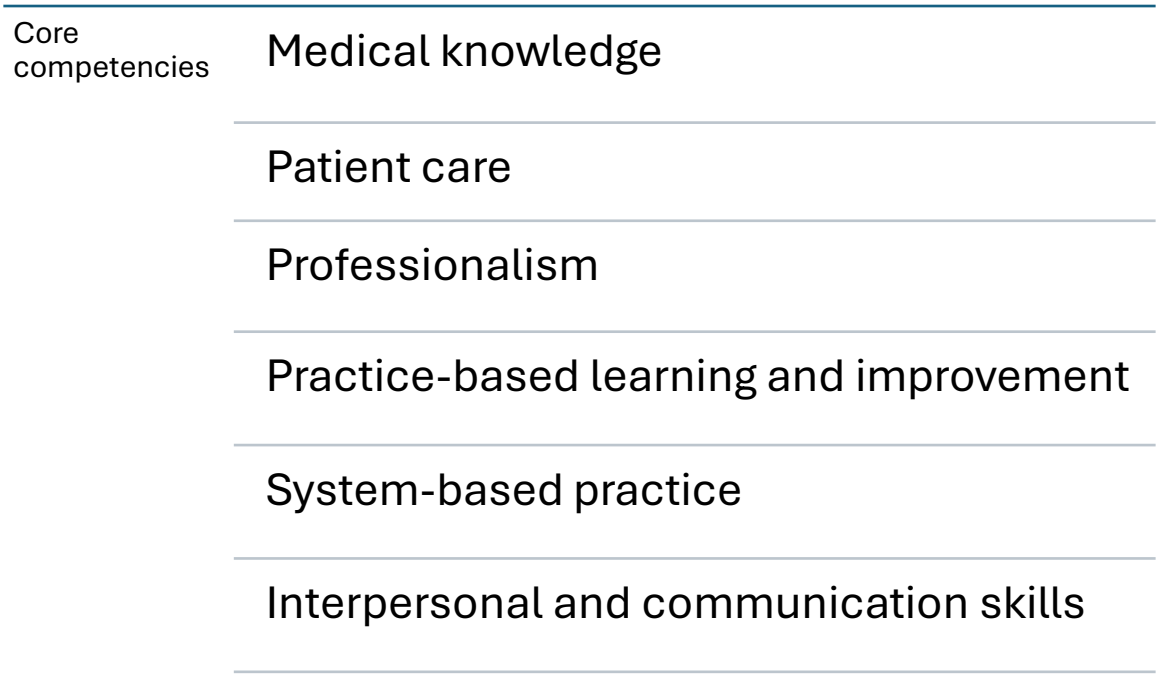

Figure 1: Core Competencies of ACGME

Under the new residency system, the cross-cluster rotation training (CCRT) was temporarily placed on hold to concentrate on other aspects of competencies. In 2020, the residency

faculty under MOHH made plans to resume CCRT. Once again, the CCRT project was deferred due to the emerging Covid infection. Fast forward three years later into 2023, the CCRT was implemented. The institutions selected for CCRT were KK Women's and Children's Hospital (KKH) which is part of the SingHealth institution and National University Hospital (NUH) which is part of the NUHS institution.

Objectives

The compulsory CCRT exercise was created to enhance residency training in both institutions and to strengthen the six core competencies set out by ACGME committee.

This study aims to explore the perceived views of all residents affected by CCRT on the experience of CCRT, a new and additional component to the familiar OBGYN residency training.

We hypothesize that residents would have both positive and negative experiences from the compulsory CCRT exercise which was introduced at short notice.

Findings from this study will allow opportunity for better CCRT curriculum development at national level and open possibilities of considering the introduction of compulsory CCRT in other residency programs around the world.

Methods

A total of 13 OBGYN R5s from both SIs underwent CCRT exercise in the 2023/24 academic year (Chart 1). There were eight SingHealth residents and five NUHS residents involved in this assignment. The rotation periods varied due to the difference in numbers of residents. To ensure manpower allocation in both institutions were balanced, NUHS residents spent 2 months in KKH, while SingHealth residents spent 1-2 months in NUH. The postings included in this rotation were Reproductive Medicine (RM), Maternal Foetal Medicine (MFM), and General Obstetrics and Gynaecology (GOG) which were the core postings in R5 rotation (Figure 2 and 3). Arrangements were made to ensure the residents' training were not compromised in any way. The residents were supervised by the program director, associate program director or the core faculty members during their CCRT.

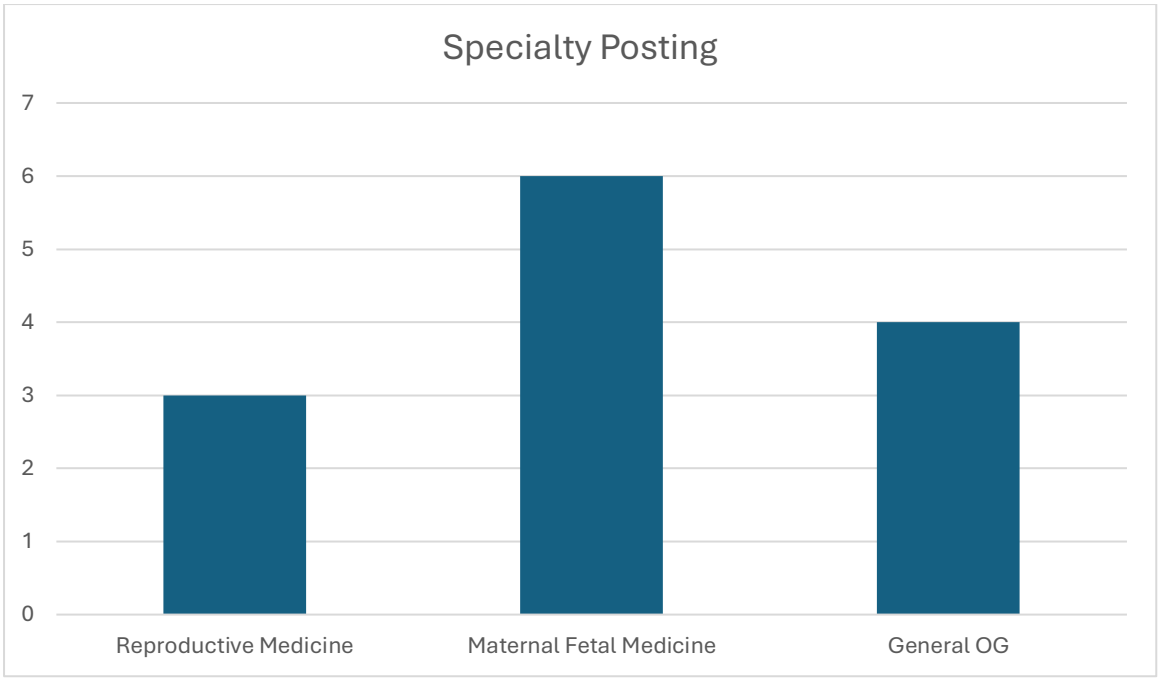

Chart 1: Number of Residents in Each Specialty Posting During Cross Cluster Rotation Training

R5	Reproductive Medicine (3 months)	Maternal Fetal Medicine (2 months)	Benign Gynaecology (2 months at NUHS/KKH, 2 months at KKH)	Benign Gynaecology at SGH (2 months)	Gynae Oncology at SGH (1 month)
R6	Maternal Fetal Medicine (3 months)	Reproductive Medicine (3 months)	Gynae Oncology (4 months)	Maternal Fetal Medicine at SGH (1 month) / Reproductive Medicine (1 month)	Gynae Oncology at SGH (1 month)

Figure 2: Sample Rotation Chart for Senior Residents of SingHealth OBGYN Residency Program

R5 & R6

	Training Objectives					
POSTING	Stations to cover	Learning objectives	Patient Care	Medical Knowledge	Communication Skills	Systems-based Practice
MFM	Obs ward (pre/postnatal), Jade OBS, FCC, GDM + HRC, FCC + fetal anomalies/genetic counselling, supervise EL LSCS, EM LSCS	Antenatal and postnatal care, low and high risk pregnancies, Priming Suite, MTPT, discharge summaries and audits. Intrapartum care, operative deliveries, Em + EL CS, acute complications. Senior Resident OSATS.	• Comprehensive understanding of varying presentations and treatment options for OBGYN conditions. • Recognizes atypical presentations of OBGYN conditions. • Manages patients with complex and atypical OBGYN conditions and complications. • Effectively supervises and educates R1-4. • Arranges for multidisciplinary and collaborative care. • Delivers bad news on complications or death.	Demonstrates advanced knowledge necessary for management of OBGYN conditions. • Effectively supervises and educates lower level residents regarding OBGYN conditions. • Collaborates and provides consultation to other members of the OBGYN team regarding care of patient. • Manages or co-manages critically ill patients. • Implements evidence-based treatment.	• Counsels patients/families about complications/bad outcomes. Incorporates risk management in process. • Participates in patient/family education • Leads interdisciplinary health care teams • Leads effective transitions of care and team debriefing. • Responds to requests for consultation in a timely manner and communicates recommendations to the requesting team.	• Compassion, integrity, respect for others. Punctuality, responsiveness; Reliability. Coaches others to do the same. • Self-awareness of fatigue and stress, management of stressors. • Reports errors / near misses to the institutional surveillance systems. Able to conduct root cause analysis. • Actively participates in quality improvement /patient safety projects. Organises and leads institutional QI /patient safety projects. • Contributes to peer reviewed medical literature.
GYN-ONC	Gyn-Onc ward, pre-/post-surgery care, Cancer clinics. Colposcopy, MBOT Gyn Onc + Robotics	Pre-/Post-surgical care, RT/chemotherapy care, ordering TPN, Tumour Board, proficiency in major abdominal surgery. Senior Resident OSATS.				
REI	REI ward (pre/post surgery) + Jade GYN + Menopause/Adol outpt + Subfertility clinic + CHR + MCOT/IVF + MBOT/MIS	Gyn pre-/post-op care, complex conditions (OHSS, TOA, AUB), EMD gyn admissions, discharge summaries and audits. Senior Resident OSATS.				
BG	MCOT (minors) + Jade GYN + NTF GYN + MBOT (majors) + BG/UG wards + Outpt hysteroscopy / UG + MIS Accreditation (To reach Level 2) + Robotics SR training	Inpatient pre-/post-surgery care, proficiency in major operations, independence and safety in emergency surgeries, ambulatory care, outpatient procedures. To complete Senior Resident OSATS.				
CCR	2 months (minimum of 1 month) in whichever posting they are assigned by their PD. The R5 will continue with the subspecialty training programme in the host institute, and this will be accredited towards their 6 month posting at their parent institute.	Subspecialty training mirroring the R5's assigned posting + general OG; R5 will fulfill existing list of requirements. The content/skill to achieve during the cross-cluster rotation will need to ensure that the residents' training needs are not compromised in any way and will not result in the need to make up for them in other rotations. The appropriate handover of supervision will be handled between the PDs.				

Figure 3: Sample Rotation Chart for Senior Residents of NUHS OBGYN Residency Program

They were invited to write a reflection essay on their experience of CCRT at the mid-point or endpoint of their CCRT posting. Resident identities were anonymized prior to qualitative analysis. Using a constructivist approach, these essays were analysed thematically and grouped under the six core competencies of the ACGME.

Results/Discussion

Eight out of 13 reflection essays were analysed according to the six core competencies of the ACGME.

Residents from both sponsoring institutions (SI) agreed that this CCRT rotation allows them to enrich their medical knowledge via evidence-based practice and practice-based learning. They were able to experience the outpatient services in both general clinics and specialty clinics and participate in active counselling during clinic sessions which builds their confidence and further enhance their knowledge. Practice-based learning enhances the trainees' ability in various aspects of self-learning and self-improvement (Yang, B, 2024). One resident recommended tagged clinic session before running the clinic independently to allow time to adapt to the new institution's practice.

The area of greatest gain was in system-based practice. System-based practice allows the residents to understand complex systems and the physician's role in them, navigate them for the benefit of patients, and participate in continually improving them (Guralnick, S., 2021). Residents observed different models of care and reflected on strengths, challenges and recognized areas to benefit patients' care and safety. The NUH residents acknowledged the significant heavier workload and valued the extensive range of OBGYN case varieties in KKH, especially the non-obstetric related conditions in pregnant patients. The exposure to such cases was beneficial to their clinical development. In addition, they were impressed with the multi-disciplinary care provided by the STORK (One Stop Obstetric High Risk) Centre for obstetric patients with medical conditions and hope that this service can be started in NUH. Similarly, the KKH residents agreed that the daily morning meetings in NUH with teaching didactics protected from clinical service commitments were very educational and mind-stimulating. However, one resident reported a disadvantage of these daily meetings – very early daily ward round before the meetings.

Each OBGYN resident in KKH has a mentor which changes every 6 months. This allows a one-to-one assessment and supervision which includes surgical procedure opportunities. On the other hand, the NUH residents do not have a specific mentor, but they have a protected operating time as per rotation schedule. All SingHealth residents reported limited surgical exposure during their CCRT, and one resident reported unequal division of surgical cases among the residents. On the contrary, the NUH residents appreciated the mentor-mentee relationship in SingHealth institution but felt that this may compromise the learning opportunity for other trainees in the same subspecialty rotation. Another resident felt that the junior residents' involvement in surgical cases was limited.

About half of the residents reported good exposure to procedures such as assisted vaginal deliveries and foetal-related procedures during their CCRT rotation. At the end of their rotations, the SingHealth trainees felt more empowered and pro-active in guiding the junior residents through procedures and surgeries which is a common practice in NUH.

Both SI have different electronic system platforms - Sunrise Citrix Manager in KKH and Epic Systems Corporation in NUH. Majority of the residents reported difficulty adjusting to the new electronic systems. In addition to the anxiousness that came with new working environment, this technical issue created unnecessary stress to the residents during this transition. This can adversely affect the residents' training and overall experience in the SI.

One resident suggested to take into consideration the resident's subspecialty of interest when planning CCRT exercise. This may help to create positive attitude and attentiveness during the rotation.

Interpersonal communication is paramount for forming and maintaining relationships (Govindaraju, 2021). The residents reported improved interpersonal communication not just across institutions but also for their individual skills as they learn from and observe a greater number of faculty through the CCRT. New friendship was formed, social circles were expanded, and the residents did not report any struggle in forming peer relationship with colleagues and faculty.

Whilst all residents expressed anxiety prior to CCRT, host program directors provided adequate support to visiting trainees through close faculty and peer support. The consultants and residents in both the SI were helpful, friendly and approachable.

Interestingly, there were different opinions regarding the adequacy of CCRT duration. Some residents felt a 2-month rotation was adequate while the others felt it was relatively short. A resident who did a 1-month rotation preferred a longer posting while another resident felt the CCRT exercise was not beneficial and minimised the learning opportunities in their own institution.

Conclusions

CCRT allows the residents to enhance their existing residency training, further develop their core skills, and push them to achieve greater heights in their professional career. The residents felt their medical knowledge significantly improved since the CCRT as they learned the different practices in both institutions.

Additionally, interpersonal interaction and communication among the healthcare personnel in both institutions which were fortified during this exchange further ensure a holistic care for our large population of OBGYN patients.

Most of the residents expressed slight anxiety at the beginning of their rotation. Nevertheless, they felt adequately supported during their CCRT exercise. This allows the residents to adapt and build resilience, a quality that would come in handy in their lifelong learning journey.

Recommendations from the residents should be taken into consideration to improve CCRT planning for the upcoming R5 residents in the 2024/2025 academic year.

In conclusion, majority of the residents felt that CCRT was beneficial, and it was a good experience.

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Contact email: Phoycheng.chun@mohh.com.sg

A Generative AI Puzzle Educational Game for Decision Making Skill Training With a Clue Exploration Mechanism

Hung-Yu Chan, National Taiwan University of Science and Technology, Taiwan
Yu-Chi Chen, National Taiwan University of Science and Technology, Taiwan
Chih-Chung Chien, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
Decision making is an increasingly valued skill in both schools and workplace. Lectures and case analysis remain limited in fostering decision-making skills due to a lack of contextual simulation, insufficient interactivity, and low learning motivation. Utilizing game-based learning to develop decision-making skills may help overcome these limitations. Therefore, in this study, we designed a decision-making game with a story plot, generative AI (GAI) simulation character interaction, and a clue inference mechanism to solve the limitations. This study designed a Non-Player Character (NPC) in a simulated dialog style through GAI. Learners played the role of a police detective in the game and they could talk to the victim which played by a GAI NPC, which was scripted by our research team. They have to explore, collect, and analyze clues, and make decisions about the location of the robbers' hideout within a limited period of time. A total of 15 participants engaged in the empirical evaluation of this study. It was found that the learners had a high level of flow, and moderate anxiety, and a high level of acceptance of the game, and that they believed that the game could help them to develop their ability. In addition, 80% of these learners felt that the game experience was more anthropomorphic than common GPTs, and the dialogues were more like real-life interactions. Learners also mentioned that the clues provided by the NPC were helpful, including location characteristics, and experiences of the incident, which could help them reason during decision-making.

Keywords: Generative AI, Decision-Making Skills, Contextual Simulation

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Introduction

Bhatti and colleagues (2022) identified the required employability skills of business graduates and business executives also agreed on the employability skills of the graduates such as problem solving, decision making skills are listed among the important workplace skills in their study. Decision making is also considered as an important skill in the workplace (Chowdhury & Miah, 2019). As decision making skill is emphasized in the workplace and schools, how to cultivate these skills has become an important issue. It has been mentioned that when learners do not receive adequate and timely guidance, it will affect their knowledge acquisition and learning effectiveness (Tsai et al., 2015). An appropriate decision-making training environment can help learners better understand the course content, and appropriately challenging tasks can help develop competence (Türkistanli & Kuleyin, 2022). In an error-aware environment, learners are able to deal with simulated situations in their own way and acquire employability skills. However, it has been mentioned that the construction of the simulation environment and the design of the game requires a significant time cost (Lean et al., 2020).

Therefore, this study focuses on the simulation part of the storyline, character setting and dialogues, and presents the game through the Web, and designs a GAI decision-making training game. It has been found that the main function of asking the player questions in games is to: solve problems for the learner, provide guidance for the learner's task, and stimulate his/her thinking process (Sung & Hwang, 2013). The design of the character dialogues in this study contains many clues to the case. Learners must play the game and gradually piece together the truth of the events.

Methods

The participants of this study were recruited through a recruitment process and consisted of 15 individuals. In order to assess the learners' flow status, this study referred to Kiili's (2006) flow status chart and used the Chinese version translated by Hou and Li (2014). In order to assess learners' acceptance of the game, this study modified the Technology Acceptance Scale proposed by Davis (1989). In addition, this study referred the game motivation elements proposed by Hou (2016). The studies used a five-point Likert scale to evaluate the game design elements.

This study designed the GAI decision-making game” The case of the kidnapping of the writer Xiang”. The game featured a realistic storyline, generative AI for realistic character interaction, and a clue-based inference mechanism. Learners took on the role of a police detective in the game and talk to GAI's realistic NPC characters, which scripted by our research team, to explore, collect and analyze clues, and make decisions on the location of the gangster's hideout and the case in a limited period of time. Players were allowed to enter the words they want to ask in the dialog box and get a reply from Writer Xiang, as shown in Figure 1. At the same time, they used the map at the bottom left of the game interface to find the place where Writer Sho is imprisoned, and wrote down the result of their inference in the Google form at the bottom right, as shown in Figure 2.

Figure 1: Game Interface for "The Case of the Kidnapping of the Writer Xiang"

Figure 2: Google Form for Decision Making

Results and Discussions

Table 1 presented the statistical results of learner's flow status after the task. Overall flow status (M=4.07) was significantly higher than the scale median (i.e., 3), and the sub-dimensions flow antecedents (M=3.85), and flow experience (M=4.25) were also significantly higher than the scale median (i.e., 3). It could be seen that learners have a high level of immersion as they talk to GAI simulated NPC characters, analyze clues, locate places of captivity and make inferences. Türkistanli and Kuleyin (2022) mentioned that appropriately challenging tasks in decision-making training environments and assignments also contribute to the development of competence.

Table 1: The Statistical Results of Learner's Flow Status

	(*N*=15)			
	M	*SD*	*Z*	*Sig.*
Overall Flow	4.07	.472	3.411**	.001
Flow antecedents	3.85	.498	3.301**	.001
Challenge-skill balance	3.43	.884	1.865	.062
Goals of an activity	4.27	.704	3.361**	.001
Unambiguous Feedback	3.43	.776	1.872	.061
Control	4.10	.806	3.170**	.002
Playability	4.03	.719	3.082**	.002
Flow experience	4.25	.514	3.414**	.001
Concentration	4.45	.561	3.436**	.001
Time distortion	4.33	.699	3.236**	.001
Autotelic experience	4.45	.465	3.431**	.001
Loss of self-consciousness	3.37	1.008	1.334	.182

*p <0.05, **p <0.01

Table 2 presented the statistical results of activity anxiety. Overall anxiety (M=2.62) was lower than the median (i.e., 3) of the scale, indicating that the learners were less anxious during the game. According to the game acceptance statistics, the overall acceptance (M=4.04), sub-dimensions cognitive usefulness (M=3.91) and cognitive ease of use (M=4.18) were significantly higher than the median of the scale (i.e., 3); and the game design element (M=4.23), was significantly higher than the median of the scale (i.e., 3). The results showed that the game was well accepted and not only did it help the learners at the cognitive level, the game was also easy to use. Kuo and Hou (2024) mentioned that learners were highly receptive and motivated to decision-based game-based training. Chien and colleagues (2023), on the other hand, mentioned that interactive and immersive contextual decision-making games, in addition to providing learners with a high level of concentration, also have high flow status and high acceptance.

Table 2: The Mean and Standard Deviation of Learners' Game Anxiety, Game Feedback, and Game Elements

	(*N*=15)			
	M	*SD*	*Z*	*Sig.*
Game Anxiety	2.62	.783	-1.736	.083
Game Feedback	4.04	.700	3.24**	.001
Game Usefulness	3.91	.947	2.73**	.006
Game Ease of Use	4.18	.700	3.34**	.001
Game elements	4.23	.539	3.41**	.001

*p <0.05, **p <0.01

Conclusions and Limitations

This study found that learners had a high degree of flow status, and moderate anxiety, and high acceptance of the game during the GAI decision-making game, which learners perceived as helping them develop their abilities, and also showed that the form of the game in dialogue with the GAI was acceptable to the learners. In addition, according to the feedback from the learners, 80% of the learners think that it is more anthropomorphic than the general GPT, and the conversation is more like a real person interaction. Some learners also mentioned that the

clues provided by the NPC characters were very helpful, including the characteristics of the location and the experience of the incident, which helped them to inference in decision-making.

In addition to the above findings, this study also identified some limitations and research directions. Decision making can be measured and explored in greater depth in the future, and the content of conversations between learners and GAI can be analyzed in greater depth. Include the content of the inquiry, the classification of clues, such as: the background story of the GAI character, the details of the kidnapping process, and the description of the captivity site, in order to better understand the learner's mastery of the clues and why to make the final inference.

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Contact email: hthou@mail.ntust.edu.tw

Literature Review of the Impact of Strength Training and Plyometric Training on Basketball Performance

Jun Wan, Jiangxi University of Software Professional Technology, China

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Abstract
This paper aims to provide an extensive literature review of academic papers written in English about the impact of strength exercises on basketball performance across different educational and training institutions. Resistance training, also known as strength training or weight training, involves using resistance to muscle contractions to enhance strength, anaerobic endurance, and muscle size, and plyometric training enhances neuromuscular coordination by training the nervous system, making movements more automatic during activity, resulting in improved performance. This article comprehensively reviews and evaluates basketball players' strength and plyometric training methods, offering valuable insights and references for scientifically enhancing their shooting, dribbling, and speed performance. The literature review found several key insights into the effects of strength and plyometric training on basketball players. Previous research highlighted that plyometric training (PT) effectively enhances agility, and functional strength training was found to significantly boost lower limb explosive power. Combining strength and plyometric training improved vertical jump performance and reduced injury risk. Core training improved endurance and balance but had limited sport-specific effects. Overall, the literature supports the importance of strength training in enhancing performance and preventing injuries in basketball players. Strength training seems to be very important for inducing basketball performance. It not only builds muscle but also improves basketball skill level. The results show us that a lot of the research has been done on these two training methods separately, and these results imply that more research needs to be done on combining the two methods to impact basketball performance.

Keywords: Strength Training, Plyometric Training, Basketball Performance, Review

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Introduction

With the continuous development of the economy, basketball has become increasingly popular. There are basketball leagues of different levels worldwide, such as the Chinese Professional Basketball League, the European Professional Basketball League, and the American Professional Basketball League. Basketball is a group competition that involves high-intensity activities like jumping, sprinting, directional changes, and physical confrontations. Due to the limited space of basketball games, it is easy to get injured during the fierce competition. (Ransone, 2017). According to research strength training can enhance the strength and endurance of basketball players and improve their game performance while reducing the risk of injury. Knowing how individual athletes should adapt the strength training regime to their usual practice routine is also essential in basketball training. It can not only help improve muscle strength but also prevent injuries.

Terminology

Basketball

Basketball was invented by Dr. James Naismith in 1891. Since then, it has spread and developed rapidly around the world. It is currently estimated that about 450 million players and fans worldwide exist. Basketball is also one of the most popular sports in China today, and basketball has become a part of Chinese culture. The most prestigious basketball league is the American Professional Basketball League. There are also basketball leagues of different levels in different parts of the world, such as the Chinese Basketball Professional League, the European Basketball Professional League, etc. (*About FIBA About the CIES SPORTS Observatory*, n.d.).

Strength Training

Strength training, which includes weightlifting and resistance exercises, focuses on building muscular strength and endurance. Beyond traditional weightlifting, it includes bodyweight exercises, isometric holds, and plyometric movements. This wide range of methods makes it adaptable to different sports, helping to enhance athletic performance and physical conditioning (*Strength Training*, 2024). Strength training follows the basic principle of repeatedly overloading a muscle group. This is usually done by contracting the muscle against heavy resistance and returning to the starting position. The process is repeated several times until the muscle reaches the point of failure. The fundamental approach to resistance training is based on progressive overload, where muscles are subjected to increasing resistance levels to promote strength gains. This method enhances muscular strength and endurance by progressively challenging the muscles within their capacity. They respond by becoming more prominent and more substantial. Beginner strength trainers are training the neurological aspect of strength, which is the brain's ability to generate a rate of action potential in neurons that will produce a muscle contraction close to the maximum potential of the muscle. (Schoenfeld et al., 2017). Strength training can alter the body's metabolic rate by utilizing anaerobic energy metabolism to support muscle development and promote long-term metabolic adaptations. Regular resistance training induces the adaptation of enzymes and substrates involved in energy supply, ultimately leading to increased muscle mass. Studies have shown that chronic resistance training responds to glycolytic muscle fibers with more vital anaerobic metabolism (Freitas, 2017).

Plyometric Training

Plyometric training (PT) is a specialized form of strength training commonly employed in team and individual sports to enhance sport-specific performance. It focuses on explosive movements, improving power, speed, and agility, essential for athletic success (Davies et al., 2015). It has become increasingly popular and recognized by many athletes and coaches in the past few decades. PT is one of the practical training methods that can improve athlete performance, and compared with other training, it is more targeted and can help shorten the muscle training cycle (Ugarkovic et al., 2021). Some research indicates that a 7-week plyometric training program improved quadriceps muscle contractility in adolescent female basketball players but reduced agility and jump performance, with no change in balance (Meszler & Váczi, 2019a). PT has been shown to improve physical qualities, such as strength, jump height, running economy, agility, sprint speed, and endurance. PT exercises involve explosive muscle movements, which are divided into three phases: the pre-activation phase (eccentric contraction), retention phase (isometric contraction), and shortening phase (concentric contraction), which together constitute the stretch-shortening cycle (SSC). The rapid transition from the eccentric phase to the concentric phase will increase force output by inhibiting the protective function of the Golgi tendon organ to a greater extent, and it can enhance the mechanical properties of the tendon complex, strengthen the elasticity of connective tissue, and optimize the mechanics of the myofilament bridge structure and motor unit activation (Davies et al., 2015). These adaptive changes help improve muscle strength, dynamic stability, neuromuscular control, contraction speed, and joint stiffness.

The Impact of Strength Training on Basketball

In basketball games, good athletes usually have strong bodies and sufficient advantages in basketball confrontation. Strength training is a widely recognized and very effective training method that can improve muscle function, functional performance, and health parameters (Garber et al., 2011). During the off-season of basketball, athletes will improve their physical fitness and reduce the risk of injury by enhancing explosive power, endurance, and high-intensity strength training. This is a straightforward and effective training method. Helming, (2019, as cited in Strasunskas & Guðjónsson, 2020a), pointed out that adding strength training to a regular training program is generally valuable in competitive sports because it can help athletes perform at a higher level and prevent injuries. This shows the importance of strength training. Strength depends on more than just muscle size, as neural adaptations play a significant role in strength gains. These adaptations improve the nervous system's ability to recruit muscle fibers efficiently, enhance motor unit synchronization, and increase firing rates. As a result, individuals can experience differing strength improvements even with similar muscle mass, as the nervous system optimizes muscle activation and coordination, leading to enhanced force production (Brooks et al., 2019). Studies have shown that strength exercises improved vertical jump performance, take-off speed, maximal jump height, work output, power, and running speed over short distances (5 and 20 meters), and another study also concluded that strength training directly enhances basketball performance by increasing players' strength and power (Mikolajec et al., 2012). Türker & Yüksel (2021) found that the findings of this research indicate that functional and supportive strength training has positively impacted body fat percentage, aerobic capacity, and dynamic balance. Basketball is a sport that requires frequent contact and confrontation between players. The game is fast-paced, and players must have excellent explosive power to sprint, stop, and jump quickly to complete each round of offense and defense. At the same time, basketball players must have good muscle endurance and stamina. A study by Yong (2023) showed that the results

suggested that functional strength training can significantly enhance the explosive power of basketball athletes' lower limbs.

Plyometric Training Impact on Basketball

Basketball is a very confrontational sport. Plyometric training effectively enhances agility in basketball players, and plyometric jump training (PJT) increases tendon stiffness, allowing for a faster and more effective force transfer from muscle to bone (Legerlotz et al., 2016; Meszler & Váczi, 2019a). Such an effect may improve the physical fitness of youth athletes (Myers et al., 2017). Chen and colleagues (2023) studied the impact of PT on the lower limbs of young athletes (including football players, track and field athletes, and basketball players. The findings revealed that PT can help improve muscle maximum strength and neural adaptation and improve the explosive power and jumping of adolescent athletes' lower limbs. Research also shows that even a limited amount of plyometric training could improve jumping performance in elite junior basketball players, and this improvement could be partly related to an increase in the maximal voluntary force of hip extensors and the rate of force development of knee extensors (Ugarkovic et al., 2021). Scholars added that PT could improve hip joint force generation characteristics, the transmission efficiency of the connection between upper and lower limbs, and the speed of fast breaks after basketball players receive the ball. Another study showed a fascinating experiment in which they found that PT can significantly improve basketball players' muscle strength, linear sprint speed, change of direction speed, and balance, and pointed out that the results of the effects are not related to gender or age, especially in basketball. Among athletes, PT can significantly increase the distance of the standing long jump and significantly shorten the time of the 10-meter and 40-meter change of direction sprint (Ramirez-Campillo et al., 2022). PT has also considerably improved the performance of female basketball players in multiple areas. These include jumping and shooting skills, sprinting and cutting abilities, muscle characteristics, balance, and overall skill-related performance. This indicates that PT positively enhances female basketball players' physical fitness and sports performance. It can be seen that the impact of PT on basketball is not only the basketball technology itself but also the effect on physical fitness, helping to improve muscle strength and enhance explosive power and self-coordination.

Summary

A review of previous research relevant to this study establishes a solid foundation for understanding the role of strength training (ST) and plyometric training (PT) in enhancing basketball performance. The growth of basketball as a sport must be distinct from scientific training models, particularly those that target specific athletic needs. PT, in particular, focuses on the lower limbs and involves explosive jumping exercises that strengthen leg muscles and enhance overall jumping ability. Multiple studies have reinforced the strong connection between PT and improved jumping performance, which is especially critical in basketball, where strength training plays an integral role. Muscle strength is a key source of athletic power, and strength training has been shown to increase muscle fiber density and enhance various forms of strength, including maximum strength, endurance, and explosive power. When integrated with plyometric exercises, strength training significantly improves speed, agility, dynamic balance, and overall physical performance. It also contributes to injury prevention and endurance enhancement. The simplicity of PT and ST makes them practical for daily training and suitable for broad applications. This review highlights the scientific basis for adopting these methods in basketball training, offering a valuable framework for

coaches to design more effective training regimens and player selection strategies. By combining strength and plyometric training, basketball players can experience enhanced physical attributes crucial for performance on the court.

Table 1: Review of Previous Research

Author	**Research Focus**	**Key Findings**
(Woolstenhulme et al., 2004)	Strength training	This study shows that strength training does not negatively affect vertical jump height, anaerobic power, or shooting accuracy.
(Meszler & Váczi, 2019b)	Plyometric training	The study indicates that when regular basketball training and games are combined with high-volume plyometric training, there are no significant functional improvements. This is attributed to the fatigue resulting from insufficient recovery between training sessions, which can hinder the intended benefits of plyometric exercises.
(Mikolajec et al., 2012)	Strength exercise	"This study underscores that strength exercises improved vertical jump performance, take-off speed, maximal jump height, work output, power, and running speed over short distances (5 and 20 meters).
(Mikolajec et al., 2012)	Strength exercise	The study concluded that strength training enhances basketball performance by increasing players' strength and power.
(Strasunskas & Guðjónsson, 2020b)	Strength training	This research concludes that adding strength training to a basketball training regime leads to positive outcomes in physical performance, injury prevention, and endurance.
(Zhang & Zhang, 2023)	Strength training	The research highlights that strength training can enhance physical endurance and explosive power in young people, improving speed, agility, and other physical attributes.
(Türker & Yüksel, 2021)	Strength training	This research indicates that functional and supportive strength training has positively impacted body fat percentage, aerobic capacity, and dynamic balance.
(Yong, 2023)	Strength training	The results suggested that Functional strength training can significantly enhance the explosive power of basketball athletes' lower limbs.
(Meng, 2022)	strength and Quality Training	The results suggest that strength and Quality Training achieved significantly better bench press performance than the traditional group, confirming the effectiveness of the new strength training method.
(Uysal et al., 2023)	plyometric exercises and traditional strength exercises	The investigation demonstrates that Combining both ways is designed to help basketball players improve their ability to jump higher.

(Woolstenhulme et al., 2004)	Strength training	The data indicates that prior strength training does not negatively affect the vertical jump height, anaerobic power, or shooting accuracy of collegiate women's basketball players.
(Yáñez-García et al., 2022)	combined high-speed resistance training and plyometrics	These findings suggest that high-speed resistance training combined with plyometrics improves strength, jumping, and sprint speed in young basketball players, but its effectiveness decreases with age.
(Li, 2022)	Core strength training	The research highlights that Core strengthening training can improve the physical fitness of college basketball players.
(Şahiner & Koca, 2021)	Core training	The research emphasizes that core strengthening training can significantly enhance the physical fitness of college basketball players, contributing to improvements in stability, balance, and overall athletic performance.
(Feng et al., 2024)	core strength training	The findings of this research indicate that the 12-week CST program significantly enhanced dynamic balance, agility, and dribbling skills in adolescent basketball players, highlighting its value in training.
(Ugarkovic et al., 2021)	plyometric training	The study proves limited plyometric training could improve jumping performance in elite junior basketball players. This improvement could be partly related to an increase in the maximal voluntary force of hip extensors and the rate of force development of knee extensors.
(Meszler & Váczi, 2019a; SENTU MITRA et al., 2013)	Plyometric training, Resistance training	The results indicate that plyometric training effectively enhances agility in basketball players.
(Kons et al., 2023)	plyometric training	The available evidence indicates that plyometric training improves most related physical fitness parameters and sports performance.
(Meszler & Váczi, 2019a)	plyometric training	Based on the study's findings, a 7-week plyometric training program improved quadriceps muscle contractility in adolescent female basketball players but reduced agility and jump performance, with no change in balance

Practical Recommendations for Coaches and Athletes

Basketball training programs should incorporate specific plyometric exercises, such as box jumps, depth jumps, and bounding drills, to enhance explosive power, speed, agility, balance, and coordination, particularly in young athletes through low-frequency, high-volume, mixed-type sessions over the long term (Zhou et al., 2024). To translate these physical fitness gains into game performance, integrating sport-specific drills like sprinting to a jump shot ensures improved speed and power are effectively utilized in real game situations, bridging the gap between conditioning and technical skills (Deng et al., 2023). Monitoring athlete progress

and adjusting programs based on individual responses, including performance metrics, fatigue, and recovery, is essential for optimizing outcomes (Sáez De Villarreal et al., 2021). Additionally, combining plyometrics with strength, core, and functional training offers a holistic approach that enhances endurance, strength, balance, and agility. Tools like the Reactive Strength Index (RSI) and force-velocity profiling can further tailor plyometric exercises to address specific athletic needs, making training regimens more targeted and effective for basketball performance (Bremec, 2017).

Future Research Directions

Future research should explore optimal training schedules that align with athletes' seasonal demands and avoid overtraining to enhance the scope and effectiveness of strength and plyometric training in basketball. There is also a need for individualized training programs that consider athletes' unique physiological and experiential backgrounds to maximize performance gains. Understanding the underlying physiological mechanisms of training adaptations through advanced molecular and biomechanical studies could further refine training methods. Additionally, evaluating the effectiveness of various recovery interventions could provide insights into maximizing training benefits and minimizing injury risks. Comparative studies are also crucial to identify which exercises most effectively enhance specific basketball skills, such as shooting and dribbling. Finally, investigating the long-term effects of systematic strength and plyometric training on athletes' career longevity and injury prevalence could offer valuable guidelines for sustained athletic development. Addressing these areas will provide a deeper understanding of how tailored training protocols can be developed to enhance basketball players' performance and well-being.

Conclusion

This literature review underscores the significant impact of strength and plyometric training on enhancing basketball performance. Strength training has been proven to build muscular strength, endurance, and explosive power, which are pivotal for basketball players in achieving superior performance and mitigating injury risks. Plyometric training complements these gains by improving neuromuscular coordination, agility, jump height, and speed—attributes that are essential for basketball's high-intensity demands. Combining strength and plyometric training offers synergistic benefits, including improved vertical jump height, sprint speed, and overall athletic functionality. However, core strengthening demonstrates limited sport-specific effects while contributing to stability and balance. This indicates a need for more integrated approaches to training regimens.

Future research should prioritize exploring the combined effects of strength and plyometric training on basketball performance, mainly focusing on sport-specific adaptations and individualized training protocols. The findings of this review provide a robust framework for coaches and athletes to adopt scientifically informed training programs that not only maximize athletic potential but also address injury prevention, ensuring sustained performance and career longevity for basketball players.

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An Alternative Reality Museum Tour Game Integrating Realistic Historical Storyline and Role-Playing for Learning Cultural Heritage

Shen-Yang Ni, National Taiwan University of Science and Technology, Taiwan
Chih-Chen Kuo, National Taiwan University of Science and Technology, Taiwan
Hung-Yu Chan, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
Although museums converted from cultural heritage are of high historical value, they may not be able to retain the old historical elements due to changes in business strategies and lose the historical value of the original scene. Museum tour guides can still take visitors back to the past through oral tours, there is still limited understanding due to insufficient information retained on site. Therefore, this study attempts to design an alternative reality museum tour game that combines simulated historical storylines and role-playing for a marine museum transformed from a thermal power station. Players can use their mobile phones to open the game and read the storylines to match the real historical scene in the museum park. Using first-person role-playing, players can walk around the existing museum park and explore the events of each historical site, interact with the virtual characters and solve the unexpected events that happened at the thermal power station at the time to immerse themselves in the simulated historical situation. Seventeen participants engaged in this study. The result revealed that the players had a high level of flow, and moderate anxiety. About cognitive loads, a certain degree of intrinsic cognitive load was generated by the long storytelling, the low level of extraneous cognitive load and the high level of germane cognitive load reported indicated that this game can increase the player's commitment to the game and advance the player to think about the content of the game simultaneously.

Keywords: Alternate Reality Game, Digital Game-Based Learning, Educational Game, Museum Tour Guide, Personal Digital Mobile Guide, Situated Learning

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Introduction

In order to promote the preservation and safeguarding of the world heritage, UNESCO launched the Memory of the World Programme in 1992, which has three main objectives: to preserve the world heritage using the most appropriate techniques, to facilitate access to and use of the world heritage, and to raise awareness among all human beings of the existence and significance of the world heritage (Edmondson et al., 2020).

Under the promotion of this project, more and more cultural heritage in Taiwan have been transformed into museums and preserved using adaptive re-use of old buildings. Unfortunately, many of the revitalized cultural assets can hardly show the historical features and values of the old venues due to the different management policies of the venues and the functions of the old buildings. Although many museums have used oral guided tours to recreate the appearance of the museums before the revitalization process, they still suffer from the problem of incomplete information or the limited number of guided tours.

As a result, many museums have turned to the development of digital educational games recreating the original appearance of cultural heritage through digital technology and game mechanisms. Many studies have pointed out that digital educational games can not only attract learners of different educational levels and knowledge areas to learn about cultural heritage but also raise learners' awareness of the preservation of cultural heritage (Petrucco & Agostini, 2016; Garcia-Fernandez & Medeiros, 2019).

Alternative Reality Game (ARG) is a type of game that uses digital technology to connect virtual reality and physical interaction. It is very suitable for educational games with cultural heritage themes (Zarraonandia et al., 2024) The characteristic of alternative reality games is that they use immersive narrative methods to attract players into the game, which can not only inspire players' literacy skills, but also create novel visiting experiences for museums (Davies et al., 2012).

However, some studies have said that many ARGs on the topic of cultural heritage lack interactivity and explorability, which makes it more difficult for players to feel like they are stepping into a historical context, and it is difficult for them to gain a deeper understanding of the historical content and preservation value of cultural heritage. The key reason for this may lie in the fact that these games are not designed from the experiences and perspectives of the educators in the field, which can lead to the production of games that do not meet the educational needs of the field and the game mechanisms of the learning context (Zarraonandia et al., 2024).

Therefore, this study attempts to design an alternative reality museum tour game that combines a simulated historical storyline and role-playing for a marine museum converted from a thermal power station, based on the museum's collection of literature and historical materials by educators familiar with the museum's background. Players can use their mobile phones to open the game and read the storylines to match the real historical scene in the museum park (Figure 1). They were using first-person role-playing, and the learning scaffolding of the digital system to understand the historical information of each site, summarize the answers to the puzzles from the dialogue between yourself and the virtual NPCs, and generate the immersive feeling of returning to the past historical scene, to achieve the effect of both learning scientific knowledge and historical immersion (Figure 2).

Figure 1: Players play the game through the graphic story in the ARG game against the real historical sites.

Figure 2: After entering the game, players can read the game content and puzzle clues to think, deduce, and summarize the answers.

The purpose of this study was to investigate the flow, activity anxiety, and cognitive load condition of the learners in an alternative reality museum tour game of cultural assets that combines a simulated historical storyline with role-playing, and to observe the historical immersive experiences generated by the learners during the game. Therefore, the following two research questions were asked in this study:

Q1: What are learners' state of flow, activity anxiety, and cognitive load during the game?

Q2: Can learners produce historical empathy phenomena in this game?

Method

The participants in this study were 17 university students and public people (8 males and 9 females) in Taiwan. We used the post-test questionnaire survey method in quantitative

research all experiments were conducted online. The Kiili Flow Scale (2006) translated and revised by Hou & Li (2014) was referred to in this study. The flow scale includes two dimensions: Flow Antecedents and Flow Experience. All scales were scored according to the Likert scale. The reliability of the flow questionnaire (Cronbach's alpha=0.792) indicated a high degree of internal consistency. In terms of the anxiety of the game by the learner, the AMAS anxiety scale proposed by Carey, Hill, Devine and Szűcs (2017) modified by this study and the Likert scale was used. The reliability of the anxiety scale (Cronbach's alpha=0.853), which has credibility. In terms of the cognitive load of the learning by the learner, the cognitive load scale proposed by Leppink, Paas, Van der Vleuten, Van Gog and Van Merriënboer (2014) modified by this study was used, which included three dimensions: Intrinsic Cognitive Load, Extraneous Cognitive Load, and Germane Cognitive Load, and the Likert scale was used. The reliability of the cognitive load scale, intrinsic cognitive load (Cronbach's alpha=0.846), extraneous cognitive load (Cronbach's alpha=0.817), germane cognitive load (Cronbach's alpha=0.899), three cognitive load dimensions has credibility. Historical empathy quantitative survey proposed by Endacott and Brooks (2013) historical empathy interview methods, which included three dimensions: Historical Contextualization, Perspective Taking, and Affective Connection, used to understand learners' cognitive understanding and emotional engagement with historical scenes and characters. Prior to the study, subjects would sign an institutional review board. The learning activity was an alternative reality museum tour game, which included game explanation (10 minutes), game activities (60 minutes), and post-test questionnaire (20 minutes).

Result

In this study, the Wilcoxon signed-rank test was used to analyze learners' flow, anxiety, and cognitive load, the results shown as Table 1. The result revealed that the overall flow (M=4.37) was significantly higher than the median (the median in a five-point scale=3). This indicates that the overall game activity design mechanism enables the learner to clearly understand the game's objective of the activity and is proactively engaged in the game to complete tasks, achieving a high level of flow experience. The result revealed that the overall anxiety (M=1.99) was significantly lower than the median. The result revealed that the cognitive load, intrinsic cognitive load (M=2.12) was significantly lower than the median. This indicates that the content of the game is designed to have a lower intrinsic cognitive load on the learner; extraneous cognitive load (M=1.12) was significantly lower than the median. This indicates that the game does not place too much external cognitive load on the learners; germane cognitive load (M=4.72) was significantly higher than the median. This indicates that the game design promotes learners to think more and generate useful cognitive. Furthermore, historical empathy surveys show that most of the learners said that they could feel that they were in Japanese colonial period in Taiwan when thermal power plants were still in operation, and that they could empathize with the difficulties faced by the staff of the power plants during emergencies, as well as the lives of the people living in the vicinity of the thermal power plants at that time.

Table 1: Flow, Anxiety and Cognitive Load Descriptive Statistical Analysis

Dimension	***M***	***SD***	***Z***	***p***
Overall Flow	4.37	0.34	3.626***	.000
Flow antecedents	4.31	0.46	3.625***	.000
Flow experience	4.42	0.35	3.625***	.000
Overall Anxiety	1.99	0.73	-3.386**	.001
Overall Cognitive Load				
Intrinsic Cognitive Load	2.12	0.98	-2.748**	.006
Extraneous Cognitive Load	1.12	0.20	-3.782***	.000
Germane Cognitive Load	4.72	0.39	3.711***	.000

***$p < 0.001$; **$p < 0.01$

Conclusion

In this study, we use design an alternative reality museum tour game that combines simulated historical storylines and role-playing for a marine museum transformed from a thermal power station. Players can use their mobile phones to open the game and read the storylines to match the real historical scene in the museum park. Using first-person role-playing, players can walk around the existing museum park and explore the events of each historical site, interact with the virtual characters and solve the unexpected events that happened at the thermal power station at the time to immerse themselves in the simulated historical situation.

The result revealed that the players had a high level of flow, and moderate anxiety. About cognitive loads, a certain degree of intrinsic cognitive load was generated by the long storytelling, the low level of extraneous cognitive load and the high level of germane cognitive load reported indicated that this game can increase the player's commitment to the game and advance the player to think about the content of the game simultaneously. After the initial analysis of this study, this study will continue to explore the effect of the study on the learners compared to the control group (join other learning scaffolds) by means of a quasi-experimental design.

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Combining Realistic Story Situations and GPT-Based NPC Framework for Historical Knowledge Problem-Solving Games

Cheng-Yuan Wei, National Taiwan University of Science and Technology, Taiwan
Yu-Chi Chen, National Taiwan University of Science and Technology, Taiwan
Chih-Chung Chien, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
In recent years, the application of generative AI's (GAI) adaptive characteristics in education has rapidly emerged. However, general GAI in educational games often lacks realistic situations and operational fidelity, leading to limited authentic experiences and difficulties in learning transfer. Additionally, GAI frequently produces inaccurate or off-topic responses. To address these limitations, this study designs a historical education problem-solving game based on a previous research team's framework of using GPT as a game Non-Player Character (NPC) (Chen & Hou, 2024). The game incorporates realistic story situations and reduces off-topic NPC responses. In the game, learners play as the close friend of the protagonist and collaborate with GPT-based NPC peers designed by the research team. They conduct online information searches within a limited time to find the historical period in which the game protagonist disappeared and the name of the current building to save the protagonist. A total of 17 participants engaged in the empirical evaluation of this study. The study found that learners exhibited a high flow state, perceived the game as highly playable and enjoyable, and had a high acceptance of the game. Additionally, 70% of learners believed that the game helped with historical learning, and nearly 50% felt that it was closer to real human interaction compared to typical GPT conversations. The study demonstrates that a GPT-based NPC, enhanced with contextual stories and reduced off-topic responses, can effectively improve learners' gaming experience.

Keywords: Generative AI, Problem-Solving Exploration Skills, Operational Realism

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Introduction

With the rapid emergence of generative AI, various educational applications have quickly risen, bringing benefits to learners. Research has shown that AI-generated gamified assessment strategies significantly enhance student engagement and motivation, improving learning outcomes (Bachiri et al., 2023). Integrating escape room games with AI chatbots allows educators to design immersive educational experiences more easily, enhancing teaching efficiency and effectiveness (Fotaris et al., 2023). AI-assisted gamified learning can boost students' intrinsic motivation, reduce cognitive load, and foster effective learning behaviors in scientific education (Chen, C.-H., & Chang, C.-L., 2024). Chen and Hou (2024) found that incorporating ChatGPT-based situational NPCs into educational games enables students to maintain high motivation and engagement without excessive anxiety. However, general generative AI lacks situational and operational realism in educational games, limiting the sense of authenticity and making learning transfer more difficult. For instance, Benjamin Emihovich and colleagues (2020) examined improvements in problem-solving skills and found no significant difference in PISA problem-solving test performance between using popular video games like *World of Warcraft* and cognitive training games like *CogniFit*. This suggests that without realistic scenarios or relevant subject knowledge, effectiveness remains limited, and the same holds for AI-driven research. Furthermore, current generative AI answers often contain a certain error rate, but tutor versions designed by researchers show lower error rates than those without prior configuration (Bastani et al., 2024).

Building on this, our research developed a narrative context and implemented character-personalized GPT. Furthermore, based on previous research by Chen and Hou (2024), which used GPT as an NPC in games, we designed a historical educational problem-solving game titled *The Disappearance of Bi-Ting*, incorporating a realistic narrative and reducing off-topic NPC responses.

Methods

Participants in this study were 17 adults over the age of 18 from Taiwan (8 males and 9 females), recruited through online registration. None of the participants had previously experienced a GenAI-integrated game-based learning activity. Each participant used a personal computer and conducted the online learning activity in a private space. The entire study was conducted online.

This activity is conducted on a Google Sites webpage, integrating game text, Google Form puzzles, and GPT-based NPCs. Before starting, learners watch an introduction video covering the game story and instructions. Learners play as the protagonist's close friend, tasked with finding the year and specific time-space location where their friend has disappeared within a limited timeframe. Throughout the game, learners interact with a GPT-based NPC developed by the team, which guides players to think critically without directly providing correct answers. Learners must assess the NPC's information and may conduct online searches for further information.

The activity was divided into several stages. First, a 10-minute introduction was given on the game story and operation. This was followed by a 30-minute game experience. After the game, a 20-minute post-test was conducted. Finally, a 10-minute discussion and explanation session was held to conclude the day’s activity, making the total duration approximately 70 minutes.

The instruments included a Flow Scale, a Game Anxiety Scale, a Game Feedback Scale, a Game Elements Scale, and a self-reported questionnaire. The Flow Scale, translated and revised by Hou and Li (2014) from Kill's Flow Scale (2006), covered flow antecedents and flow experience. To assess participant anxiety, this study adapted Hung's (2001) Activity Anxiety Scale. Game Feedback was measured using Davis's (1989) scale, which includes perceived usefulness and ease of use. The Game Elements Scale was based on game motivational elements proposed by Hou (2016). All of the above scales were evaluated using a five-point Likert scale. The self-reported questionnaire collected data on realism and usage effectiveness based on the characteristics of the GPT-based NPC and historical learning outcomes in this study.

Figure 1: Game Format and NPC Interaction Interface

Results and Discussions

In the quantitative questionnaire section of this study, a one-sample Wilcoxon signed-rank test was used to analyze. Table 1 shows that the overall flow (M=4.19) is significantly higher than the median of the scale (i.e., 3), indicating that the design of this study provided learners with clear goals, appropriate difficulty, and a high sense of self-mastery, thereby fostering a high flow experience and encouraging active participation. Game anxiety (M=2.80) did not significantly differ from the median of the scale (i.e., 3), suggesting that the study design created a moderate level of anxiety during the learning process. Game acceptance (M=4.08) was significantly higher than the median of the scale (i.e., 3), indicating that the game is easy to engage with and helps users develop online information skills. Additionally, game elements (M=4.19) were significantly higher than the median of the scale (i.e., 3), suggesting that the study design allowed learners to feel a sense of control while incorporating a degree of uncertainty and challenge, which made the game enjoyable. Participants also reported a sense of achievement upon completing levels and expressed a willingness to experience similar games in the future.

Table 1: Flow and Activity Anxiety and Game Acceptance Descriptive Statistical Analysis

Dimension	*M*	*SD*	*Z*	Sig.
Overall Flow	4.19	0.62	3.62***	0.000
Flow antecedents	4.18	0.65	3.52***	0.000
Flow experience	4.20	0.64	3.58***	0.000
Game Anxiety	2.80	0.82	-1.11	0.266
Game Feedback	4.08	0.49	3.52***	0.000
Game Usefulness	3.93	0.64	3.45**	0.001
Game Ease of Use	4.27	0.63	3.54***	0.000
Game Elements	4.19	0.65	3.64***	0.000

**$p < 0.01$, ***$p < 0.001$

In the self-reported questionnaire section, as shown in Figure 2 and 3, regarding the realism of NPC dialogue, 41.8% of participants felt that it resembled a real person, while 11.76% mentioned that it was similar to other AIs but still felt like conversing with a human. They noted that the responses were more emotional, less rigid, and did not reveal all the answers at once, prompting further inquiries. In terms of providing informational support, 76.47% reported that the NPC was helpful in the information search process, such as by answering with relevant details (who, when, where, what), offering related keywords, and helping to narrow down the scope of clues. During gameplay, 70.59% indicated that with the help of NPC Xiao-Rou, they could conduct information searches more quickly and efficiently focus on relevant data. Additionally, 70.59% of participants mentioned that the game enhanced their understanding of Tainan's history during the Japanese colonial period, motivating them to explore the bustling locations, historical events, architecture, and streets of Tainan at that time, thus contributing positively to their learning.

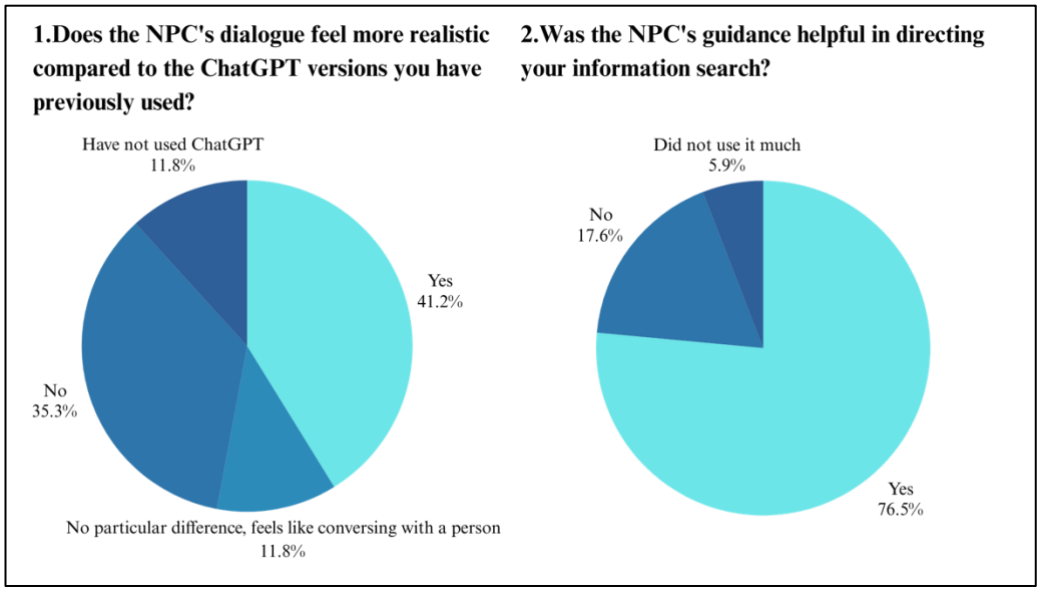

Figure 2: Responses of Participants in the Self-Reported Questionnaire

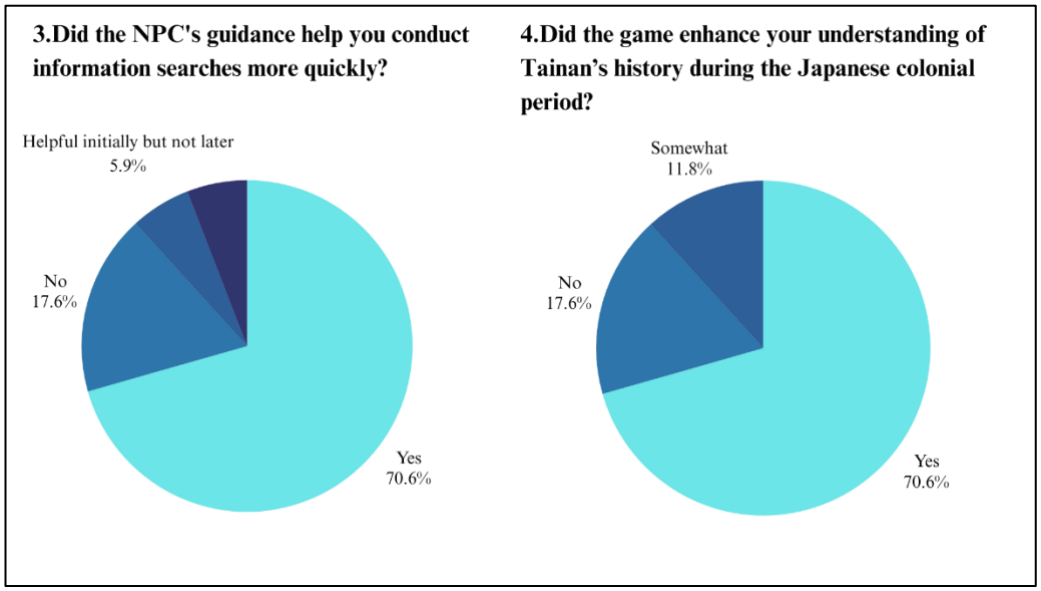

Figure 3: Responses of Participants in the Self-Reported Questionnaire

Conclusions and Limitations

"The Disappearance of Bi-Ting" is a history-themed problem-solving game, based on situational storytelling and GPT-based NPCs designed to minimize off-topic responses. Players use textual clues and interact with the NPC to gradually gather and focus on relevant information, fostering participants' information-gathering skills. Data analysis reveals significant differences in flow state and game acceptance, suggesting that the problem-solving game, which integrates realistic storytelling and GPT-based NPCs, not only enhances learners' gaming experience and flow but also improves their ability to utilize information effectively. Additionally, anxiety levels did not reach statistical significance, indicating that the study did not induce excessive or inadequate activity-related anxiety among participants. This approach can serve as a model in designing educational games. The study's historical knowledge problem-solving game was reported by learners to be beneficial for understanding local historical culture.

Future research will employ a quasi-experimental design to compare the effects on learners between an experimental group using GPT-based NPCs and a control group (two participants per group engaging in online text discussions without GPT-based NPCs).

Acknowledgments

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Contact email: hthou@mail.ntust.edu.tw

Implementation of EMI in Taiwan's Higher Education: Exploring Students' Perspective on the Challenges and Their Needs

Chen-An Chang, National Chengchi University, Taiwan
Shan-Yun Huang, National Taiwan University, Taiwan
I-Jan Peng, National Taiwan University, Taiwan

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Abstract
Taiwan's recent bilingual education policy has driven universities to promote English-medium instruction (EMI) courses. While research has explored teacher perspectives on EMI implementation, student experiences remain understudied. This quantitative study addresses this gap by investigating the perceptions and self-reported experiences of 1,137 Taiwanese Mandarin-speaking university students enrolled in EMI courses, whose first language is Taiwanese Mandarin only. This research sheds light on student preferences, challenges, and learning needs in EMI courses. By highlighting these aspects, the study aims to inform instructors on how to effectively plan and deliver EMI instruction while providing appropriate learning resources aligned with students' varying English abilities.

Keywords: English-Medium Instruction (EMI), Students' Perception and Experience, Quantitative Study

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Introduction

In line with global trends in politics and economics (National Development Council, 2018; Hsu, 2021), Taiwan has developed its bilingual education policy, known as the Bilingual Policy 2030. The primary objectives of this policy are to "raise the nation's international perspective" (National Development Council, 2018, p. 2), "spur national economic prosperity" (National Development Council, 2018, p. 6), and "enhance young people's English communication skills" (National Development Council, 2018, p. 1). To support these goals, Taiwan's Ministry of Education (MOE) launched the Program on Bilingual Education for Students in College (BEST Program) in 2021, establishing two specific targets for higher education students (Ministry of Education, 2020):

I. Goals of BEST Program

a. 50% of undergraduate students acquire an English proficiency equivalent to CEFR B2 before entering their sophomore year
b. 50% of credits earning from EMI classes for second-year and first-year graduate students

To achieve this goal, higher education institutions in Taiwan, supported by the BEST Program, have introduced English as a Medium of Instruction (EMI) courses. These courses aim to immerse students in an English-speaking environment, facilitate the acquisition of technical vocabulary, and foster disciplinary literacy. Since the implementation of EMI courses in 2021, limited research has explored students' learning preferences, challenges, and needs under this new language policy. To address this gap, we conducted a quantitative study to evaluate students' perceived challenges, learning strategies, and preferred support or resources for EMI courses.

This paper is structured as follows: first, it reviews the existing literature on EMI in Taiwan, identifies research gaps, and highlights the significance of the present study. It then outlines the quantitative study conducted with students at National Taiwan University and examines the findings, with a focus on variations in students' English proficiency levels. Finally, the paper concludes by summarizing the key insights and offering recommendations for instructors to design and adapt EMI courses to better meet students' needs.

Literature Review

Recent studies on bilingual education in Taiwan can be categorized into three areas: course development and pedagogical skills (e.g., Chen et al., 2020; Lin, 2016), challenges and arrangements from teachers' perspectives (e.g., Graham et al., 2021; Graham & Yeh, 2023), and concerns regarding language policy (e.g., Chen & Lin, 2021; Hsu, 2021; Ngangbam, 2022; Ferrer & Lin, 2021; Huang, 2021; Chou & Ching, 2012; Tsou, 2021; Wang, 2021; National Development Council, 2018, 2021).

While these studies shed light on teachers' and scholars' perspectives, they often neglect students' actual experiences with the policy. This oversight creates a critical gap, as understanding students' challenges is essential for educators to refine EMI course design and for policymakers to make the language policy more practical for classroom implementation. Addressing this gap forms the core motivation for our study. In the following subsection, we present our research objectives and questions, highlighting the significance of our work.

Research Objectives, Questions & Its Significance

This research has two primary objectives: to identify the challenges students face in EMI courses and to determine the types of learning support they prefer from instructors. To achieve these goals, we formulated the following research questions:

II. Research Questions

a. What are students' expectations when enrolling in EMI courses?
b. What are students' preferences regarding course activities?
c. What are students' actual experiences in EMI courses?

These questions address students' perspectives at different stages of their engagement with EMI courses: before enrollment, during the courses, and after completion. The first question examines whether students enroll in EMI courses primarily for content learning or to improve English proficiency. The second explores activities instructors could apply to enhance learning experiences. The third investigates challenges faced during the courses and the types of support students find most beneficial.

While teachers and institutions are key to implementing the Bilingual Policy 2030, students play an equally critical role in the success of EMI classrooms. This study examines students' expectations, preferences, and challenges, offering both practical and theoretical contributions. The findings aim to support the development of more inclusive, student-centered bilingual education policies and equip educators with evidence-based strategies to adapt their teaching practices, ultimately enhancing learning outcomes. Finally, this research contributes to global discussions on bilingual education by offering comparative insights for regions pursuing similar policies and bridging the gap between institutional objectives and classroom realities.

Current Study

This section presents a quantitative study that investigates the challenges students encounter in EMI courses and the types of support they prefer. The study is structured as follows: the first subsection outlines the research design and method, the second details the procedures, and the third presents the results.

Design & Method

To address the research questions, this study organizes its survey questions into four main categories: students' backgrounds, expectations for EMI courses, preferences for course activities, and actual experiences in EMI courses, represented as (1), (2), (3), and (4), respectively. Categories (2), (3), and (4) align directly with the research questions outlined earlier, with specific questions tailored to each category.

(1) Student's backgrounds:

a. Which degree am I in?
b. Which college am I from?
c. Which year of study am I in?
d. What is my English proficiency level on the CEFR scale?
e. What is/are my native language(s)?

(2) The expectations of taking EMI courses:

a. What was my expectation of this course before I signed up? (single-select)
b. How confident am I in using English to take this course? (single-select)

(3) The preference for activities in courses:

a. Irrespective of the language of the course, to me, what is the most interesting activity? (single-select)
b. In this course, the most interesting activity for me is? (single-select)

(4) The actual experiences in EMI courses:

a. What am I most worried about using English in this course? (multi-select)
b. Among all the EMI courses (not English language learning courses) I took, what methods can assist me in comprehending the course material most effectively? (single-select)
c. Considering this course is mediated in English, I would appreciate it if my instructor could provide me with the following learning support or resources. (multi-select)

Note that this study specifically focuses on the perspectives of Taiwanese students whose mother tongue is exclusively Taiwanese Mandarin. To ensure the validity of the data, question (1-e) serves as a control measure.

Procedure

The data for this questionnaire study was collected via Google Forms, requiring all participants to complete the survey in full. A total of 1,373 students participated, incentivized by a lottery offering multiple rewards. Of these, 1,175 identified Taiwanese Mandarin as their sole native language, while the remaining 198 were either bilingual in Taiwanese Mandarin and English or non-native speakers of Taiwanese Mandarin.

Results

This section presents the results of the collected data. As our research focuses on university students whose native language is exclusively Taiwanese Mandarin, we analyze and report the findings from the 1,175 participants in this category. For clarity, the results are presented according to the categories outlined earlier. We begin with the findings from category (1).

Results of Category (1)—Student's Backgrounds.

The first question (1-a) asked students about their level of study. Among the 1,175 Taiwanese Mandarin-speaking students, 886 were undergraduates, 251 were graduate students, and 38 were PhD candidates. The proportions for each group are illustrated in Figure 1.

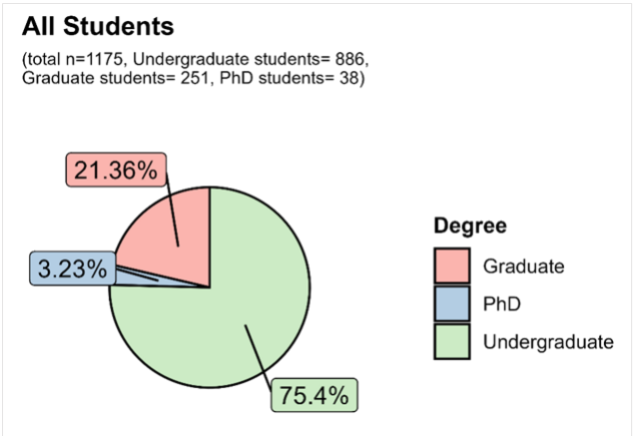

Figure 1: The Results of (1-a), *"Which degree am I in?"*

Figure 1 shows that the majority of participants in this study are undergraduates. Note that course designs for undergraduates and graduates in Taiwan often differ significantly: undergraduate courses are typically lecture-based, while graduate courses are more likely seminar- or colloquium-based. To ensure accurate representation of students' opinions and needs, the data from this study are analyzed separately by degree level.

The data from PhD students, due to their negligible proportion compared to undergraduates and graduates, are excluded from specific analysis to avoid bias. We begin by examining the undergraduate participants, starting with their colleges, as shown in Figure 2.

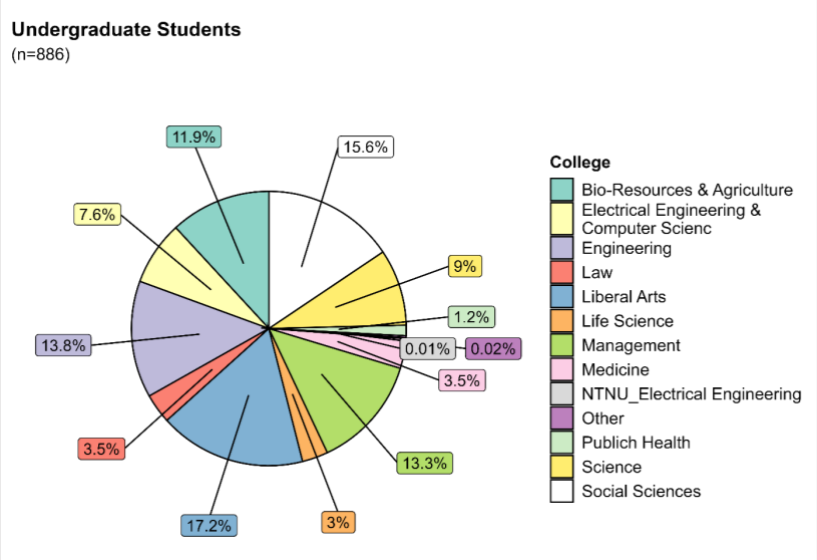

Figure 2: Undergraduate Students' Result of (1-b),
"Which college am I in? "

Figure 2 reveals that undergraduate students represent a diverse range of colleges. However, the majority of participants are concentrated in five colleges: Liberal Arts, Engineering, Bio-Resources & Agriculture, Management, and Social Sciences.

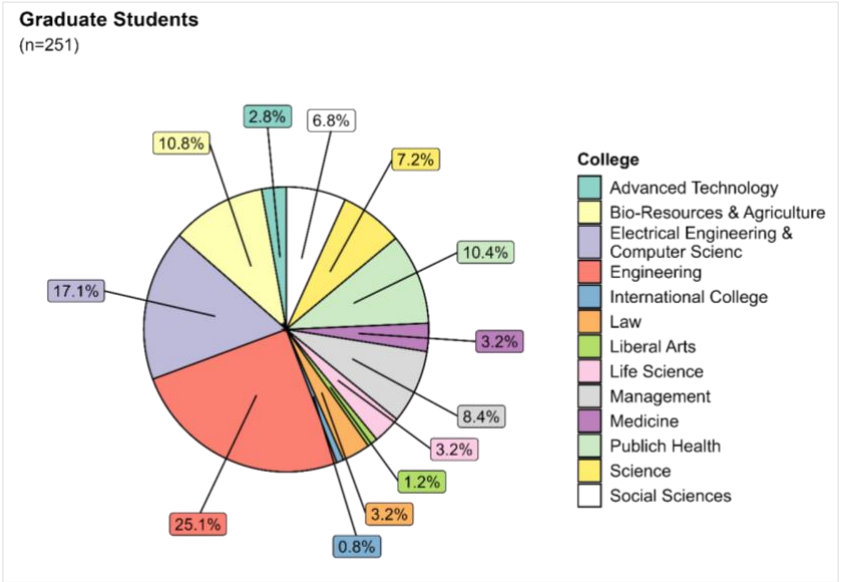

Figure 3: Graduate Students' Result of (1-b),
"Which college am I in?"

Figure 3 shows that graduate students come from various colleges. Unlike undergraduates, the majority of graduate participants are from the College of Engineering, comprising over one-quarter of the sample. Other significant groups include students from the College of Electrical Engineering & Computer Science (17.1%), College of Bio-Resources & Agriculture (10.8%), College of Advanced Technology (10.4%), and College of Social Sciences (8.4%).

Next, students were asked about their year of study. Figures 4 and 5 present the results for undergraduates and graduates, respectively. Among undergraduate participants, 28.5% are freshmen, 34.4% sophomores, 18% juniors, and 18.9% seniors or higher. The distribution of undergraduates across years of study is relatively balanced.

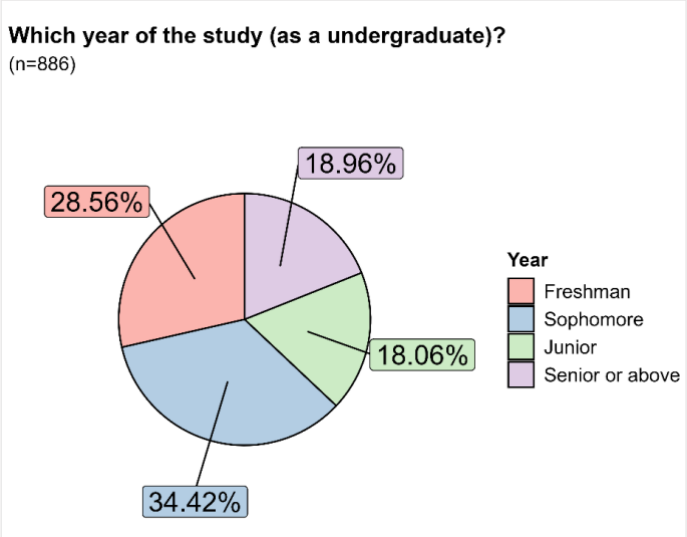

Figure 4: Undergraduate Students' Result of (1-c),
"Which year of the study am I in?"

In contrast to undergraduates, the data collected from graduate students in their third or fourth year of study is minimal. This is expected, as graduate programs typically require 18 months to two years of full-time study. As shown in Figure 5, the majority of graduate participants are first-year students (71.3%), while second-year students comprise 25.5%, accounting for over a quarter of the graduate sample.

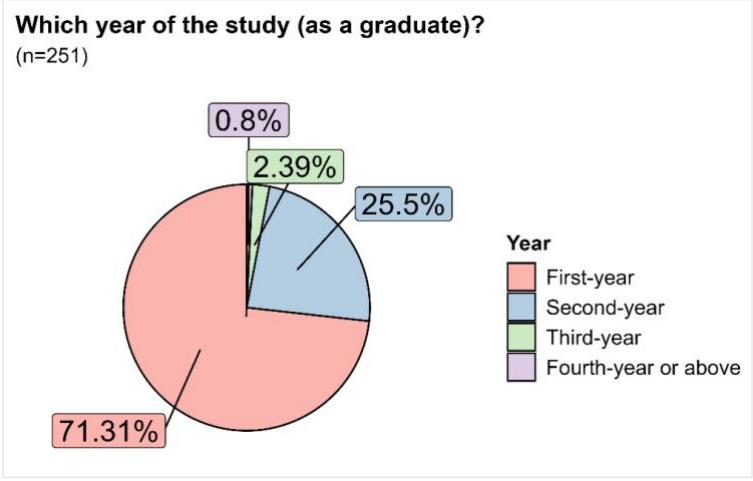

Figure 5: Graduate Students' Result of (1-c),
"Which year of the study am I in?"

The final question in category (1) assessed students' English proficiency using the Common European Framework of Reference for Languages (CEFR) scale. Figure 6 presents the results for undergraduate and graduate students.

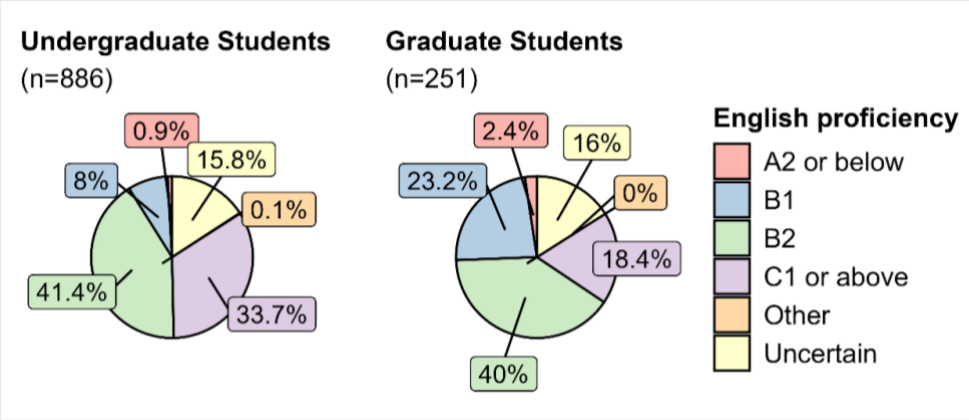

Figure 6: Undergraduate and Graduate Students' rResult of (1-d),
"What is my English proficiency level?"

Figure 6 shows that 33.7% of undergraduate students are at the C1 level or higher, while 41.4% are at the B2 level. This indicates that most undergraduates at National Taiwan University possess upper-intermediate to advanced English proficiency. In comparison, graduate students' English proficiency is slightly lower. Only 18.4% of graduate students are at the C1 level or higher, while 23.2% are at the B1 level. This suggests that graduate students generally have intermediate to upper-intermediate proficiency.

Results of Category (2)—Expectation of Taking EMI Courses.

Next, we examine students' expectations for taking EMI courses, the second category of this study. The first question in this category explores students' expectations prior to enrolling in the courses, with the results shown in Figure 7.

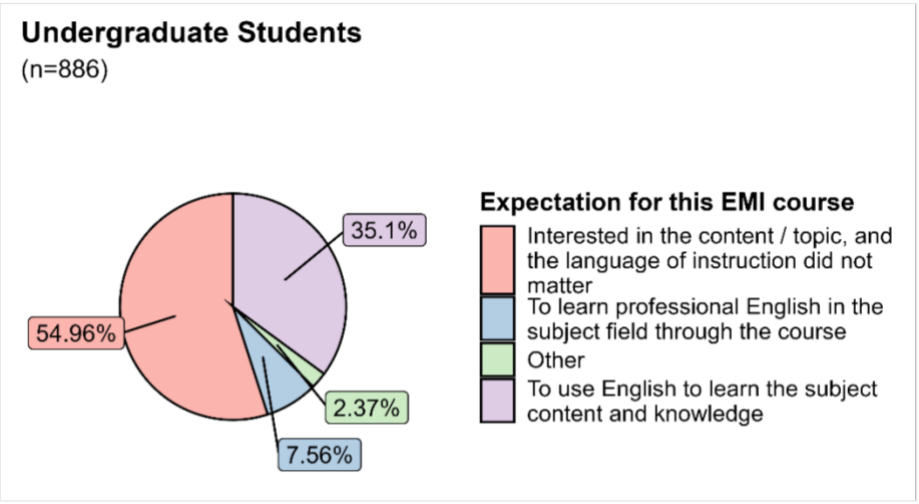

Figure 7: Undergraduate Students' Result of (2-a),
"*What was my expectation of this course before I signed up?*"

Figure 7 shows that over half of undergraduate students prioritize the content or topic of the EMI course, with the language of instruction being largely irrelevant to them. In contrast,

35.1% of undergraduates express a desire to use English as a medium for learning subject content and knowledge. Only 7.5% aim to develop professional English skills specific to their field of study, while 2.4% mention other reasons.

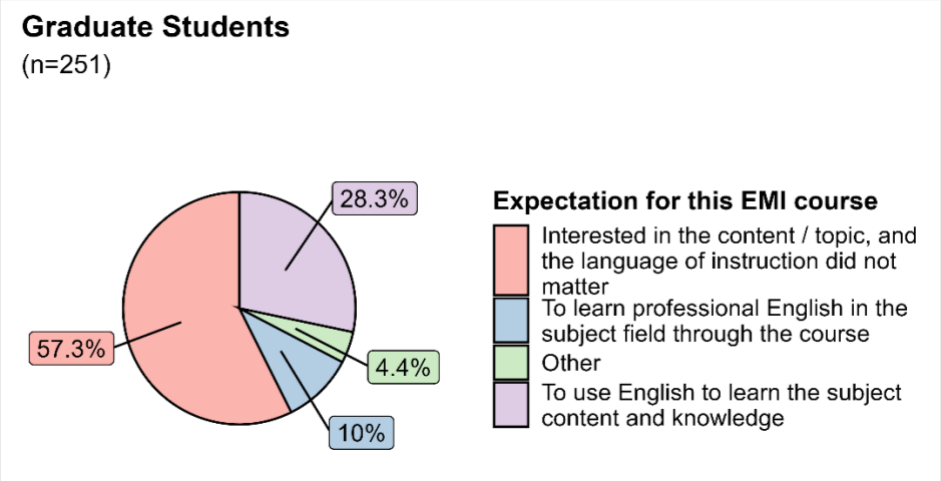

Figure 8: Graduate Students' Result of (2-a),
"*What was my expectation of this course before I signed up?*"

The results for graduate students in question (2-a) are similar to those of undergraduates. As shown in Figure 8, 57% of graduate students take EMI courses primarily out of interest in the content or topic, while 28.3% aim to use English to learn subject content and knowledge. Only 10% expect to acquire professional English specific to their field.

The final question in (2-b) explores students' confidence in using English to take EMI courses. The results are presented in Figure 9.

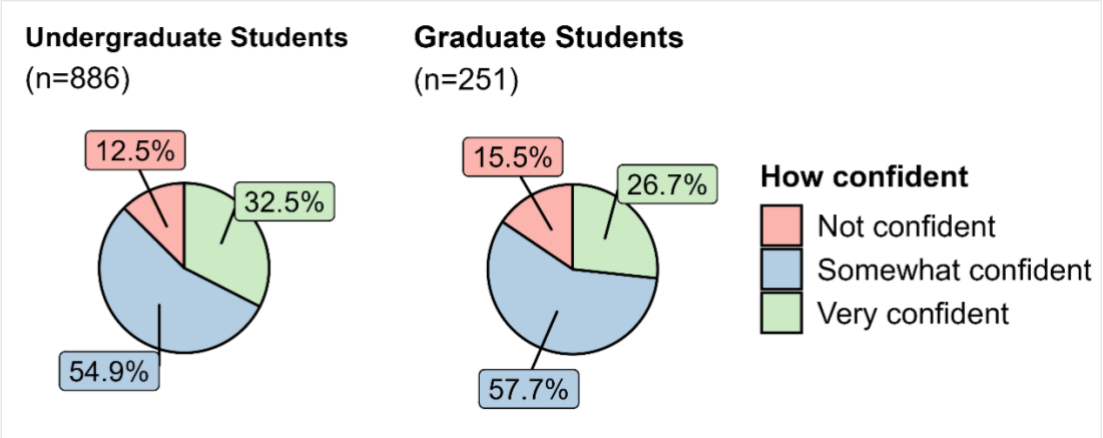

Figure 9: Undergraduate and Graduate students' Result of (2-b),
"*How confident am I in using English to take this course?*"

The results indicate that more than half of undergraduate and graduate students are somewhat confident in using English for EMI courses (54.9% and 57.7%, respectively). While 32.5% of undergraduates are very confident, the percentage is lower among graduates, with only 26.7% reporting high confidence. However, a notable portion of students lack confidence entirely, with 12.5% of undergraduates and 15.5% of graduates indicating no confidence at all.

Results of Category (3)—Preference for Activities in Courses.

Beyond exploring students' expectations for EMI courses, we also examined their preferences for course activities. The first question in this category (3-a) asks about the most interesting activities, regardless of the course language. Figure 10 presents the results for undergraduate students, revealing clear preferences. The top three activities are group discussions (30.7%), applying course content to real-life scenarios (27.4%), and midterm/final projects, essays, or displays (17.5%).

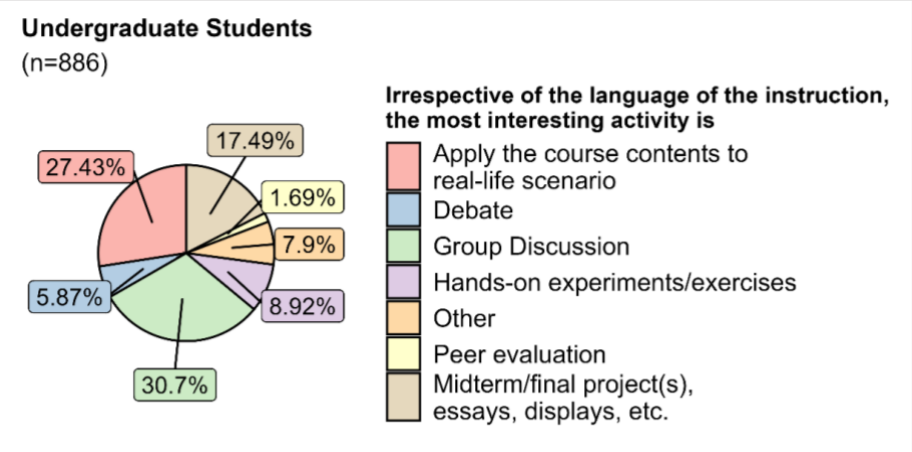

Figure 10: Undergraduate Students' Result of (3-a),
"*Irrespective of the language of the course, to me, what is the most interesting activity?* "

Similarly, graduate students identified group discussions (26.3%), midterm/final projects, essays, or displays (25.9%), and applying course content to real-life scenarios (23.5%) as the most interesting activities, as shown in Figure 11. These results highlight that debate and peer evaluation are the least preferred activities among both undergraduate and graduate students.

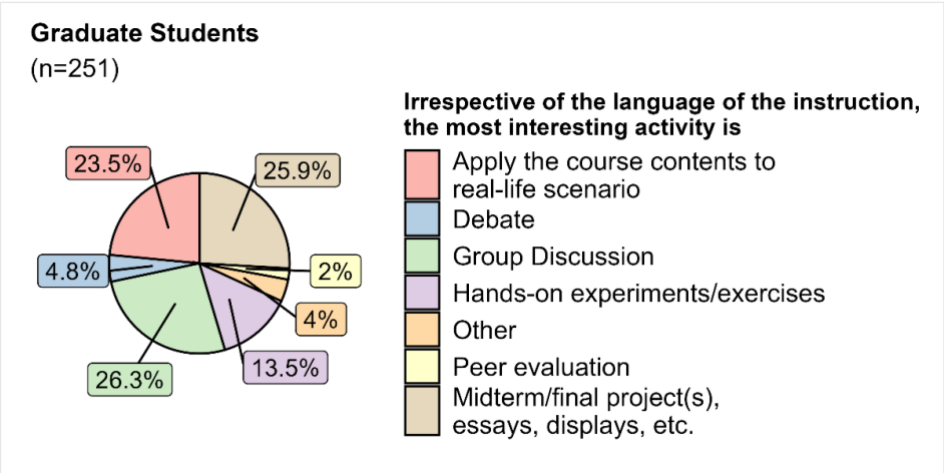

Figure 11: Graduate Students' Result of (3-a),
"*Irrespective of the language of the course, to me, what is the most interesting activity?*"

We also examined whether students' activity preferences change when courses are delivered in English. Comparing Figure 10 (undergraduates' preferences regardless of the language of

instruction) with Figure 12 (preferences in EMI courses), no notable differences in activity preferences were observed for undergraduate students.

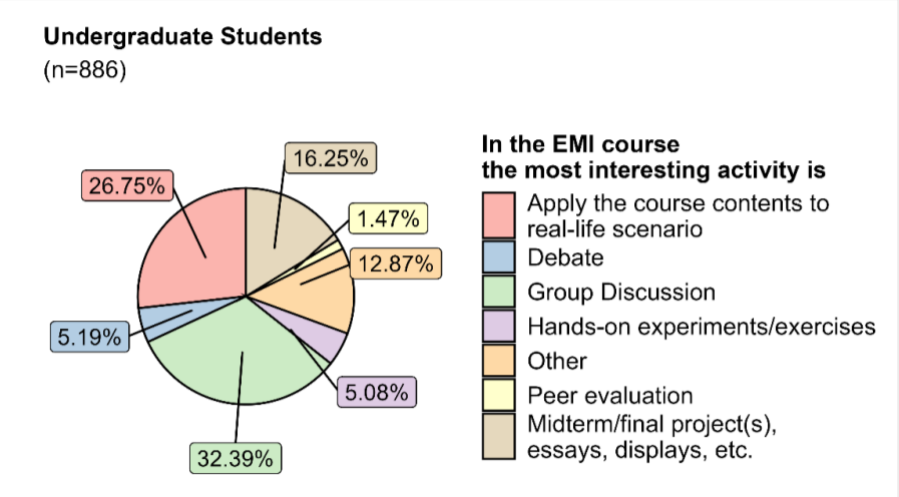

Figure 12: Undergraduate Students' Result of (3-b),
"*In this course, the most interesting activity for me is?*"

Similarly, we investigated the most interesting activities for graduate students and whether their preferences differ in EMI courses. The results are presented in Figure 13.

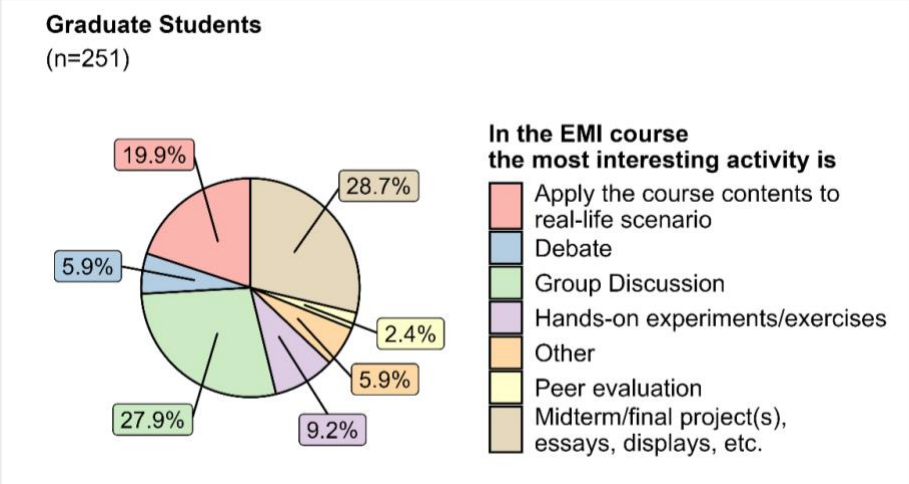

Figure 13: Graduate Students' Result of (3-b),
"*In this course, the most interesting activity for me is?* "

Figure 13 shows that for graduate students, group discussions remain the most favored activity. However, midterm projects, essays, and displays emerge as the second most preferred activity, differing from undergraduate preferences. This may reflect graduate students' need for tangible achievements, given their advanced theoretical knowledge.

When we compare the graduate results of (3-a) and (3-b), we find no significant differences. This indicates that the language of instruction does not influence students' activity preferences.

Results of Category (4)—Actual Experiences in EMI Courses.

Finally, we examine students' actual experiences in EMI courses. The first question in this category (4-a) addresses concerns about using English in EMI courses. As a multi-select question, the results for undergraduate students are presented in Figure 14.

Only 22% of students express concerns about reading course materials and assigned papers in English. However, understanding course content delivered in English (42%) and asking questions or participating in discussions in English (38%) are notable areas of concern. Conversely, giving presentations in English (22.5%), taking exams in English (15%), and completing assignments in English (15%) seem to pose fewer challenges for students.

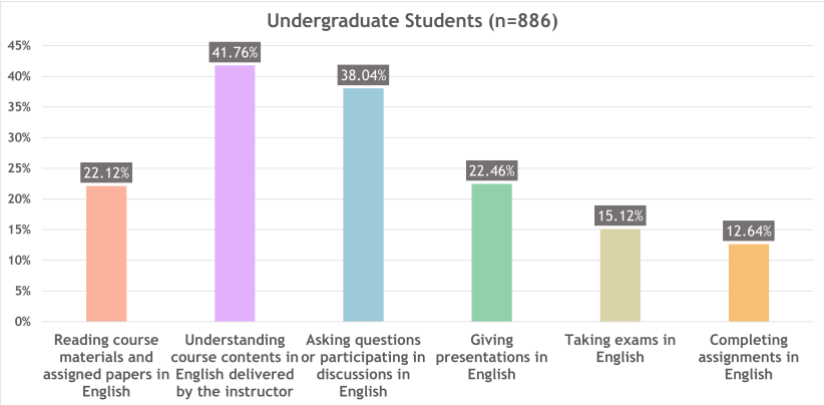

Figure 14: Undergraduate Students' Result of (4-a),
"What am I most worried about using English in this course?"

In contrast to undergraduate results, Figure 15 reveals that graduate students report lower levels of concern regarding reading course materials and assigned papers in English (11.2%), taking exams in English (6.4%), and completing assignments in English (10.8%). However, like undergraduates, graduate students express significant concerns about understanding course content delivered in English (40.6%) and asking questions or participating in discussions in English (41.4%). Notably, concerns about giving presentations in English are higher among graduate students (30.3%) compared to undergraduates. This may be attributed to the seminar- or colloquium-based nature of graduate courses, often requiring students to present in class.

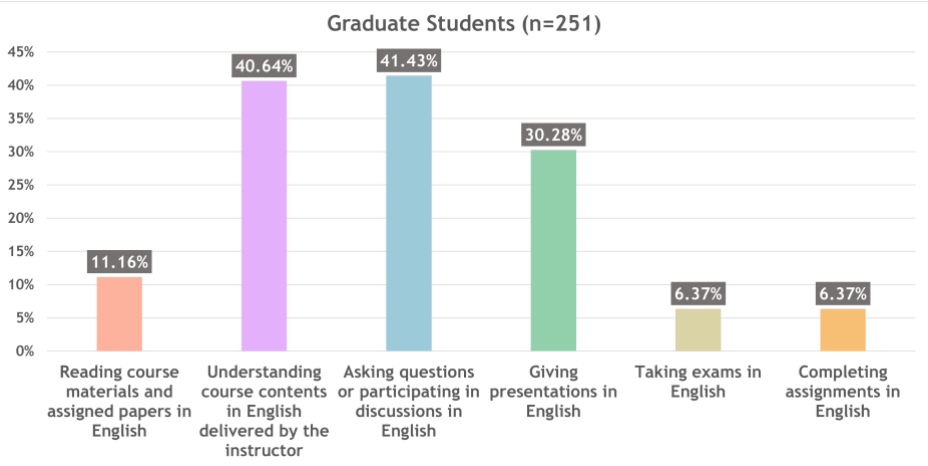

Figure 15: Graduate Students' Result of (4-a),
"What am I most worried about using English in this course?"

To better understand how students effectively comprehend course material in EMI courses, we analyzed undergraduate responses, as shown in Figure 16. The most effective method identified is using supplementary materials, accounting for 38.5% of responses. Taking notes is the second most effective method, favored by 25.6% of students. Interacting in pairs or small groups (16%) and asking questions (14.3%) also contribute to better comprehension. Conversely, discussing course content with TAs was deemed least helpful, with only 4% of students selecting this option.

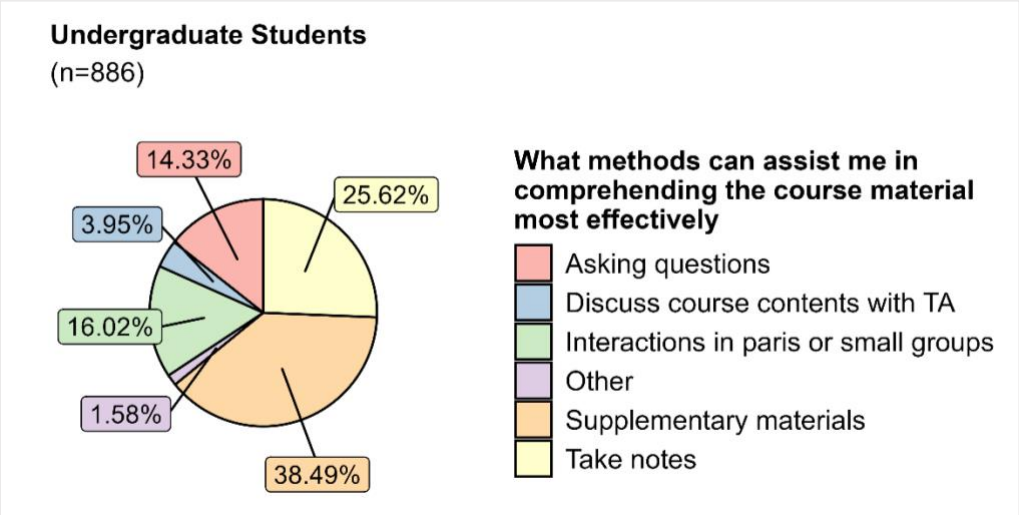

Figure 16: Undergraduate Students' Result of (4-b),
"Among all the EMI courses I took, what methods can assist me in comprehending the course materials most effectively?"

For graduate students, the most effective method for understanding course content mirrors undergraduate results, as shown in Figure 17. Supplementary materials remain the most preferred method, comprising 37.4% of responses. Other effective strategies include taking notes (21.5%), interacting in pairs or small groups (20.3%), and asking questions (16.3%). Similar to undergraduates, discussing course content with TAs is deemed least effective, with only 3.2% of graduate students selecting this option.

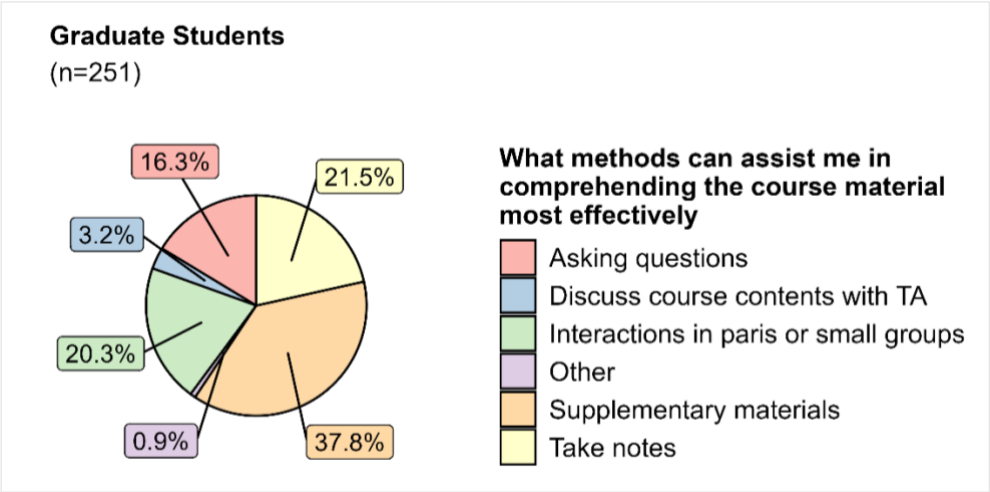

Figure 17: Graduate Students' Result of (4-b),
"Among all the EMI courses I took, what methods can assist me in comprehending the course materials most effectively?"

The final question in the questionnaire explores the types of learning support or resources students would like from their instructors. Figures 18 and 19 present the results for undergraduate and graduate students, respectively. This question allowed multiple selections.

As shown in Figure 18, nearly half of undergraduate students prefer a glossary of course terminology (44.9%) and supplementary materials for preview or review (34.7%). Furthermore, 32.6% value instructors providing relevant prior knowledge. In contrast, only 22.2% of students consider tutorials or counseling with EMI teaching assistants helpful.

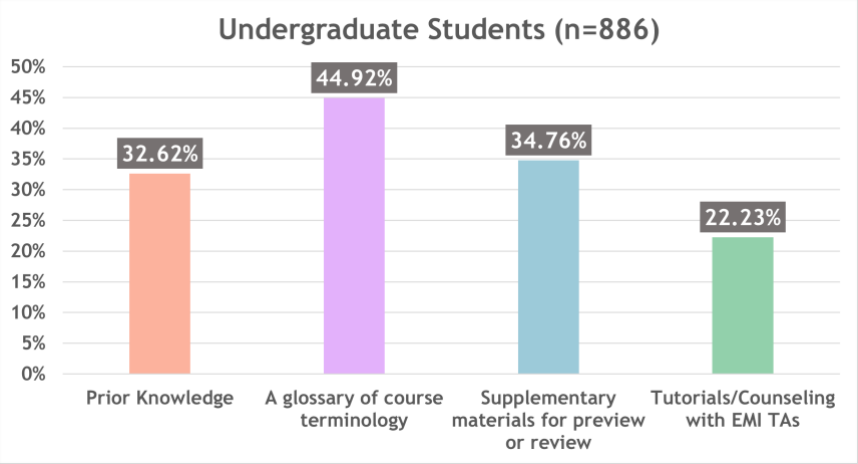

Figure 18: Undergraduate Students' Result of (4-c),
"Considering this course is mediated in English, I would appreciate it if my instructor could provide me with the following learning support or resources."

When we examine the results for graduate students, as shown in Figure 19, nearly half (49%) identify supplementary materials as a key resource for their learning. In contrast, only 20.7% find tutorials or counseling with EMI teaching assistants helpful. Compared to undergraduates, a higher proportion of graduate students (42.6%) value the provision of prior knowledge, while fewer (29.5%) prioritize a glossary of course terminology. This difference is unsurprising, as graduate courses typically require a stronger foundation of background knowledge, and graduate students are generally more familiar with field-specific terminology from their undergraduate studies.

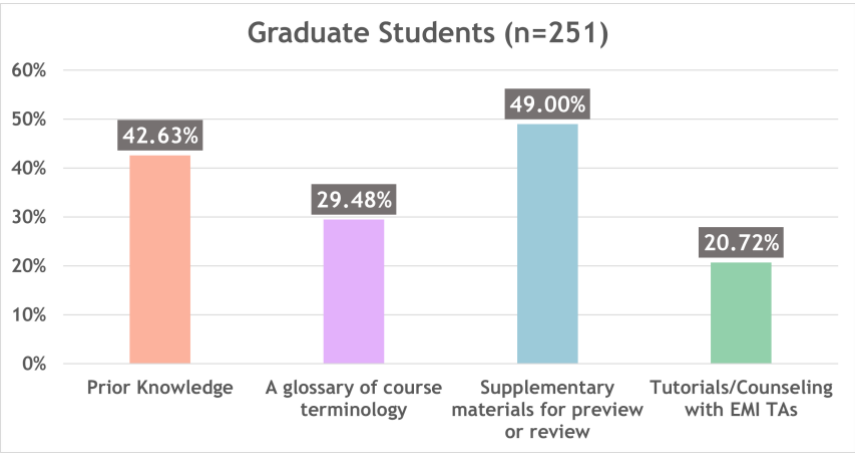

Figure 19: Graduate Students' Result of (4-c),
"Considering this course is mediated in English, I would appreciate it if my instructor could provide me with the following learning support or resources."

Summary of Results

The key results of this questionnaire study are summarized below.

1. Most undergraduates have upper-intermediate to advanced proficiency, while most graduate students are at an intermediate level.
2. The primary motivation for both undergraduates and graduates is interest in course content or topics, regardless of the language of instruction.
3. Over half of both undergraduate and graduate students are somewhat confident in using English for EMI courses.
4. Undergraduates favor group discussions and applying course content to real-life scenarios, while graduates prefer midterm/final projects, essays, displays, and group discussions.
5. Both undergraduates and graduates are most concerned about understanding course content delivered in English and engaging in discussions or asking questions. In addition, nearly one-third of graduate students also worry about giving presentations in English.
6. Both undergraduates and graduates find the following most effective:
    - Supplementary materials
    - Taking notes
    - Asking questions
7. Undergraduates value a glossary of course terminology and supplementary materials, while graduates prioritize supplementary materials and prior knowledge.

Data Analyses & Discussions

Given that English proficiency plays a critical role in students' ability to succeed in EMI courses, we conducted a further analysis to examine whether challenges and needs differ based on proficiency levels. In this section, the results are grouped according to students' English proficiency as defined by the CEFR. Data from students who were uncertain about their proficiency level were excluded, resulting in a total of 983 valid responses. Among these, 16 students were at A2 level or below, 131 at B1 level, 486 at B2 level, and 350 at C1 level or above.

Data Analyses

The first issue we address is students' confidence in using English in EMI courses. We hypothesize that students with intermediate or lower English proficiency are less confident in EMI courses compared to those with upper-intermediate or advanced proficiency. To examine this assumption, we present the data in Figure 20.

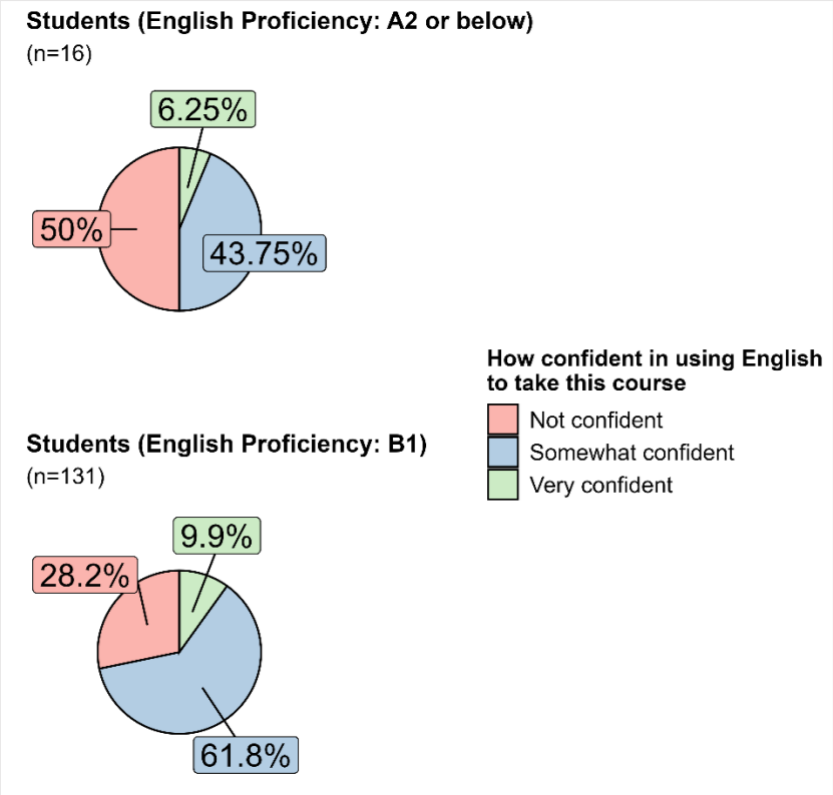

Figure 20: Pre-intermediate and Intermediate Students' Confidence in Using English to Take EMI Courses

Based on the results shown in Figure 20, approximately half of the students whose English proficiency is A2 or below are not confident at all in using English for EMI courses, while the other half are somewhat confident. The data suggest that confidence significantly increases as English proficiency improves. For students at the intermediate level (i.e., B1), nearly 62% are somewhat confident. However, around 30% of B1-level students still report lacking confidence. To enhance students' confidence in taking EMI courses, higher education institutions should consider offering training courses or EMI preparation programs to help students improve their English proficiency before enrolling in EMI courses.

Another key issue is understanding students' performance in EMI courses. To address this, question (5) in the questionnaire investigates the strategies students use to comprehend course content. We are particularly interested in whether these strategies differ between students with lower and higher English proficiency. Figure 21 presents the results of question (5), categorized by English proficiency level.

(5) Among all the EMI courses (not English language learning courses) I took, what methods can assist me in comprehending the course materials most effectively?

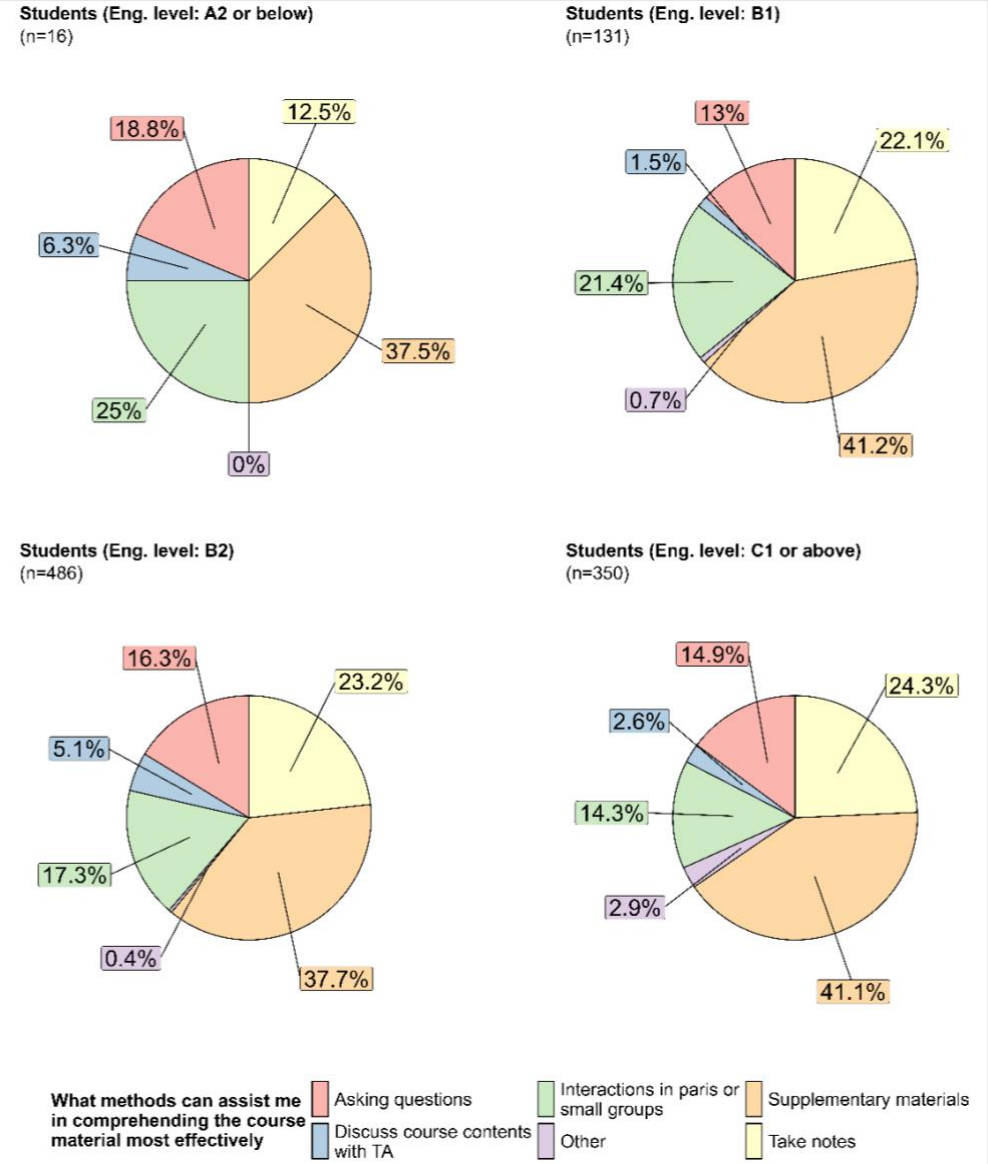

Figure 21: The Result of (5) Grouped by English Proficiency

As shown in Figure 21, the most effective method for all students, regardless of English proficiency level, is using supplementary materials. For pre-intermediate students, approximately one-fourth found pair or group interactions particularly helpful, while only about 13% considered note-taking effective. This contrasts with the results for intermediate and advanced students. It is possible that pre-intermediate students lack the proficiency needed to simultaneously listen to EMI course content and take notes, making peer discussions a more significant learning strategy for them.

In addition to examining students' strategies for coping with EMI course content, we aim to identify additional learning supports or resources that instructors could provide. This is addressed by question (6) in the study, with the results presented in Figure 22.

(6) Considering this course is mediated in English, I would appreciate it if my instructor could provide me with the following learning supports or resources (Select all that apply).

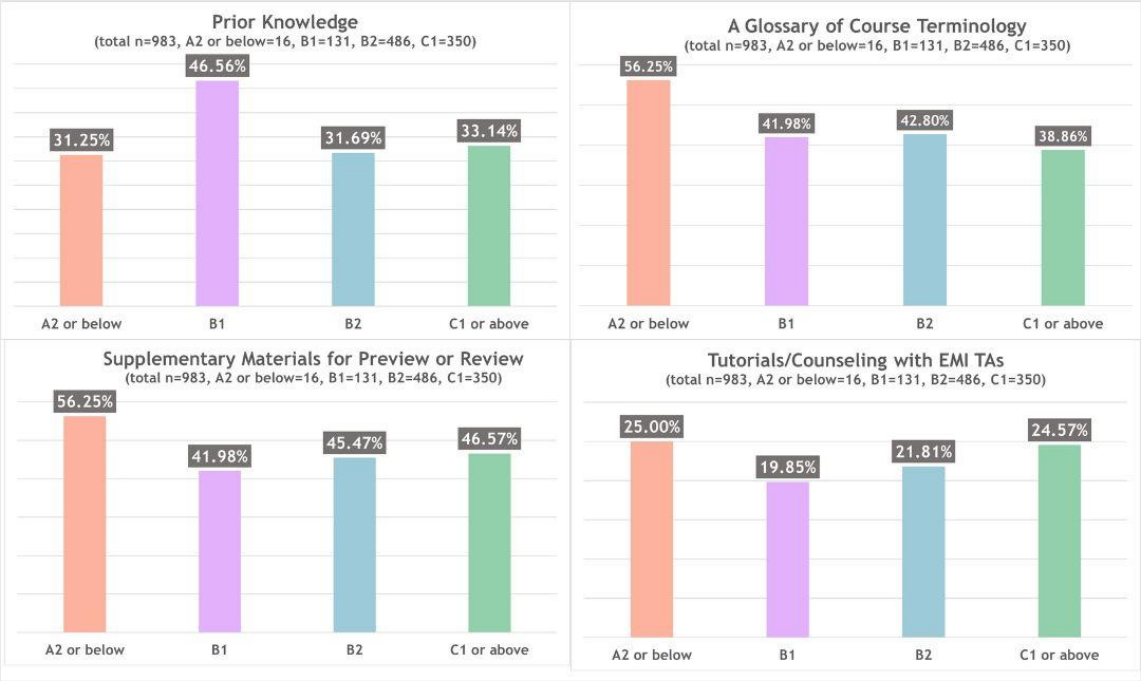

Figure 22: The Result of (6) Grouped by English Proficiency

We begin by addressing the need for prior knowledge. Approximately 30% of pre-intermediate, upper-intermediate, and advanced students reported requiring prior knowledge, with intermediate students showing an even higher need—an unexpected result.

Next, regarding the provision of a glossary of terminology, nearly 60% of pre-intermediate students found it necessary, while the need declined to around 35% among more advanced students.

Providing supplementary materials emerged as another key resource. Across all proficiency levels, at least 40% of students appreciated supplementary materials, with pre-intermediate students expressing a particularly high demand, exceeding 50%.

The final option considered was providing tutorials or counseling with EMI teaching assistants (EMI TAs). This form of support was the least favored, with only around 20% of students across all proficiency levels expressing a need for it. This finding prompts further questions about the low perceived usefulness of EMI TA support.

Two possible reasons were identified. First, in some departments, TAs are assigned limited roles, such as taking attendance or grading basic assignments, which may render them ineffective in addressing students' academic needs. Second, current TAs may lack adequate training, particularly in instructional English, as tutorials and counseling sessions are conducted in English. For instance, leading discussions in English requires specialized skills. Therefore, similar to instructors, TAs must undergo targeted training to effectively support students in EMI contexts.

Lastly, we aim to understand students' concerns about using English in EMI courses, which is addressed by question (7) in the study. This question is particularly significant, as it allows us to consider how instructors might help alleviate students' anxiety about using English in these

courses. The results of question (7), categorized by students' English proficiency, are presented in Figure 23.

(7) What am I most worried about using English in this course (Select all that apply).

Figure 23: The Result of (7) Grouped by English Proficiency

Based on the results in Figure 23, it is evident that reading course materials and assigned papers in English, as well as taking exams in English, are not significant concerns for students, regardless of their English proficiency level. These findings are unsurprising, as students are likely to have anticipated and prepared for these common requirements when opting to enroll in EMI courses.

Next, we examine the results concerning students' ability to understand course content delivered in English by instructors. It is important to clarify that this focus is on the delivery of content in English, not the content itself. Over half of pre-intermediate and intermediate students expressed concerns about this issue, with the figure only slightly declining to around 45% for upper-intermediate students—a level we still consider significant. This finding shows the critical role of instructors' instructional English proficiency and pedagogical skills in EMI teaching. On one hand, better instructional English is believed to enhance students' comprehension of course content. Thus, we recommend that institutions offer training in instructional English, such as formulaic expressions, to support instructors. On the other hand,

even instructors with advanced English skills may struggle to deliver content effectively when transitioning from teaching in their native language to teaching in English. This challenge suggests the need for improved pedagogical approaches. As Prabjandee and Nilpirom (2022, p. 424) argue, "Transforming monolingual disciplinary classes into EMI is not simply about changing the language of instruction; instead, it requires teachers to re-evaluate their existing pedagogy and change it to a learner-centered approach." Consequently, institutions should also prioritize workshops on teaching enhancements to help instructors adapt their methodologies to the EMI context.

Next, we examine the results related to asking questions or participating in discussions in English. Surprisingly, over 50% of students with intermediate English proficiency express concerns about this—a proportion even higher than that of students with pre-intermediate proficiency (37.5%). Notably, upper-intermediate (42.1%) and advanced-level students (29%) also report similar concerns. These findings suggest that institutions should design EMI preparation programs, focusing on enhancing students' oral communication skills.

Furthermore, when it comes to giving presentations in English, as many as 43% of pre-intermediate students express concerns about this task—a significantly higher proportion compared to intermediate or more advanced students. This outcome likely reflects the fact that presentations can be prepared and practiced in advance, whereas asking questions or participating in discussions often requires spontaneous responses. Therefore, it is crucial for students to recognize the importance of improving their English-speaking proficiency before enrolling in EMI courses.

Lastly, we note that most students are not concerned about completing assignments in English, although around 30% of pre-intermediate students express concerns. Based on this finding, we recommend that instructors offer additional support to pre-intermediate students when assigning tasks.

Discussions

In this section, we further analyze the collected data by students' English proficiency levels to identify the specific needs at each level. First, we found that as students progress from lower-intermediate to upper-intermediate English proficiency, their confidence in using English in EMI courses significantly increases. This indicates the need for adequate training to improve students' English proficiency, providing a solid foundation for successful participation in EMI courses.

In addition, we observed that supplementary materials are the most effective method for aiding course comprehension across all proficiency levels. However, for students with a proficiency level of B1 or below, pair or small group interactions also play a particularly important role.

We furthermore explored whether instructors should offer differentiated support based on students' English proficiency levels. The results show no significant differences: students across all levels value the provision of a glossary of course terminology and supplementary materials.

Finally, we analyzed students' primary concerns about EMI courses in relation to their proficiency levels. Students at the C1 level or above expressed minimal concern about

understanding course content delivered in English. In contrast, those at the B2 level or below reported significantly greater challenges with comprehension. For intermediate and upper-intermediate students, participating in questions or discussions in English emerged as a major concern. These findings highlight the importance of enhancing both listening and speaking skills for students across different proficiency levels.

Conclusion

This paper explores students' perspectives on the challenges and needs of EMI courses, drawing on data from 1,137 Taiwanese Mandarin-speaking university students. The findings reveal students' expectations, preferred activities, and actual experiences. For most students, the primary focus of EMI courses is the course content, with the language of instruction being a secondary concern. Regardless of the language used, students favor group discussions and activities that apply course content to real-life scenarios.

However, students express concerns about understanding course content delivered in English and participating in discussions conducted in English, underscoring the importance of developing listening and speaking skills in EMI contexts. Supplementary materials and glossaries of terminology are identified as valuable resources to help address these challenges.

These quantitative findings offer valuable insights into student perspectives on EMI in Taiwan’s higher education. With the EMI policy now in its third year, we recommend that future research reevaluate students' needs to determine whether adjustments are required to enhance the EMI learning environment.

Acknowledgments

This research would not have been possible without the support of the Center for Bilingual Education (CBE) at National Taiwan University (NTU). We also wish to express our gratitude to Shi-Tong Ding, Hung-Jen Wang, and Hsiao-Wei Yuan for their valuable contributions to the CBE. A special thanks goes to team members for their assistance with the questionnaire study. Finally, we extend our appreciation to all the NTU students who participated in the questionnaire, providing the data for this study. We gratefully acknowledge the funding support from the Ministry of Education of Taiwan for the NTU CBE.

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Contact email: cachang@nccu.edu.tw

Evaluation of a Financial Education Board Game Integrating Historical Contextual Events and Simulated Trading Mechanisms

Zheng-Hong Pan, National Taiwan University of Science and Technology, Taiwan
Shen-Yang Ni, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
The key to financial education is not merely financial knowledge, but more importantly, the skills of money investment and management. Without simulated financial operations and experiencing the effects of social contextual events on the market, learning transfer becomes challenging. Game-based learning provides a solution that motivates learners to engage actively, while also simulating contextual events, thus offering realistic experiences and feedback. By integrating real historical background events, learners can immerse themselves in a vivid trading scene. This immersive experience not only enhances the fun of learning but also facilitates historical empathy among learners, while simultaneously deepening their historical knowledge and financial skills. In our study, we developed a financial education board game set in 17th-century Europe, where learners played the role of the Dutchman. The game allowed learners to participate in the flower futures market, experiencing market fluctuations due to historical events and making investment decisions based on risk assessments. The empirical evaluation involving 16 participants indicated that the board game with historical contexts enabled learners to enter a state of flow and achieve focused learning. Moreover, learners found it beneficial to grasp the concepts of futures trading through the game. Furthermore, 80% of participants reported feeling immersed in the historical setting, and they were able to empathize the Dutch sentiments about the futures market at that time.

Keywords: Game-Based Learning, Situated Learning, Financial Education, Historical Empathy

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Introduction

Financial literacy is crucial in the 21st century (OECD, 2014), and improving public financial literacy has become a significant global educational priority. Financial education effectively addresses gaps in financial literacy and enhances financial decision-making (Von Gaudecker, 2015). Promoting financial education not only improves financial literacy but also guides learners in making informed financial decisions in diverse scenarios. Game-based learning provides learners with the opportunity to make decisions by simulating financial operations and experiencing the impact of social contextual events on the market, thereby fostering decision-making skills and shaping positive financial attitudes. However, games can be overly engaging, sometimes causing learners to prioritize entertainment over educational objectives. Some games may be too complex or disconnected from real life, diverting learners' attention from the intended learning content. Previous research suggests that effective learning games integrate content knowledge into gameplay (Ke, 2016). Learning games should provide structured problem-solving experiences that facilitate knowledge and cognitive development applicable beyond the game context. According to Habgood and Ainsworth (2011), a game's educational value lies in its core game mechanism, with learning elements integrated into engaging gameplay.

In this study, we developed a financial education board game set in 17th-century Dutch history, where learners played the role of Dutchman. The game allows learners to engage in a flower futures market, draw event cards reflecting the effects of historical events on market volatility, and assess the risks of futures trading. The game mechanism is repeated in a turn-based manner, and each turn is divided into the following four stages:

(1) Information search - players can use their mobile phones to search for market information and clues as a reference for investment targets. This will help players enter the futures market and make early arrangements, as shown in Figures 1 and 2.
(2) Commodity trading - players can freely choose to buy and sell spot goods and futures, or hand over the spot goods to historical figures to complete tasks and earn rewards. The narrative of historical figures is also one of the clues in the game, as shown in Figure 3.
(3) Events occurring - fluctuations in flower market prices will be affected by wars or economic events in the 17th-century Netherlands. Players cannot predict whether a war or an economic event is about to happen, which will make the flower market full of uncertainty, as shown in Figure 4.
(4) Price Settling - players who invest in futures will experience gains and losses based on the fluctuations in futures prices.

Competition is a crucial element in a play-and-learn environment, as the decisions of other players can influence individual choices and judgments regarding the investment market. The player with the most funds will win the game.

Figure 1: Players Search for Information via Mobile Phones

Figure 2: Determine Future Changes in the Flower Market Through Information and Make Early Arrangements

Figure 3: Needs and Clues of Historical Figures

Figure 4: Impact of War Events and Economic Events on the Flower Market

By incorporating real historical situations and events, learners can immerse themselves in a vivid trading environment, allowing them to empathize with the decisions and emotions of historical figures in relation to the futures market. The purpose of this study is to explore learners' flow state, activity anxiety, and game acceptance in a financial education board game that combines historical contextual events, and to observe learners' experiences of historical empathy in the game. Therefore, this study poses the following two research questions:

(1) What are learners' flow state, activity anxiety, and game acceptance in games?
(2) Can learners experience historical empathy in games?

Method

The participants were 16 students in the 12th grade (9 males and 7 females) in Taiwan. We used a single-group posttest design. This study adopted the Kiili Flow Scale (2006) translated

by Hou and Li (2014) and revised into Chinese. The flow scale consists of two dimensions: flow antecedents and flow experience. The reliability (Cronbach's alpha=0.934) of the flow questionnaire showed a high degree of internal consistency. The reliability of the learning anxiety scale, assessed using the AMAS Anxiety Scale developed by Carey et al. (2017), was found to be acceptable (Cronbach's alpha=0.710). Regarding the scale used to measure learners' acceptance of games, this study adopts the technology acceptance scale proposed by Davis (1989) modified by Hou and Li (2014), which includes three dimensions: perceived usefulness, perceived ease of use, and game design elements. The Acceptance scale demonstrated high reliability (Cronbach's alpha=0.923). Historical empathy is the process by which learners engage cognitively and emotionally with historical figures in order to better understand their life experiences, decisions, and behaviors at that time. This study developed a questionnaire based on the concept of historical empathy proposed by Endacott and Brooks (2013) to observe the phenomenon of learners' historical empathy. The scholar divided historical empathy into three dimensions, namely Historical Contextualization, Perspective Taking and Affective Connection. Prior to the study, all participants were asked to sign an informed consent form. The study activities consisted of 10-minute game explanation, 60-minute game activity, and 20-minute post-test questionnaire.

Results

The Wilcoxon signed-rank test was used to analyze learners' flow, learning anxiety, and acceptance in this study, with results presented in Table 1. The findings revealed that the overall flow (M=4.26) was significantly higher than the median (median 3 on a 5-point Likert scale), indicating that the gamified activity design effectively conveyed the game's objectives to learners, prompting active engagement and resulting in a heightened flow experience. Furthermore, the overall anxiety (M=2.02) was significantly lower than the median, suggesting a reduction in anxiety among learners during gameplay. Similarly, the overall acceptance (M=4.65) exceeded the median, signifying learners' positive reception of the game's ease of use and its facilitation of understanding futures concepts and trading processes. In addition, 80% of the participants in the historical empathy questionnaire said that they were immersed in the Dutch era, empathized with people's feelings about the futures market, and deeply understood the impact and emotions brought about by the economic bubble.

Table 1: Flow, Anxiety and Acceptance Descriptive Statistical Analysis

Dimension	***M***	***SD***	***Z***	***p***
Overall Flow	4.26	0.60	3.517^{***}	.000
Flow antecedents	4.21	0.65	3.443^{**}	.001
Flow experience	4.32	0.55	3.466^{**}	.001
Overall Anxiety	2.02	0.49	-3.522^{***}	.000
Overall Acceptance	4.65	0.43	3.536^{***}	.000
Perceived Usefulness	4.75	0.34	3.591^{***}	.000
Perceived Ease of Use	4.56	0.61	3.570^{***}	.000
Game Elements	4.63	0.53	3.556^{***}	.000

$^{***}p < 0.001$; $^{**}p < 0.01$

Conclusion

This study designed a financial education board games integrating historical contextual events, enabling learners to understand the experiences of the Dutch in the 17th century. It aimed to enhance financial literacy through practical futures trading operations. Furthermore, guided by the game's context, learners can immerse themselves in the political and social atmosphere of that era, providing a first-person perspective to examine the environment of historical figures. This approach allows for a deeper understanding of the decision-making behaviors of those figures and the impact of historical events, fostering a sense of historical empathy among learners.

We adopted a single-group posttest design to analyze learners' flow state, activity anxiety, and game acceptance in a financial education board game combined with historical situations, and to observe learners' experiences of historical empathy in the game. The results showed that board games integrating historical contextual events can help learners enter a flow state, reduce anxiety, and foster a high level of acceptance for learning through board games. After preliminary analysis, this study will continue to explore learners' learning effectiveness in depth through a quasi-experimental design in the future, and explore the impact of board game learning on learners compared to video learning methods.

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Contact email: hthou@mail.ntust.edu.tw

One Program, Two Pathways: The Transformative Learning Journeys of 2 Adult Learners in Graduate School

Jennifer Poh Sim Tan, HELP University, Malaysia

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Abstract
This paper documents the transformative learning of 2 working women adult learners who returned to higher education for the Master of Education (Teaching and Learning). This graduate degree offers two different teaching and learning pathway; the traditional pathway comprising on-campus classes with 11 modules to complete and the APEL Q pathway which requires learners to complete 4 instruments instead of the 11 modules. Learners do not attend physical classes and are assigned an Advisor each who will guide the learners throughout their entire academic journey. To understand how adults learn, Knowles's (1984) Andragogy framework and Mezirow's (2000) transformative learning provide the conceptual framework. The Andragogy framework proposed a set of five assumptions i.e. the learner's making personal decisions, life experiences, readiness, orientation, and motivation to learn explains the learners' intentions for further study while Mezirow's (2000) definition of transformative learning enlightens on how both learners acquired new perspectives which lead to understanding the changes in events. Narrative inquiry was used as the research approach with questionnaire and interviews as data to answer three research questions; what are the experiences of working adult who return to school, have these experiences transformed their lives and does the program structure make a difference in the learning journey? Results reported positive outcomes from the emotional, professional, social, and even physical aspects since completion of the graduate program.

Keywords: Transformative Learning, Adult Learners, Graduate School

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Introduction

This paper presents a detailed examination of the transformative learning experiences of two working women who returned to higher education to pursue the Master of Education (Teaching and Learning) degree in a Malaysian private university in. The graduate program offers two pathways: a traditional on-campus route that involves 11 modules, and the APEL Q (Accreditation of Prior Experiential Learning) route, which allows learners to complete four instruments rather than attending physical classes. This study investigates how both adult learners navigated their educational journey and what transformations they experienced in the process.

The theoretical frameworks that underpin this study were Knowles's (1984) *Andragogy* and Mezirow's (2000) *Transformative Learning Theory*. These frameworks offer a comprehensive understanding of how adults learn and change through when they decide to go back to school after a long period of absence due to work, family and other personal commitments. Through the narrative inquiry approach which comprised a set of questions for the participants to reflect on before the lengthy interview of 2.5 hours, this paper explores the learners' experiences, the impact of the program structure, and how their educational journey transformed their lives, both personally and professionally. The findings reveal significant emotional, professional, social, and physical changes in the learners' lives after completing the program.

The Context: A Dual Pathway Graduate Program

The Master of Education (Teaching and Learning) in a Malaysian private institution of higher learning, offers adult learners two distinct pathways for completing their degree: the traditional pathway and the APEL Q pathway. The traditional pathway is held during the weekends and is an on-campus, modular system, requiring students to attend classes and complete 11 modules. In contrast, the APEL Q pathway is designed for adult learners with at least 20 years of prior work experience and relevant qualifications. Instead of attending physical classes, learners in this pathway are required to complete four comprehensive assessment instruments.; Portfolio, Field Validation Visit, Challenge Test and the Capstone Project. For the APEL Q program, each learner is assigned an academic advisor who provides guidance throughout the program, ensuring that their learning is both self-directed and tailored to their individual experiences, 2 assessors (internal and external) and a moderator who ensures the validity and reliability of the assessments.

Both routes allow for working adults, who often have professional and personal commitments, the flexibility to pursue higher education while continuing their careers and managing other responsibilities. For the two learners in this study, both routes provided an opportunity to reflect on and integrate their professional experiences into their academic learning. Three research questions guide this study; what are the experiences of working adults who return to higher education, how have these experiences transformed their lives and does the program structure (traditional vs. APEL Q) make a difference in the learning journey.

Theoretical Frameworks: Andragogy and Transformative Learning

To understand the learning experiences of these adult learners, the study is grounded in two key theoretical frameworks: *Andragogy* (Knowles, 1984) and *Transformative Learning* (Mezirow, 2000).

Knowles' (1984) Andragogy emphasizes that adults learn differently from children and identifies five key assumptions about adult learners:

1. Self-Concept: Adults prefer to be self-directed in their learning and are accountable for making decisions about their education which include the route of their studies and the strategies they use to achieve learning goals.
2. Life Experience: Adults learners bring a wealth of life experiences to the learning process which in turn, enhances their understanding and affords a valuable basis for learning.
3. Readiness to Learn: Adults learners are driven to learn when they see the learning as relevant to their life or career and are more likely to participate in learning that is relatable to their lives.
4. Orientation to Learning: Adult learners tend to focus on problem-solving and real-world applications of knowledge. They seek learning that helps them address specific challenges in their professional and personal lives.
5. Motivation: Adults learners are motivated primarily by internal factors, such as the desire for personal growth or career advancement, rather than external rewards.

In the case of the two learners in this study, both demonstrated high levels of self-direction, bringing their life experiences into their learning process. Their readiness to learn was driven by the desire to enhance their professional competences, and their motivation to complete the program was entrenched in a commitment to self-improvement and career progression as noted in the interview when one mentioned that "*I decided to give it a try because I was thinking why not challenge myself to do something."* and *"one of the main reason* (to do this) *is I want to upscale myself.*

Transformative Learning, as defined by Mezirow, involves a process of critical reflection that leads to a shift in perspective. Mezirow (2000) argues that transformative learning occurs when individuals critically examine their beliefs, assumptions, and understanding of the world, often resulting in a profound change in how they perceive themselves and their environments. This process involves the following stages:

1. Disorienting Dilemma: Learners face an experience that challenges their existing worldview.
2. Critical Reflection: Learners engage in reflection, questioning their prior assumptions and beliefs.
3. Perspective Transformation: As a result of critical reflection, learners adopt new ways of thinking and understanding.

For the two learners in this study, their return to education highlighted the disorienting dilemma(s) that challenged their current professional and personal identities for example, how they learnt in the past and their teaching and classroom management in the present. One learner mentioned "*main reason for taking the program is really to answer questions for myself from my younger colleagues and it's good to probably hear about different ways to doing things."* These experiences allowed them to reflect on their teaching practices, professional roles, and approaches to learning. Through this process of reflection, they both

experienced a perspective transformation, which led them to re-evaluate their pedagogical practices and consider alternate approaches to teaching and learning.

Research Methodology: Narrative Inquiry

The study employed narrative inquiry as its research approach. Narrative inquiry is a qualitative method that emphasizes understanding individuals' lived experiences through storytelling. This approach was particularly suited to capturing the transformative learning journeys of adult learners, as it allowed the researchers to explore the personal narratives of the participants in depth.

The participants comprised Shean, a mother of two who is in her early 50s. She obtained her undergraduate degree in Canada and works in an organization that organises team building sessions for corporate organisations. Once a week, she teaches English in a private tuition centre. Shean underwent the conventional program. Kris, who is also in her early 50s, received her Diploma in Early Childhood a few years ago, and was trained as a music teacher. Her hobbies include travelling and she is also an art and craft enthusiast. Kris is the owner and Principal of an Early Childhood Centre and she undertook the APEL Q route.

Data was collected through a in-depth interview which comprised a 185-page transcript with the two learners. The research sought to answer three central questions:

1. What are the experiences of working adults who return to school?
2. How have these experiences transformed their lives?
3. Does the program structure make a difference in the learning journey?

Findings and Discussion

The findings of this study highlight the significant transformations that occurred in the emotional, professional, social, and physical aspects of the learners' lives after completing the graduate program.

Emotional Transformation*:* Both learners reported a sense of pride and fulfilment from overcoming the challenges of balancing work, family, and study. The emotional satisfaction of completing a graduate program despite these challenges was apparent when one of them mentioned that she "*never knew I had done so much in the past, and I am proud of what I have achieved."*

Professional Transformation: Professionally, both learners experienced substantial growth. They reported feeling more competent and confident in their teaching roles. Through the program, they were exposed to new pedagogical strategies and invaluable insights, which they were able to integrate into their teaching practices. For example, one of them mentioned that she has "*become so much more confident in my work place…the past traumatic incident that took place which I was doing this… and how I managed to overcome all of it…while struggling with the project (capstone)…."* The other learner was excited because she learnt new ways to teach, "*experimenting on my students on when I learned about flip learning from Dr XXX ... what was this flip learning? I tested that even on my students and WOW, it works."* She continues to be current in her teaching and says *I'm still experimenting up to today and that that really drives me, I have to say."*

This led to a shift in their professional identity, as they saw themselves not just as educators, but as lifelong learners and reflective practitioners.

Social Transformation*:* Socially, the learners noted the importance of building connections with peers and mentors throughout the program, although this was more apparent for the learner in the conventional route who mentioned that she reminded herself that she has to be "*really very conscious about every decision I make in group projects "*. Additionally, the opportunity to collaborate with others helped her expand her professional networks and gain a sense of community.

Physical Transformation*:* Although the program was intellectually stimulating, it also brought physical challenges. The learners had to balance demanding work schedules, family responsibilities, and academic commitments, for example one learner mentioned that she and her peers would *"meet at like 11:00 PM to 12 midnight …only then we can work because some mums put their kids to sleep at 12 midnight, you know?"* Additionally, the flexibility of the APEL Q pathway allowed one learner to manage these challenges more effectively, and both learners reported that the program's structure made it possible for them to succeed without significant physical or emotional burnout.

Conclusion

The findings of this study demonstrate the transformative potential of adult education programs like the Master of Education (Teaching and Learning) that offer flexible learning pathways, such as the APEL Q route. The use of Knowles's Andragogy and Mezirow's Transformative Learning theories provides a useful framework for understanding the motivations, experiences, and outcomes of adult learners in this context. The learners in this study experienced significant emotional, professional, social, and physical transformations, all of which were made possible by the program's structure and the opportunity to engage in self-directed, reflective learning.

Ultimately, this study highlights the importance of providing adult learners with flexible, relevant, and supportive learning environments that cater to their unique needs and life experiences. By doing so, higher education institutions can foster transformative learning that positively impacts both the personal and professional lives of adult learners.

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Contact email: jennifer.tan@help.edu.my

Challenges and Opportunities of AI in Revitalizing and Preserving Endangered Languages in Kenya

Hesborn Ondiba, Tokyo University of Science, Japan

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Abstract
Kenya's rich variety of languages carries important cultural and traditional knowledge. However, many of these languages are disappearing because of the growing influence of English, Kiswahili, and other challenges. This language loss threatens cultural identity and the preservation of traditional knowledge. This study aims to explore how Artificial Intelligence (AI) can help revitalize endangered languages in Kenya and ensure their survival. The study uses secondary data from reports, academic studies, and policy reviews to examine Kenya's language landscape, technological capabilities, and challenges to AI adoption. Key challenges include a lack of skilled professionals, limited internet access, weak policies, and ethical concerns about data ownership. Findings show that despite these challenges, AI offers opportunities to preserve endangered languages. For example, AI can create digital tools for speech-to-text transcription, personalized learning platforms, and digital repositories for storing linguistic data. These tools can help younger generations reconnect with their cultural roots. While AI has great potential, addressing infrastructure gaps, creating clear policies, and involving communities are essential to success. With strategic efforts, AI can play a transformative role in preserving Kenya's endangered languages and protecting its cultural heritage for future generations.

Keywords: AI, Endangered Languages, Culture

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1. Introduction

1.1 Importance of Language in Society

Language is a cornerstone of human society, serving as a fundamental tool for communication, cultural expression, and the preservation of knowledge. Scholars consistently assert that language and culture are inseparable, with language acting as both a mirror and a shaper of cultural identity (Peeters, 2015). The interplay between language and culture extends beyond communication; it transmits traditions, values, and norms across generations. Jiang (2000) captures this duality through metaphors, likening language and culture to a living organism: language represents the flesh, and culture the blood. Without culture, language would lack depth, and without language, culture would lose its form. This metaphor underscores the significance of language as a communicative tool and as the societal glue facilitating mutual understanding and cohesion.

The relationship between language and identity further demonstrates its societal importance. Rovira (2008) highlights that language is intrinsic to cultural identity and serves as how people convey their innermost selves across generations. She describes how the loss of one's language often leads to a disconnection from cultural roots and identity, emphasizing that language carries a community's history, traditions, and shared experiences. For instance, the erosion of a home language among immigrants can disrupt familial bonds and cultural continuity, illustrating language's vital role in shaping personal and collective identity.

Languages in Africa play key role in preserving and sharing cultural traditions, as seen in practices like songs, proverbs, riddles, and tongue twisters. Zeleza (2016) explains that African languages are not just tools for communication. They represent communities' values and creative expressions, holding their cultural history and shared ideas. He also emphasizes that African languages support the transfer of culture and problem-solving across disciplines. These languages store traditional knowledge and provide ways to work together and innovate in modern settings. Supporting African languages is more than protecting heritage; it strengthens societies and encourages creativity to tackle today's challenges (Mbunwe-Samba, 2012).

1.2 Language Endangerment in Kenya

Language loss is a pressing global issue that poses significant risks to cultural diversity and human heritage. The gradual disappearance of languages erodes communities' collective identity and knowledge. Several critical factors contribute to this phenomenon, each deeply interconnected with societal, environmental, and political contexts (Derhemi & Moseley, 2023).

In Kenya, urbanization and social mobility have contributed to a decline in the use of indigenous languages. Parents often prioritize teaching their children English or Kiswahili, which are viewed as symbols of education and socioeconomic advancement. This shift is further reinforced by educational policies prioritizing dominant languages over indigenous ones. For example, local languages are taught only up to the third grade in linguistically homogenous areas, while Kiswahili replaces indigenous languages in urban schools (Wamalwa & Stephen, 2013).

Economic imperatives often force members of Indigenous communities in Kenya to migrate to urban centers in search of better education and employment opportunities. In these new environments, dominant languages frequently replace indigenous ones as tools for communication and socioeconomic mobility. This trend diminishes the use of indigenous languages, as children who grow up in urban centres are disconnected from their linguistic heritage (Obiero, 2008). Over time, such shifts contribute to the erosion of linguistic diversity, particularly among younger generations in urbanized settings.

The spread of global media and digital platforms has worsened the decline of minority languages. Indigenous communities often lack the resources to represent their languages in these spaces. This allows dominant languages like English and Kiswahili dominate media, education, and online platforms. In Kenya, many endangered languages, are not documented or codified, making it difficult to include them in digital technologies. As a result, younger generations prefer dominant languages that are more accessible and seen as economically beneficial, further pushing native languages aside (Wamalwa & Stephen, 2013).

1.3 Kenya's Linguistic Landscape

Kenya's linguistic landscape is both diverse and complex, reflecting the country's rich cultural and ethnic heritage. Estimates of the number of languages spoken in Kenya range widely, from 30 to 74, depending on classification criteria. Obiero (2008) notes between 30 and 60 languages, while Barasa (2023) identifies 66 native and eight non-native languages, including English and French. These languages belong to three primary linguistic families: Bantu, Nilotic, and Cushitic. Bantu languages account for the majority at 65%, followed by Nilotic at 32%, and Cushitic languages comprising the remaining 3% (Obiero, 2008). Kiswahili, the national language, is a Bantu language widely used as a lingua franca, facilitating communication across the country's ethnolinguistic groups. Meanwhile, English is an official language and the primary medium of instruction from primary school through university, reinforcing its prominence in formal education and governance.

Wamalwa and Oluoch (2013) report that at least seven languages in Kenya, are classified as endangered. They are predominantly spoken by the older generation, particularly those aged 50 years and above, and according to the Atlas of the World’s Languages in Danger (2010), six Kenyan languages, El Molo, Kore, Lorkoti, Sogoo (also known as Okiek), Yaaku, and Kinare have already become extinct, as illustrated in Table 1. This alarming trend prompts a critical question: Can Artificial Intelligence (AI) be harnessed to revitalize Suba and preserve the invaluable indigenous knowledge embedded within the language?

Table 1: Vitality Levels for Endangered Languages of Kenya

Language	No. of speakers	Vitality
Suba	157,787	Vulnerable
Burji	39,000	Vulnerable
Boni	20,103	Definitely endangered
Bong'om	1,000	Definitely endangered
Dahalo	575	Severely endangered
Ongamo	200	Critically endangered
Omotik	50	Critically endangered
Elmolo	-	Extinct
Kinare	-	Extinct
Kore	-	Extinct
Lorkoti	-	Extinct
Sogoo	-	Extinct
Yaaku	-	Extinct

Source: Moseley, C. (2010) and KNBS (2019)

1.4 Rationale for AI in Language Preservation

A growing number of researchers in sociolinguistics and anthropology are examining the AI's transformative potential in revitalizing endangered languages and preserving cultural heritage (Gray, 2023; Jafari, 2023). Advances in AI, particularly in Natural Language Processing (NLP), have resulted in innovative tools that enhance communication, translation, and education across diverse languages (Hohenstein et al., 2023). These technologies play a pivotal role in preserving endangered languages and expanding their accessibility to wider audiences.

However, significant challenges persist, particularly in underrepresented regions such as Africa and other developing countries, where the application of AI for language preservation remains largely unexplored. Factors like limited institutional capacity, inadequate Information and Communication Technology (ICT) infrastructure, and region-specific socio-cultural barriers shape the outcomes of AI initiatives (Romaine, 2017). To address these issues developing AI-driven models tailored to local contexts is crucial, moving beyond "one-size-fits-all" approaches that often fail to meet the unique needs of diverse linguistic communities (Arakpogun et al., 2021).

This study seeks to identify key challenges and opportunities in leveraging AI to revitalize and preserve Kenya's endangered linguistic heritage. Specifically, the study aims to:

i. Identify challenges to AI adoption in Kenya.
ii. Explore how AI tools can support endangered language revitalization and preservation in Kenya.

2. Materials and Methods

The research design follows a qualitative approach, focusing on secondary data and literature analysis. Secondary data was gathered from existing databases, reports, and field studies to

contextualize the challenges and opportunities specific to Kenya. The research focused on several key for preserving endangered languages in Kenya. First, demographic and linguistic trends were analyzed to gather data on endangered language speakers, providing insights into language vitality and usage patterns. Second, the study examined educational resources and initiatives to support language learning and revitalization efforts. Third, Kenya's technological and policy landscape was assessed, including an evaluation of the country's ICT infrastructure, AI readiness, and policy frameworks related to digital tools and language preservation. This comprehensive analysis was essential for identifying barriers to AI adoption and evaluating the feasibility of implementing AI-driven interventions tailored to the Kenyan context.

3. Challenges to AI Adoption in Kenya

3.1 Limited Skilled Professionals

Kenya faces significant challenges in harnessing the potential of AI due to a shortage of skilled professionals with the necessary technical expertise and training. The current education system in Kenya does not adequately prepare students for careers in AI, leaving a gap in technical knowledge and expertise. AI requires specialized skills in machine learning, data science, and software development, but there are too few qualified instructors to provide advanced training in these fields. A study by Omonga (2023) showed that there are not enough qualified individuals in Kenya to manage AI technologies effectively.

A related issue is the brain drain, where skilled professionals migrate to the Global North or the Arab Gulf regions for better job opportunities. Political instability, limited resources, and economic challenges drive this trend, leaving Kenya with fewer experts to tackle local AI problems (Omonga, 2023). This loss of talent makes it difficult to build sustainable AI solutions tailored to Kenya's linguistic and cultural diversity.

Insufficient funding for AI research worsens the situation. Projects that preserve endangered languages often receive little financial support compared to urgent priorities like healthcare and food security. The high cost of AI implementation, and Kenya's reliance on foreign aid limit the ability to fund and prioritize local initiatives (Ndungi & Siregar, 2023). This lack of funding limits the opportunities for young researchers to advance their skills in localized AI and technology research, stifling the development of a skilled workforce needed to address these challenges effectively.

3.2 Insufficient Research Data and Infrastructure

Another barrier to effective AI adoption in Kenya is the lack of comprehensive frameworks and infrastructure for research data management (RDM). While the Data Protection Act (2019) focuses on safeguarding personal data, it does not address research data management (RDM) (Imbuga, 2017). This leaves individual researchers or institutions to handle data independently, often without consistent standards or guidelines, which makes data sharing and reuse extremely difficult. For example, NACOSTI (the National Commission for Science, Technology, and Innovation) does not require researchers to submit data management plans (DMPs) when applying for funding. As a result, RDM practices remain uncoordinated, and valuable research data is often poorly managed (Nakitare et al., 2024).

The lack of intense Information Technology (IT) infrastructure worsens this problem. Kenya has made some progress with data repositories; for instance, it hosts Africa's second-highest institutional repositories (Nakitare et al., 2024). However, these repositories are not well-utilized for research data storage. Platforms like the Kenya Open Data Portal and the Kenya Medical Research Institute (KEMRI) Welcome Trust Research Programme Data Repository exist. However, their use remains limited, and researchers often struggle to archive or retrieve data. There is also a shortage of dedicated research data storage systems, which are crucial for building AI tools to preserve endangered languages (Ng'eno & Mutula, 2022).

Many researchers in Kenya lack the necessary data management skills to effectively use existing infrastructure effectively. A 2019 study at the Technical University of Kenya found that RDM practices were happening at an individual level, with no institutional support to standardize data management processes. This skill gap means datasets are often poorly archived, fragmented, or inaccessible for further use (Allela & Mwai, 2019).

3.3 Internet Connectivity and Accessibility

Internet connectivity remains a significant challenge in using AI to preserve indigenous languages in Kenya, particularly in rural areas where most endangered speakers live. A significant digital divide exists between urban and rural populations (Mukuni, 2019). While cities enjoy better internet access, rural areas still face poor or non-existent connectivity, limiting their ability to use AI tools effectively.

The high cost of ICT services further restricts access. For many communities, the subscription fees for reliable internet are unaffordable, making digital resources inaccessible to those who need them most. Even where the internet is available, the poor quality of connections causes disruptions (Ntorukiri et al., 2022). Unreliable and slow speeds make tasks such as speech-to-text transcription and managing large language databases extremely challenging, delaying AI model development.

Kenya benefits from infrastructure like submarine fibre-optic cables; however, these advancements have primarily served urban centers. Rural populations continue to be excluded from these benefits due to limited investments in last-mile connectivity (Ntorukiri et al., 2022).

3.4 Lack of AI Use and Regulatory Policies

While initiatives such as the National AI Strategy by the Ministry of ICT and the AI Code of Practice drafted by the Kenya Bureau of Standards (KEBS) are steps in the right direction, progress has been slow, and specific policies focusing on AI for language preservation are still lacking (Ndungi & Siregar, 2023). This leaves a regulatory gap, making integrating AI solutions into cultural and linguistic preservation challenging.

One major issue is that existing laws like the Data Protection Act (2019) and the Computer Misuse and Cybercrimes Act (2018) primarily focus on personal data protection and critical infrastructure (Amol et al., 2024). However, they do not address critical concerns such as the ownership of linguistic data or the fair use of AI in marginalized communities. For example, Indigenous knowledge and cultural data could be exploited without clear policies governing

their use, leading to ethical challenges and mistrust between communities and AI developers (Amol et al., 2024).

The lack of institutional support and proper governance frameworks for AI adoption worsens the problem. Universities and research institutions often struggle with insufficient funding and infrastructure to develop localized AI tools that meet Kenya's specific needs (Imbuga, 2019). For instance, similar infrastructural challenges have been observed in Kenyan universities, where poor investment in ICT tools like computers and weak internet connectivity hinder technology adoption. These barriers slow AI innovation and prevent partnerships and funding opportunities essential for building AI-driven solutions tailored to Kenya's endangered languages (Ntorukiri, 2022).

3.5 Ethical Concerns: Data Ownership and Cultural Sensitivity

Ethical concerns about data ownership and cultural sensitivity present significant challenges in using AI to preserve endangered languages in Kenya. One critical issue is determining who owns the cultural and linguistic data collected for AI projects (Gray, 2023). Without clear rules, indigenous communities risk losing control of their cultural heritage. For example, Ndungi & Siregar (2023) highlight that data collected for AI tools in healthcare and education often lacks local consent and ownership frameworks, leading to concerns about data exploitation. These practices can create mistrust between communities, researchers, and developers, making collaboration more difficult.

Cultural sensitivity is equally important because indigenous languages are deeply connected to unique beliefs, spiritual practices, and sacred knowledge. AI models that misrepresent or commercialize these cultural elements can harm communities and reduce trust in technology (Raj, 2024). For instance, generalized AI tools often fail to capture the contextual depth of Indigenous languages, leading to inaccurate portrayals that erase their true meaning and significance. This problem is particularly evident when AI is applied to oral languages, where nuances like tone and rhythm are integral to meaning (Huriye, 2023).

The issue is further complicated by low digital literacy among indigenous communities. Without the skills to understand or monitor AI tools, these communities cannot ensure their data is used ethically or advocate for their rights. Huriye (2023) points out that in areas like agriculture, communities are often left out of decisions about AI tools, leading to solutions that do not fit their cultural, social, or economic needs.

4. AI Opportunities

Advancement in AI offers significant opportunities for revitalizing and preserving endangered languages in Kenya. By leveraging modern technologies, AI can address challenges such as insufficient documentation, low digital literacy, and cultural marginalization (Jafari, 2023). Key opportunities include language and cultural documentation, technological integration, AI-powered learning tools, and cultural content creation.

4.1 Language and Cultural Documentation

AI can play a key role in documenting and preserving endangered languages in Kenya by using innovative tools. Technologies such as speech-to-text recognition and audio

transcription enable the digital recording of oral traditions, conversations, and stories (Hohenstein et al., 2023). These tools are exceptionally vital for the languages listed in Table 1, which are at varying levels of endangerment. The development of digital repositories and databases enhances these preservation efforts by providing a secure and organized means of storing linguistic data. Additionally, metadata integration captures essential details such as speaker demographics, cultural significance, and geographical contexts, ensuring comprehensive and meaningful documentation. Data compression and forward-compatible technologies can be employed to safeguard this linguistic heritage for future generations, to ensure long-term accessibility and adaptability to future innovations (Raj, 2024).

4.2 Integration in Technology and Digital Platforms

Using technology to support endangered languages makes them more visible and accessible. AI-powered tools, like linguistic corpora, help create models for annotation, transcription, and text-to-speech conversion tasks. These tools are handy for preserving oral histories and cultural details often missing from written records (Jones-Evans et al., 2011).

Digital platforms like search engines, websites, and social media make these languages accessible to a broader audience and encourage active use. AI can also track language trends, helping communities stay visible online. Voice and speech recognition technologies further aid in preserving oral traditions. Integrating endangered languages into digital platforms ensures they remain relevant and valuable in today’s connected world (Jones-Evans et al., 2011).

4.3 AI-Powered Language Learning Tools

AI-driven tools are transforming how endangered languages are taught and revived. Platforms like Duolingo and Memrise use AI to create personalized learning experiences that match each learner's pace and needs (Tennell & Chew, 2024). These tools make learning endangered languages fun and interactive. In addition, conversational AI assistants allow learners to practice real-time communication, creating immersive learning experiences. Gamified methods, and virtual and augmented reality, bring cultural and linguistic settings to life, making learning enjoyable and meaningful. These technologies are especially effective for younger generations, helping pass on knowledge between generations and supporting the revival of endangered languages (Tennell & Chew, 2024).

4.4 Cultural Content Creation

AI is creating new ways to express culture and share traditional stories. Tools like AI storytelling platforms help turn folktales and oral traditions into digital formats, preserving them as multimedia (Gray, 2023). Text-to-image tools and animated video creators also bring these stories to life visually, making them more engaging and dynamic. These technologies give local communities the power to create and share content that reflects their culture and connects with people worldwide. By combining storytelling and art with AI, endangered languages and traditions can be celebrated and preserved creatively and modernly (Hohenstein et al., 2023).

5. Conclusion

This study has explored the challenges and opportunities of using AI to revitalize and preserve endangered languages in Kenya. The findings indicate that significant barriers remain while AI offers transformative tools for language documentation, education, and cultural preservation. The challenges include a lack of skilled professionals, insufficient research data and infrastructure, limited internet access, weak regulatory policies, and ethical concerns surrounding data ownership and cultural sensitivity. For instance, rural communities with low connectivity and digital literacy face exclusion from AI-driven initiatives, while dominant languages like English and Kiswahili continue to overshadow indigenous ones. There is urgent need for collaborative efforts among stakeholders, including government bodies, technology developers, researchers, and local communities. Clear policies must govern ethical AI use, ensuring cultural sensitivity and equitable data ownership for indigenous groups. Strengthening Kenya's ICT infrastructure and investing in capacity-building programs will be critical for overcoming technical and resource-related challenges.

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Contact email: hondiba@rs.tus.ac.jp

e-Training With AI Prompts on Preparing Articles for International Academic Conferences and Publication in International Journals

Theerapong Maneepen, King Mongkut's University of Technology Thonburi, Thailand
Narong Mungkung, King Mongkut's University of Technology Thonburi, Thailand
Suchapa Netpradit, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
This research aims to create e-training with AI prompts for international academic conferences and publication in international journals. To determine the efficiency of e-training. Find the effectiveness of the Learner's success through improved e-training and find satisfaction with e-training. The methodology used in the research consists of 5 main steps: analysis, design, course development, e-training development, and evaluation and summary, using AI prompts to help carry out each topic according to Interactive Multimedia Computer-assisted Instruction (IMMCAI principles) to find Interval-test/Post-test (E1/E2), effectiveness, and Satisfaction. The sample group consisted of staff and students—faculty of Industrial Education and Technology (FIET), King Mongkut's University of Technology Thonburi (KMUTT), 30 people. The evaluation test results found that the e-training was created with an efficiency of 83.78/81.56 according to the specified criteria, which is 80/80. The training achievement of the trainees increased by 30.78 percent. The content quality score was equal to 4.11 and the participants' satisfaction with the online training was 4.38, which is considered good. It can be concluded that e-training for publishing articles can be used for individual learning and development. There will be a high number and quality results from AI prompts to help work more accurately, conveniently, and quickly.

Keywords: e-Training, International Conference, Journal Publication, Effectiveness (Post-test – Pre-test), Efficiency (E1/E2), AI Prompt

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Introduction

The rapid advancement of computer technology can be seen today computers have played a significant role in business, communication, and even education because every organization, every industry, and every educational institution must use technology. This is because technology facilitates and makes every operation fast and flexible. E-learning is learning through the Internet. The teacher will present information and knowledge for the students to study through the World Wide Web service or website Pairoj Trironthanakol et al. (2011). It may allow interaction (conversation, response, sending news) between each other at any time and any place (Learn for all: anyone, anywhere, and anytime) Pairoj Teeronthanakool. (2001). E-learning can respond to and fit into the lifestyle of students in their teens. Therefore, electronic lessons are another development option that can promote students' self-research skills.

Online training (e-training) has become essential to education and professional development systems. Integrating artificial intelligence (AI) into e-training platforms promises to revolutionize how training programs are designed, delivered, and assessed. This paper explores the intersection between e-training and AI, aiming to identify how AI technologies can enhance e-training outcomes. Specifically, this study examines the effectiveness of AI-enhanced learning paths, automated feedback systems, and adaptive learning technologies.

The e-training field has evolved dramatically with the advent of digital technologies. An early study by Smith and colleagues (2015) highlighted the potential of e-training to provide scalable and flexible learning solutions. More recent research has focused on the role of AI in improving e-training platforms. Johnson and Roberts (2018) showed that AI algorithms can optimize learning experiences, resulting in better learner engagement and retention. However, there are still gaps in understanding the long-term impact of AI on learning outcomes and the specific mechanisms through which AI improves the effectiveness of e-training.

The purpose of the research is as follows: 1. To create and develop an e-training with AI prompts on preparing articles for international academic conferences and publication in international journals, 2. To find the efficiency of e-training with AI prompts on preparing articles for international academic conferences and publication in international journals, 3. The achievement of e-training with AI prompts on preparing articles for international academic conferences and publication in international journals, 4. Study of user satisfaction with e-training with AI prompts on preparing articles for international academic conferences and publication in international journals.

Therefore, the researchers saw that increasing the achievement in the knowledge and skills of personnel and interested persons by using AI to help in important steps to be accurate, fast, and efficient, in line with the set goals, as well as making the work of better quality in order, is an essential function in the current business environment, education, research, and innovation that is constantly changing. To transfer knowledge effectively, we should find a way to make it easier for interested persons to come in and learn and lead to effective practices.

Methods

The methodology used in this research consists of five main steps: analysis, design, courseware development, e-training development, and evaluation and conclusion, as shown in Figure 1.

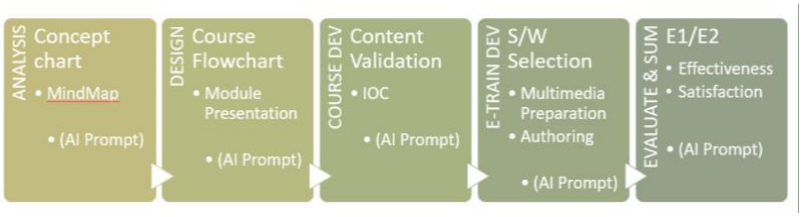

Figure 1: Displays the e-Training With AI Prompt Methods

The details of each step have the following sub-steps (T. Maneepen et. al., 2001):

1. Analysis

Created the initial mind map. This step was to find out all related topics concerned. Created the concept/final mind map. This step was to rearrange and regroup the related topics that will benefit from creating the final mind map.

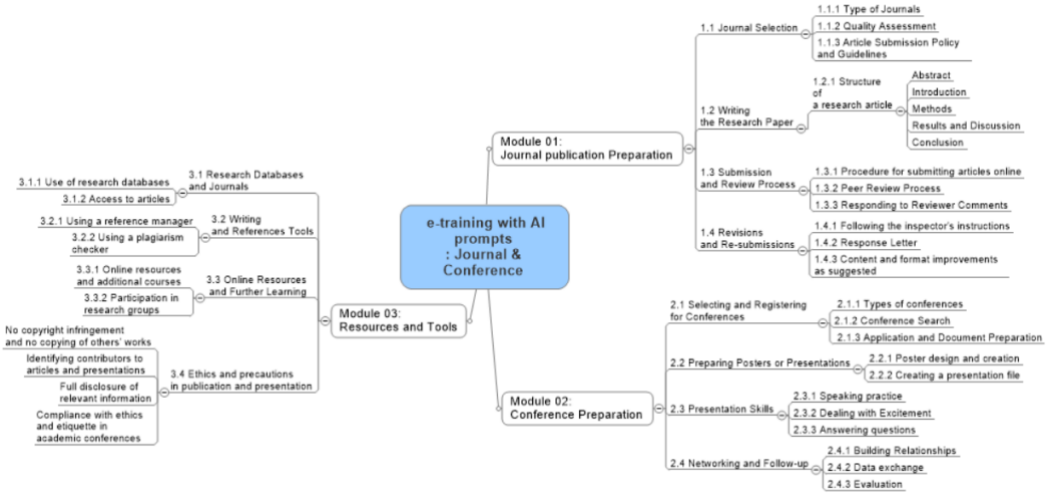

Figure 2: Displays the Mind Map of Contents Analysis

2. Design

Created the strategic presentation plan and behavioral objective for the course curriculum analysis table. Created the module presentation chart. Created the chart for each module according to its importance for best learning effectiveness or achievement.

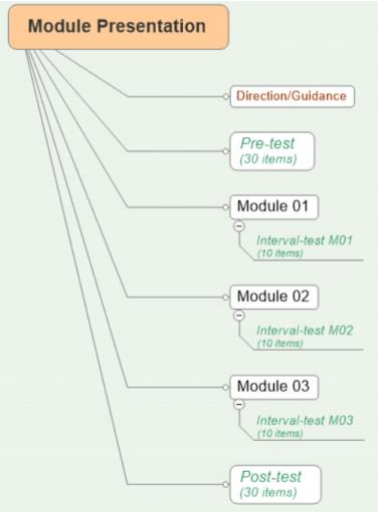

Figure 3: Displays the Module Presentation

3. *Development of Course*

Script development. This step was written according to the plan for each frame using images, colors, graphics, video, etc. Storyboard development. The frames of content were reviewed by experts for content correctness. This step produced the content accuracy and validity which was represented in terms of appropriateness of content as compared with the concept chart according to the subject. Development of Test Items. This step was to analyze the behavioral objective and the contents of test items.

4. *Development of e-Training With AI prompts*

Select an appropriate program. Such as Moodle programs to edit. To select and prepare resources. Such as text, graphics, images, video, animation, etc. The correct content and quality test items. This step was to create a web-based platform. E-training checked by the media's expert. Three experts in media to check the quality.

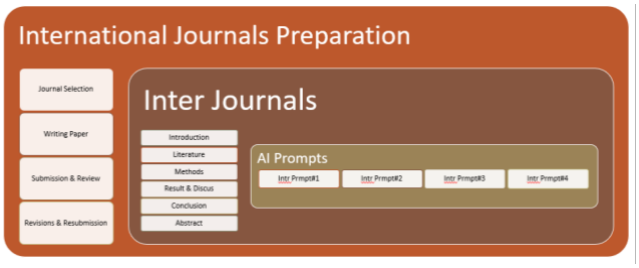

Figure 4: Displays the Content With AI Prompts on the International Journals

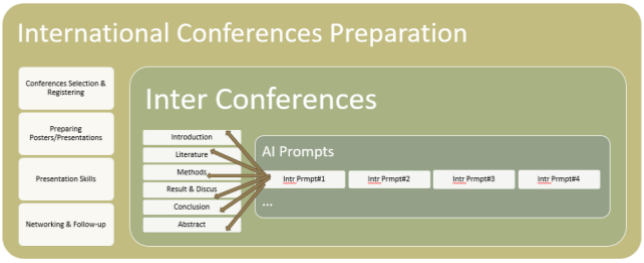

Figure 5: Displays the Content With AI Prompts on the International Conferences

Table 1: Essence Prompt for Research Writing Using Generative AI

Item	Prompt#1	Prompt#1	Prompt#1	Prompt#1
Introduction	Prompt: Write "research background, motivation the important of this research why it is needed" the research topics and information is "……" (add research topic and some more research information	Prompt : Generate the paragraphs to address the " research gap " using "advantage, disadvantage and draw back of the following article "……" (Search for 3-5 closely relate article, summarize Advantage disadvantage , drawback by using other AI tools such as "chatwithanypdf, Scispace, paper digest".	Prompt : Re write the previous information to "Pin out more clear research gap of this research (has to directly follow the previous prompt)	Prompt : Generate the paragraphs to explain the "research contribution and expected implication " using the following information "……" (add the result from the first two prompts in "introduction section (background and research gap))
Relate Literature	Prompt : Use the following information "……" (add the introduction section of the research) to organize the "literature review section and also suggest me the sub-topics that I should integrate in this section.	Prompt : Find 5-7 articles form your own knowledge using "scholar AI plug in" to discuss in direction of "……" (the direction obtained from sub topics of the previous prompt) [4.0]	Prompt: Generate the paragraphs to discuss in direction of "…." (add detail of selected sub topics). The information and detail of researches that you can use is as follow " …" (add summary of research here). Please cite the article in "intext" citation form [3.5]	
Method	Prompt : Use the following information to Organize the "Research Method section" of this research ,the information of this research is as follows "……" (information need :Introduction, relate literature)	Prompt : Generate the paragraph to explain detail of the following topic " " (add topic that you need information), write the paragraph in academic English for research paper writing and make it smooth to read and easier to understand.	Prompt : If I perform the experiment to test for the effectiveness of the my method and model which as the following detail "……" (add detail of experiment), could you please suggest the "Performance measure metrics for this experiment" and guide me how to collect the data for these KPIs.	Prompt :could you please design the questionnaire to use to survey to reveal the "SUS-score" of the system that has following detail "……" (add detail of the developed system)
Result	Prompt : Use the following information Organize the "result section" of this research (information need :Introduction, relate literature, method)	Prompt : Generate the paragraph to explain more detail about "……" (add the topic information)	Prompt : Generate the paragraph to write introduction to the reader to know about the experiment that has result shown in the following information "……" (add Table)	Prompt : Generate the paragraphs to write "in-dept analysis and result interpretation focusing on "……" (add direction of discussion), and the is shown as follows "……" (add result table)
Discussion	Prompt : Please use the following information to organize or suggest the discussion sub topic for this research paper "……"(information uploaded with this prompt: Introduction, relate literature, method, Result)	Prompt: Discuss in dept, and rational discussion of this research paper in direction of "…." (this part add direction generated from sub topic) when you cite the article please cite the articles in "intext citation", and cite only the references cited in "introduction, literature review and research methodology of this research. Detail of this research is as follows (This part added introduction, literature review and methodology), result of this article is as follows "…." (this part add result)	Discuss every sub topics , each sub topics each time	
Conclusion	Prompt: Generate paragraphs explaining the conclusion of this research paper, covering the following elements: (1) research motivation and problem restatement, (2) detailed research methodology, (3) significant results, (4) important findings, (5) research implications, and (6) potential future research directions. (information uploaded with this prompt ; Use all "introduction", "literature review, Research method, Result, discussion)			
Abstract	Prompt: Generate paragraphs elaborating on the 'abstract' of this research paper, covering the following elements: (1) research motivation and problem restatement, (2) detailed research methodology, (3) significant results, (4) key findings, and (5) research implications. (information needed to be update with this prompt: Upload whole article from Introduction to conclusion; or only conclusion)	Prompt : Rewrite the information using a total of 200-250 words		
Title	Upload whole research paper then Prompt : Please suggest a research title for the uploaded research paper to be published in the journal " Expert systems with applications" (information uploaded with this prompt: Whole article and "title of target journal)			Prompt : Rewrite the title to make it more concise
General Prompt for Research	Prompt: Generate the paragraph of "…." (generate new paragraphs for specific topics)	Prompt: To ensure the overall content flows smoothly and coherently, both between paragraphs and sentences, rewrite the following information to make it more smooth to read.	Prompt : Re write this information in paragraphs manner (when the AI provides you result that look like bullet points)	Prompt : Re write the following information to make it more smooth to read, To ensure the overall content flows smoothly and coherently, both between paragraphs and sentences. (use when you need to paragraphs more than one paragraphs)

From Table 1 This prompt is applicable for ChatGPT, Claude, Gemini, and Perplexity.

5. *Evaluation and Summary*

Determine efficiency. To make a pilot test with a small group representation from the sample. Test efficiency with the sample. E-training was conducted on staff who were

interested in Article preparing, FIET, King Mongkut's University of Technology Thonburi.

Results and Discussion

1. e-Training With AI Prompt

The results of e-training development are as follows:

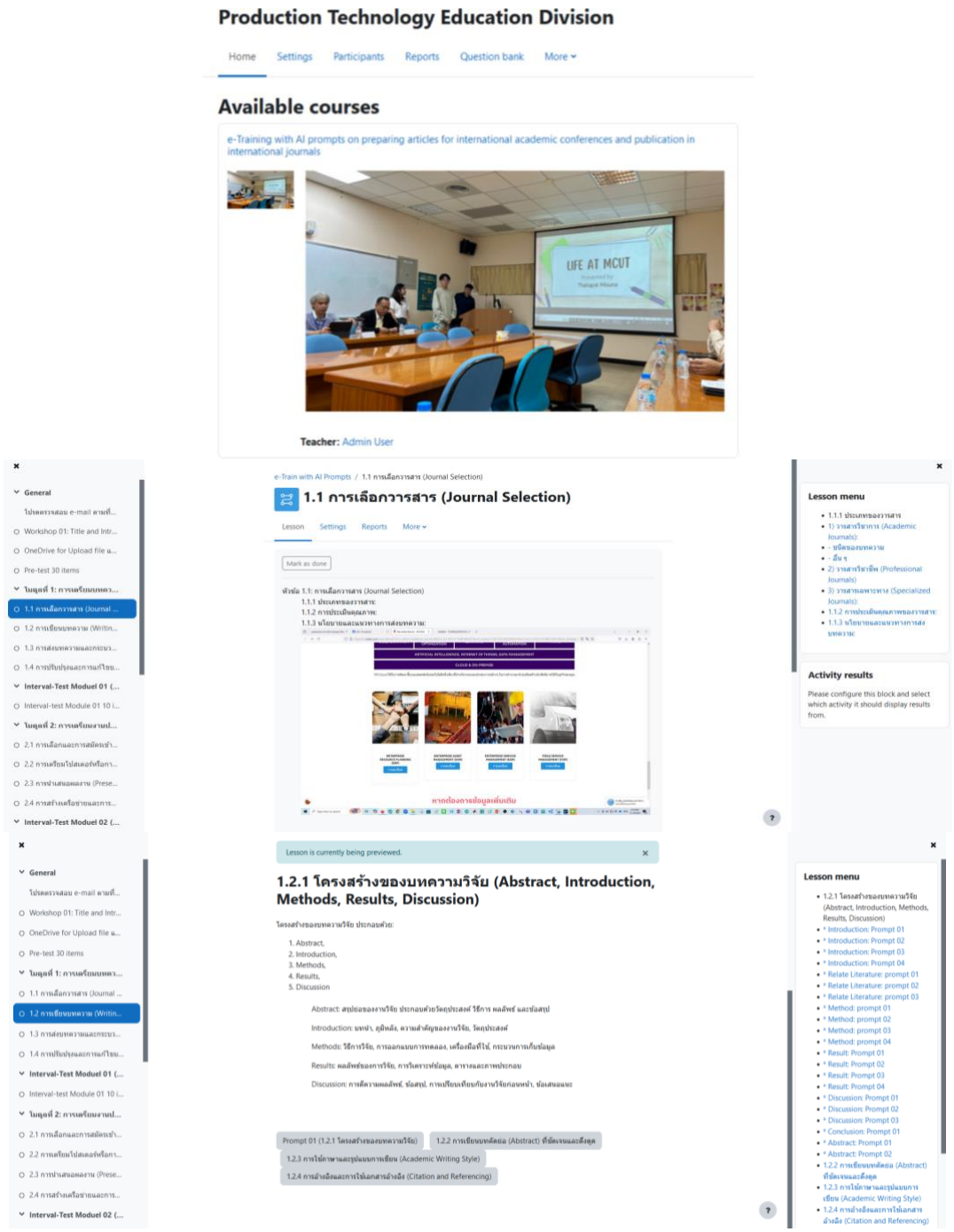

Figure 6: Displays e-Training With AI Prompt: Module 1 for Example

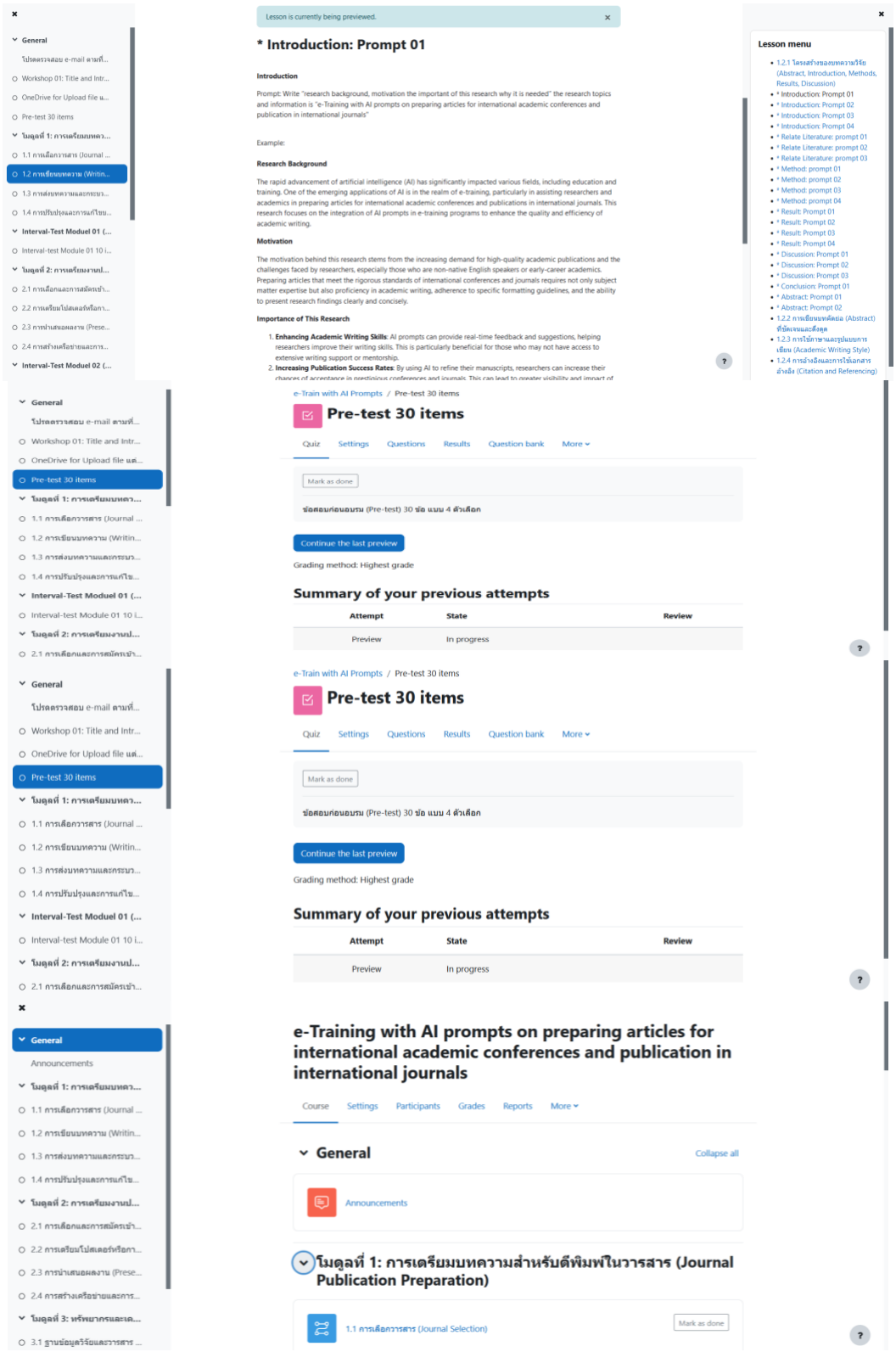

Figure 6: Displays e-Training With AI Prompt: Module 1 for Example. (Cont.)

2. Contents and Media Quality

Table 2: Result of Contents Quality by Experts

Item	Person 1	Person 2	Person 3	Satisfaction level Average	S.D.
1. The content is consistent with the objectives and topics.	4	5	4	4.33	0.58
2. The content is presented in a way that is easy to remember and understand.	5	4	4	4.33	0.58
3. The content can make trainees understand the process in real life.	4	5	4	4.33	0.58
4. Sequencing and continuity of content.	4	4	4	4.00	0.00
5. Completeness of content.	4	5	4	4.33	0.58
6. Accuracy of content according to academic curriculum.	4	4	5	4.33	0.58
7. The content is complete according to academic principles.	4	5	4	4.33	0.58
8. The content is consistent with the picture.	3	3	4	3.33	0.58
9. Content is appropriate for the purpose.	4	3	4	3.67	0.58
SUM(∑)				37.00	4.62
Average(X)				4.11	0.51

When considering the quality level in the assessment that the 3 experts assessed, the average value was in the Good range, with a score of 4.11. It can be used to create e-training lessons. When considering the quality of the lesson, Therefore, it can be concluded that the e-training lesson for use is good quality and suitable for testing with the target group.

3. e-Training Satisfaction

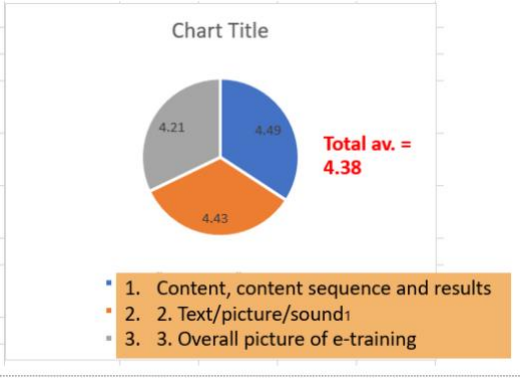

Figure 7: Displays Satisfaction of e-Training With AI Prompt

The learners' satisfaction with the lessons showed that the results of the evaluation of the media quality of the learners at the attitude level were at a high level. In the assessment of the quality of the content, the learners have a high level of satisfaction, with an average value of 4.38.

4. e-Training Efficiency and Effectiveness

Table 3: Shows the Average of the Pre-test, Interval Test, and Post-test

Item	Pre-test (D)		Interval test (E1)		Post-test (E2)	
	Point	%	Point	%	Point	%
Total	457	1523.33	754	2513.33	734	2446.67
Average	15.23	50.78	25.13	83.78	24.47	81.56
S.D.	4.00	13.32	2.08	6.93	2.70	9.00

The efficiency result of e-training with AI prompts was shown at 83.78/81.56, higher than the standard requirement set at 80/80. Finally, the effectiveness of learners who studied the e-training with AI prompts was shown at 30.78%. (Table 1)

Conclusions

The conclusion of the research follows:

1. Evaluation of the content and media quality of e-training lessons. The results from the evaluation by 3 content experts had a total average of 4.11, considered a good evaluation result. The content evaluated by experts can be used to create online lessons.
2. Efficiency of lessons. The results of the e-training lessons in the test during the learning were 83.78 percent and the post-learning test was 81.56 percent. Therefore, the efficiency of the online lessons was 83.78/81.56, which is in line with the criteria set at 80/80, which is effective enough to be used.
3. The learners' satisfaction with the lessons showed that the results of the evaluation of the media quality of the learners at the attitude level were at a high level. In the assessment of the quality of the content, the learners have a high level of satisfaction, with an average value of 4.38. Therefore, it can be concluded that the learners' attitudes are at a good level.
4. The learning achievement of the learners who passed the e-training lesson is 30.78, the achievement value of the pre-test is 50.78 percent and the achievement value of the post-test is 81.56 percent. After studying each module, it resulted in knowing the results of their development.

The next development suggestion is to track the productivity, and results from individual development according to the agreed goals and performance Agreement to achieve the mission and future objectives.

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Contact email: narong_kmutt@hotmail.com

Soft Skills in a Multicultural Society Context: A Case Study of Teaching Profession Students in the Southern Border Provinces of Thailand

Maithai Chaiyapan, Sukhothai Thammathirat Open University, Thailand
Jirasuk Suksawat, Sukhothai Thammathirat Open University, Thailand
Purimpratch Khaninphasut, Sukhothai Thammathirat Open University, Thailand
Putcharee Junpeng, Khon Kaen University, Thailand

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Abstract
Developing soft skills in the teaching profession students is important for teachers to facilitate the learners to learn to live together peacefully in the society. This research aims to investigate the soft skills in a multicultural society of the teaching profession students in the southern border provinces of Thailand through a qualitative method using the phenomenological approach. Data was collected by the researcher through in-depth interviews with 10 stakeholders including educational supervisors, school directors, university lecturers, psychologists, teachers and guidance counselors in the southern border provinces. and through content analysis. The results were found and classified into four main themes: (1) Communication and relationship building consisting of speaking, writing, and body language used to communicate and build relationships with people in a multicultural society; (2) Working with other people, consisting of co-working with others, joining together, taking initiative, coordinating, helping, and supporting other people in a multicultural society; (3) Adaptation consists of changing one's own ideas, feelings, and behaviors to suit the environment in the society of different cultures; (4) Accepting cultural diversity consists of learning the cultures of other people by showing respect for their differences. The results of this study provided an understanding of the development of soft skills among teaching profession students in a multicultural society. The conclusion and application of research results for educators, researchers, and counseling psychologists to promote the development of soft skills leading to quality teacher development are discussed and presented in this article.

Keywords: Soft Skills, Multicultural Society, Teaching Profession Students

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Introduction

In the provision of education in the 21st century, educational institutions play an important role in developing students in both core subjects and other skills needed for future careers. "Teachers" are therefore like "creators," who have a primary role in transferring knowledge and facilitating the learning process until the learners are able to discover their true potential and have the skills necessary for employment and living (Paengthai, 2019; Wangsrikoon, 2014). Therefore, the Faculty of Education is one important unit of an institution that aims to produce “teaching profession students with four desired characteristics: 1) professional skills, 2) soft skills, 3) citizens and citizens of the world, and 4) entrepreneurs or job creators of career skills (Office of Higher Education Policy and Planning, 2018). The desired characteristics of "soft skills" are one of the skills that are important for the development of teaching profession students to become qualified graduates and teachers who will advance to higher professional status.

The southern border provinces have their own cultural identity that are different from other provinces in terms of culture, race, religion, language, dressing, and way of life, which is considered a “multicultural society.” This region consists of Narathiwat, Pattani, Yala, Songkhla, and Satun provinces, serving as the center of educational resources because there are up to seven institutions that focus on producing teachers and promoting the academic standing of local teachers in a multicultural society (Suwanvong, 2017; Thongmark1 et al., 2018). This results in the flow of many multicultural students from all provinces in the south of Thailand into this area to study (Augnoil et al., 2020).

Therefore, developing teaching professional students to adopt soft skills is an important mission for educational institutions that produce quality teachers (Gonzalez et al., 2018; Malykhin et al., 2021). especially the teaching profession students in the multicultural society context who will serve as facilitators for learners to have a learning process for living together, respect the rights of others, appreciate human dignity and prestige, cultivate conscious mind and awareness of cultural identity of oneself and others, and connect them to create understanding under the differences (Watthanabut, 2021). This is in line with the study by Capella University (2018), which indicated that soft skill is a characteristic of teachers of a new era. Thus, it is necessary and important to prepare teaching professional students to become "professional teachers."

The researchers realize the importance of developing soft skills in a multicultural society in order to understand the meaning and the components of soft skills in a multicultural society based on experiences of stakeholders who are involved in educational management, guidance, and psychology in the context of a multicultural society. This is done through group discussions about the components of soft skills in a multicultural society, leading to the development of soft skills for students in the southern border provinces in the future.

Methodology

This study was conducted with a phenomenology qualitative research design, as detailed below.

Participants

Participants were 10 stakeholders involved in educational management, comprising educational supervisors, school directors, university professors, psychologists, teachers, and guidance counselors in the southern border provinces chosen through the purposive sampling.

The criteria for selecting key informants for group discussions were specified as follows:

1) Have knowledge and understanding about teaching and learning conditions for teaching professional students in southern border provinces within the context of a multicultural society.
2) Have either a doctoral degree or master's degree in education, counseling psychology, or guidance.
3) Have work experience in research, supervision, providing psychological counseling services, guidance, educational administration, textbook writing, trainer or speaker for psychological and educational work in the southern border provinces within the context of a multicultural society.
4) Be capable of conveying experiences well.
5) Be willing to participate in their research, serving as key informants, signing a letter of intent. to participate in their research and joining 2–3-hour group discussions. Details are shown on the table below.

Table 1: Key Informants

Participant	Gender	Career	Education level
1	Male	School director	Doctor's Degree
2	Female	Educational supervisor	Doctor's Degree
3	Male	Educational supervisor	Master's degrees
4	Male	University lecturer	Doctor's Degree
5	Female	University lecturer	Doctor's Degree
6	Female	University lecturer	Doctor's Degree
7	Female	Psychologist	Master's degrees
8	Female	Psychologist	Master's degrees
9	Male	Guidance counselor	Master's degrees
10	Female	Guidance counselor	Master's degrees

Instruments

Research tools include**:**

1. The researcher is considered an important tool for qualitative research. This is because the researcher is the person who observes, builds up relationships with informants, records information, and runs data analysis. Therefore, the researcher will prepare himself/herself well in terms of knowledge and understanding of a qualitative research method to carry out research efficiently.
2. Sample questions for group discussions include:
   a. "How important do you think soft skills are for the teaching profession students in a multicultural society in the southern border provinces?"
   b. "What is the meaning of soft skills in multicultural society for students in the teaching profession in the southern border provinces? What aspects or elements are there in soft skills, and what does each aspect or element mean?

c. “Do you think which aspect or element of soft skills in a multicultural society is the most important or necessary for teaching profession students in the southern border provinces?" Please prioritize the said elements.”

3. The record of the interview is for recording general information about the informants and that obtained from group discussions, such as conversation atmosphere and behaviors of the informants that occurred during the group discussions.
4. Audio and image recording equipment The Microsoft Teams program is used for group discussions.

Data Analysis

After verbatim transcription of the interview tapes, the scripts were analyzed by coding messages with similar meanings together. Then those with the same themes were grouped into subcategories and categories. The trustworthiness of the validity of the analysis, interpretation, and summary of supportive data were achieved through external auditing conducted by an expert on qualitative research.

Results

Four main themes emerged from the findings as detailed below.

From the interviews with key informants, it was concluded that soft skills in a multicultural society referred to skills of teaching professional students, both internal and external skills, which were related to interactions and collaborations between teaching profession students and students, school personnel, local community networks, and religion leaders. These skills included thoughts, emotions, feelings, and behaviors under cultural diversity in the southern border provinces, which were used to improve oneself in communication and relationship building, teaching and learning, collaborative promotion, development, prevention and solving problems of the students, adaptation, and acceptance of cultural diversity, and living happily in the multicultural society context in the southern border provinces. There were 4 elements: communication and relationship building, working collaboratively with others, adaptation, and accepting cultural diversity, as described below.

Theme 1: Communication and Relationship Building

Communication and relationship building are important skills that teaching profession students must have in themselves. They consist of self-disclosure and healing, choosing effective communication methods, listening carefully and attentively, honoring yourself and your interlocutors, understanding others sympathetically and without quick judgement, and solving communication problems appropriately. Details are as follows.

1. Self-disclosure and tuning in. It is an expression of sincerity, building good relationships with each other, revealing emotions, feelings, and exchanging stories, and public mindedness, especially to students and communities, through different forms of communication, including verbal communication, body language, smiling, showing good friendliness, and understanding each other.

   “Teaching profession students must speak professionally, have good human relations with others, be broad-minded and sincere, have good personality, good mood, and care for others. This is because a person who has good human relations is able to get

along with others easily, which becomes a characteristic of a person that strengthens interpersonal relationships very well." (ID10)

"Being a teacher, a person needs to have a sense of giving help to students and good communication skills in working with communities, parents, and religious leaders. If anyone has this skill, he/she will be able to make connections and reconcile with people and the communities." (ID5)

2. Choosing effective communication methods is the action of using the language that suits the local context. Either the use of a local dialect to make the "we-group conversation or a straightforward and polite way is acceptable. We can use tones that indicate sincerity and show facial expressions that do not cause misunderstandings and conflicts.

"Teaching profession students should know how to use the language that corresponds to the spatial context, words that do not cause conflict and violence. They should show their humility to each other—both the people of the same religion and those of different religions and cultures." (ID3)

"The languages that teachers should use in communication could be body language, facial expressions, gestures, spoken language, and the use of a polite tone of voice, speaking logically, and speaking with the tone that indicates sincerity." (ID10)

3. Listening carefully, attentively and respecting yourself and your interlocutor in a multicultural society, being a good listener is important and necessary because of the differences in cultural context. The teachers should understand their interlocutors of other religions through attentive listening, paying attention, and respecting interlocutors.

"The relationship is a matter of value. Appreciation, regardless of conflicts, respect and honor each other, flexible adjustment for involvement in the society where cultures are different and unfamiliar." (ID3)

"Listening is an action that is shown outwardly. Everyone can notice this behavior. Therefore, the communication that comes in the form of listening respectfully is a good thing that helps students in the teaching profession apply it in their work in general, in teaching and learning, and in their harmonious coexistence in a multicultural society." (ID 4)

Theme 2: Working With Other People

Working with other people is an important skill that teaching profession students must have. This skill includes a willingness to work with people and communities of diverse cultures, sharing opinions, listening to other people's views, showing a sense of being equally important, understanding each person's roles and responsibilities, and unity and coordination with agencies both inside and outside the school.

1. Willingness to work with other people is the action when a person shows that he is open-minded and accepts the diversity of the people in the community in which he

lives. Adjusting the mind or behavior of the teaching profession students is therefore important.

"Start from yourself. You must be ready for adjustment, have flexible thoughts, and know how to control your own emotions when you work with other people like parents and communities, not school staff only." (ID2)

"In working together, we have to be open-minded. We must listen to other team members or to the community. We have to welcome diverse ideas and opinions. If the said matters can be resolved, the work will be easily accomplished because it comes from the cooperation of all parties." (ID8)

2. Understanding the roles and responsibilities of each person and cooperating in goal setting means the ability to understand own roles and responsibilities, the state of having skills when serving as a leader or a follower, and the ability to cooperate in goal setting or guidelines for working together.

"Teaching profession students should have a good human relationship in persuading other people to do things that serve the set goal and work collaboratively in goal setting with other team members based on mutually set criteria." (ID3)

"First, teaching professional students must have a clear behavior in terms of understanding their own roles and responsibilities when serving as a leader or a follower, knowing how to set goals of thoughts and life. When you have a clear goal or clear direction, you will be able to encounter various obstacles and will have the determination to face them. Being farsighted will make cooperative work go smoothly." (ID6)

3. Coordination with agencies both inside and outside the school is the action of working in a multicultural area under good coordination and relationships with the communities or outsiders and networks. There are also plans to prevent and solve problems.

"Among the diversity of a multicultural society, from a psychological point of view, it might be that teachers must have their mental processes in terms of thoughts. Their thoughts and emotions need to be appropriately managed when coordinating with agencies both inside and outside the school. Problem solutions should be direct to the points." (ID 4)

"Students in the teaching profession must have a good verbal communication manner and know how to work together in harmony, leading to mutual cooperation and coordination within the school and with the communities surrounding the school." (ID 10)

Theme 3: Adaptation

Adaptation is an important skill for teaching professional students. It includes flexibility in thinking, sensible analytical thinking, controlling and expressing emotions and feelings appropriately, as well as participating in various activities of the schools and communities.

1. Having flexibility in thinking means knowing how to adjust oneself to suit one's role and duties, knowing how to be kind to others, and being considerate, for example.

   "Teaching profession students in the context of a multicultural society should adjust themselves peacefully according to roles, duties, responsibilities, and the time frame context without causing trouble to others." (ID3)

   "Adjusting oneself and to be accepted that I am like this, you are like this, and what is the middle part between us? What topics can we not touch on? What topics can we warn each other about? We have good relations, and we help each other in order to adjust ourselves." (ID9)

2. Sensible analytical thinking is the state of having good judgment in living in an area of diversity, knowing how to think over cultural differences to be able to understand the real world.

   "To be able to live together happily in a multicultural society, those who want to be teachers must learn how to live together in the society with judgment and how to think analytically and logically amidst the differences that are unfamiliar in order to cope with self-adjustment and work." (ID1)

   "Being calm, mindful, still, and knowing how to think reasonably amidst cultural differences. Accept and understand your own attitudes and those of others well." (ID10)

3. Participating in various school and community activities is the action of modifying one's own behavior in participating in activities in the Buddhist community, Muslim community, or Christian community, listening to opinions or criticisms and applying them in self-adjustment in living together in the community.

   "The action shows that he can listen to criticism and different opinions. When he is in the community, he can adjust himself to participate appropriately in school or community activities." (ID7)

   "Changing one's own behavior; for example, if one goes to live or do activities in a Buddhist Thai community, a Muslim community, or a Christian community, one must behave accordingly, adjust himself to interact with students, teachers, colleagues, or the community, or understand the nature, conduct, customs, behavior, and differences of each culture." (ID8)

Theme 4: Accepting Cultural Diversity

Accepting cultural diversity is an important skill that teaching profession students must have. It includes adjusting their views and leading their lives relevant to the cultural context, appreciating the value of other cultures, showing respect in doing all actions, no insulting, no offending other cultures, and seeing the differences and similarities of one's own culture and other cultures.

1. Adjusting views and conduct following the cultural context is the action showing understanding what other people are doing in different environments and self-conduct

following the principles of one's own religion to understand the limitations and conditions of the people of other religions, resulting in being able to become open-minded and learn more about the differences.

"Differences and diversities are everywhere. We will have to learn to understand other people's actions. Especially in the teaching profession, students who are going to teach schoolchildren have to attentively and deeply understand the way of life and differences of cultural context." (ID1)

"Firstly, in the teaching profession, students must understand the differences among people by adjusting their own views. Let's say we have to work in another province and must stay in a provided residential area in the school. However, we can't accept why we must go there. Why do we follow the others? If we cannot accept the local context of the school, it could be a hard time." (ID5)

2. Appreciating the value of other cultures is an acceptance of the differences of other cultures that are different from our own and knowing how to learn the ways of life of other cultures. This will make you understand other people more, especially valuing the culture of each area.

"We must accept. In addition to understanding, you must also accept and realize that the cultural behavior practiced by others is something different from what we already are. For example, in the southern border provinces, Muslims have their own way while Buddhists have another way, and so do the Chinese." (ID2)

"We know that when teaching profession students are in school, it is necessary for them to observe and learn about other cultures that are different, including organizational culture. And I personally think that organizational culture is something they must learn, especially the issues regarding gender diversity, diversities in classes, ages, and culture that interact with one another in order to understand more about work." (ID3)

3. Showing respect, no insult, and no violation of other cultures is an expression of respect to the values of other cultures, no insult, no abuse, listening to beliefs and applying them with understanding. Never argue with other people's opinions that are different from our own one.

"An important thing about being a teacher is never argued against other people's opinions that may be different from your own. However, the differences should be taken as advantages, strengths, and focuses of learning to create interactions with each other in the form of expressing respect for each other's opinions in living together in diverse cultures." (ID4)

"The teaching profession students must have the skills to learn different cultures that they are not familiar with since their birth and learn to accept that culture without insults nor violation. Accept beliefs in order to develop yourself." (ID8)

Discussion and Conclusion

This study reflects the important soft skills that teaching profession students should have in working within the context of a multicultural society in the southern border provinces of Thailand. The informants reflected those soft skills in a multicultural society consisted of 4 skills: (1) communication and relationships, (2) working with other people, (3) adaptation, and (4) accepting cultural diversity. The details are as follows:

1. Communication and relationship-building skills include self-disclosure and healing behaviors that require the disclosure of emotions and stories to be exchanged with one another, selecting the communication method that suits the local context, learning local dialects, listening attentively and carefully, and honoring the interlocutor by being a good listener. These matters will become a foundation for empathy and without quick judgments of the people who have different views or cultures, leading to living together in a positive atmosphere. The results of the study on this issue are consistent with the study by Mailool, Retnawati, Arifin, Kesuma, and Putranta (2020), which investigated teachers' experiences teaching soft skills in professional courses in Indonesia. It was found that communication skills are very necessary that every teacher must have because teachers must use many communication skills together to organize learning so that learners will have knowledge, skills, and desirable characteristics as specified. In addition to teaching, teachers will have to do other jobs in the school. Teachers' work requires communication skills, which consist of listening, reading, speaking, and writing, especially when working with culturally diverse individuals.
2. Skills for working with other people consist of a series of behaviors that reflect willingness to work with diverse community members, both inside and outside the school, starting from being open-minded to accept the diversity of individuals and communities we are interacting with and sharing opinions in a democratic way. Everybody is equally important, and all reasons are welcome. These actions will lead to unity in the future. The results of the study in this issue are consistent with the study of the characteristics of teachers that students are satisfied with (Chananil, Chaisawat, Konchalard, & Chanapan, 2020), which found that students expected that teachers were their good role models. The learners would develop good learning behavior using teachers as role models. Therefore, if teachers showed they honored other people, helped each other, and knew their own roles and responsibilities, the learners would absorb and imitate such desired behaviors. In addition, Ağçam and Doğan (2021) had suggested that the important skills in working together with others were the ability to work with a variety of people (not just the people you agreed with) and a willingness to find new perspectives regarding various issues. A recognition of other people's skills and experience and understanding that you don't have them should be beneficial to the project or the team in finding the best solution.
3. Adaptation skills consist of behaviors that are flexible in thinking, controlling, and expressing emotions appropriately. It includes participating in various activities of community schools in the area and paying serious attention to religious activities that are different from one's own for a good adaptation to living together in a diverse cultural context. Arias, Sancho, Vergara, & Barrientos (2021) had studied the soft skills of American university professors' self-perception. An interesting finding from this study is that teachers should have emotional and mental flexibility and have an attitude that is open to growth. Open to learning new challenges. Be open to opinions that are beneficial to yourself. Always be ready to change, adapt, and develop yourself. Under a peaceful multicultural society, with reliance, respect, and non-

violation of each other's rights. Because if teachers are able to adapt and create equality in multicultural classrooms, these things will be the beginning of an open society full of equality where everyone has rights and freedom under the uniqueness of each person, so that students have the opportunity to learn from each other and accept differences. This is why adaptability skills are so important.

4. Skills in accepting cultural diversity consist of the behavior in adjusting ideas and attitudes and the practice in the cultural context. Teachers have to understand the action performed by people from different cultures or religions, including seeing the value of learning ways of life and the conducts that reflect respect, no insult, no infringe on other cultures that are different from one's own, and without using one's own thoughts to judge, in line with the study by Cinque and Kippels (2023), which found that teachers with positive attitudes toward multicultural classrooms are the person who can promote peaceful coexistence by promoting students to live together, think together, and realize that no matter what race or religion, these differences are not barriers to friendship. In living together and being successful in life, the teacher must be the one who initially introduces the exchange of cultural understanding of the students in a classroom or even in the communities on basic matters such as language, dressing, way of life, or working together in order to encourage students to understand and accept differences without the feeling of being separated. The cooperation in building up unity in diversity by encouraging children to do activities together with their parents to expand the children's society. In the event that a problem is encountered, the teacher should give advice to the students to solve the problem in a peaceful way. For respect, culture, humility, and open-mindedness, in a small society like a multicultural classroom, the teachers are the ones who encourage and provide guidance in learning to understand and live with people who are different, including sharing, caring, and openness. These elements will be a good foundation for students to go out and create an open society in the future.

Therefore, self-development for teachers of today is not only the preparation for classroom teaching and constructing the body of knowledge, but also the ability to cope with fluctuation and the changing diverse society. The ability to understand the meaning and the skills the teachers should develop in themselves is important and necessary because they are the skills that the teachers can be trained to foster. These skills are not only beneficial to the teaching job but also to the teachers themselves.

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Contact email: maithai.ch@gmail.com

Development of the Multimedia Modules for Interactive Online Learning to Enhance Understanding of Principles of Graphic Design on Packaging

Suchapa Netpradit, King Mongkut's University of Technology Thonburi, Thailand
Tanatorn Tongsumrith, King Mongkut's University of Technology Thonburi, Thailand
Worawimon Bunlungsup, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
Currently, the packaging industry is experiencing a shortage of graphic designers and the lack of interactive learning materials about graphic design. The purpose was to design motivational videos and audio in 7 modules to enhance understanding of graphic design using Adobe Illustrator. Each video clip for few minutes duration was produced with Adobe Premiere Pro and uploaded to the Google Classroom platform to be accessed by QR code scanning. The qualities of the multimedia were evaluated by three content experts and three media experts using a 5-point rating score. The learning effectiveness was observed using a specific focus group of 30 undergraduate students in the Printing and Packaging Technology program at KMUTT. The pre-tests and post-tests for each module were created with Google Forms using ten optimal multiple-choice questions in a module with IOC and difficulty level analysis. The qualities of the content and the media were rated as good with the mean score of 4.01 and 4.37, respectively. The learning efficiency, determined from the total post-test scores (E1) to the mean score of the final exercise (E2), was 84.2/88.14, which was higher than the expected criteria. The mean of post-test score was 48.24% increasing from the pre-test score which was significantly difference at the 0.05 level. Learners' satisfaction with the content was high ($\bar{x}$=4.47), and satisfaction with the multimedia was the highest ($\bar{x}$=4.54). The results suggested that this multimedia modules could be effectively applied to improve understanding of graphic design on packaging using Adobe Illustrator.

Keywords: Multimedia Modules, Interactive Online Learning, Graphic Design, Packaging

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Introduction

Due to the COVID-19 situation, there have been changes in lifestyles, leading to a "New Normal" where people interact less closely. As a result, many have sought to start their own businesses to increase income, which requires the use of packaging for product wrapping and safety. Packaging also helps maintain product quality and simplify transportation, aligning with the creative design for motivation. However, the packaging industry is experiencing a shortage of graphic designers and a lack of interactive learning materials about graphic design.

As technology advances and Internet accessibility improves globally, more students and educators are embracing digital platforms for learning and teaching. This shift has also been further accelerated by the COVID-19 pandemic, which forced educational institutions worldwide to adapt to remote learning models rapidly. With the rise in online learning, educational media must also adapt to become a valuable tool in modern education, offering flexibility and variety to meet the needs of learners. The computer, tablet, or mobile phones can easily access resources for everyone's self-learning anywhere and anytime by connecting via the Internet.

In the meantime, micro-credentials: short, module or focused online courses leading to skill development (Upskill/Reskill) are becoming increasingly popular for many occupations. Modular learning is a teaching and learning approach that breaks down a course or curriculum into smaller ones. The self-contained modules can incorporate interactive elements such as quizzes and multimedia resources to enhance engagement and retention. Adobe Illustrator is the most popular program for graphic art creation such as logos, illustrations, graphics, line, etc. This work aimed to design motivational multimedia containing videos and audio in 7 modules to enhance understanding of graphic design with Adobe Illustrator on the folding box packaging.

Methodology

The interactive online learning entitled "Principles of Graphic Design with Adobe Illustrator on Folding Box Packaging" of 7 modules with each video clip for 2-3 minutes duration was produced with Adobe Premiere Pro and uploaded to the Google Classroom platform to be accessed by QR code scanning. The Google Classroom is a free web-based learning platform developed by Google, where teachers can run a class online, create curriculums, and share assignments with students by logging in with a Gmail address to access the Google Classroom.

The quiz for pre-tests and post-tests of each module was created with Google Forms using ten optimal multiple-choice questions for a module with IOC and difficulty level analysis as (1):

$$\textit{Difficulty Index } (P) = R/T \tag{1}$$

(Where R is the number of correct responses,
and T is the total number of responses in the sample group)

The appropriate difficulty is 0.20-0.80 because the exams that were too difficult (<0.20) or too easy (>0.80) were unable to classify the learning outcome.

The multimedia qualities were evaluated by three content experts and three media experts with work experience related to design and teaching media for not less than 2 years, selected by purposive sampling using a 5-point rating score. The learning effectiveness was observed using a specific focus group of 30 undergraduate students in the Department of Printing and Packaging Technology at King Mongkut's University of Technology Thonburi. The sample group consisted of the second and the third year students of a 4-year program in the academic year 2023, selected by convenience. The samples had to take a pre-test before self-learning each module and then a post-test.

After completing seven modules, the learners took a final test and questionnaire to evaluate their satisfaction using a 5-point rating score, as shown in Table 1. The learning efficiency was determined from the total post-test scores of each module as the efficiency of the process during class (E1) to the average score of the final exercise as the efficiency of outcome after all classes (E2), which was set E1/E2 at 80/80.

Table 1: The Criteria of the 5-Point Rating Score for Evaluation

Scale	Scale Interval	Opinion for Quality	Description for Satisfaction
5	4.50-5.00	Excellent	Very Satisfied
4	3.50-4.49	Good	Satisfied
3	2.50-3.49	Average	Neutral
2	1.50-2.49	Poor	Dissatisfied
1	1.00-1.49	Very Poor	Very Dissatisfied

Results and Discussion

The learners can use computers, notebooks, mobile phones, tablets, or iPads to access the Google Classroom which can be downloaded for either Android or IOS anywhere that Internet availability, as Fig. 1 (a). In this Google Classroom, there are seven codes to enter each lesson module or scan the QR Codes of each lesson, as Fig. 1 (b). The topic, learning objective, and video clip duration of each lesson are shown in Table 2.

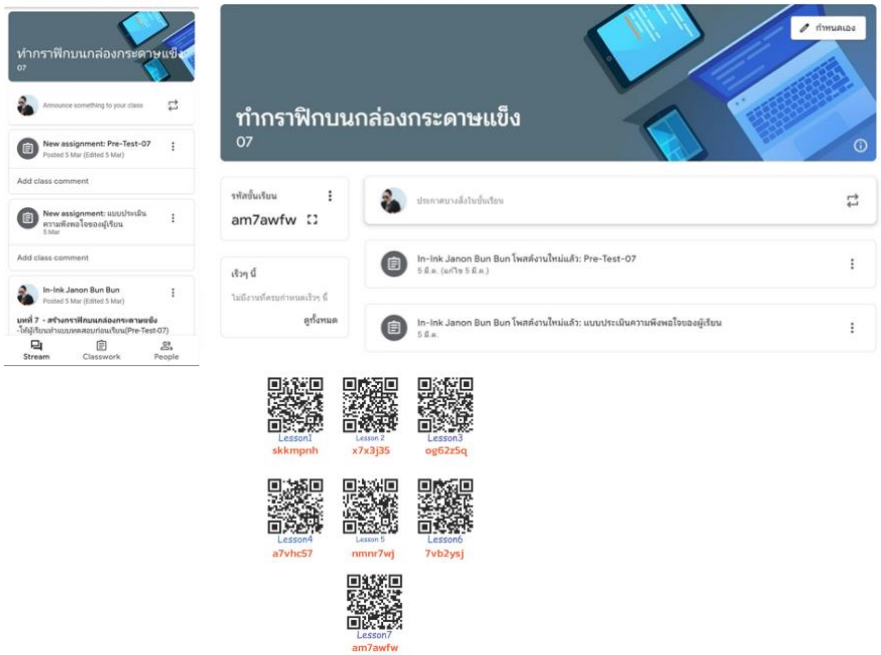

Figure 1: Displaying in a Google Classroom on Electronic Devices (a) and QR Codes for Access 7 Lesson Modules

Table 2: Lesson Modules of the Interactive Online Learning

Module	Topic	Learning Objective	Period (min)
1	Introduction to Basic Principles of Art	To improve the basics of art for learners.	02:07
2	Objectives of Packaging Design	To provide learners with an awareness of basic packaging design objectives.	01:57
3	Basic Application of Adobe Illustrator	To make learners understand the essential tools of Adobe Illustrator.	22:43
4	Additional Techniques for Adobe Illustrator	To support learners applying additional techniques for Adobe Illustrator.	09:54
5	Recommendation of resources for workpiece preparation	To guide learners aware of the source of additional resources for creating products.	08:21
6	Layout and Die Line for Folding Box Structure Design	To enhance learners building the folding box themselves.	09:11
7	Graphic Design and Creation on Folding Box	To enhance learners creating the graphics on the folding boxes.	08:54

The multimedia learning material of each module includes graphics, pictures, video, and audio to provide knowledge about the graphic design program Adobe Illustrator. They were produced using the Adobe Premiere Pro and uploaded in the Google Classroom platform. The examples of pictures captured from the multimedia are shown in Fig. 2.

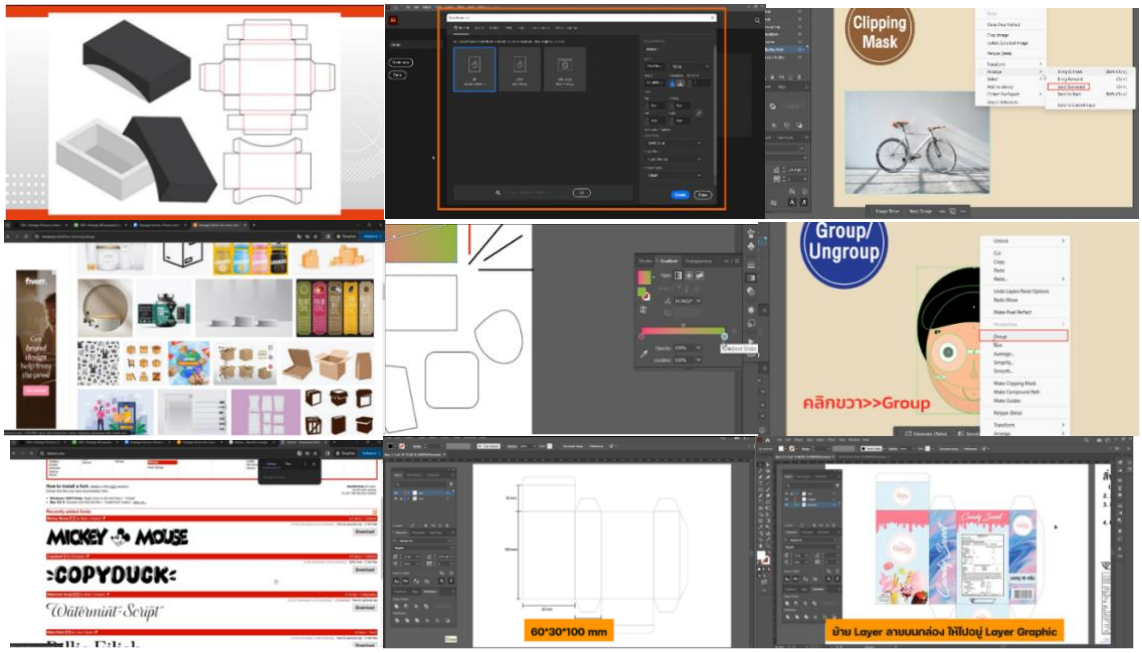

Figure 2: Examples of Picture Captured From the Created Multimedia

For the evaluation by 3 content experts and 3 media experts, the qualities of the content were rated as good ($\bar{x}$=4.01) from 10 evaluation topics and the qualities of the media were rated as good ($\bar{x}$=4.37) from 10 evaluation topics, as shown in Tables 3 and 4.

Table 3: The Quality Evaluation of the Content of the Interactive Online Learning

Item	Evaluation Topic	Mean	SD	Definition
1	Appropriateness of the content to the learning objectives	4.0	1.0	Good
2	Accuracy of content	4.3	1.2	Good
3	Appropriateness in arranging content	4.3	0.6	Good
4	Modernity of content	3.7	0.6	Average
5	Categorization of content	4.3	0.6	Good
6	Appropriateness of the amount of content	3.3	0.6	Average
7	Appropriateness of the sentences used in the content	4.0	1.0	Good
8	Content suitable for the target group	3.7	0.6	Average
9	Content completeness	3.7	0.6	Average
10	Suitability of illustrations and graphics with content	4.8	0.6	Excellent
	Total mean score	4.01	0.74	Good

Table 4: The Quality Evaluation on the Multimedia of the Interactive Online Learning

Item	Evaluation Topic	Mean	SD	Definition
1	Appropriateness of the use of background colors	4.3	0.6	Good
2	Appropriateness of the font style and size	4.7	0.6	Excellent
3	Appropriateness of the font color	4.3	0.6	Good
4	Suitability of elements on the screen	4.7	0.6	Excellent
5	Appropriateness of the sound effects	4.0	1	Good
6	Consistency of illustrations with content	4.7	0.6	Excellent
7	Sharpness of images and clarity of sound in video	4.3	0.6	Good
8	Solution of scores summarize in exercises	4.0	1	Good
9	Interesting and engaging learning of lesson	4.0	0	Good
10	Suitability for dissemination of lessons learned	4.7	0.6	Excellent
	Total mean score	4.37	0.62	Good

There were some topics should be improved for the content such as modernity, amount, suitable for the target group and completeness. For modernity, many updated programs should be recommended. The content amount of each module should be of similar length. The content should be adjusted to be appropriate for adult learners and added design examples to make the content more complete. For the media, the experts suggested that interactive online learning should be made into a website, including YouTube or a Learning Management System (LMS), for easy access and user data collection.

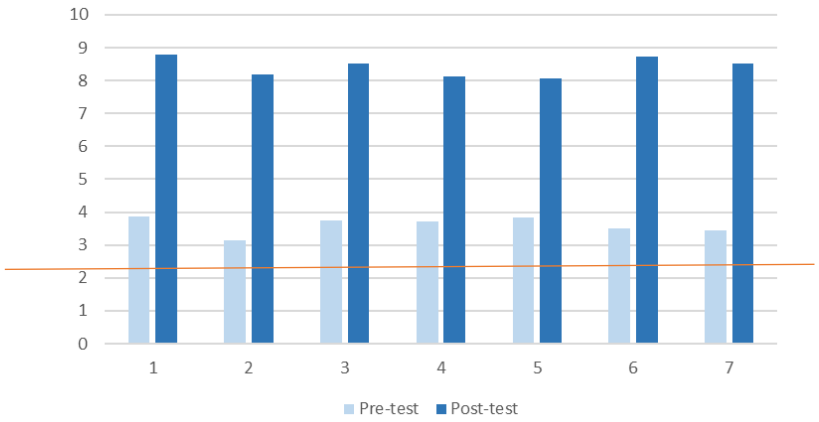

Figure 3: Average Scores of Pre-test and Post-test for Seven Modules

To investigate the learning effectiveness of the learners, the average scores of pre-test were compared to the average scores of post-test for seven modules, as shown in Fig. 3. The result showed that each module's content was consistent with each module's questions. The learning materials were so good that the learners gained a greater understanding. The average score of the sample group before learning the lesson was 3.60 points, while the average score after learning the lesson was 8.42 points, meaning that the average score increased by 48.24%. Comparative result of learning achievement was analyzed using one-way ANOVA with the Tukey method. It was found that the average score after learning all seven modules was higher than the average score before learning, with a statistically significant at 0.05 level.

The average score in the percentage of the final test, which was 10 appropriate questions by the sample of respondents after learning all 7 modules is shown in Table 5. The learning efficiency, determined from the total average post-test scores as the efficiency of the process during class (E1) to the average score of the final exercise as the efficiency of outcome after all class (E2), was 84.2/88.14, which was higher than the expected criteria of 80/80.

Table 5: Scores of the Final Test After Learning All 7 Modules

Question No.	1	2	3	4	5	6	7	8	9	10	Average
Point (%)	100	65.6	75	100	81.3	93.8	87.5	87.5	93.8	96.9	88.14

For the satisfaction of the sample group of 30 learners with the learning media, the results are shown in Tables 6 and 7. It was found that the learners were satisfied with the content ($\bar{x}$=4.47), and very satisfied with the multimedia ($\bar{x}$=4.54).

Table 6: The Satisfaction Level of the Sample Group with the Content of the Interactive Online Learning

Item	Evaluation Topic	Mean	SD	Definition
1	Appropriateness of the content to the learning objectives	4.55	0.51	Very Satisfied
2	Accuracy of content	4.5	0.51	Very Satisfied
3	Appropriateness in arranging content	4.5	0.61	Very Satisfied
4	Modernity of content	4.45	0.51	Satisfied
5	Categorization of content	4.5	0.51	Very Satisfied
6	Appropriateness of the amount of content	4.5	0.51	Very Satisfied
7	Appropriateness of the sentences used in the content	4.4	0.6	Satisfied
8	Content suitable for the target group	4.5	0.51	Very Satisfied
9	Content completeness	4.25	0.64	Satisfied
10	Suitability of illustrations and graphics with the content	4.5	0.61	Very Satisfied
	Total mean score	4.47	0.74	Satisfied

The mean score for satisfaction of sound effects was the lowest (4.15) which might be caused by the subtitles where some words were not pronounced clearly. Some learner samples complained that there were too many exercises before and after class of each module for seven lessons which may cause learners to waste time for their self-learning.

Table 7: The Satisfaction Level of the Sample Group With the Multimedia of the Interactive Online Learning

Item	Evaluation Topic	Mean	SD	Definition
1	Appropriateness of the use of background colors	4.8	0.41	Very Satisfied
2	Appropriateness of the font style and size	4.75	0.44	Very Satisfied
3	Appropriateness of the font color	4.7	0.47	Very Satisfied
4	Suitability of elements on the screen	4.6	0.5	Very Satisfied
5	Appropriateness of the sound effects	4.15	0.67	Satisfied
6	Consistency of illustrations with content	4.4	0.5	Satisfied
7	Sharpness of images and clarity of sound in video	4.4	0.6	Satisfied
8	Solution of scores summarized in exercises	4.6	0.6	Very Satisfied
9	Interesting and engaging learning of the lesson	4.4	0.5	Satisfied
10	Suitability for dissemination of lessons learned	4.6	0.5	Very Satisfied
	Total mean score	4.54	0.52	Very Satisfied

Conclusion

The online learning multimedia contained graphics, photos, videos, and audio to provide knowledge about using the Adobe Illustrator program. There were seven modules created by Adobe Premiere Pro through the Google Classroom platform accessed with seven unique codes or QR codes. The content qualities rated as good with a mean score of 4.01 and the media qualities also rated good with a mean score of 4.37.

The experiment was conducted with a sample of 30 undergraduate students of the Department of Printing and Packaging Technology in the academic Year 2023 at King Mongkut's University of Technology Thonburi, Thailand. There were a pre-test and post-test for each module with ten multiple choice questions, created in Google Forms.

The mean post-test score was 48.24% higher than the mean pre-test score, with a significant improvement at the 0.05 level. The learning efficiency, based on post-test (E1) and final exercise (E2) scores, was 84.2/88.14, exceeding the expected criteria (80/80).

The learners were satisfied with the content with a mean score of 4.47 and very satisfied with the multimedia with a mean score of 4.54. The study suggested that this multimedia modules could be effectively applied to improve understanding of graphic design on packaging using Adobe Illustrator program.

Acknowledgements

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Contact email: suchapa.net@kmutt.ac.th

Effect of Developing Multimedia for Three Phase Induction Motor Rewinding Using ADDIE Model

Nantarak Reungruk, King Mongkut's University of Technology Thonburi, Thailand
Chamnan Ratsamee, King Mongkut's University of Technology Thonburi, Thailand
Pakpoom Chansri, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
Motor rewinding skills are one of the practical skills of an electrician. Generally, it will be organized as a vocational certificate program, emphasizing practical training in disassembly and reassembly motors, form coils of copper wire and electrical circuit connections. Over the course of the last few years, there has been a there has been a decline in learning and proficiency in practice capabilities due to the pandemic. Utilizing media technology in the classroom facilitates practice by letting students' study and work through material independently. As a result, the Addie model is used in the research to create multimedia materials for motor rewinding. The results of the study found that: 1) Develop multimedia to enhance skills in three-phase induction motors according to the ADDIE Model concept. The multimedia was examined by three experts, and 2) results of finding the quality of developing multimedia to create skills in three-phase induction motors according to the ADDIE model. Regarding the appropriateness of the contents of disassembling a three-phase induction motor, the experts had a high overall opinion ($\overline{X}$=4.11, S.D.=0.93). The overall development of learning outcomes from the content structure of three-phase induction motors was rated highly ($\overline{X}$=4.5, S.D.=0.56). The psychomotor domain was at the skill movements level, while the cognitive domain was at the comprehension level. In the development of multimedia media to increase learning skills regarding three-phase induction motors according to the ADDIE Model can be used as teaching media and can also allow students to study outside of class time appropriately, which will affect their learner development according to the ADDIE Model.

Keywords: ADDIE Model, Developing Multimedia, Motor Rewinding, Three Phase Induction Motor

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Introduction

Currently, where digital technology is a big part of our everyday lives, creating engaging and effective learning materials is crucial. Consequently, the deployment of simple-to-understand media technology, which combines words, images, sounds, and videos for independent training and practice, can enhance learning. The earlier reports (Ye, 2000) exemplify the utilization of multimedia in teaching to enhance students' understanding and engagement, be it in business models, science, engineering, or any other subject (Doni, 2023; Gabriel, 2023; Pramudita, 2018). Multimedia is often applied to technically complex subjects where learners have little ability to understand the lesson and practice, and multimedia is often created about practical skills that make the skill more proficient, such as the technique of winding a 3-phase induction motor, which is considered one of the most important practical skills of all electricians and requires extensive training. Focusing on the fundamentals of motor winding, motor disassembly, winding copper form coils, installing coils in the stator motor, connecting the motor's electric circuit, and assembling the electric motor, particularly in the group of vocational certificate students grouped in the practical electrical machine subject. Nevertheless, the epidemic has made it impossible to exercise practical skills in the laboratory in recent years. Students may receive no practice, only online instruction, a change in the structure of instruction, or none at all, leaving them without any practical skills. These skills have declined as a result of a learning regression.

Since induction motors are the key components that drive the machinery and manufacturing processes in the industry, education and training in induction motor winding are vital. Numerous industrial sectors, including manufacturing, energy, transportation, and electrical appliances, employ induction motors. Consequently, it is critical to ensure the motors operate safely and effectively. Because winding an induction motor includes several intricate and exact processes, each of which is crucial to the motor's operation, it is a procedure that calls for specific knowledge, experience, and extreme caution. Any errors might lead to the motor breaking down or performing poorly. Thus, systematic motor winding training equips students with the information and abilities needed for real-world work, which is crucial for advancing professional talents and enhancing the working capacities of engineers and electricians (Masoumi, 2022). Possessing the right information and abilities for motor winding also lowers the possibility of mishaps and equipment damage, which boosts productivity and lowers maintenance and replacement expenses. Furthermore, high-quality education and training may help to develop skilled workers who can produce new inventions and technologies for the industry. In the long run, developing these employees will support the industry's growth and competitiveness.

One of the techniques that can be used to design and develop multimedia in the motor winding process for efficiency is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) technique, which is an instructional design process that emphasizes analysis, design, development, implementation, and evaluation (Aldoobie, 2015). Because it offers a precise and organized framework that makes learning media creation efficient and student-centered, the ADDIE model is one of the most well-liked and often applied instructional design models globally (Sahaat, 2019; Spatioti, 2022). Every stage of the model—which includes analyzing learners and their content learning needs, designing and planning instruction, choosing tools and technologies, producing and testing multimedia content, setting up equipment, overseeing and assisting instruction, assessing instruction, and refining the quality of the media—contributes significantly to the creation of high-quality learning materials (Budoya, 2019). Therefore, this article focuses on using the ADDIE Model

concept to develop multimedia for teaching three-phase induction motor winding. This model enables the creation of learning media that are systematic and effectively respond to learners' needs. The developed media will help learners understand and learn complex subjects more effectively and interestingly. The design focuses on responding to learners' specific needs and continuous improvement.

This research presents a study on the development of multimedia materials for motor winding using the ADDIE model, which consists of five steps in designing and developing learning processes through multimedia. The aim is to enhance learners' understanding and align with 21st-century skills (Binkley, 2012). The multimedia integrates visual, auditory, and explanatory elements to improve the learning and comprehension of motor winding. The study evaluates the impact of the developed multimedia on learners in three areas: 1) professional skills, 2) learning skills, and 3) positive attitudes. Additionally, it compares the multimedia-based learning process with teacher-centered methods that focus on motor-winding content. The research highlights the creation of effective tools for both teachers and students, enhancing understanding of motor winding processes, which will significantly benefit future industrial and technological development.

ADDIE Model

The ADDIE Model allows for continuous adaptation and development, ensuring effective learning that aligns with learners' needs. The ADDIE model is popular because of its flexibility and the freedom it gives instructors in designing and developing web-based teaching (McGriff, 2000). This model consists of five key stages:

Analysis: The first stage focuses on gathering and analyzing information about learners, as well as the content and potential issues. Instructors must understand the target audience, including their prior knowledge, interests, and learning goals.

Design: Instructors use the information from the analysis to design the lesson. Instructors will define lesson objectives, structure content, and create learning activities. They will also select appropriate teaching media to help learners achieve the goals.

Development: This stage entails the creation of the designed content and instructional materials. It includes writing scripts or storyboards, creating graphics, audio, and video elements, followed by testing and refining to ensure the lesson works effectively.

Implementation: After development, we put the lesson into practice. This could include testing it with students or using it in a real-world setting to assess its effectiveness.

Evaluation: The final stage assesses the effectiveness of the lesson. It includes formative evaluation during development to make improvements and summative evaluation after implementation to gather data for future development.

The entire process is adaptable, allowing for modifications as needed to ensure that teaching is efficient and meets the specific needs of learners in various contexts

Designing Multimedia on Induction Motor Winding Based on the ADDIE Model

Due to issues observed during practical induction motor winding, where students often failed to plan the winding sequence properly, causing delays and missed deadlines, this research

employs Kruse's (Kruse, 1999) design and development principles. These principles follow the systematic ADDIE Model, which consists of five stages, as outlined below:

Analysis: This stage concentrates on analyzing learner information and requires alignment of the multimedia content with the target audience and learning objectives. Examples include:

- Target learners: Electrical engineering students or those working in the electrical field.
- Prior knowledge: Students should have a basic understanding of induction motor operation.
- Objectives: Learners should understand how to wind an induction motor and perform the task correctly.
- Challenges: While learners may understand the theory, they often lack practical skills, so the media should emphasize hands-on practice.

Design: This stage involves structuring and designing multimedia content.

- Learning objectives: Focus on ensuring learners understand and follow the motor winding process.
- Content layout: Start with an explanation of induction motor theory, followed by motor winding procedures.
- Learning Activities: The multimedia should include virtual motor winding simulations for learners to practice.
- Media selection: Use graphics, instructional videos, and audio narration to explain each step.
- Presentation plan: Structure the lesson from theory to practical application.

Development: At this stage, the design plan guides the development of the actual multimedia content. Scripting is the process of writing scripts and creating storyboards for each content section.

- Multimedia creation: developing graphics, videos, and interactive simulations for learners, integrating visuals, audio, and text.
- Alpha testing: testing the multimedia with experts to identify and fix any issues.

Implement: This phase involves the use of multimedia with actual learners.

- Teaching and usage: Students use the multimedia to learn and practice motor winding.
- We check the effectiveness and make the necessary adjustments.

Evaluation: At this stage, the success of the multimedia is evaluated.

- Learner assessment: Evaluate through both theoretical and practical exams.
- Feedback: Gather input from students and instructors to improve the multimedia for future use.

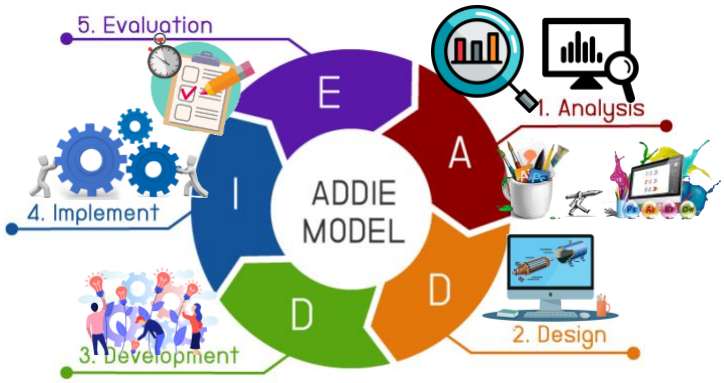

Figure 1: Using the ADDIE Model to Design Multimedia on Induction Motor Winding

Results of Teaching Design in Three-Phase Induction Motor Using ADDIE Model

The presentation of instructional design principles for three-phase induction motor rewinding following the ADDIE model requires effective implementation through systematic analysis, design, development, implementation, and evaluation. The outcomes for each step are as follows.

Analysis Results Using ADDIE Simulation Approach for Three-Phase Induction Motor Winding

In recent years, the pandemic has caused a decline in hands-on skill training, leading to gaps in practice. Furthermore, universities and educational institutions that offer practical courses in motor rewinding have reduced the number of practice hours due to the introduction of new courses. Mismatched schedules between instructors and students have resulted in frequent changes to class times, giving students less time for learning and practice. To address this issue, the use of multimedia technology can enhance the effectiveness of teaching and learning. Students can access and benefit from course content anytime and anywhere, allowing them to learn independently before engaging in actual hands-on practice.

In terms of learner analysis, the target group consists of undergraduate students in Electrical Engineering Education who already have basic electrical knowledge. This allows for the development of foundational lessons specific to electrical work that can help students review and practice three-phase motor rewinding, as well as test their learning outcomes after completing the course.

Design Results Using ADDIE Simulation Approach for Three-Phase Induction Motor Winding

We divide the learning objectives into terminal objectives and enabling objectives. The terminal objectives refer to what students should achieve after the teaching process, while the enabling objectives indicate what students gain during the study of the lesson. The content must follow proper procedures. As for the media used in teaching, the content, students' needs for learning resources, and the specific requirements for the “Electrical Engineering Skill” subject were considered. Problems identified during the process led to the development of multimedia using the ADDIE model. This process led to the creation of an animation video, which starts by demonstrating the steps involved in dismantling the motor's end caps, removing the rotor from the stator, extracting the coil from the motor's frame, inserting insulation paper into the motor slots, winding of 12 form coils, installing the coil sets into the stator, connecting the wiring, and reassembling the motor. This multimedia content is 6 minutes and 3 seconds long, featuring animations and graphics with narration.

The content must align with the learning outcomes of the "Electrical Engineering Skill" subject, and the terminal objectives are set for students to learn and practice induction motor rewinding. Moreover, they should be able to apply this knowledge in their daily lives.

The learning management plan emphasizes enabling students to perform motor rewinding according to the step-by-step learning process from the multimedia lesson on three-phase induction motor rewinding. Students are encouraged to learn in advance before engaging in hands-on practice. This approach helps students plan and perform motor rewinding in a

shorter period. We found that rewinding a motor without multimedia support took 7 hours, while using multimedia reduced the rewinding time by 4 hours.

The age of students is a factor affecting motor rewinding practice. The first-year Electrical Engineering Education students consist of two groups: vocational students and general education students, each with different levels of specialized knowledge. Therefore, it is essential to design detailed lessons that enable all students to follow the multimedia motor rewinding steps.

Regarding motor rewinding exercise, the students have favorable attitudes and confidence. As a result, students like their work, feel comfortable expressing themselves, make judgments without worrying about making a mistake, and prepare methodically.

Development Results Using ADDIE Simulation Approach for Three-Phase Induction Motor Winding

The design and production of multimedia materials, lessons, and content fall into eight main categories: 1) remove a cover motor, 2) removing the rotor from the stator, 3) taking out the coil from the motor's stator frame, 4) folding and inserting insulation paper into the motor slots, 5) winding of 12 form coils, 6) installing the coil sets into the motor's stator, 7) connecting the wiring, and 8) reassembling the motor. We incorporate each part of the content into a narrative format that narrates the story of motor rewinding. This step is crucial because the lesson's appeal and ability to stimulate student interest in learning depend on how the designer presents the material and selects appropriate media for the lesson's content. Following this, the designer invites experts and students, who are the end users, to provide their feedback on the materials for further enhancement and development.

Implementation Results Using ADDIE Simulation Approach for Three-Phase Induction Motor Winding

A group of undergraduate students in the Electrical Engineering Education program trialed the use of multimedia materials in teaching to identify potential errors and gather suggestions for improvements. Initially, the instructor should conduct one-on-one evaluations, allowing individual students to consider any issues they encounter while using the lesson. The instructor can interview students or ask them to express their opinions while engaged with the lesson, using the problems identified to enhance it. Next, conduct a small group assessment with 3-5 students to test the created lesson and observe their interaction and assistance needs. The instructor will use the gathered information to refine the multimedia lesson on motor rewinding and forecast its effectiveness for larger groups in the future.

This evaluation will involve having all students in the class participate in learning using the improved lesson. Students can learn from the created lesson by integrating ongoing assessments into the teaching process. After the lesson, students must take a quiz to determine whether they have met the learning objectives. If there are any shortcomings in achieving the objectives, we can use that information to improve and enhance the web-based teaching for better effectiveness. This research focuses on the development of multimedia learning materials on three-phase induction motor rewinding using the ADDIE process for media development. The sample population consisted of 97 first-year Electrical Engineering Education students from King Mongkut’s University of Technology Thonburi. The study included the entire population, with the inclusion criteria being: 1) students enrolled in the

"Electrical Engineering Skill" subject during the second semester of the 2023 academic year, and 3) students who could participate in the project throughout its duration. The exclusion criteria were: 1) failure to complete the practical sessions and knowledge tests, 2) incomplete or insufficient data responses, and 3) illness during the project at its conclusion.

Evaluation Results Using ADDIE Simulation Approach for Three-Phase Induction Motor Winding

This study checks and measures outcomes in two areas: the quality of multimedia materials about taking apart three-phase induction motors and the growth of learning outcomes based on the motors' structural content. Evaluators include experts in electrical engineering from technical colleges and specialists directly involved in motor rewinding (motor winders), as well as students who take knowledge assessments to improve learning outcomes.

1) Evaluation Results of the Quality of Developing Multimedia to Create Skills in Three-Phase Induction Motors

We used the ADDIE process to evaluate the multimedia materials for the disassembly content of three-phase induction motors, with a focus on the following criteria:

- Content Accuracy and Relevance
- Clarity of Presentation
- Aesthetics and Visual Appeal
- Audio and Visual Quality
- Accessibility
- Alignment with Instructional Principles
- Usability and Functionality

The evaluation of the quality of multimedia materials for the content on disassembling three-phase induction motors revealed that, overall, experts rated the quality of the materials highly, with an average mean score of 4.11 and a standard deviation (S.D.) of 0.93. Particularly in the area of content accuracy and relevance, the highest score was 4.4, with a standard deviation of 0.83. This indicates that the content is reliable and aligns with academic standards, making it suitable for the students' knowledge level. The content follows a clear sequence that aligns with the learning objectives.

Table 1: Results of the Quality Evaluation of the Multimedia Content of the Disassembly of Three-Phase Induction Motor

Quality of Multimedia Content	$\overline{X}$	S.D.	Opinion Level
Content Accuracy and Relevance	4.40	0.83	High
Clarity of Presentation	4.12	0.91	High
Aesthetics and Visual Appeal	4.00	0.92	High
Audio and Visual Quality	4.30	0.90	High
Accessibility	3.90	0.93	High
Alignment with Instructional Principles	3.80	0.96	High
Usability and Functionality	4.30	0.95	High
Average	4.11	0.93	High

However, alignment with instructional principles received the lowest score of 3.8, suggesting that further improvements are necessary in this area to better match teaching principles.

Generally, practical courses emphasize hands-on experience for first-year students, leading to a lack of connection between theory and practice.

2) Evaluation Results of Learning Outcomes From the Content on the Structure of Three-Phase Induction Motors

In this research, the quality of the content of the multimedia materials on winding three-phase induction motors was tested using the ADDIE development process. The content includes disassembling the end caps of the motor, removing the rotor from the stator, taking out the windings from the stator frame, folding and inserting insulation paper into the motor slots, winding of 12 form coils, installing the coil sets in the motor stator, connecting wires, and assembling the motor frame. For each content area, students were required to take a post-test after using the multimedia materials to evaluate the quality and understanding of the content related to three-phase induction motors, as shown in Table 2. We divided the learning content into eight topics to assess students' understanding, providing a clear view of the learning outcomes in the psychomotor domain (6 topics) and the cognitive domain (2 topics), specifically the winding of 12 form coils and the wiring.

Table 2: Results of the Evaluation of the Development of Learning Achievement Fromthe Content of the Structure of Three-Phase Induction Motor

Content of Three-Phase Induction Motor Winding	$\overline{X}$	S.D.	Opinion Level
Remove a cover motor	4.4	0.56	High
Removing the rotor from the stator	4.6	0.58	High
Taking out the windings from the stator frame	4.8	0.51	High
Folding and inserting insulation paper into the motor slots	4.5	0.56	High
Winding of 12 form coils	4.3	0.61	High
Installing the coil sets in the motor stator	4.1	0.61	High
Connecting wires	4.6	0.60	High
Assembling the motor frame	4.8	0.48	High
Average	4.5	0.56	High

From the evaluation of the development of learning outcomes based on the content regarding the structure of three-phase induction motors, the overall average learning achievement was found to be 4.5, with a standard deviation of 0.56, indicating a “high” level of opinion. This aligns with the results of the quality assessment of the multimedia content for disassembling three-phase induction motors, demonstrating that students can develop learning outcomes in the psychomotor domain at the level of skill movements and in the cognitive domain at the level of comprehension (Begam, 2018). This was measured based on the topics of winding 12 form coils and wiring. There was variability in the levels of achievement, with standard deviations of 0.56 and 0.60, respectively, in skill movements. This indicates that the difficulty in practice, particularly in the processes of folding paper and inserting insulation paper, may require precision and accuracy, as the dimensions should not exceed the slots. Therefore, students felt that these tasks were more challenging compared to other content areas.

Conclusion: Summary of Results

This study focused on the development of multimedia resources to enhance skills in winding three-phase induction motors by utilizing the ADDIE Model for media creation. The quality

of the multimedia content for disassembling three-phase induction motors was assessed by experts, highlighting the appropriateness of the content, which received an average score of 4.11 (S.D.=0.93). This indicates that the content is suitable and meets the objectives of disassembling three-phase induction motors. The average score for the development of learning outcomes from the content on the structure of three-phase induction motors was 4.5 (S.D.=0.56), indicating that students were able to develop learning outcomes in the psychomotor domain, specifically in skill movements, and in the cognitive domain, specifically in comprehension. Therefore, motor winding skills are essential for electricians and are typically taught at the vocational certificate level and within electrical education programs, which emphasize hands-on training. However, the integration of multimedia technology into the learning process can serve as an effective tool for training and learning. The developed multimedia resources not only enable students to learn motor winding skills during class time but also allow them to study further outside of class. This will enhance their understanding and proficiency in practical work.

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Development of Training Curricula to Improve Engineers' Learning Capacity in Manufacturing Facilities Using the Production Support System Based on DAPOA

Chamnan Ratsame, King Mongkut's University of Technology Thonburi, Thailand
Pakpoom Chansri, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
To provide training experience for engineers working in industrial plants, this research developed and evaluated a training model for industrial production support systems using the DAPOA learning framework. The five steps of the DAPOA project learning model were used to organize teaching and learning for the academic year 2023–2024. These steps are topic identification, analysis, planning and design, implementation, and evaluation. The study of the production support system combined theoretical and practical teaching approaches. The study used a sample group of 20 plant engineers who expressed interest in participating in the experiment. We examined classroom and workplace skills and assessed the trainees' abilities. The results showed that the DAPOA project learning framework was moderate-to-highly appropriate. Following the training, the establishment's air compressor system engineers demonstrated significantly higher knowledge and practical abilities. This training course design also worked because the DAPOA learning model worked well. It gave an average result (E1/E2) of 80.45/83.95 percent, which showed that engineers were better at analyzing data in industrial compressed air systems. Although some parts of the training steps for energy analysis of compressed air systems were deemed appropriate by experts, all assessments were carried out by experts about energy use standards for industrial production support equipment and the standards were found to be appropriate. The practical training manual of the sample group had the highest satisfaction ($\bar{x}$=4.45) according to the evaluation results.

Keywords: DAPOA, Competency, Engineer, Production Support

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Introduction

At present, the industrial sector is facing technological changes. Developing energy management systems (El-Fawair et al., 2023) in the production process is a crucial factor that can enhance efficiency and reduce costs. One such system is the compressed air system, a high-energy system that plays a significant role in industrial production. Without effective management, the compressed air system will affect the organization's competitiveness. However, international guidelines such as ISO 50001 (Chaves et al., 2020) have certified appropriate energy management, emphasizing efficient and sustainable energy use. Past research has revealed that lecture-based learning (LBL) (Dutta et al., 2022) offers benefits such as time and resource savings in teaching and learning but also suffers from a deficiency in skill training. The demonstration learning model, also known as Simulation-Based Learning (SBL) (Pratumsuwan et al., 2020), suffers from a lack of continuous training in evaluation skills and process improvement, and it cannot cover all situations that may arise in real-world scenarios. The project-based learning model (PBL) (Honglin et al., 2022) enhances problem-solving skills in real-world scenarios, such as fostering analytical thinking, planning, and teamwork. However, the evaluation process may be unclear as the results may not demonstrate complete success. This research presents a learning model that combines process-based learning and the DAPOA (Determination, Analysis, Plan, Operate, Assess) process. Process-based learning focuses on learning that emphasizes clear process understanding and systematic steps to follow, while DAPOA process steps enhance skills in planning, evaluation, and continuous process improvement. Therefore, combining these two approaches will enhance important skills in energy management processes in industrial engineers.

Overview of Research

Process-Based Learning and Training Processes in DAPOA Model

Process-Based Learning (PBL) (Heng et al., 2024; Li et al., 2024) is a theory of learning that emphasizes learning through actual practice, making it suitable for training on air compressors. We will teach learners through activities that align with their learning content, enabling them to solve problems in real-world scenarios. This training will help increase experience and confidence in deep, sustainable learning. It also helps as a guideline for energy use in production, especially using air compressor systems according to energy management standards that focus on improving energy efficiency. This research will introduce a learning management model based on the DAPOA principle, a training model for knowledge creation that prioritizes the practical application of scientific processes and problem-solving techniques, as illustrated in Figure 1. The model is divided into five steps as follows:

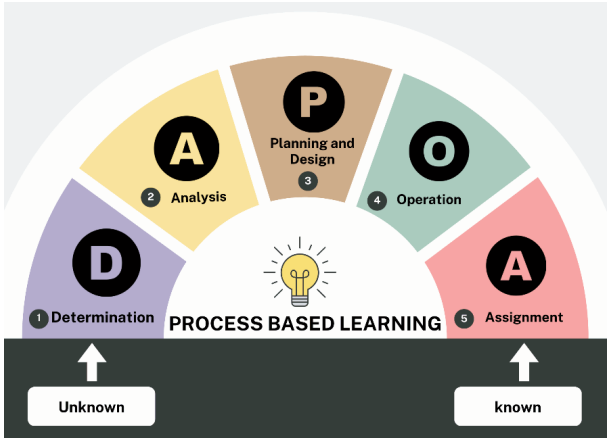

Figure 1: The DAPOA Process-Based Learning Model

Determination: The process of determining the goals and objectives of the training content.
Analysis: The process of analyzing relevant theoretical data to help trainees gain a deeper understanding of the problem.
Planning and Design: This refers to strategizing enhancements by outlining specific steps and methods for implementation in the laboratory to compile an analysis of evaluation criteria that impact the compressed air system (Thabet et al., 2020; Kasprzyk et al., 2023).
Operation: The process of implementing the plan that requires continuous improvement and monitoring of progress in each of the trainee's establishments.
Assignment: The process of evaluating the results and evaluating the learning efficiency to summarize the results of improving the production process.

Learning and Teaching Processes

Research Design.

This research is experimental. Production engineers comprise the research population, who are in charge of using air compressor systems in industrial plants. The sample group was selected by purposive sampling from 20 establishments. Figure 2 illustrates the training of air compressor systems using the DAPOA principle in the process-based learning model. The target data will be related to the efficiency of air compressor use and the skills of the trainees will be collected and analyzed both before and after the training.

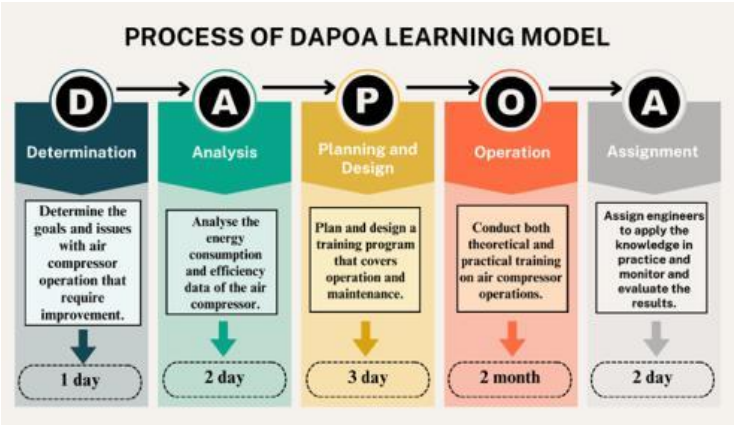

Figure 2: The Process-Based Learning of DAPOA Learning Model

Research Procedures.

Determination Stage (D): The initial process begins with defining the training objectives and goals, which is a crucial step that directly affects the success of air compressor training. Consistency with workplace problems and needs and the desired expectations for trained engineers are crucial for practical training. Examples include,

- Establishing training objectives involves determining the knowledge and understanding that trainees must possess and their ability to analyze and evaluate after training. Examples of training objectives in this regard include increasing knowledge and understanding of air compressors. Developing skills in using compressed air systems. Reducing energy consumption in compressed air systems.
- The objectives of theoretical training are what is desired to be achieved after the training is completed. These objectives can be used as indicators of the success of training and the development of the trainees' potential. The objectives of this training will focus on increasing the efficiency of air compressor usage and reducing energy costs in the production process in the organization.
- Setting key performance indicators (KPIs) is important in evaluating training results that can be used in this case, including trainee satisfaction level.

Analysis Stage (A): Data analysis is an important step after defining training objectives and goals, as shown in Fig. 3. This step collects data related to compressed air system usage, along with additional data from the determination step, to analyze the efficiency of compressed air system usage.

Figure 3: Analysis Process

- Data Collection: Analysis of the data obtained can be used to evaluate the efficiency of air compressor usage and plan training, such as Energy Efficiency Analysis. Analyzing the energy use of air compressors is an important step in finding ways to reduce energy consumption and improve efficiency.
- Conclusion: The presentation of the conclusions obtained from analyzing each issue will be important information for designing training content consistent with specific training problems and needs.
- Evaluation: This analysis will lead to the design of training content that is precise and responsive to the problems encountered in the air compressor operation process, to the evaluation of learners' progress after training, to the training achievement.

Planning and Design Stage (P): Two days of practical theoretical training on air compressor systems. Figure 4 shows the training program on appropriate and sustainable electric energy-

saving techniques of air compressors. After completing the contents according to the specified objectives, an experiment worksheet will be organized.

Figure 4: Planning and Design Process

Operation Stage (O): In this phase, learners will participate in the training according to the plan, focusing on learning through actual practice in a safe environment. In the practical phase, learners will try to use the actual air compressor with an expert instructor to guide and answer questions. The practical training will commence with a simulated air compressor room demonstration and actual practice. The design of the content and preparation of training documents are based on the data obtained from the previous analysis step. Divide into groups of 5 people and test the operation of the 22 KW electric air compressor to identify the variables that influence the energy consumption of the air compressor in the upcoming section.

- Testing of flow rate adjustment using valve of air compressor system.

Set value of pressure : On-load at 0.6 MPa, Un-load at 0.7 Mpa

Time		Orifice Flow	Pressure for Correction	Temp for Correction	Elec. Power	Discharge Pressure	Suction Temp	Time of Load
Simbol		Q_N	P_Q	T_Q	L	Pd	Ts	S
Unit		$m^3/h(n)$	kPa-G	℃	kW	kPa-G	℃	sec
	ON	148.90	711.00	28.68	28.20	698.00	33.97	12.00
	UN	0.00	618.00	28.75	8.36	595.00	34.24	36.00
	ON	158.00	713.00	28.85	29.11	697.00	34.18	15.00
	UN	0.20	617.00	29.48	10.05	595.00	34.30	23.00
	ON	163.90	714.00	31.45	28.84	697.00	34.36	22.00
	UN	5.70	620.00	32.45	12.37	597.00	34.72	16.00
	ON	165.10	710.00	33.28	28.91	696.00	34.69	30.00
	UN	14.00	618.00	34.85	13.41	595.00	34.90	13.00

Set value of pressure : On-load at 0.5 MPa, Un-load at 0.6 Mpa

Time		Orifice Flow	Pressure for Correction	Temp for Correction	Elec. Power	Discharge Pressure	Suction Temp	Time of Load
Simbol		Q_N	P_Q	T_Q	L	Pd	Ts	S
Unit		$m^3/h(n)$	kPa-G	℃	kW	kPa-G	℃	sec
	ON	139.00	608.00	32.30	27.26	599.00	34.84	11.00
	UN	0.05	515.00	31.10	8.28	494.00	35.15	48.00
	ON	149.55	609.00	30.35	27.62	599.00	35.05	13.00
	UN	0.05	515.00	30.18	8.84	493.00	35.02	28.00
	ON	163.80	607.00	31.25	27.44	598.00	35.08	17.00
	UN	5.15	516.00	32.05	11.46	496.00	35.32	16.00
	ON	166.40	606.00	33.60	27.36	596.00	35.23	29.00
	UN	17.85	512.00	35.15	12.70	494.00	35.38	12.00

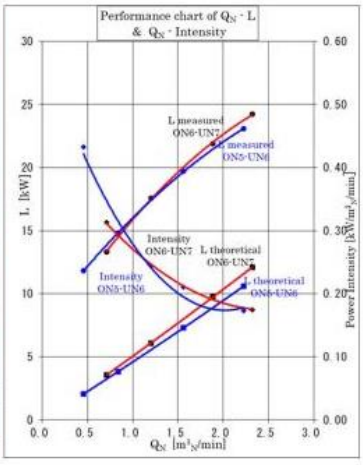

Figure 5: Summary of Data That Illustrates the Correlation Between Flow Rate and Electrical Power During the Test

Figure 5 summarizes the experimental results. Higher compressed air flow rates due to valve adjustments result in higher load and lower drain conditions. For example, the experimental log shows that at a flow rate of 1.461 m3N/min, we measured 29.110 kW of electrical power in the load phase and 10.058 kW in the working phase, with a working period of 15 seconds and a stopping period of 23 seconds. Therefore, the average electrical power of the compressor in this operating condition is 17.57 kW.

Table 1: Results From the Graph Showing the Relationship Between Average Electrical Power and Compressed Air Flow Rate

Flow rate		**Electrical power**		**Period**		**Power Average**	**Saving percentage**	
m^3N/min	%	Load (KW)	Unload (KW)	Load (Sec)	Unload (Sec)	(KW)	(KW)	%
0.925	35.83	29.20	8.36	12.00	36.00	13.57	10.65	43.97
1.461	56.57	29.12	10.04	15.00	23.00	17.57	6.64	27.45
2.142	82.98	28.68	12.96	22.00	16.00	22.06	2.15	8.91
2.581	100.00	28.90	13.42	30.00	13.00	24.22	-	-

From Table 1, the higher the air flow rate, the higher the average power. Therefore, the correct use of an air compressor must consider the appropriate amount of air demand. The experiment results show that adjusting the flow rate to 1.461 m3N/min can reduce the valve to 56.579%, resulting in an average power reduction of 6.64 KW, or 27.45% of the power required to open the valve at 100%.

- Pressure loss testing in various pipe sizes of compressed air systems

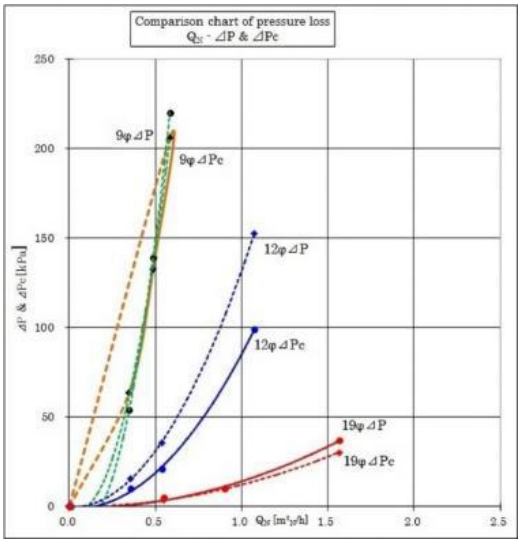

Figure 6: Summary of Pressure Loss Data in Various Pipe Sizes of Compressed Air System

A summary of the pressure loss test results in various pipe sizes of the air compressor system is shown in Figure 6. When considering the test result recording table and the obtained graph, it was found that when the pipe is small, the pressure loss in the pipe is more significant. At the same time, if the airflow rate is greater, the pressure in the pipe is more significant. Therefore, selecting the appropriate pipe size is another way to save energy. Usually, the pipe size is selected from the velocity of compressed air flowing in the pipe, which will be between 25 and 40 meters per second.

- Air leakage loss test of the compressed air system.

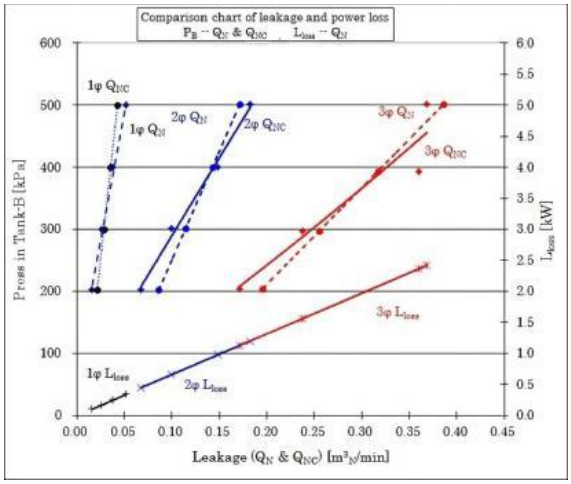

Figure 7: Data Showing Air Leakage Loss Test Results of the Compressed Air System

From the test results in Figure 7. The test of air leakage loss of the compressed air system, when considering the graph comparing the loss of different size holes with the lost electrical power to be a straight line.

Assessment Stage (A): In order to measure the success of the training program in this research, the trainees were required to return to their work on the energy use of air compressors project. They were instructed to use the PDCA (Xu, 2020) energy management planning principle to evaluate their performance, enabling them to plan, operate, inspect, and improve systematically. The following case study summarizes the operation steps.

- The planning process involves gathering data on electricity usage for product production.

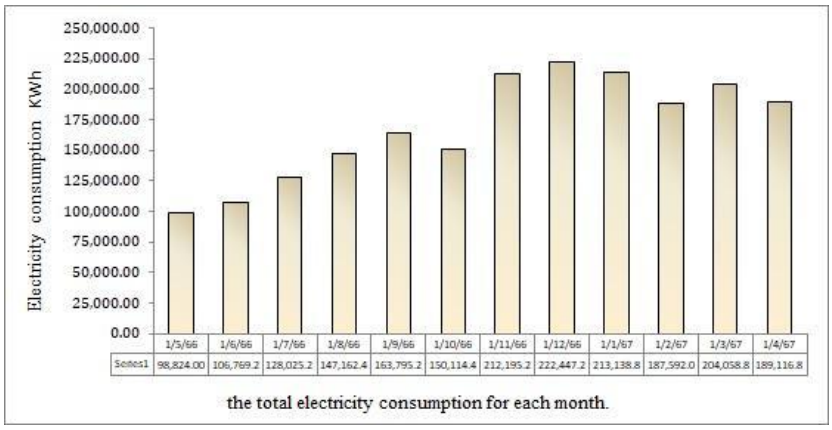

Figure 8: Graph Showing Electricity Consumption Data and Production Before Operation

Figure 8. It was found that the average electricity usage per month was 168,603.27 kilowatt hours., with 39,502 products produced. The average electricity usage trend per shot was 4.25 KWh. This data will be used for analysis to create a regression model equation to predict the amount of electricity usage appropriate for the production process. Then, another experiment was conducted to collect data according to the planned data under the regression equation that was compared with the data before and after the improvement of the project, along with a summary of the results of the operation.

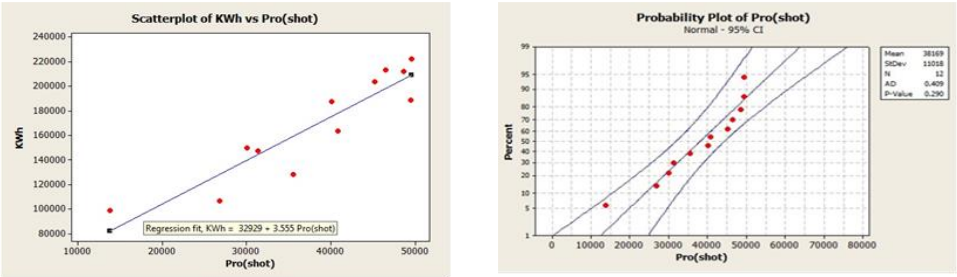

Figure 9: Scatter Plot Between Electrical Energy and Monthly Output

From the analysis of the prediction equation between electrical energy and monthly production, shown in Figure 9, it was found to be equal to KWh=3.55 Pro(shot)+32929, where R-Sq(adj)=82.9%, meaning that the production volume can predict the electrical energy consumption by 82.9%. The remaining 17.10% is influenced by other factors, with a P-value of 0.00. For the form of the normal probability plot of a residual graph.

- Methods for collecting data on air compressor systems from preliminary assessments.

Figure 10: Measurement of Usage Before the Improvement

Table 2: Data Obtained from the Measurements

Data obtained from preliminary measurements to calculate Free Air Delivery (FAD comp)	
Compressed air storage tank size V_{tank} (m^3)	12
Time taken to compress air into the tank from minimum to maximum pressure (sec)	153.04
Maximum test pressure (bar_g)	8.00
Minimum test pressure (bar_g)	7.00
Total size of pipe before distribution to use V_{pipe} (m^3)	0.97
Absolute atmospheric pressure, P_{atm} (bar)	1.013
Electrical power (KW)	39.98

- The results of the obtained data are analyzed to improve energy efficiency.

The calculation of free air delivery efficiency (FAD comp) (Mei et al., 2020) of an air compressor uses the following calculation equation:

$$FADcomp = \frac{(P_{2g}-P_{1g})(V_{Pipe}-V_{tank})}{(P_{atm})(t)} \quad (1)$$

Summary of the results from Table 2. The efficiency value (FAD comp) of the air compressor from the calculation of equation 1. is equal to 5.020 m3/min or 0.084 m3/sec.

Therefore, the specific energy consumption value when the machine is under load (KW on Load/FAD) is equal to 7.966 KW/m^3/min. When comparing the performance and efficiency and electrical energy in air compression according to the standard 1/sec/KW at a value of 0.45, it was found that the efficiency of the machine is equal to 94%.

- Analysis and calculation of energy leakage rate of a compressed air system.

Data from monitoring and data collection can be used to calculate the compressed air leakage rate of the system using Equation 2.

$$\mathrm{FAD_{leak}} = \left(\frac{\mathrm{t_{onload}}}{\mathrm{t_{onload}+t_{unload}}}\right)\mathrm{FAD_{comp}} \quad (2)$$

The results from the test were summarized and calculated according to the theory. When the compressor was working (onload) 171.30 sec, stopped working (unload) 193.60 sec, the efficiency (FAD comp) of the air compressor was 0.074 m^3/sec. The leakage of compressed air was found to be 0.035 m^3/sec, which is a leakage rate of 12.50% or the electric energy of the air compressor that was reduced by 24,336 KWh/year.

- Analysis and calculation of pressure reduction

Data from the monitoring and data collection can be used to calculate measures to reduce the pressure of the compressed air system using Equation 3.

$$\mathrm{KW_{th}} = 1.205\left[\mathrm{T_1} - \mathrm{T_{1adj}}\right]_1\left[\left(\frac{\mathrm{P_2}}{\mathrm{P_1}}\right)^{0.286} - 1\right](\mathrm{FAD})_{\mathrm{com}} \quad (3)$$

Summarize the results from the test and calculate according to the theory. When setting the operation of the air compressor, starting from reducing the level of the low value from the original 7 bar down to 6 bar and reducing the maximum value of 8 bar down to 7 bar, the absolute temperature value is 308 Kelvin and the efficiency value of the air compressor (FAD) comp is 0.091 m3/sec. The calculation will find that the electrical energy value before reducing the pressure is equal to 29.49 KW. After reducing the pressure, the electrical energy used will be equal to 27.39 KW, which is an energy reduction rate of 7.12%, or the electrical energy of the air compressor that is reduced will be equal to 15,120 KWh/year.

- Analysis and calculation of suction temperature of air compressor.

$$\Delta\mathrm{W_{isen}} = \frac{ik\mathrm{R_w}\mathrm{T_1}-\mathrm{T_2}}{k-1}\left[\left(\frac{\mathrm{P_2}}{\mathrm{P_1}}\right)^{\left(\frac{k-1}{i*k}\right)} - 1\right] \quad (4)$$

$$\mathrm{KW} = \Delta\mathrm{W_{isen}} * \mathrm{Da_{(kJ/kg)}} * \mathrm{FAD_{(l/sec)}} * \%\mathrm{L_{DU}} \quad (5)$$

where,

D_a = Densities of Air, 1.225×10^{-3} kg/liter
L_{DU} = Fraction of Onload status
i = Stage Compressor
K = Isentropic of Air Constant
R_w = Gas Contant at T_1
T_1 = Air inlet Temperature Before Improving
T_2 = Air inlet Temperature After Improving

Summarize the results from the test and calculate from equation 4,5. When reducing the working temperature of the air compressor from the original 40 degrees Celsius and adjusting to reduce the air intake to 35 degrees Celsius, the low-pressure value is 7 bar and the highest value is 8 bar, and the efficiency of the air compressor (FAD) is 0.091 m^3/sec. It can be seen that the electrical energy value before reducing the pressure is equal to 29.49 KW. After adjusting to reduce the suction temperature into the air compressor by 5 degrees Celsius, the electrical energy used will be equal to 28.63 KW, which is an energy reduction rate of 2.91% or the electrical energy of the air compressor that is reduced equal to 6,192 KWh /year.

- Summary of operating results

This assessment of the project trainers was done by collecting data on compressed air systems to determine the performance and efficiency of the air compressors. Three measures were implemented, and it was found that the total electrical energy usage could be reduced by 45,648 KWh/year. When comparing with the data before the implementation of the preliminary data for 12 months, it was found that the electrical energy cost was reduced by 2.25%, with the average electrical energy usage trend per product value being 4.17 KWh/shot.

Research Results

In summary, The IOC (Index of Item-Objective Congruence) evaluation results are based on the 5-level evaluation principle of Lickel (Guo et al.,2023) of the air compressor training content, both in theory and practice, with 5 experts from higher education institutes and the Ministry of Energy as content experts. The criteria for considering the content consistency value are +1 means appropriate, -1 means inappropriate. The summary of the evaluation results of the consistency value is between 0.67 and 1.00, with values higher than 0.50 considered to pass all criteria, with an average value of 4.30 and a standard deviation of 0.55. The evaluation of the quality of satisfaction uses a 5-level evaluation scale: very satisfied, satisfied, moderately satisfied, slightly dissatisfied, and extremely dissatisfied. Overall, the experts evaluated the quality at a good level, with the evaluation results as shown in Table 3.

Table 3: Results of Evaluation of Air Compressor Training Content in Theory and Practice

Topics of theoretical training content	$\bar{X}$	**S.D.**	**Opinion Level**
Working principle of an air compressed system	4.50	0.65	Excellent
Air compressed system efficiency	4.62	0.51	Excellent
Safety of air compressor systems	4.23	0.52	**good**
System stability and reliability	4.30	0.47	**good**
Maintenance and care of air compressor systems	4.12	0.58	**good**
Environmental impacts	3.98	0.56	**good**
Responding to user needs	4.30	0.45	**good**
Average	**4.29**	**0.53**	**good**
Training content topics in practical section	$\bar{X}$	**S.D.**	**Opinion Level**
Study of air compressed systems and components	4.40	0.43	**good**
Pre-testing system check	4.42	0.57	**good**
Setting parameters for testing	4.51	0.52	Excellent
Performance testing	4.53	0.62	Excellent
Air compressor safety testing	3.95	0.63	**good**
Continuous operation and durability testing	3.92	0.66	**good**
Recording test results and analyzing test summaries	4.43	0.55	**good**
Average	**4.31**	**0.57**	**good**
Average Total	4.30	0.55	good

Results of the evaluation of learners' satisfaction with the developed learning model. The results of the evaluation of learners' satisfaction with the teaching management using the developed DAPOA process-based learning model revealed that the trainees were overall satisfied at a satisfactory level (mean 4.13 and S.D. 0.23). They agreed that the developed learning model focused on learners, promoted diverse learning activities, and clearly integrated many disciplines. In addition, the designed learning media and activities could develop learners to learn by themselves, leading to practical application in the air compressor system. The results of the research are shown in Table 4.

Table 4: Results of the Evaluation of Participants' Satisfaction in Learning Using the DAPOA Process as a Base

Evaluation list	$\bar{X}$	**S.D.**	**Quality level**
DAPOA Model Learning Model.	**3.93**	**0.27**	Satisfied
1. learning format supports the teaching curriculum.	3.87	0.35	Satisfied
2. learning process that focuses on developing the trainees.	4.30	0.41	Very Satisfied
3. Learning processes that are related and continuous.	4.15	0.46	Satisfied
4. Teaching and learning activities are appropriate and sufficient.	3.93	0.88	Satisfied
5. learning format promotes learning appropriately.	3.40	0.51	Satisfied
Teaching and learning activities are organized in a process-based manner.	**4.00**	**0.41**	Satisfied
1. Activities are consistent with the DAPOA Model learning model.	4.35	0.52	Very Satisfied
2. The specified activities can be performed at the specified time.	3.98	0.62	Satisfied
3. Learning activities are diverse and integrated.	4.23	0.52	Satisfied
4. The developed learning activities help the learners to learn by themselves.	3.85	0.56	Satisfied
5. Learners interact/work/do activities together.	3.60	0.51	Satisfied
Process-based teaching management	**4.12**	**0.30**	Satisfied
1. The duration of the event is appropriate.	4.18	0.50	Satisfied
2. Promotion of knowledge competence	3.78	0.51	Satisfied
3. Promotion of practical skills	4.35	0.51	Very Satisfied
4. Promotion of creative thinking skills	4.10	0.57	Satisfied
5. Can manage teaching and learning appropriately.	4.21	0.72	Very Satisfied
Measurement and Evaluation	**4.45**	**0.24**	Very Satisfied
1. Can assess both knowledge, abilities, and skills.	4.28	0.41	Very Satisfied
2. The measurement and evaluation methods are consistent with the learning model.	4.26	0.57	Very Satisfied
3.You can use it to evaluate each step because it is multipurpose.	4.67	0.49	Very Satisfied
4. Evaluation criteria are clear and appropriate.	4.58	0.50	Very Satisfied
5.The measurement method can be used to collect learning data according to the actual training content.	4.56	0.51	Very Satisfied
Overall satisfaction in all aspects.	**4.13**	**0.23**	Satisfied

Efficiency analysis results of the DAPOA process-based training model The evaluation of the effectiveness of the developed learning model used in the compressed air training during the training in the created laboratory and after the training of the project in the workplace of the trainees found that the average value of the process (E1) was 80.45 percent, and after the training of the project in the workplace, the average value of the outcome (E2) was 83.95 percent, which is consistent with and meets the specified standard criteria of 80/80. The results of the research are shown in Table 5.

Table 5: Results of Analysis of the Effectiveness of Training Using a Process-Based Model

Knowledge and skill tests	Score obtained		Average Percentage	Efficiency of learning models
	Full score	Average score		
Laboratory training (Process or E1)	100	80.45	80.45	80.45 / 83.95
Project training in the workplace (Result or E2)	100	83.95	83.95	

Conclusion

The design of the training program on air compressor system learning for engineers working in industrial plants using the developed DAPOA process-based learning model, which consists of 5 steps: 1. Determination 2. Analysis 3. Planning and Design 4. Operation and 5. Assessment found that the learning model emphasizes the participants learning and creating quality knowledge by themselves that can be used to manage the use of air compressors for higher efficiency appropriately. When tested with a sample group of trainees, it was found that the training program method, including knowledge in the content after the practical training, showed that the learning achievement increased, especially in the operation and development of the air compressor system. From the follow-up of the work performance after learning according to the process-based learning model, it was found that the trainees were very satisfied with the training program because they could use their knowledge and work skills to improve the efficiency of the air compressor.

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Contact email: Chamnan.rat@kmutt.ac.th

ChatGPT's Impact on Education: Increasing Student's Learning Interest

Evaristus Didik Madyatmadja, Bina Nusantara University, Indonesia
Debri Pristinella, Atma Jaya Catholic University of Indonesia, Indonesia
Edbert Kurniawan, Bina Nusantara University, Indonesia
Dharmawan Elmadya, Bina Nusantara University, Indonesia
Priscillia Utama Christy, Bina Nusantara University, Indonesia
Rolando Krisnanto, Bina Nusantara University, Indonesia

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Abstract
ChatGPT has become a popular tool because of the ease it offers to obtain a variety of information. However, the decision of users such as students to use ChatGPT in the world of education and increase interest in learning can be influenced by several factors. In this research, researchers want to test variables in the Unified Theory of Acceptance and Use of Technology research model which consists of Performance Expectancy (UTAUT), Effort Expectancy, Social Influence, Facilitating Conditions, Behavioral Intention, and Decision to Use ChatGPT with the aim of determining variables which is a positive influencing factor that supports students to use ChatGPT in education which increases interest in learning. This research was carried out by distributing an online questionnaire in the form of a Google form containing 30 questions with each research variable having 5 indicators which received 322 respondents. The data obtained were analyzed using Smart PLS 3 and the research results found that the use of ChatGPT by students in education to increase interest in learning was most influenced by the Facilitating Conditions variable, but the Performance Expectancy variable was an insignificant variable in influencing students to use ChatGPT in education and increase interest in learning. To help understand the interactions between the variables being tested and find out the factors that influence students to use ChatGPT in education and increase interest in learning, further research is needed that is more in-depth and uses a larger number of respondents to get accurate results.

Keywords: ChatGPT, Study, Education, UTAUT

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Introduction

The development of technology has become a means to simplify human life. Lately, there has been a lot of discussion about AI-based chatbot technology because it can facilitate individuals, especially in seeking specific insights. One of the most popular AI-based chatbots is ChatGPT, an acronym for Generated Pre-trained Transformer, discovered and developed by OpenAI. (Kartono et al., 2021). The reason this technology is widely discussed is due to its ease in helping find information. There is a statement suggesting that ChatGPT might surpass Google's search engine in one or two years (Ahuja et al., 2021). ChatGPT can answer user queries in human language, eliminating the need for users to search for keywords. With this convenience, it's not surprising that ChatGPT is widely used in various fields of life, including education. The utilization of ChatGPT in education has its strengths and weaknesses. While ChatGPT can assist learners in finding answers and getting online advice, the data may not be accurate (Li et al., 2020). The existence of these pros and cons underscores the importance of employing the right strategies for ChatGPT in education. Educators and students must understand the limitations of this technology when using it as a tool to provide guidance and insights. It is also essential to validate and scrutinize all information provided. Educators should help students develop critical and analytical thinking skills with ChatGPT so that they can distinguish between right and wrong information. The role of educators in assisting students in using ChatGPT requires an understanding of how ChatGPT operates, ensuring that its usage enhances the learning experience (Cho et al., 2019).

In the digital era where almost every aspect of life has been modernized, education also indicates the need for awareness in utilizing technology for positive impacts on life, to align the fundamental direction of technology development that positively facilitates human life. This can be applied in education with the use of ChatGPT. The presence of ChatGPT, which facilitates its users, including students, in searching for specific information and answers, does not automatically make ChatGPT a tool resulting from technological development that has a positive impact. The existence of drawbacks such as the lack of data validation from ChatGPT requires users to double-check the data generated by using ChatGPT (Madyatmadja et al., 2020).

A. Research Problem

Certainly, the process of data validation assurance can influence the use of ChatGPT, such as its impact on students' learning interests. The possibility exists that the development of ChatGPT could enhance the learning experience, potentially increasing students' interest in learning. However, due to the mentioned drawbacks, ChatGPT may not be sufficiently capable of boosting this interest. In line with this specific research aiming to test ChatGPT in education associated with students' learning interests, the following are the problem formulations in this study:

A. Does Performance Expectancy have a positive effect on Behavioral Intention in the use of ChatGPT regarding student learning interests?
B. Does Effort Expectancy have a positive effect on Behavioral Intention in the use of ChatGPT regarding student learning interests?
C. Does Social Influence have a positive effect on Behavioral Intention in the use of ChatGPT regarding student learning interests?
D. Does Facilitating Conditions have a positive effect on Decision to Use in the use of ChatGPT regarding student learning interests?

E. Does Behavioral Intention have a positive effect on Behavioral Intention to Decision to Use in the use of ChatGPT regarding student learning interests?

B. Research Objectives

The objective of this research is to examine the impact of using ChatGPT in education, specifically on students' learning interest, while testing the following aspects:

A. To understand the impact of Performance Expectancy on Behavioral Intention in the use of ChatGPT regarding students' learning interests.
B. To understand the impact of Effort Expectancy on Behavioral Intention in the use of ChatGPT regarding student learning interests.
C. To understand the impact of Social Influence on Behavioral Intention in the use of ChatGPT regarding student learning interests.
D. To understand the impact of Facilitating Conditions on Decision to Use in the use of ChatGPT regarding student learning interests.
E. To understand the impact of Behavioral Intention on Behavioral Intention Decision to Use in the use of ChatGPT regarding student learning interests.

Background Study

A. Friendship With ChatGPT: A Transformation in Education

ChatGPT is a tool that plays a significant or beneficial role in the field of education. ChatGPT has the potential to assist individuals in the educational realm by personalizing learning development, making it easier by providing specific assessments, feedback, and accuracy that aid in alleviating cognitive load. However, it also has drawbacks and challenges related to plagiarism, which poses a threat to the integrity of education (Gavilan et al., 2020).

B. The Use of ChatGPT in the World of Education for Students

ChatGPT, based on Artificial Intelligence (AI) and developed by OpenAI, is now widely accepted in various fields, including education. Students can learn about ideas and theories using this technology while generating content with ChatGPT (Tandon et al., 2021). ChatGPT provides highly useful benefits in the field of education, particularly in delivering more personalized learning experiences, offering broad and affordable accessibility, providing highly interactive learning resources, and assisting in problem-solving tasks.

C. UTAUT (Unified Theory of Acceptance and Use of Technology)

The Unified Theory of Acceptance and Use of Technology (UTAUT) is one model that aims to understand and examine user behavior toward the use of information technology (Prasetyo, Y. T., 2021). Within UTAUT, there are four core determinants: performance expectancy, effort expectancy, social influence, and facilitating conditions.

D. Performance Expectancy

Performance Expectancy is a measure of an individual's belief in the ability of an information system technology to enhance job performance (He et al., 2018). Based on this explanation, Performance Expectancy is related to users' expectations regarding the use of information system technology, such as AI ChatGPT, to enhance students learning interests.

E. Effort Expectancy

Effort Expectancy is a measure that gauges the level of effort or exertion from users regarding the use of a system or technology. Within this measure, there are two dimensions: complexity and ease of use. Complexity measures the user's perceived level of difficulty in using the technology, while ease of use measures the user's perception of how easy it is to use the technology (Prasetyo, 2021). Effort Expectancy is broadly related to the complexity and ease of use of information system technology, such as AI ChatGPT, in enhancing student learning interests.

F. Social Influence

Social Influence is a measure that assesses the extent to which a user or an individual can influence others to believe and be confident in using a technology, such as AI ChatGPT. Within this measure, there are two dimensions: social factor and subjective norm. Social factor measures how much a person is influenced by others using the technology, while subjective norm is related to the importance and influence of significant others on the user's adoption of the technology (Prasetyo, 2021). In broad terms, Social Influence is about measuring how much an individual user can influence others to believe and trust in using information system technology, such as AI ChatGPT, to enhance students learning interests.

G. Facilitating Conditions

Facilitating Conditions is a measure that assesses the extent to which users believe that the resources and technical infrastructure available in the information system technology can support them in using that technology. Within this measure, there are three dimensions: resource, knowledge, and compatibility. The resource dimension helps identify external sources that can influence the use of the information system technology. The knowledge dimension assesses external sources of knowledge to use the information system technology. The compatibility dimension evaluates the alignment of the system with the technology used by the user (Prasetyo, 2021). In broad terms, Facilitating Conditions are about measuring how much users can trust and rely on the technical infrastructure and resources available in the technology. This, in turn, supports users in using information system technology, such as AI ChatGPT, to enhance students learning interests.

H. Behavioral Intention

Behavioral Intention is a measure that gauges the extent of a user's desire to continue using the technology continuously (Puspita, M. et al., 2020). There are two dimensions: intention and continuation. The intention dimension measures the user's level of willingness to continue using the information system technology, while the continuation dimension assesses how far the user plans to continue using the information system technology (Prasetyo, 2021). In broad terms, Behavioral Intention is a measure of how much users desire to continue using information system technology, such as AI ChatGPT, to consistently enhance students learning interests.

Research Method

This research employs a quantitative method that collects respondent data through an online questionnaire distributed and processed using SMART PLS. The study also utilizes various

previous research journals and articles as literature reviews and a Systematic Literature Review (SLR).

The research model used in this study is the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT is one of the frequently used research models to explain or describe user acceptance of technology use. In this research, it tests an information system in the form of AI named ChatGPT. When using UTAUT as the research model, several modifications were made to the original model. Based on research conducted by Dwivedi et al. in 2019, it was mentioned that many studies only use the main concepts because researchers found that previous studies might not have used moderators since no differences were found in adoption and usage contexts (He, et al., 2018). The UTAUT model used in this study includes six main constructs: Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Behavioral Intention (BI), and Decision to Use (DU). The following is the form of our research model:

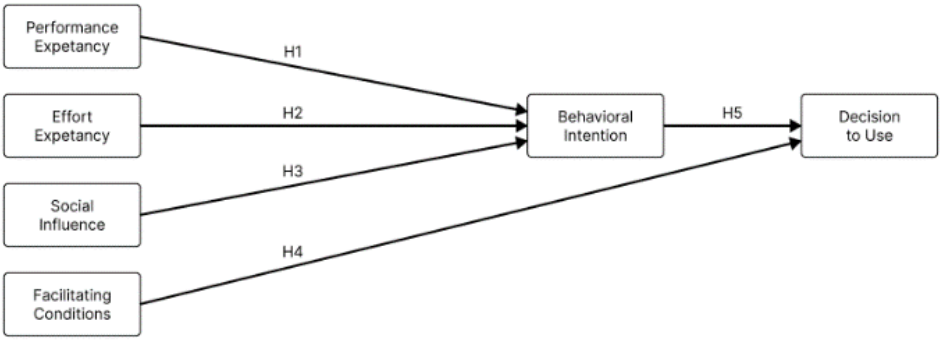

Figure 1: Research Model

A. Hypotheses

1) Performance Expectancy on Behavioral Intention in the use of ChatGPT regarding students' learning interests.

When an AI application of information system technology such as ChatGPT is able to provide a good user experience, it will be able to enhance behavioral intentions about the usefulness of such technology. In this case, behavioral intent refers to the student's desire to behave in a particular way, for the purpose of learning. Based on previous research, Perceived Usefulness Performance Expectancy has a similar relationship with the benefits of a technology. Both are related to the extent to which the use of AI-based information systems such as ChatGPT can help learning (Zhao et al., 2020). From the statement arose the argument that Performance Expectancy could have a positive influence on the Perception of Usability (Perceived Usefulness). To prove the hypothesis, here are the arguments to be tested in this study:

H1: Performance Expectancy positively influences the Behavioral Intention

2) Effort Expectancy on Behavioral Intention in the use of ChatGPT regarding students' learning interests.

The use of AI information system technology such as ChatGPT, should have a good performance and of course easy to access and use by the user, so that the user can directly feel the performance of the information system such as AI such as chatGPT. Based on

research by Menon and Shilpa (2023), if ChatGPT feels comfortable to use, it is likely that users will more often integrate it into their daily activities. This can result in increased use and gain further benefits from such technology (Afrilia, 2018). The argument in the study suggests that Effort Expectancy can have a positive influence on behavioral intentions (Behavioral Intention). To prove the argument, here are the hypotheses that will be tested in this study:

H2: Effort Expectancy positively influences the Behavioral Intention

3) Social Influence on Behavioral Intention in the use of ChatGPT regarding students' learning interests.

When the use of information system technology such as ChatGPT is easy to use by the user, then the technology can surely benefit the user. This can happen because users can explore and exploit it easily. The use of ChatGPT by a person can be influenced socially, especially by young people through social media, because a positive social influence is capable of encouraging a person to use ChatGTP (Lapalelo, 2022). So it can be said that Perceived Ease of Use can have a positive influence on the perception of usability (Perceived Usefulness). To prove the argument, here are the hypotheses that will be tested:

H3: Social Influence positively influences the Behavioral Intention

4) Facilitating Conditions on Decision to Use ChatGPT in the use of ChatGPT regarding students' learning interests.

According to Menon and Shilpa (2023) in the case of ChatGPT, the existence of facilitative conditions such as access to devices with a good Internet connection and adequate technical assistance will have a significant impact on acceptance by users (Afrilia, 2018). Based on this argument, it can be concluded that if access to facilities and technical assistance that a student has sufficient will encourage the intention to use ChatGPT in learning, but otherwise if access is insufficient facilities or technical assistance then it may be an obstacle for students to be able to consistently use the ChatGTP in learning. To prove the argument, here are the hypotheses that will be tested:

H4: Facilitating Conditions positively influences the Decision to Use ChatGPT

5) Behavioral Intention on Decision to Use ChatGPT in the use of ChatGPT regarding students' learning interests.

ChatGPT is a technological development in the field of AI that has many benefits for its users. It does not exclude the possibility of making ChatGPT a friend and more than just a tool to encourage the use of ChatGTP over a long period of time (Maretha et al., 2020). Through the statements of the previous research, the argument arises that the Behavioral Intention has an influence on the decision to use of ChatGPT. To prove the argument, here is the hypothesis tested:

H5: Behavioral Intention positively influences the Decision to Use ChatGPT

Results and Discussion

In our research on the impact of ChatGPT on education: increasing student learning interest, we used SmartPLS 3 to process data collected through online questionnaires. The results of the calculations for the relationship between variables that represent each hypothesis on this study in the research model used:

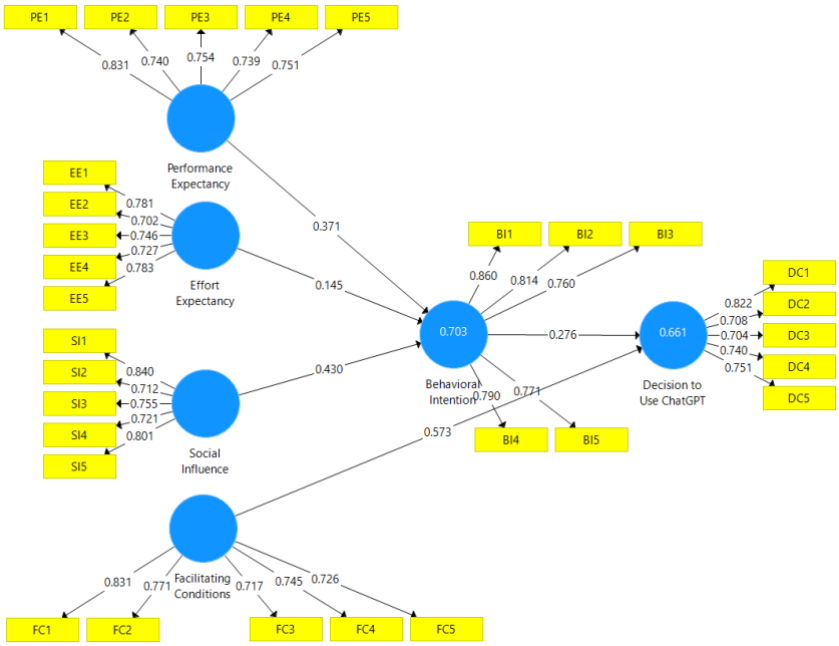

Figure 2: Calculation Result

A. Indicator and Construct Validity

In the process of validation of indicators and constructions, the method used is outer loading. Outer loading exceeding the value of 0.6 indicates that the indicator formed has a high significance and can effectively reflect the design in question. Conversely, if the outer loading value is below the minimum limit, the recommended step is to eliminate the indicator by deleting it. Here are the results of our research that reflects indicator and construct validity.

B. Reliability

To assess the validity of a structure and to measure its reliability, the method that can be used is the Average Variance Extracted (AVE). A structure is considered valid if its AVE value is equal to or greater than 0.50. Meanwhile, to assess the reliability of the structure in the study, it can be done by considering the Cronbach alpha value on each factor. A factor is considered to have good reliability if its Cronbach Alpha value exceeds 0.70 (Prasetyo et al., 2021).

Table 1: Reliability Scores

Variables	Cronbach's Alpha	AVE	Reliability
Performance Expectancy	0,822	0,583	Reliable
Effort Expectancy	0,803	0,560	Reliable
Social Influence	0,824	0,589	Reliable
Facilitating Conditions	0,816	0,576	Reliable
Behavioral Intention	0,859	0,640	Reliable
Decision to Use ChatGPT	0,800	0,557	Reliable

C. Path Coefficients

In path analysis, the calculation of a path coefficient involves the use of original sample data and a p value. A path model is considered significant if its p value is less than 0.05 (Prasetyo et al., 2021). This indicates that the probability of the result being found is due to coincidence less than 5%. The value of the initial sample reflects the extent to which the total variability in the dependent variable can be explained by the set of independent variables in the model.

Table 2: Path Coefficients

Hypotheses	Original Sample	Sample Mean	Standard Deviation	T Statistics	P-Value
BI>DC	0,276	0,279	0,076	3,655	0,000
EE>BI	0,145	0,138	0,100	1,457	0,145
FC>DC	0,573	0,571	0,078	7,387	0,000
PE>BI	0,371	0,375	0,095	3,905	0,000
SI>BI	0,430	0,435	0,077	5,593	0,000

D. Discussion

To evaluate whether a hypothesis can be accepted or rejected, the original sample data and p-values obtained from bootstrapping results need to be examined. This Hypothesis Testing is conducted with the assistance of the SmartPLS 3 application, and the results can be seen in the table showing path coefficients in the previous section.

1) Performance Expectancy positively influences the Behavioral Intention

It tests whether Performance Expectancy can have a positive effect on Behavioral Intention. Based on the test results, the Original Sample Data shows a value of 0.371 and P Values of 0.000. According to these results, it can be considered significant as it has P Values <0.05, so the fourth hypothesis is accepted. This proves that Performance Expectancy can have a positive effect on Behavioral Intention. According to the research findings, Performance Expectancy positively influences Behavioral Intention by 37.1%, related to the use of ChatGPT to enhance students' learning interest. The recommendation is to conduct further research related to the benefits and productivity derived from the use of ChatGPT for students, specifically concerning improving learning interest. Productivity and performance of ChatGPT can be influenced by various factors such as information sources affecting the quality of information provided by ChatGPT to students.

2) Effort Expectancy positively influences the Behavioral Intention

In the second hypothesis, it tests whether Effort Expectancy can have a positive effect on Behavioral Intention. The test results show that the Original Sample Data has a value of 0.145 and P Values of 0.145. These results are considered not significant as they have P Values >0.05, so the second hypothesis is rejected. This indicates that Effort Expectancy cannot have a positive effect on Behavioral Intention when related to increasing learning interest with the use of ChatGPT. The recommendation is to conduct further research on factors influencing Effort Expectancy not having a positive effect on Behavioral Intention, which can be done by changing the research target and adding supportive factors related to the positive influence of Effort Expectancy on Behavioral Intention, such as usage guidelines.

3) Social Influences positively influences the Behavioral Intention

In the third hypothesis, it tests whether Social Influence can have a positive effect on Behavioral Intention. The test results show that the Original Sample Data has a value of 0.430 and P Values of 0.000. These results are considered significant as they have P Values <0.05, so the fifth hypothesis is accepted. This proves that Social Influence can have a positive effect on Behavioral Intention. According to the research findings, Social Influence positively influences Behavioral Intention by 43%, related to the use of ChatGPT to enhance students' learning interest. The recommendation is to conduct further research to identify supportive factors for Social Influence that can strengthen the positive influence on Behavioral Intention in the use of ChatGPT by students to enhance learning interest. Some supportive factors that can be considered include the type of social influence and social experience. The type of social influence relates to the source of influence obtained, and social experience is related to the actual use of ChatGPT, which can socially influence students to use ChatGPT and enhance their learning interest.

4) Facilitating Conditions positively influences the Decision to Use ChatGPT

In the fourth hypothesis, it tests whether Facilitating Conditions can have a positive effect on Decision to Use ChatGPT. The test results show that the Original Sample Data has a value of 0.573 and P Values of 0.000. These results are considered significant as they have P Values <0.05, so the third hypothesis is accepted. This proves that Facilitating Conditions can have a positive effect on Decision to Use ChatGPT. According to the research findings, Facilitating Conditions positively influence Decision to Use ChatGPT by 57.3%. The recommendation is to conduct further research focusing on the long-term use of ChatGPT, considering the ease of obtaining devices or technological facilities that can be used by users, especially students, in using ChatGPT to enhance students' learning interest in the long term.

5) Behavioral Intention positively influences the Decision to Use ChatGPT

In the fifth hypothesis, it tests whether Behavioral Intention can have a positive effect on Decision to Use ChatGPT. The test results show that the Original Sample Data has a value of 0.276 and P Values of 0.000. These results are considered significant as they have P Values <0.05, so the first hypothesis is accepted. This proves that Behavioral Intention can have a positive effect on Decision to Use ChatGPT, meaning that the more someone intends to use something in an activity such as learning with ChatGPT, the more it supports their decision to use it. Based on the hypothesis testing results, it can be concluded that Behavioral Intention positively influences Decision to Use ChatGPT by 27.6%, related to the use of ChatGPT to

enhance students' learning interest. The recommendation is to increase focus on identifying supportive factors for users, especially students, in using ChatGPT to enhance learning interest, such as psychological factors and the impact resulting from the use of ChatGPT in student learning.

Table 3: Hypothesis Testing Results

Hypotheses		Result	Explanation
H1	*Performance Expectancy positively influences the Behavioral Intention*	Original Samples = 0,371 P-Values = 0,000	Accepted
H2	*Effort Expectancy positively influences the Behavioral Intention*	Original Samples = 0,145 P-Values = 0,145	Rejected
H3	*Social Influence positively influences the Behavioral Intention*	Original Samples = 0,430 P-Values = 0,000	Accepted
H4	*Facilitating Conditions positively influences the Decision to Use ChatGPT*	Original Samples = 0,573 P-Values = 0,000	Accepted
H5	*Behavioral Intention positively influences the Decision to Use ChatGPT*	Original Samples = 0,276 P-Values = 0,000	Accepted

In addition to the recommendations that can be given above based on each hypothesis, there are also other recommendations when referring to the results of the test of hypotheses by taking the value of the original sample data with the highest value and the lowest value. The hypothesis that Facilitating Conditions may have a positive influence on Decision to Use ChatGPT is the hypotheses with the highest original sample value of 57.3%. This suggests that a statement that indicates that when a user is a student it is easy to get a device to use ChatGTP then it is the most influential positive factor in determining the use of chatGPT for learning and increasing interest in learning. This hypothesis could be the highest percentage because it could be influenced by the respondents answered by the majority of 19-20 years of age who are a generation of rapid technological developments, so respondents have a habit of using technology in everyday life that also supports the real use of such technology when using it because ChatGPT is part of the latest technological development that uses AI to make it easier for its users to obtain a variety of information simply by writing the questions they want to ask and ChatGTP can provide answers based on the source of information.

Meanwhile, there is a second hypothesis that the Effort Expectancy may have a positive influence on the Behavioral Intention becomes a rejected hypothesis. If linked with respondents to this study, it shows that the ease of using ChatGPT is not significant in supporting the use of ChatGTP in learning that enhances student learning interests. This may be because generally the generation between the ages of 19 and 20 is a Z gene that is still in the adolescent phase and may have a high level of curiosity and competitiveness so that it is more interested in using things that require a more complex process of understanding in their use so that they can adapt well.

Conclusions

In this study, six variables were used, consisting of Performance Expectancy (PE), Effort Expectance (EE), Social influence (SI), Facilitating Conditions (FC), Behavioral Intention (BI), and Decision to Use ChatGPT. (DC). A total of five hypotheses were tested using the SmartPLS 3 application to answer the research question with the following results.

First, to test whether Performance Expectancy can have a positive influence on Behavioral Intention. Based on the results, it was demonstrated that Performance Expected has an influence over Behavioral Intentions, so this hypothesis is acceptable. The result is because students who have a goal or a task feel that using ChatGPT will be more effective and help them in achieving the goal or completing the task.

Second, to test whether the Effort Expectancy can have a positive effect on the Behavioral Intention. The result is because students feel that their efforts in using ChatGPT are not in line with their expectations, in which case they may not want to use ChatGPT and switch to other software like ChatGPT.

Third, test whether Social Influences can have a positive effect on Behavioral Intention. Based on the results, it is shown that social influences can positively influence behavioral intention, so this hypothesis is acceptable. The result is because students gain a strong influence from several things, such as the influence of friends, social media influence, and the student's personal experience in using ChatGPT.

Fourth, to test whether Facilitating Conditions can have a positive impact on Decision to Use ChatGPT. Based on the results, it has been demonstrated that facilitating conditions can positively influence the decision to use ChatGPT, so this hypothesis is acceptable.

Fifth, testing whether Behavioral Intention can have a positive influence on the Decision to Use ChatGPT. Based on the results, it has been shown that Behavioral Intentions have an influence over the decision to use ChatGPT, so this hypothesis is acceptable. The result is because students who are willing and accustomed to using ChatGPT in education encourage the use of ChatGPT in the world of education and increase interest in learning.

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Challenges of Language Learning in a Multicultural Context: International Students Learning BIPA (Bahasa Indonesia bagi Penutur Asing) in University Level

Aldian Idris Febrianto, Universitas Negeri Yogyakarta, Indonesia
Joko Priyana, Universitas Negeri Yogyakarta, Indonesia

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Abstract
This study examined the challenges international university students faced learning Bahasa Indonesia bagi Penutur Asing (BIPA) or in English Indonesian for Foreign Speakers. The researcher examined the challenges these students faced from diverse linguistic, cultural, and educational backgrounds. This research used a mixed-methods approach, incorporating quantitative survey data and qualitative interviews to understand these problems. The research sample was 30 international students studying at Universitas Negeri Yogyakarta. Purposive sampling was employed for the questionnaire, which was based on the Likert scale, and random sampling was used for the interviews. The data analysis techniques utilized include thematic analysis to extract meaningful patterns from the collected data. A significant issue identified was the language barrier. The grammar and vocabulary of Bahasa Indonesia differed from the students' native languages, causing them to struggle. Pronunciation and intonation further hindered communication. Additionally, understanding cultural nuances required cultural sensitivity. The students' diverse educational backgrounds affected their preparedness and familiarity with Indonesian university teaching, slowing their learning and comprehension. The findings of the study revealed that teachers need to adapt their methods in multicultural classrooms. Institutions also should provide language labs and cultural orientation programs to help international students overcome these challenges. Additionally, researchers recommend improving teacher training to meet the needs of diverse students. The research informs these proposed solutions by highlighting specific difficulties faced by students, such as linguistic and cultural misunderstandings.

Keywords: BIPA Challenges, Linguistic Barriers, Multicultural

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Introduction

The significance of acquiring competence in Bahasa Indonesia bagi Penutur Asing (BIPA) has greatly increased in recent years as a result of the rising worldwide demand for Indonesian language skills. As Indonesia enhances its economic, political, and cultural connections with nations globally, the ability to speak Bahasa Indonesia has become a key asset for both overseas students and professionals (Novera, 2004; Fachri & Saragih, 2020). Universitas Negeri Yogyakarta, a prominent educational institution in Indonesia, has created specialized programs to meet the needs of individuals who are not a native speakers of Indonesian. These programs seek to provide students with the essential language skills required especially necessary to learn in Indonesia educationally and in culture successfully.

The BIPA program at Universitas Negeri Yogyakarta is specifically tailored to cater to the distinct requirements of foreign students, who originate from a wide range of language, cultural, and educational backgrounds. These disparities might have a substantial impact on their learning experiences and results, presenting distinct obstacles that must be comprehended and resolved to guarantee efficient language acquisition. Prior studies have shown that overseas students often encounter several challenges, such as language hurdles, cultural adaptation, and divergent educational expectations. These impediments may impede their academic advancement and overall welfare (Li et al., 2010; Sawir, 2005).

Gaining a comprehensive understanding of the difficulties encountered by these students is essential for devising efficient pedagogical approaches and support systems. Although language limitations are a notable factor, cultural adaptations also have a crucial impact. Students often have difficulties in assimilating to the social and cultural conventions of a foreign nation, which might impede their capacity to actively participate in the educational process. Moreover, the educational systems and teaching techniques in their respective home countries may exhibit substantial differences compared to those in Indonesia, resulting in additional challenges when it comes to adjusting to new academic standards and approaches (Nurhayati, 2018; Sawir, 2005).

This study employs a mixed-methods approach to get a thorough knowledge of these problems. This research seeks to provide a comprehensive perspective on the challenges encountered by foreign students in the BIPA program by integrating quantitative survey data with qualitative interviews. Quantitative data provides a comprehensive understanding of general difficulties, but qualitative interviews explore individual experiences and viewpoints in more detail, offering valuable contextual insights (Creswell & Plano Clark, 2011).

The linguistic difficulties faced by overseas students studying Bahasa Indonesia are often the most immediate and conspicuous hurdles. These issues include obstacles in articulation, syntax, and lexicon assimilation, which may hinder effective communication and understanding. For example, students from diverse linguistic backgrounds may find Bahasa Indonesia's phonetic system strange, which might result in pronunciation problems that may impact their confidence and desire to engage in speaking activities. Furthermore, the distinctive grammatical framework of Bahasa Indonesia, in contrast to several other languages, might provide supplementary difficulties for individuals acquiring the language (Novera, 2004; Putri & Wahyuni, 2019).

Cultural adaptations are another crucial aspect of concern. International students are required to manage both the academic setting and the wider social and cultural context of Indonesia.

The process of adjustment may be intricate and multidimensional, including the comprehension and adaptation to new social norms, beliefs, and behaviours. The cultural aspect of language acquisition is crucial since it shapes pupils' perception and interaction with their unfamiliar surroundings. Instances of cultural misconceptions or a lack of cultural awareness may result in individuals experiencing emotions of isolation and frustration, which can in turn make the learning process more complex (Sawir, 2005; Setiyawan, 2021).

The experiences of overseas students are significantly influenced by educational expectations and practices. The teaching methodologies and dynamics inside Indonesian institutions may vary in comparison to those in the students' countries of origin. For instance, the focus on repetitive learning and memorisation in some educational systems differs from the interactive and engaging teaching approaches often used in Indonesian classrooms. Students who are used to alternative learning and evaluation methods may find this adjustment difficult, since they will need to adjust to new academic standards and expectations (Li et al., 2010).

Moreover, the support systems provided to foreign students play a vital role in supporting their adaptation and educational progress. Universities must ensure that they provide sufficient resources and support services to assist students in overcoming language, cultural, and educational obstacles. Support methods such as language tutoring, cultural orientation programs, and academic advising may significantly contribute to students' academic success. Gaining insight into the efficacy of these support services and pinpointing areas that may be enhanced are crucial for improving the entire student experience (Sawir, 2005; Utami, 2022).

Research Questions

What are the primary challenges faced by foreign students in the BIPA program at Universitas Negeri Yogyakarta, and how can tailored pedagogical approaches and support systems be developed to enhance their language acquisition and cultural adaptation?

Research Objectives

This study aims to address the gap in current literature by thoroughly examining the challenges faced by foreign students in the BIPA (Bahasa Indonesia untuk Penutur Asing) program at Universitas Negeri Yogyakarta. Utilizing a mixed-methods approach, combining qualitative and quantitative research, this study seeks to analyze the multifaceted obstacles foreign students encounter, such as language barriers, cultural adaptation issues, and academic integration. By incorporating up-to-date insights from recent research on language acquisition and intercultural learning, this study will also consider the broader socio-cultural dynamics influencing students' learning experiences. According to the latest studies by Jones & Smith (2022), effective language instruction for non-native speakers requires not only pedagogical adjustments but also the establishment of strong support systems for cultural acclimatization. This research will offer valuable recommendations to enhance both academic performance and the overall well-being of international students. The outcomes of this study will contribute to the development of improved instructional strategies, more effective language support frameworks, and comprehensive welfare systems for non-native speakers, thereby fostering a more inclusive and supportive learning environment. Ultimately, the findings will help shape educational policies that better cater to the diverse needs of international students in Indonesia.

Literature Review

In this section, the authors conducted a comprehensive evaluation of the literature pertaining to intercultural learning.

Multicultural Learning

emerged as a crucial approach to address the diverse needs of students from varying racial, socioeconomic, gender, linguistic, cultural, and ideological backgrounds within the educational sphere (Banks, 2019). It seeks to create an inclusive environment that respects and values the contributions of different cultures to enrich the learning experience for all students. According to Gay (2018), multiculturalism serves as a valuable resource that enhances students' knowledge and understanding of other cultures, thereby promoting empathy and global awareness. These educational programs offer opportunities for learners from all cultural backgrounds to interact and cultivate positive attitudes towards cultural diversity (Nieto & Bode, 2018). They aim to equip students with the necessary skills to thrive in an increasingly pluralistic society. Linguistic diversity plays a significant role in this context, as individuals often utilize their own dialects to express their identity and maintain cultural heritage (García & Wei, 2014). Recognizing and valuing linguistic variety among ethnic groups can foster a more inclusive and supportive educational environment.

Promoting Cultural Diversity

Thought for 43 seconds Promoting Cultural Diversity A fundamental goal of multicultural education is to acknowledge and promote cultural diversity. According to Banks (2019), multicultural education seeks to transform educational institutions so that all students have equal opportunities to learn, regardless of their cultural backgrounds. Nieto and Bode (2018) emphasize that multicultural education provides a platform for students from diverse cultures to actively engage and develop positive attitudes towards cultural diversity. This involvement is crucial in constructing a community that respects and honors cultural differences. Gay (2018) highlights the significance of culturally responsive teaching in promoting cultural diversity. She argues that incorporating students' cultural experiences into teaching practices enhances learning and fosters an inclusive classroom environment. By acknowledging and utilizing the cultural assets that students bring, educators can promote mutual respect and understanding among students from different backgrounds. Furthermore, Ladson-Billings (2021) reiterates the importance of culturally relevant pedagogy in addressing the educational needs of diverse learners. She contends that educators must recognize and utilize students' cultural strengths as assets in the learning process. This approach not only supports academic success but also affirms students' cultural identities. Moreover, international organizations emphasize the importance of promoting cultural diversity in education. The UNESCO (2020) Global Education Monitoring Report highlights that embracing cultural diversity in educational settings is vital for achieving inclusive and equitable quality education for all. Therefore, integrating multicultural education and culturally responsive teaching practices is essential in fostering a community that esteems and honors cultural disparities. By drawing on the latest insights from experts and international educational bodies, educators can create inclusive learning environments that prepare students to thrive in a diverse and interconnected world.

Enhancing Linguistic Diversity

Linguistic variety has a crucial role in the context of multicultural education. Cummins (2021) emphasises that acknowledging and appreciating students' mother tongues and regional speech patterns in the educational setting might enhance their self-confidence and scholastic achievements. By integrating students' language origins into the curriculum, educators may create a learning atmosphere that is more inclusive and supportive.

Research Methodology

This research employed a mixed-methods approach to investigate the difficulties encountered by foreign university students in studying Bahasa Indonesia bagi Penutur Asing (BIPA). A mixed-methods approach integrates quantitative and qualitative methods to provide a comprehensive understanding of the research problem (Creswell et al., 2018). The quantitative component involved a survey administered to 30 international students enrolled in the BIPA program at Universitas Negeri Yogyakarta. This sample size was deemed appropriate for the exploratory nature of the study and is consistent with recommendations for minimum sample sizes in preliminary research (Marshall et al., 2013). Purposive sampling was used to select survey participants, ensuring that only students with relevant experience in the BIPA program were included. Purposive sampling allows researchers to focus on participants who can provide rich and relevant information (Etikan et al., 2016). For the qualitative component, semi-structured interviews were conducted with a subset of participants selected through maximum variation sampling. This strategy ensured a diverse representation of students' backgrounds and experiences, enhancing the depth and richness of the data collected (Patton, 2015). Maximum variation sampling is effective in capturing a wide range of perspectives, which strengthens the credibility and transferability of the qualitative findings (Palinkas et al., 2015).

Data Collection

Quantitative Data Collection

A structured questionnaire based on the Likert scale was designed to collect quantitative data. The questionnaire covered aspects such as linguistic difficulties (grammar, vocabulary, pronunciation, and intonation), cultural challenges, and educational background impacts.

Qualitative Data Collection

Semi-structured interviews were conducted to gather in-depth qualitative data. The interviews aimed to explore personal experiences, specific challenges, and coping strategies employed by the students.

Data Analysis

The data analysis for this study involves both quantitative and qualitative techniques to provide a comprehensive understanding of the challenges faced by international students learning Bahasa Indonesia bagi Penutur Asing (BIPA). Descriptive statistics were used to summarize the survey responses, including frequency distributions (e.g., strongly agree, agree, neutral, disagree, strongly disagree) and measures of central tendency (mean) and variability (standard deviation). Inferential statistics were applied to explore relationships

between specific linguistic challenges (e.g., grammar, vocabulary, pronunciation) and overall language learning difficulty. In addition, thematic analysis, including transcription and coding, was employed to identify recurring themes and patterns from the qualitative data.

Results

Quantitative Analysis

Generally the study found the mean score for “Importance of Cultural Understanding is the highest with 4.23 suggests that students overwhelmingly agree that understanding Indonesian culture is important for effective communication followed by "Grammar significantly different from native language" & “Pronunciation challenges are 3.8, indicating moderate agreement that Indonesian grammar differs from students' native languages and pronunciation is perceived as moderately challenging comparing to students’ natives languages. Table 1 shows the mean score of the five constructs for all respondents of study.

Table 1: Mean Score for All Constructs

	Constructs	Mean Score	Standard Deviation
1	Grammar Differences	3.8	1.1
2	Pronunciation Challenges	3.8	1.1
3	Cultural Challenges	3.4	1.2
4	Grammar vs Vocabulary Difficulty	3.6	1.1
5	Importance of Cultural Understanding	4.2	0.9

Table 2: t-Test Results for 5 Constructs

	Constructs	T-Statistic	P-Value
1	Grammar Differences	3.89	0.0
2	Pronunciation Challenges	4.0	0.0
3	Cultural Challenges	1.75	0.09
4	Grammar vs Vocabulary Difficulty	2.98	0.01
5	Importance of Cultural Understanding	7.87	0.0

Findings

The quantitative analysis underscores several statistically significant constructs, with grammar and pronunciation being the most prominent challenges. The mean scores for "Grammar Differences" and "Pronunciation Challenges" (3.8) reflect a moderate consensus among students that these aspects pose considerable difficulty. The T-test results further affirm this, showing statistical significance for both constructs (p-value=0.0), indicating that the observed differences are not random but are widespread issues across the student cohort.

Moreover, the construct "Importance of Cultural Understanding" has the highest mean score (4.2), highlighting a strong agreement that cultural understanding plays a pivotal role in

effective communication. However, "Cultural Challenges" (mean score of 3.4) was not statistically significant (p-value=0.09), suggesting variability in students' experiences regarding cultural barriers in language learning. While this might imply that some students adapt more easily to cultural nuances, others may find them less relevant or challenging in their learning process.

Qualitative Analysis

Interviews were transcribed literally and analysed using directed Qualitative Content Analysis to describe emerging themes in a systematic way (Mayring, 2000, 2015; Schreier, 2014). The qualitative data, gathered from students' personal experiences, offers a rich, contextualized understanding of the quantitative findings. For instance, while the statistical significance of grammar challenges is evident in the quantitative results, the qualitative feedback provides a nuanced view of how these challenges manifest. Students like P1, who highlighted difficulties with formal grammatical structures, found that constant review and repetitive practice were necessary coping strategies. This reflects a deeper, often frustrating, engagement with grammar that goes beyond mere recognition of its difficulty, pointing to a persistent struggle that requires time and focused effort to overcome.

Similarly, pronunciation challenges, which the quantitative data identifies as significant, are qualitatively illustrated by students like P2, who noted that certain sounds in Indonesian do not exist in her native language (Urdu). The use of specific coping strategies such as flashcards and language apps adds depth to the statistical observation, showing not only the nature of the difficulty but also how students adapt their learning methods to address these phonetic barriers.

When it comes to cultural adaptation, the qualitative data introduces important insights that the quantitative analysis does not fully capture. While the quantitative results indicate variability in students' perceptions of cultural challenges, the qualitative themes reveal that cultural adaptation is an individualized process. P3's experience with "jam karet" (a term reflecting flexible time management in Indonesian culture) and P2's difficulty grasping the indirect communication style showcase that cultural challenges are not uniformly experienced. For some, these challenges require active engagement, such as consuming local media (Indonesian literature or comedy) to better understand social norms and behaviors.

The interviews reveal that grammar is one of the most significant challenges students face, particularly in mastering formal grammatical structures and the use of affixes. P1 shared their frustration with this aspect, stating:

> Indonesian grammar is quite different from my own language. I often struggle with prefixes and suffixes, especially in formal writing. It takes a lot of effort and time to get used to them.

This sentiment highlights not only the inherent complexity of Indonesian grammar but also the mental and emotional toll it takes on learners. P1 copes with this challenge by dedicating extra time to reviewing grammar rules and practicing them in exercises. Their approach of repetitive learning underscores the need for constant exposure and engagement with grammar, indicating that students must go beyond simply learning the rules to truly internalize them through practical application.

Pronunciation

Pronunciation is another area where students experience significant difficulty, especially when dealing with sounds that do not exist in their native languages. P2 described their struggle with pronunciation, stating:

> The hardest part for me is pronouncing sounds that aren't in my native language, like certain vowels. It's really frustrating because I know what I want to say, but it just doesn't come out right.

To cope with these challenges, P2 turned to using flashcards and language apps, tools that helped them to familiarize themselves with the sounds and practice them in context. This coping strategy reflects the importance of technology-assisted learning in overcoming phonetic barriers, particularly for students who encounter unfamiliar sounds that require focused, repetitive practice to master.

Vocabulary challenges, particularly when it comes to idiomatic expressions and slang, are a recurring theme in the interviews. P3 emphasized the difficulty of learning vocabulary that does not have direct equivalents in their native language, sharing:

> What makes learning Indonesian hard is the idiomatic expressions and slang. They don't translate easily, and I often don't understand what people mean when they use them.

To address this, P3 turned to Indonesian literature and conversations with locals to improve their understanding of these expressions. By actively seeking out examples of idiomatic language in real-world contexts, they were able to expand their vocabulary and grasp the deeper cultural meanings behind certain phrases. This suggests that students need more exposure to authentic language use, as relying solely on formal instruction may not adequately prepare them for the colloquial nuances of everyday communication.

Cultural differences play a significant role in students' experiences of learning Indonesian. For some, like P3, adapting to cultural norms such as "jam karet" (flexible time management) posed a real challenge. They explained:

> At first, I found it really confusing when people said they would arrive at a certain time but then showed up late. It took a while to adjust to the idea that time is more flexible here.

This cultural adaptation required them to recalibrate their expectations and understanding of social norms. P3's experience demonstrates how cultural factors can complicate language learning, as students must not only learn the language but also adjust to the cultural practices that shape communication. Similarly, P1 found the use of formal titles challenging, commenting:

> I wasn't used to the formality in addressing people. I had to learn how to use the right titles in different contexts, which was sometimes confusing.

P1 dealt with this challenge by observing local interactions and seeking clarification from instructors, emphasizing the importance of learning through immersion and social observation in navigating cultural differences.

Across the interviews, a variety of coping mechanisms emerged, demonstrating how students adapt to the challenges they face in learning Indonesian. For instance, P1's strategy of reviewing grammar rules and doing extra exercises reflects a methodical approach to overcoming grammatical difficulties, while P2's use of flashcards and language apps highlights the role of technology in addressing pronunciation challenges. P3's reliance on literature and conversations with locals to understand idiomatic expressions shows the value of immersing oneself in the target language's cultural context. These diverse strategies reveal that successful language learning requires not only cognitive effort but also a willingness to engage with the language in practical, everyday situations.

Conclusion

The integration of both quantitative and qualitative data reveals a comprehensive understanding of the challenges faced by students learning Indonesian as a second language. The quantitative results clearly highlight that the most significant obstacles include grammar and pronunciation, both of which are statistically significant with mean scores of 3.8. These findings are complemented by qualitative insights, where students detail their experiences and strategies in overcoming these challenges. For instance, while grammar is quantitatively shown to be a prominent difficulty, students like P1 emphasize the emotional and mental effort required to master complex grammatical structures, revealing the depth of their struggles through personal experiences.

Similarly, pronunciation difficulties identified quantitatively are brought to life through qualitative narratives, such as P2's frustration with sounds that do not exist in their native language. The use of flashcards and language apps as coping strategies shows how students apply technological tools to manage these challenges effectively. The cultural adaptation, which quantitatively shows variability (mean score of 3.4 and a non-significant p-value), is further unpacked in the qualitative analysis. Students like P3 and P2 describe how specific cultural norms, such as "jam karet" or the indirect communication style, add layers of complexity to their language learning. This suggests that while cultural challenges may not be universally perceived as difficult, those who do encounter them must engage deeply with the local culture to succeed. Overall, the combined data illustrates that learning Indonesian is not only a cognitive process but also requires emotional resilience, cultural adaptability, and the use of diverse coping mechanisms. By weaving together statistical trends with individual stories, the discussion captures the multifaceted nature of language acquisition.

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Contact email: aldianidris25@gmail.com

Exploring the Effects of Automatic Speech Recognition Technology in EFL Students' Speaking Performance

Hui-Wen Liu, National Taipei University of Technology, Taiwan
Pei-Shan Tsai, National Taipei University of Technology, Taiwan

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Abstract
This study examined the impact of Automatic Speech Recognition (ASR) technology, specifically Sensay, on the speaking performance and anxiety levels of 110 non-English major students, including 86 males and 24 females. Using the Foreign Language Classroom Anxiety Scale (FLCAS), students were grouped into "low anxiety," "medium anxiety," and "high anxiety" clusters. The results showed that low anxiety students initially outperformed the other groups. Furthermore, ASR technology significantly improved fluency across all anxiety levels, highlighting its effectiveness in providing repetitive practice opportunities. Notably, high-anxiety students, particularly those with high levels of Test Anxiety (TA), Fear of Negative Evaluation (FNE), and Communication Apprehension (CA), experienced a reduction in their anxiety levels after using ASR technology. These findings suggest that ASR technology can help reduce anxiety, potentially enhancing performance. The study underscores the potential of ASR in EFL education as a tool for educators to reduce students' anxiety and improve their speaking performance. The study concludes with a discussion of pedagogical implications and recommendations for future research.

Keywords: English Speaking, Automatic Speech Recognition (ASR), Foreign Language Classroom Anxiety

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Introduction

English, recognized as the global lingua franca, has become one of the most widely studied foreign languages (Walker, 2021). Its status as a universal medium for communication across varied linguistic and cultural backgrounds underscores the importance of mastering the four key language skills: listening, reading, speaking, and writing. Among these skills, speaking English is particularly valued as it enables immediate and effective communication (Akhter et al., 2020). However, English as a Foreign Language (EFL) learners often face significant challenges in acquiring proficient speaking abilities due to the language's complexity and dynamism. These challenges are further intensified by negative emotions such as nervousness, fear, and anxiety, which are frequently elicited by the daunting task of articulating thoughts and ideas in a non-native language. Such emotions can provoke physiological reactions, like trembling and sweating, indicative of stress, and pose a substantial barrier to language learning. Anxiety is strongly correlated with speaking performance (Fitri et al., 2021); however, Young (1990) highlighted the necessity of considering variables like language skills for a more comprehensive understanding of the relationship between anxiety and learning outcomes. Research has identified several contributors to EFL learners' speaking anxiety, including the fear of making grammatical or pronunciation errors, adverse past experiences, pressure from peers or teachers, and a lack of confidence (Nurilahi & Suhartono, 2022). Pronunciation, in particular, has been emphasized as vital for effective communication, with clear and understandable pronunciation greatly enhancing communication success. The causes of speaking anxiety are diverse, but a common factor among EFL learners is the reported lack of practice. Alnahidh & Altalhab (2020) observed that insufficient speaking practice leads to increased speaking anxiety, underscoring the need for more opportunities to engage in speaking activities within EFL learning environments.

Educators in the EFL field have continuously devoted efforts to instructional methodologies and interventions aimed at alleviating speaking anxiety and enhancing spoken language proficiency among learners. A variety of teaching methods and learning strategies have been employed to create conducive environments for EL speaking practice (Yesilçinar, 2019), supplemented by the introduction of technological tools and resources designed to bolster EFL learners' speaking abilities (Fathikasari et al., 2022). These endeavors highlight the transformative potential of innovative pedagogies and technology-assisted language learning in positively influencing EFL learners' speaking, especially in the fundamental domain of pronunciation. In the pursuit of refining EFL learners' pronunciation, the necessity for targeted pronunciation training is inevitable. Feedback from teachers plays an important role in improvement (Akhter et al., 2020); yet, traditional approaches, often characterized by repetitive listening and speaking exercises without tailored feedback, fall short in fostering learner autonomy and fail to equip them with the ability to independently identify and rectify their pronunciation errors (Cucchiarini & Strik, 2019;). Addressing this challenge, the adoption of Automatic Speech Recognition (ASR) technology, a sophisticated application of Artificial Intelligence (AI) technology based on Machine Learning, has gained acceptance. This innovative approach has illuminated the integration of various ASR-based tools into classroom settings to facilitate EFL speaking training and practice.

This study aimed to investigate the impact of the possible clusters of students' foreign language classroom anxiety on their learning processes and outcomes. Therefore, this study aimed to explore the following research questions: (1) What kinds of foreign language classroom anxiety exist when students participated in AI supported learning activities? (2)

How did the different foreign language classroom anxiety related to the students' learning processes and learning outcomes?

Methods

Participants

The study involved 110 participants, aged 18-19, enrolled in three intermediate-level English classes at a Taiwanese university of technology. Freshman English, a mandatory course, aims to enhance students' language proficiency, focusing on grammar, essential language skills development, and fostering cross-cultural communication, with placement based on English entrance exam scores.

Experimental Procedure

Throughout the 18-week semester, three sections (50 min for each) of each English class were conducted each week, during which participants received lecture-based instruction in line with the university's curriculum and objectives. All three classes were taught by the same instructor, who was also one of the researchers. In the second week, participants were required to take a speaking test as the pre-test, involving video-recording their responses, and subsequently upload these files to Padlet for analysis. Following the pre-test, participants completed the Foreign Language Classroom Anxiety Scale (FLCAS) questionnaire.

Instruments

In this study, the Foreign Language Classroom Anxiety Scale (FLCAS) developed by Horwitz et al. (1986) was utilized. FLCAS is designed to assess the level of anxiety learners experience in foreign language classrooms. The scale consists of 33 items rated on a 5-point Likert Scale, including 24 positively worded and 9 negatively worded statements.

To investigate EFL learners' engagement with technology and their adoption of new approaches, "Sensay," an ASR-based language learning tool, was introduced within a college setting. Sensay employs artificial intelligence to generate audio files and instantly evaluate pronunciation, fluency, and accuracy.

The scores of learning processes result from the evaluation of the learning process It was based on three speaking tasks selected from a total of ten.

Data Analysis

The data analysis of this study was performed in three steps. First, an exploratory factor analysis (EFA) with varimax rotation was performed to clarify the structural validity of the FLCAS questionnaire. Second, a k-mean clustering analysis was conducted to classify the students with similar degree of foreign language anxiety into groups. To compare the three clusters in terms of foreign language anxiety, Kruskal-Wallis tests and Mann-Whitney U Tests were conducted. Finally, the impact of the different clusters' foreign language anxiety on their learning processes and learning outcomes was also examined.

Results

K-means cluster analysis was conducted on the three factors to classify the students with similar degree of foreign language classroom anxiety into homogeneous groups, involving communication apprehension (CA), test anxiety (TA), fear of negative evaluation (FNE). As shown in Table 1, students in cluster 1 (n=27) have lower anxiety in CA and NE than students in other clusters. Students in cluster 2 (n=48) have higher anxiety in CA, TA and NE than students in other clusters. Students in cluster 3 (n=35) have lower anxiety in TA than students in other clusters.

Table 1: Cluster Analysis of Students' Foreign Language Classroom Anxiety

Factors	Cluster 1 (n=27)	Cluster 2 (n=48)	Cluster 3 (n=35)
CA	2.44	3.55	3.16
TA	2.90	4.19	2.87
FNE	2.13	4.18	3.60

Furthermore, the results of Mann-Whitney U tests showed that significances existed in the CA, TA, FNE except in the following case: the TA factor (cluster 1 vs. cluster 3). In sum, these indicated that the degree of CA and FNE in cluster 1 are significantly lower than those in other clusters. It is thus proposed to label cluster 1 as "low anxiety." On the contrary, the degree of CA and FNE in cluster 2 are significantly higher than those in other clusters. It is thus proposed to characterize cluster 2 as "high anxiety." The degree of CA and FNE in cluster 3 are significantly lower than those in cluster 2 and higher than those in cluster 1. Hence, cluster 3 was labelled as "medium anxiety."

To examine whether the students had similar speaking skills among the three clusters before participating in the ASR-supported learning activities, Kruskal-Wallis tests and Mann-Whitney U tests were employed in this study. The results revealed that the students had similar speaking skills among the three clusters, including F (χ^2 (2, N=110)=2.19, p=0.33), P (χ^2 (2, N=110)=0.30, p=0.86), and I (χ^2 (2, N=110)=1.73, p=0.42). Pairwise Mann-Whitney U tests also revealed that three were no differences among the three clusters in all comparisons. Thus, it may be inferred that students in the three clusters had similar speaking skills before they joined in the learning activities.

Furthermore, Kruskal-Wallis tests and Mann-Whitney U tests were also employed to investigate whether the students attain different scores of learning outcomes among the three clusters. the results showed significant effects of the three clusters on the learning outcomes in the dimensions of P (χ^2 (2, N=110)=60.90, $p < 0.05$), of I (χ^2 (2, N=110)=10.57, $p < 0.01$). Pairwise Mann-Whitney U tests indicated significant differences between "low anxiety" and "high anxiety" in the dimensions of P (U=429.50, z=-2.51, $p < 0.05$), and of I (U=377.00, z=-3.13, p <0.001). Significant differences between "low anxiety" and "medium anxiety" in the dimensions of P (U=328.50, z=-2.12, p <0.05), and of I (U=303.00, z=-2.54, p <0.05). These findings revealed that student with "low anxiety" outperform than those students with "medium anxiety" or "high anxiety" in the dimensions of P and I. However, there is not significant difference among the three cluster in the learning outcomes of F (χ^2 (2, N=110)=5.68, p=0.06). This finding showed that ASR-based technology help students with "medium anxiety" and "high anxiety" attain scores in dimensions of fluent as well as those with "low anxiety."

Conclusion

The study offers empirical evidence that ASR technology aids in reducing anxiety. It was observed that students with high levels of anxiety experienced a reduction in their learning anxiety during ASR speaking tasks, covering CA, TA, and FNE. This indicates a decrease in overall anxiety levels for this group, notably in communication anxiety. Such results suggest that students who started with higher levels of anxiety saw a significant reduction in their speaking-related anxiety, thanks to the intervention. This underscores the effectiveness of ASR technology in mitigating speaking anxiety, particularly CA, in students with initially high anxiety levels. This outcome aligns with research showing that ASR technology can alleviate speaking anxiety and that technology assistance enhances EFL learners' oral performance (Bashori et al., 2022; Tai & Chen, 2023) and offers a flexible learning environment to cater to diverse learning styles. These features lead to more effective and personalized learning outcomes (Hsu, 2016; Liu et al., 2022). As mentioned above, communication apprehension, or anxiety, is a major barrier that makes learners more reluctant to speak in a foreign language context; therefore, the deployment of ASR-based tools emerges as a promising solution to reduce this anxiety, creating a more relaxed and supportive environment for communication among EFL learners (Tai & Chen, 2023).

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Profiling English Language Learning Anxiety of Selected Rural Area Secondary School Students in Kedah: A Case Study

Aini Syahira Jamaluddin, Albukhary International University, Malaysia
Aina Yasmin Mohd Amin, Albukhary International University, Malaysia
Nurul Huda Hassan Bakri, Albukhary International University, Malaysia
Asri Karolina, Universitas Islam Negeri Raden Fatah Palembang, Indonesia

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Abstract
This study investigated the phenomena of English Language Learning Anxiety among six secondary school students in Baling, the rural area of Kedah in Malaysia. It studied the relationship between two anxiety English language skills, listening and speaking, and their correlations. A quantitative survey was administered to 866 rural secondary school students using a composite questionnaire that adapted multiple language learning anxiety scales, mainly the Foreign Language Anxiety Scale, English Language Listening Anxiety, and English Language Speaking Anxiety. Descriptive analysis and Pearson Correlation analysis were utilized to extract the required information regarding the English language learning anxiety among secondary school students in Kedah. The result showed the students in all six schools experience moderate levels of anxiety in learning the English language inside the classroom. A positive and significant relationship was also discovered between English listening anxiety and English speaking anxiety from the data collected. These findings point to the fact that language learning anxiety occurs inside the classroom, even in rural area secondary schools in Kedah, and it is debilitative to the student's acquisition of the English language. The correlation of anxiety between the two language skills paves the way to simultaneously formulating methods to solve the problem. This research aims to provide additional information to the existing literature by focusing on rural secondary schools, which need more coverage regarding English language anxiety.

Keywords: Anxiety, English Speaking, Rural Area

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Introduction

It is undeniable that English is the most widespread and significant language globally. Consequently, English is the second language in Malaysia, serving as a unifying tool among the country's diverse ethnic, linguistic, cultural, and religious groups. Within the Malaysian education system, English is a compulsory subject for all students, designed to produce graduates proficient in effective communication in English. Education in Malaysia recognizes the significance of the English language (Azirah, 2004; Thirusanku & Yunus, 2012). As a result, English serves as the second language (L2) for Malaysians, given that Malaysia is among the Asian countries that implement bilingual education (Ali, 2000; Darmi & Albion, 2013). However, challenges hinder students from achieving high proficiency in spoken English. Consequently, the nuances of the English language are evident in the speech of Malaysians, who are exposed to English throughout their primary and secondary education, accumulating eleven years of learning English as a mandatory subject in public schools (Yamat et al., 2014).

The decline in English proficiency among Malaysians has drawn increased attention to the factors contributing to this issue despite 11 years of formal English education in national schools (Musa et al., 2012). This deterioration is particularly concerning as it adversely affects the employability of graduates, who are often rejected for positions due to their insufficient English language skills (Ali, 2000; Hashim, 2004; Ratnawati, 2004) despite achieving high Grade Point Averages in their university studies (Guan, 2016). Previous research on second language anxiety focused more on the tertiary level. Moreover, study in this field is fairly tiny in Malaysia. In the present study, however, the researcher would like to focus on Form 1, 2 and 4 students' English language anxiety. Thus, this research aims to investigate the level of anxiety in English as a second language among secondary school students in selected schools in rural Kedah, Malaysia, to find a correlation between listening anxiety and speaking anxiety in the English language and to see the relationship between listening and speaking anxiety among Form 1, 2 and 4 students in selected rural schools of Kedah.

Anxiety and Language Learning

In Malaysia, where Bahasa Melayu is the national language, and English is widely used as a second language, students often face unique challenges in language acquisition that can lead to anxiety. Numerous studies had been conducted focusing on the language anxiety level among students, particularly in speaking (Miskam & Saidalvi, 2018; Kayaoglu & Saglamel, 2013). The English language requirement as a compulsory subject to pass in Malaysia's education system shows the importance of mastering the language.

The Ministry of Education has made many efforts to improve students' English. Back in 2002, the government re-introduced the teaching and learning of Science and Mathematics in English; later, they introduced MBMMBI; focusing on upholding the Malay language and strengthening their command of English and in 2009, a program to improve students' English proficiency as the second language in Malaysia (Miskam & Saidalvi, 2018; Rokiah @ Rozita Ahmad et al., 2012). However, Malaysian graduates still struggle to master English, especially when using the language for communication. In 2011, the Education Blueprint underwent a significant shift to ensure Malaysian graduates are equipped with fluent communication skills upon graduating (Malaysian Educational Blueprint, 2011).

Among the factors that triggered this situation is anxiety. Anxiety leads to poor communication in the English language among graduates. According to Brown (1994), language anxiety influences language learning. Brown added that when a learner acquires a second language, a complex process, the learner becomes anxious. Speaking covers many processes involving pronunciation, pronunciation, word recognition, meaning, and grammar rules. This process can overwhelm learners (Khusnia, 2016).

English Language Anxiety Among School Students in Malaysia

Research conducted by Lian and Budin in 2014 revealed that Malaysian Form 4 students have a moderate level of English language anxiety and significant differences between genders in English language anxiety. A study by Nasir and colleagues. (2023) found that the level of English language anxiety among Malaysian Siamese students attending national and national type-secondary schools is low. A study by Idrus and Hamid (2021) examined 311 non-examination students and indicated students in rural area secondary schools experience moderate to high levels of anxiety inside the English language classroom. In addition, a study by Kamaruddin in 2009 involving 120 secondary school students found that in terms of the manifestation of anxiety, participants showed both physical and psychological signs of anxiety. Some symptoms were stutter, palpitation, shaky, trembling, shortness of breath, and restlessness. Some psychological symptoms were avoiding volunteering and being demotivated to complete the given tasks. A study by Chin (2020) consisting of 10 Form 2 students of the respective school who have been identified as students who possess language learning anxiety revealed that the factors of language learning anxiety in ESL classrooms are language barrier, low self-confidence, and fear of negative evaluation. A study by Tachinamutu and Shah 2018 involving 100 lower secondary students from a national school indicated that English learning anxiety impacted learning motivation differently depending on proficiency level.

English Language Anxiety

Second/Foreign Language Anxiety (SLA/FLA) is a significant issue in the English as a Second/Foreign Language (ESL/EFL) field and has been widely researched over the past decade. The concept was pioneered by Horwitz, Horwitz, and Cope (1986), who developed the Foreign Language Classroom Anxiety Scale (FLCAS), a functional tool for measuring learners' anxiety levels in language classrooms. The FLCAS has since become a standard instrument in ESL/EFL research, and its reliability is well-established. Horwitz and colleagues (1986) defined anxiety as feelings of apprehension, nervousness, worry, or tension experienced by learners, which activate the nervous system. This definition is distinct from Test Anxiety, which Sapp (1993) described as anxiety arising from intense emotions that affect both the emotional and physiological state of the learner. The distinction is important because test anxiety occurs in any situation where a learner's knowledge and performance are evaluated. In contrast, Foreign Language Classroom Anxiety, as defined by Horwitz and colleagues (1986), generally arises within the context of a second/foreign language classroom, which is non-native to the learners. McIntyre and Gardner (1994) further elucidated the relationship between anxiety and language learning using Tobias' (1986) cognitive model, which posits that anxiety inhibits language learning by interfering with both language input and output.

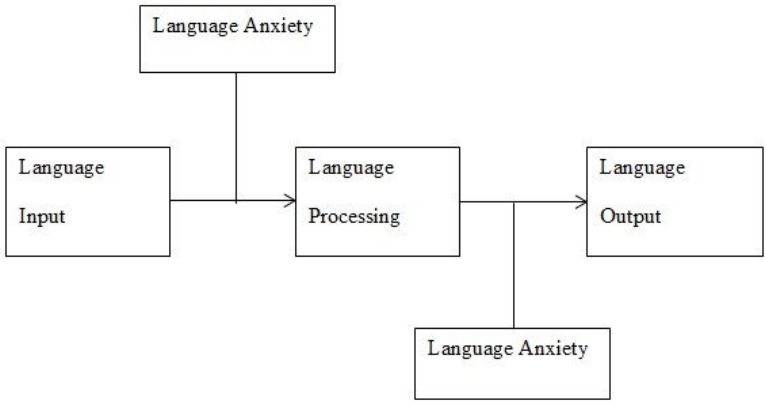

Figure 1: Intrusion of Language Anxiety in the Language Learning Process

Anxiety interferes with both the language input and output of learners in second/foreign language classrooms, in contrast to test anxiety, which occurs only during the performance evaluation of any subject matter. McIntyre and Gardner (1993) further reinforced this understanding by demonstrating how anxiety disrupts the language learning process, affecting both input and output in the classroom. This interference may also be present during listening (input) and speaking (output) activities in rural secondary schools in Kedah.

Methodology

According to statistics from Pejabat Pendidikan Daerah (PPD) Baling, there are 78 schools in Baling district, 62 primary and 16 secondary schools. This investigation utilized stratified random sampling to answer the research questions. Stratified random sampling ensures that each subgroup of a given population is adequately represented within the whole sample population of a research study. A total of 900 questionnaires were distributed to six different schools in three different rural area districts in Baling, which is a considerable sample size and representative of the population (N=6282) with a 5% margin of error and 95% confidence level as calculated by Raosoft.com, an online sample calculator. Only 866 questionnaires were collected at the end of the data collection stage. Therefore, this method seemed appropriate to the purpose of the study. The sample of this study is secondary school students who are not involved in any national exam in their year of study from five different schools in Baling, a rural area in the state of Kedah, Malaysia. The six schools selected had the highest and lowest achievement of English subjects in their National Malaysian Certificate of Education, a national examination for all fifth-form secondary school students in Malaysia. The students were not involved in the national examination, which included Forms One, Two, and Four (aged 13, 14, and 16, respectively). This ensured the sample was not affected by test anxiety, a different form of anxiety (Sapp, 1992) from Foreign Language Classroom Anxiety. The instrument employed in this study was a questionnaire based on two separate linguistic anxiety scales adopted and adapted from English Language Listening Anxiety, Kimura (2008) and English Language Speaking Anxiety, adapted from Mak (2011). A total of two sections were provided in the questionnaire: the Listening Section with 12 items and the Speaking Section with six items. The composite questionnaire was in dual language to ensure intelligibility, and items were evaluated using a 5-point Likert scale. A pilot research was done on 144 students from SMK Teloi Kanan to determine the questionnaire's validity and reliability. The Cronbach Alpha analysis yielded a value of 0.86, which is considered acceptable in social science research. According to Baharuddin (2009), students are categorized into three levels of anxiety. Table 1 shows a mean of 1.00-2.33 (low

language anxiety LLA), a mean of 2.34-3.66 (moderate language anxiety MLA), and a mean of 3.67-5.00 (high anxiety level HLA).

Table 1: Students' Mean Level of English Language Anxiety

Language Anxiety	Mean
Low	1.00 – 2.33
Moderate	2.34 – 3.66
High	3.67 – 5.00

The data collected were analyzed using SPSS, and the sum score for each response was calculated. The scores will be calculated according to their respective language skills, listening and speaking skills, and then categorized into three categories: low anxiety, moderate anxiety, and high anxiety. Descriptive statistics were computed to determine the Standard Deviation (SD) and mean scores of each section's responses to sort the highest and lowest mean score items for analysis. To determine the relationship between listening anxiety and speaking anxiety across different forms, a Pearson product-moment correlation was computed, and the result is as shown in the Findings.

Findings

Results of English Language Anxiety Among Form 1, 2 and 4 Students

The data was gathered and tabulated. Table 1 summarises the results of the level of English language anxiety in terms of listening among Form 1, 2 and 4 in rural area secondary schools students in Kedah and their corresponding anxiety levels as low, medium, or high. Table 2 reflects the level of English Language Anxiety in Terms of Speaking Among Form 1, 2 and 4 students.

Table 2: Level of English Language Anxiety in Terms of Listening Among Form 1, 2 and 4 Students

Class	n	SD	Mean	Levels of Listening Anxiety Skills
Form 1	200	0.56	2.92	Moderate
Form 2	257	0.48	2.84	Moderate
Form 4	225	0.53	2.89	Moderate
Overall	682	0.04	2.88	Moderate

Table 3: Level of English Language Anxiety in Terms of Speaking Among Form 1, 2 and 4

Class	n	SD	Mean	Levels of Speaking Anxiety Skills
Form 1	200	0.49	3.03	Moderate
Form 2	257	0.43	2.96	Moderate
Form 4	225	0.47	2.49	Low
Overall	682	0.03	2.98	Moderate

Correlation Analysis Between Listening and Speaking Anxiety Among Form 1, 2 and 4 Students

A Pearson product-moment correlation was run to determine the relationship between listening anxiety and speaking anxiety across different forms, with the results shown in Table 3. There was a moderate, positive correlation between listening anxiety and speaking anxiety with Form 1, which was statistically significant (r=.500, n=200, p=.001).

Similar scenario to Form 2, where students exhibited a moderately significant correlation between listening and speaking anxiety (r=.403, n=257, p=.001). From 5 also showed a moderate correlation between listening anxiety and speaking anxiety (r=.488, n=225, p=.001), which further supports the findings in Form 1 and 2.

Table 4: Pearson Correlation Analysis of Speaking Anxiety and Listening Anxiety Across Different Forms

Class	Variables	Speaking Anxiety	Listening Anxiety
Form 1	Speaking Anxiety	1.00 (200)	
	Listening Anxiety	.500** (200)	1.00 (200)
Form 2	Speaking Anxiety	1.00 (257)	
	Listening Anxiety	.403** (257)	1.00 (257)
Form 4	Speaking Anxiety	1.00 (225)	
	Listening Anxiety	.488** (225)	1.00 (225)

Note: ** $p < .001$.

Research Hypotheses Testing

Table 5: Simple Linear Regression Analysis: Predicting Speaking Anxiety From Listening Anxiety Across Different Forms

Hypothesis	Variables
Hypothesis 1	There is no significant relationship between listening anxiety and speaking anxiety among Form 1 students.
Hypothesis 2	There is no significant relationship between listening anxiety and speaking anxiety among Form 2 students.
Hypothesis 3	There is no significant relationship between listening anxiety and speaking anxiety among Form 5 students.

Speaking Anxiety					
Class	B	SE	β	t	Sig.
Form 1					
Constant	1.752	.159	-	11.046	<.001
Listening Anxiety	.436	.054	.500	8.126	<.001
Form 2					
Constant	1.941	.147	-	13.200	<.001
Listening Anxiety	.359	.051	.403	7.035	<.001
Form 4					
Constant	1.284	.195	-	6.573	<.001
Listening Anxiety	.549	.066	.488	8.354	<.001

Note: Dependent Variable: Speaking Anxiety.

For Form 1 students, the analysis revealed a statistically significant relationship between listening anxiety and speaking anxiety (β=0.500, p<.001). The coefficient of determination (R^2=0.250) suggests that 25% of the variance in speaking anxiety can be explained by listening anxiety. Similarly, Form 2 students displayed a significant positive association between listening anxiety and speaking anxiety (β=0.403, p<.001). The coefficient of determination (R^2=0.163) indicates that 16.3% of the variance in speaking anxiety is accounted for by listening anxiety. Form 4 students also exhibited a significant positive relationship between listening anxiety and speaking anxiety (β=0.488, p<.001). The coefficient of determination (R^2=0.238) suggests that 23.8% of the variance in speaking anxiety can be explained by listening anxiety.

Across all three forms, the findings suggest that higher levels of listening anxiety are associated with higher levels of speaking anxiety among secondary school students. However, the strength of the relationship varies slightly between forms, with Form 1 demonstrating the highest coefficient of determination (R^2=0.250). Consequently, across all forms, null hypotheses are rejected.

Conclusion

Secondary school students in rural areas of Kedah experience anxiety in the classroom, compounded by inadequate facilities, materials, and unsuitable learning conditions. This situation exacerbates the disadvantages faced by these students, even though the federal government allocates the same amount of funding to all schools (Azmi & Sham, 2018). Controlling anxiety levels in English language classrooms within rural secondary schools could enhance students' English learning experiences. This improvement could lead to more effective lessons despite the deficits in facilities, materials, and learning conditions, which are critical for better English language education and an improved learning environment.

The correlation between English listening anxiety and English speaking anxiety suggests that anxiety in a language learner may exist before engaging in a particular language skill, potentially stemming from apprehension in another language-related situation. Reducing anxiety in one language skill may also mitigate anxiety in another, enhancing the learning experience. Teachers can monitor and manage anxiety levels in one class with the understanding that this may reduce anxiety in other language classes, thereby creating more efficient learning environments. Students may perform better in subsequent language lessons by implementing strategies to reduce anxiety in one language skill. However, further research should be conducted across diverse demographics and samples to enhance the validity of these findings and to establish a solid foundation for experimental studies on the interrelationship between anxiety in different language skills. English proficiency levels in Malaysia are declining, and recent studies have highlighted the impact of affective components on language learning, noting that these can be either debilitating or facilitative. While the debilitative effects of anxiety have been extensively explored, with numerous studies presenting similar findings, there are exceptions where anxiety has been shown to facilitate language learning. Anxiety in Malaysian classrooms has been documented at both secondary and tertiary levels. However, there has been a lack of research on rural students in a developed state like Kedah. This study addresses this gap by investigating language anxiety among secondary school students in rural Kedah, thereby contributing to the broader understanding of language anxiety in Malaysia. As research on this phenomenon increases, greater focus can be directed toward addressing English language proficiency issues in Malaysia. Consequently, more efforts can be devoted to integrating the affective component of the classroom into pedagogical practices.

However, further research should be conducted, especially among secondary school students, to obtain a better understanding of the extent of English language anxiety inhibiting the English language classroom in Malaysian schools, which could play a part in contributing to the declining English proficiency among Malaysians.

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Contact email: aini.jamaluddin@aiu.edu.my

The Foreign Language Writing Anxiety of Japanese University Students

Lidija Elliott, Kwansei Gakuin University, Japan

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Abstract
This paper aims to explore foreign language writing anxiety among non-English major students enrolled in an English academic writing course in Japan. The study used questionnaires to survey 25 second-year university students to evaluate the challenges causing anxiety while writing academic papers. Results revealed that there are six primary causes of students' anxiety over their writing: time pressure for writing tasks, low self-confidence, writing rules, the presence of competitiveness, concerns about accuracy, shame, and emotional isolation. Based on the findings, the author suggests possible solutions for motivating students in the classroom. These activities may help students mitigate feelings of anxiety, which may lead to greater self-confidence, thereby potentially increasing learning results and decreasing the dropout of high-risk students in EFL settings.

Keywords: EFL, Writing Anxiety, Language Classroom, Challenges, Solutions

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Introduction

The majority of educational institutions in Japan require students to take English classes as English language proficiency is a critical skill for academic success. This is due to its application in various academic writing genres, including conference presentations, research proposals, theses/dissertations, or journal articles, (Ho, 2016). Many English language learners often express feelings of stress and anxiety when speaking or writing in English. Students with high anxiety levels end up skipping lessons and would rather not enroll in English writing courses (Cheng, 2002). Therefore Academic writing is considered to be a complex task for many ESL (English as a second language) and EFL (English as a foreign language) writers because of its intricate nature coupled with the lack of vocabulary in the writers' repertoire and the handicap in their grammatical knowledge of the English language (Sabhi et al., 2019). The study aims to investigate the challenges students face while taking English writing courses, and it further proposes solutions for overcoming the obstacles and improving their writing skills.

Literature Review

English language learners tend to experience writing anxiety, characterized by feeling worried about writing in a language they are still learning. Anxiety, alongside other sentimental variables, has the potential to influence the students' writing in the classroom significantly. In academic literature, writing anxiety is synonymous with writing block, writing apprehension, or composition anxiety (Onwuegbuzie et al., 1999). A study by Qadir, Bostanci, and Kurt 2021, showed that students at all levels of English proficiency struggle with writing anxiety in English as a foreign language. Prior research was initially focused on speaking anxiety, neglecting other relevant skills, including writing (Hislop, 2021; Horwitz, 2001). However, recent research has concentrated on writing anxiety. Studies have shown the high potential for students with writing anxiety to lack the motivation to write, have a negative disposition towards writing tasks, have poor impressions of their writing, produce subpar papers, and evade situations that involve writing (Cheng, 2002, 2004; Latif, 2007; Sanders-Reio et al., 2014). Studies have also explored various sources of anxiety while writing (Cheng, 2004; Choi, 2013), including idea organization and development during the process of writing (Jawas, 2019), low writing competence (or the perceived lack, including poor academic vocabulary and grammatical knowledge) (Yu, 2020), and the fear of negative feedback from teachers or peers (Hislop & Stracke, 2017) and the inability to get past previous negative experiences. Despite the extensive research, there was no consensus in the literature regarding if there was a change in the student's anxiety following observable academic progress (Qadir et al., 2021).

Research questions

This study aims to address the research questions as follows:

RQ1. What are the challenges students face while writing in English?

RQ2. What are the possible causes of these challenges?

RQ3. What are some recommendations for overcoming these challenges and improving the writing skills of EFL students?

Following the questionnaire, data analysis was performed on the response, which revealed six primary sources of writing anxiety: Low self-confidence, time pressure, competitiveness

(frequently comparing with peers), poor writing ability, shame, emotional isolation, and fear of making mistakes.

Methodology

Participants & Setting

Participants consisted of 25 second-year non-English majors, at a Japanese university. Classes met once a week and lasted 100 minutes. A typical session begins with freewriting, conducted in a ten-minute time interval, followed by group discussions before the teacher introduces the lesson. Workshops were often held during the second part of the instructional period. At the end of each semester, the students wrote two essays.

At the start of the semester, students completed the first questionnaire. The questions included were designed to make general inquiries about the student's views on academic writing and what they expect in the forthcoming semester. Following a review of the responses, it was observed that many students expressed anxiety. Consequently, another questionnaire was distributed at the end of the first semester, focusing on their concerns about English writing during the academic writing class.

Data Collection

A qualitative questionnaire, written in English was developed as the instrument for data collection. To ensure honest feedback, student participation was completely voluntary and anonymous.

Challenges

Writing Anxiety

EFL students who are given academic assignments often struggle with writing anxiety. This can potentially lead to debilitating effects, as reported in a study by Khattak et al. (2011), which hinders students from reaching their goals. In addition, anxiety often manifests as feelings of worry, helplessness, and unease, especially with non-English speakers. Despite the numerous possible anxiety-inducing parameters, the following were commonly reported by EFL students:

Low Self-Confidence

Learning English as a foreign language is often considered challenging, making EFL students feel uncertain about their fluency and ability to express themselves in academic English writing. As one of my student noted "*I am terrible in English writing. I make a lot of mistakes.*" A study by Rose (1984) identified negative self-talk as the root cause of writing blocks. According to Pajares & Johnson, (1994), this low self-confidence directly and negatively influences stress levels, particularly with non-native English students confronted with tasks that require demonstration of their abilities. Hence, students with the necessary writing skills who still struggle to perform are expected to address their writing anxiety. Cheng (2004) proposes a practical approach to enhance student confidence and decrease frustration with the writing process by helping them set real attainable goals, which build self-confidence through repeated successful experiences.

Time Pressure

It was shown that students often run out of deadlines because in the writing process, students need to brainstorm ideas, organize ideas, draft, re-read their writing (Hedge, 1988, as cited in Alfaki, 2015). Insufficient time to finish a writing exercise has been associated with the feeling of excessive worry among EFL students. This often causes an inability to complete assignments or tasks that reflect their true abilities. The instructors tend to give EFL students similar deadlines or timeframes as to native English-speaking students without recognizing the added stress that this action imposes on the student's academic performance. The time limitation and feeling overwhelmed by 'temporal overload' leave students anxious and eager to find shortcuts (Ylijoki & Mäntylä, 2003).

Competitiveness

University-level students often experience an underlying sense of rivalry that exacerbates anxiety. Comments like these frequently appeared in the reflections: "*My friends are better than me at grammar*", "*Especially, I am lack of vocabulary*" and "*My classmates know more more vocabulary"*. This classroom competition could also be detrimental to students' well-being, including their performance in writing. This pressure, whether self-imposed, from classmates, or from family expectations of outperforming others (both perceived or real) could negatively affect their self-efficacy should their results not align with their expectations (Murray, 2019) Failure to meet expectations can hurt their mental well-being, as well as their writing performance. Students were continually comparing their writing abilities and progress with classmates. Surprisingly, this was a belief shared among both higher and lower-level students.

Poor Writing Ability

A majority of students reported frustration and confusion with the transition in writing rules and guidelines between secondary and higher education levels. This includes inflexible writing rules, proofreading prematurely in the writing process, improper planning, having a negative attitude toward writing, or incorrect evaluation. Moreover, some students who gain confidence in academic writing are often confronted by a new set of complex and confounding rules. Some students reported struggling with balancing their perceived abilities with the fast-evolving expectations of academic English writing.

Shame and Emotional Isolation

According to the findings of questionnaires, students often mention experiencing feelings of isolation about their concerns with academic writing, "*My friend is better write*" or "*I don't know writing*" etc. The students did not attempt to discuss these feelings with one another. In addition to the instructors' comments, the shame experienced was increased, when the participants felt alone in their struggle to write in the English language. A study by Hashemi (2011) highlighted that a participant using terms like 'losing face' associated language anxiety with concepts like "face" in certain cultures – particularly in the Asian context. Similarly, a veteran female teacher noted, "*It is not just anxiety about language but differences in cultural practices*."

The Fear to Make Mistakes

EFL students feel ashamed or embarrassed when discussing their writing with peers and teachers, fearing inaccuracies in their work. The teacher has noticed more anxiety when mistakes are shared with the whole class compared to a private discussion between a student and a teacher. In addition, word selection and vocabulary are as crucial as organization, grammar, and spelling. As reported by Hislop (2021), students studying English as a foreign language are concerned about making grammatical errors, improper word use, and making mistakes in APA citations. Since having a firm grasp on these concepts proves to be challenging for non-English speaking students, submitting written assignments for assessment becomes particularly stressful. The prospect of their abilities being scrutinized adds another layer of anxiety. Students often wrote that they lacked the ability to write in academic English and some students wrote that their main goal was to develop native-level English academic writing skills.

Solutions

The circumstances of overwhelmed EFL students feeling anxious about academic English writing can be improved using the recommended solutions as follows:

Additional Time Allowances (Time Limitation)

Providing EFL students additional time to complete writing tasks, can help reduce the anxiety experienced inside and outside the learning environment. This approach can also be applied to pre-writing assignments like researching, brainstorming, outline creation, and drafting. Breaking down writing assignments into smaller, more manageable segments with extended deadlines can significantly reduce anxiety for EFL students. Additionally, providing advanced notice of timed writing exercises in the classroom allows for better preparation, ultimately increasing their chances of success.

Another strategy is providing students with extended time frames at the start of the term and progressively reducing the allotted time as students get used to writing academic papers under time pressure.

This approach does not mean students should not be accountable for meeting deadlines. Deadlines are expected to reflect appropriate expectations for EFL students. This flexibility aims to encourage students to produce their best work, and not to procrastinate.

Segmented Writing Practices

Many students reported significant levels of anxiety when asked to write single-draft assignments, therefore splitting the process of writing into several classes and steps is potentially useful to increase students' understanding of the intricacies of academic writing. Providing clear, detailed instructions and a chance to get feedback during each step–from brainstorming ideas, creating the outlines, text organization, and writing several drafts to improve the work–can significantly boost student confidence while writing in English.

Peer and Group Writing Exercises

Group exercises and peer projects reduce stress levels for EFL students taking academic writing courses. There has been an upsurge in these forms of student-focused activities following the publication of seminal research by Elbow (1968). This study paved the way for increased interest in investigating students' beliefs about peer review as well as its effectiveness. Kurihara (2016) indicates that peer feedback could improve student writing abilities in EFL classrooms.

Students expressed the significance of collaborating with peers whether during the brainstorming process or while editing. Through this approach, the student's perspective expands, and it heightens an awareness of the fact that other students struggle as well in this regard. Furthermore, the capability to work collaboratively is strengthened, inciting the potential for students to think analytically about writing. Teachers can model giving positive feedback and lastly fostering a supportive environment where classmates are viewed as colleagues rather than critics or competitors also helps students feel less anxious and isolated.

Confidence-Building and Corrections Practices

EFL students often complain about instructors using a red pan to point out their mistakes. This frequently contributes to greater writing anxiety. The method adopted to identify and correct errors also potentially affects the students' anxiety levels, although rectifying mistakes is an anticipated requirement. According to a report by Krashen (1982), error rectification is to be considered “a serious mistake” (p. 74). This is because “the practice of correcting errors has the potential to immediately make students defensive” (p. 75).

A possible strategy to alleviate the fears associated with corrective action is to acknowledge student accomplishments before identifying the areas in need of improvement. Furthermore, pessimism and hopelessness after grading are possibly eliminated by showing students the areas they have made progress. As a form of positive introduction, the instructors are in a position to help students through the process of identifying key areas to develop, serve as a model in defining realistic and attainable goals, and aid in developing an action plan required for skills acquisition, particularly for the skills needed to refine academic writing. In addition, feedback is not designed to deter EFL students, as reported in a study by Al-Bashir, Kabir, and Rahman (2016). Evidently, paying attention to aspects of the coursework that are not as effective is crucial, nonetheless, instructors have to exercise caution when delivering any form of ‘negative feedback.’ The approach of providing feedback constructively makes it possible for teachers to augment the learning environment.

Participating in Activities Aimed at Improving Fluency

The engagement of EFT students in less stressful activities geared towards increasing fluency is another method of reducing writing anxiety instead of reinforcing accuracy via consistent revision of high-stakes projects. Furthermore, practicing with frequent writing exercises independent of scoring systems reduces the overwhelming pressure students face. This further allows space for exploration and improvement in fluency with time through a process devoid of fearful experiences, worry, or concerns about being penalized.

Students and instructors may benefit greatly from engaging in daily or periodical journaling, participating in question-and-answer sessions, and writing exercises based on reading. In

addition, students are encouraged to express themselves better when excused by the pressures of grading and criticism, thus, enabling the instructors to more precisely evaluate their writing ability and identify areas in need of further development.

Emotional Support

A significant reduction in the effect of stress associated with writing may be achieved by providing EFL students with emotional support. This approach facilitates stress management, particularly with mentorship from peers learning English as a foreign language and getting feedback from instructors in an empathetic way. Teacher emotional support could directly influence college students' engagement (e.g., Crawford, 2018; Xu et al., 2020), create a supportive atmosphere, and cultivate students' sense of belonging and affinity to the classroom. When students receive teachers' emotional support that can meet their psychological needs in the learning process, they will have the internal motivation to continue to complete the given learning task (Ryan & Deci, 2020). Students who perceived high levels of emotional support from the teacher reported that the teacher made eye contact and smiled at them in class (Shen et al., 2024).

Study Limitations

The current research presented several shortcomings that need to be addressed. First, the limited study size. Second data was collected at the beginning of the course and again at the end of the semester. Regular questionnaires throughout the writing process may have revealed at what stages students experience higher levels of anxiety. Third, all questions and answers were written by students in English. If they wrote in Japanese it would ensure more effective communication.

Recommendations for Further Study

Based on personal teaching experiences and practical English course instruction, researchers are encouraged to develop several methods with the potential to help students of foreign languages improve their writing skills and overcome challenges. In addition, further studies focused on the connections between anxiety, language learning methodologies, self-esteem, and personalities are essential to gaining a deeper knowledge of anxiety experienced by EFL students and improving English writing course quality.

Conclusion

This study showed that students are anxious about writing activities. In addition, students are concerned about time limitations for writing tasks, low self-confidence, writing rules, the presence of students' competitiveness, concerns about accuracy, as well as shame and emotional isolation. One of the significant modifiers of stress levels in EFL students is providing flexible timelines. This allows students to collaborate on writing, editing, and correcting their projects more effectively. In addition, other approaches to alleviate stress include inspiring confidence through corrective practices, integrating exercises that build fluency, and providing sufficient emotional support. Helping students to become self-confident while writing in English, potentially reduces their anxiety level.

Although the classroom environment will never be anxiety-free and students are expected to be accountable for their academic achievement, an awareness of the activities that cause the

most anxiety can help instructors try to mitigate these anxieties and make a better learning environment in the classroom.

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Development of a Learning Model Integrating Service-Learning and Experiential Learning in the Educational Communication Technology Curriculum

Punsa Ekpornprasit, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
The purpose of this research was to develop the Service-Learning and Experiential Learning model, Implement the LMISEL model and Study the satisfaction of students with the LMISEL model in the Communication Technology in Education Curriculum. The experimental research samples were 100 Students, Simple Random Sampling. The instruments used in this study were LMISEL model and Satisfaction Assessment of students with the LMISEL model. The research findings were as follow: 1.The LMISEL process typically involves the following steps; Preparation, Service-Learning Experience, Analysis, Application, and Assessment, 2. Implement the LMISEL model into curriculum design for the Knowledge Management course for 4th year students in the Educational Communication and Technology program, King Mongkut's University Technology of Thonburi. Students undertake knowledge management by creating an Electronic book for the Royal Thai Police Office. Learning Outcomes: Apply concepts and principles of knowledge management to develop easily understandable and informative learning materials. Teaching and Learning Activities were as follow: Theoretical Instruction, Collaboration with Office of Police Forensic Science, Student Project Development, Project Presentations and Implementation. and 3. The LMISEL model satisfaction assessment was overall at the highest level. The feedback from students found that it was a very good experience to have the opportunity to work with large organizations and learn the work processes, gaining more understanding of the work of CSI Thailand and inspiring future careers. This project greatly developed their learning.

Keywords: Service-Learning, Experiential Learning, LMISEL

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Introduction

Thai society currently faces numerous challenges, one of which is educational inequality. A significant portion of the population lacks access to quality education, hindering their potential for self-development and career advancement. The Communication Technology in Education Curriculum aims to produce graduates equipped with the knowledge, skills,and competencies necessary to design, develop, and apply communication technology for educational purposes. However,traditional teaching methods that emphasize lectures and rote memorization may not adequately meet the needs of contemporary learners.

Experiential Learning (EL) is a pedagogical approach where students learn by actively engaging in hands-on experiences and reflecting on their learning process. This method enhances comprehension and enables students to apply their knowledge in real-world settings. Service-Learning (SL) is a learning process where students utilize their academic knowledge and skills to serve and assist the community. It not only fosters academic development but also cultivates life skills, social responsibility, and teamwork. The integration of Service-Learning (SL) and Experiential Learning (EL) is a popular contemporary learning model.These approaches emphasize active student engagement, exposure to real-world problems and situations, and the development of critical thinking, problem-solving, teamwork, and communication skills. Students learn through practical application in community-based projects, enhancing their communication, problem-solving, and teamwork abilities while fostering a sense of community and social responsibility.

Therefore the research on "Developing a Learning Model Incorporating Service-Learning and Experiential Learning in the Communication Technology in Education Curriculum" holds significant value in studying and developing learning models that effectively prepare students to navigate the challenges of the modern world. This approach enables students to learn from real-world experiences, promoting sustainable learning and the application of knowledge in real-world settings. It cultivates essential life skills such as critical thinking, problem-solving, teamwork, and communication. Students gain awareness of societal issues and develop a sense of social responsibility. Graduates of the Communication Technology in Education Curriculum, equipped with the skills developed through Service-Learning and Experiential Learning, will serve as crucial assets in national development in the future.

Purpose of Study

1. To develop the Service-Learning and Experiential Learning model in the Communication Technology in Education Curriculum.
2. To implement the Service-Learning and Experiential Learning model in the Communication Technology in Education Curriculum.
3. To study the satisfaction of students with the Service-Learning and Experiential Learning model in the Communication Technology in Education Curriculum

Population

450 students from the Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi. 1st Class of the academic year 2022.

Sample Groups

100 students from the Department of Educational Communications and Technology, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, 1st Class of the academic year 2022, Simple Random Sampling, Using lottery selection.

Research Methodology

Review of Related Theories and Research

I. Review of Service-Learning: This will involve examining literature on the theoretical underpinnings, principles, and implementation strategies of Service-Learning as a pedagogical approach.
II. Review of Experiential Learning: This will entail exploring the theoretical foundations, principles, and instructional methods of Experiential Learning as a teaching and learning strategy.
III. Review of the Communication Technology in Education Curriculum: This will involve analyzing the curriculum's objectives, structure, content, and teaching methodologies to understand its context for integrating Service-Learning and Experiential Learning.
IV. Review of Research on Learning Models: This will involve examining relevant research studies that have investigated the development, implementation, and evaluation of various learning models.
V. Review of Research on Satisfaction: This will entail reviewing research literature on the measurement and assessment of student satisfaction in various educational contexts.

Implementation of the Service-Learning and Experiential Learning Model

The developed Service-Learning and Experiential Learning model will be implemented in the Communication Technology in Education Curriculum. This will involve:

I. Curriculum Integration: Incorporating Service-Learning and Experiential Learning activities into the curriculum's content, teaching methodologies, and assessments.
II. Instructor Training: Providing training and workshops for instructors to enhance their understanding and implementation of the model.
III. Student Support: Establishing support systems to assist students in their Service-Learning and Experiential Learning experiences.

Evaluation of Student Satisfaction

Student satisfaction with the Service-Learning and Experiential Learning model will be evaluated using a mixed-methods approach.

I. Surveys: Administering structured questionnaires to gather quantitative data on students' perceptions of the model's effectiveness, engagement, and overall learning experience.
II. Focus Groups: Conducting focus group discussions to collect qualitative data on students' in-depth experiences, challenges, and suggestions for improvement.
III. Interviews: Conducting individual interviews with selected students to gain deeper insights into their individual perspectives and experiences.

The collected data will be analyzed using appropriate statistical and qualitative analysis techniques to identify key themes,patterns, and areas for improvement. The findings will be used to refine and enhance the Service-Learning and Experiential Learning model for future implementation.

Results

Service-Learning and Experiential Learning Model in the Communication Technology in Education Curriculum

The Learning Model Integrating Service-Learning and Experiential Learning (LMISEL) is an educational approach that combines two powerful learning methods: Service-Learning and Experiential Learning. This model aims to enhance students' learning experience by providing them with opportunities to engage in hands-on activities that address real-world problems while also contributing to the community. The LMISEL process typically involves the following steps:

I. Preparation: Students are introduced to the theoretical foundations and concepts related to the course or subject matter. They learn about the community or organization they will be working with and the specific challenges or needs that need to be addressed. Students develop a plan for their service-learning project, including goals, objectives, and expected outcomes.
II. Service-Learning Experience: Students engage in hands-on service activities within the community or organization. These activities are designed to address real-world problems or challenges, allowing students to apply their theoretical knowledge to practical situations. Students work collaboratively with community partners, gaining valuable experience in teamwork, communication, and problem-solving.
III. Reflection and Analysis: Throughout the service-learning experience, students are encouraged to reflect on their experiences, observations, and the impact of their actions. They analyze the connections between the theoretical concepts learned in the classroom and the practical applications encountered during their service activities. Reflection activities may include journaling, group discussions, presentations, or other forms of critical analysis.
IV. Integration and Application: Students integrate the knowledge and skills acquired through the service-learning experience with the theoretical concepts covered in the course. They apply their newfound understanding to solve real-world problems, develop new ideas, or propose solutions to the challenges they encountered during their service activities. This integration process reinforces the connection between theory and practice, enhancing students' learning and understanding.
V. Evaluation and Assessment: Students' learning outcomes and the impact of their service activities are evaluated and assessed. This evaluation may involve self-assessment, peer assessment, and assessment by instructors or community partners.

The evaluation process helps to determine the effectiveness of the LMISEL approach and identify areas for improvement.

The LMISEL model provides students with a holistic learning experience that combines academic knowledge, practical skills, and community engagement. By integrating Service-Learning and Experiential Learning, students not only deepen their understanding of course content but also develop valuable life skills, such as critical thinking, problem-solving, teamwork, and social responsibility.

The learning model incorporating Service-Learning and Experiential Learning in the Communication Technology in Education Curriculum commences with theoretical instruction to equip students with a comprehensive understanding of the course content and knowledge. Subsequently, students receive real-world projects from partnering organizations to gain practical experience. Throughout the process, they are guided and supported by faculty instructors and mentors from the respective organizations. Upon completion of their projects, students present their work for the first round to receive feedback for improvement. Finally, they present their refined projects in the final round before implementing them in real-world settings and engaging in reflective debriefing.

The debriefing process involves key questions that encourage students to contemplate their take aways from the Service-Learning project: What did they learn about the project itself? What did they learn about themselves? What differences did they observe upon project completion?

This reflective exercise fosters critical thinking skills and enables students to synthesize their experiences for future career applications.

Evaluation of the Service-Learning experience involves a multifaceted approach, engaging all stakeholders: Self-Assessment by Students: Students reflect on their personal benefits throughout the project, from ideation and design to implementation and completion. Project Evaluation by Community Members/Organizations: Individuals or communities that have directly benefited from the project's activities provide feedback, offering both formative and summative assessment insights. Instructor Evaluation: Faculty instructors evaluate various aspects of the project, including the written proposal, project content (course activities, PR materials, learning materials), and oral presentations.

This comprehensive assessment approach ensures a holistic evaluation of the Service-Learning experience, fostering student growth and project effectiveness.

Implementation of Service-Learning and Experiential Learning in the Knowledge Management Course

Course: Curriculum Design and Instruction (ETM363) Knowledge Management

Target Students: Fourth-year undergraduate students majoring in Technology and Communication Education at the Faculty of Industrial Education and Technology, King Mongkut University of Technology Thonburi.

Learning Outcomes: Apply concepts and principles of knowledge management to develop easily understandable and informative learning materials.

Collaboration: Office of Police Forensic Science Division, Royal Thai Police

Project Objectives: Manage existing knowledge in both document and individual forms. Organize and present this knowledge in an accessible, user-friendly, and durable format. Develop various learning materials such as online courses, E-books, and Videos.

Teaching and Learning Activities

1. Theoretical Instruction: Provide lectures on knowledge management concepts and principles.
2. Collaboration with Police Scientific Evidence and Identification Division:
    I. Discuss project details, including challenges, needs, and objectives.
    II. Facilitate student interactions with police officers to gather information.
3. Student Project Development:
    I. Divide students into groups to develop knowledge management materials (e-books or other learning media).
    II. Provide ongoing guidance and consultation from instructors and police officers.
    III. Encourage students to utilize questioning techniques to extract knowledge from individuals.
    IV. Guide students in recording demonstrations or interviews to capture knowledge.
4. Project Presentations:
    I. Preliminary presentation: Students present their project drafts for feedback and improvement.
    II. Final presentation: Students present their refined projects to the class and police officers.
5. Real-World Implementation:
    I. Selected student projects are implemented within the Police Scientific Evidence and Identification Division.
    II. Due to the practical nature and partial confidentiality of the knowledge, some projects cannot be publicly disseminated.
    III. Examples of implemented projects include electronic manuals for police officers on firearm examination,crime scene investigation, fingerprint analysis, DNA testing, and blood examination.

Lessons Learned

The project effectively addresses the challenge of knowledge loss upon police officers' retirement. Student-developed knowledge management materials enhance the organization's efficiency and reduce training costs. The modern, user-friendly, and engaging nature of the materials is highly appreciated by the police division.

Conclusion

The implementation of the Service-Learning and Experiential Learning model in the Knowledge Management course has proven to be a valuable learning experience for students and a beneficial contribution to the Police Scientific Evidence and Identification Division. The model has successfully addressed the organization's knowledge management challenges and provided students with real-world problem-solving opportunities.

The Results of the Students' Satisfaction Assessment Towards the Learning Model of Social Service Combined With Experiential Learning in the Educational Technology Program

Table 1: Summary Table of Student Satisfaction Assessment of LMISEL Model

Satisfaction Areas Level	Mean	Percentage	Satisfaction
Service or Coordination			
1. Able to request information within responsibilities	4.56	91.78	Highest
2. Staff had knowledge and could explain well	4.54	90.71	Highest
3. Overall satisfaction with activity	4.56	91.18	Highest
Total	4.55	90.71	Highest
Consulting and Advising			
1. Project team provided good consulting and guidance	4.55	90.71	Highest
2. Course instructors provided good consulting and guidance	4.58	91.65	Highest
Total	4.57	91.02	Highest
Working			
1. Media production equipment suitable	4.58	91.34	Highest
2. Obstacles in media production	4.43	87.56	Highest
3. Filming/production location suitable	4.57	91.02	Highest
4. Everyone worked fully as assigned	4.57	91.02	Highest
Total	4.54	90.55	Highest
Submission			
1. Production time period suitable	4.63	92.60	Highest
2. Submission channel suitable	4.54	90.55	Highest
Total	4.59	91.80	Highest
Benefits Received			
1. Applied for self-development	4.61	91.97	Highest
2. Applied for career choice	4.56	90.87	Highest
3. Applied knowledge correctly	4.61	91.81	Highest
4. Able to explain to others	4.60	91.81	Highest
5. Produced beneficial media for community	4.61	92.13	Highest
Total	4.60	91.81	Highest
Overall Satisfaction Score			
Total	4.57	91.02	Highest

From the analysis of the satisfaction assessment summary table for the media production project to raise awareness for CSI Thailand, it was found that all assessed items across the 5 areas of 1) Service or Coordination e.g. able to request information, knowledgeable staff, overall satisfaction 2) Consulting and Advising e.g. good guidance from project team and instructors 3) Working e.g. suitable equipment, obstacles, location, everyone worked fully 4)

Submission e.g. suitable time period, channel and 5) Benefits Received e.g. applied for self-development, career, knowledge, able to explain, produced beneficial media, had an overall mean satisfaction score of 4.57 at the highest level. 1) Service or Coordination had a mean satisfaction of 4.55 at the highest level. Section 2) Consulting and Advising had a mean satisfaction of 4.57 at the highest level. Section 3) Working had a mean satisfaction of 4.54 at the highest level. Section 4) Submission had a mean satisfaction of 4.59 at the highest level. Section 5) Benefits Received had a mean satisfaction of 4.60 at the highest level.

The summary of reflecting on the learning outcomes found that the benefits occurred not only for the students who could apply it for self-development in their future careers or further studies. The feedback from students found that it was a very good experience to have the opportunity to work with large organizations and learn the work processes, gaining more understanding of the work of forensic police officers and inspiring future careers. The work was fun and informal. They had new experiences such as learning the DNA testing process step-by-step and gained more understanding about personal and property safety. They felt more engaged and understood the lessons better by having to learn from information not commonly available, requiring a deep understanding of the rare and unfamiliar content, so this project greatly developed their learning. They got to work with others, learn real work experience, learn formal working methods, and work together with police officers, exchanging knowledge - an invaluable experience. They felt very fortunate to learn from the police officers, never thinking they would get to see and do things like this. It was fun and challenging their abilities.

The benefits for external organizations were receiving promotional media or educational media for communicating with the public or between agencies that matched the problems and needs of the organizations, and were modern and economical without incurring costs and budgets for knowledge management.

The benefits for the instructors were providing academic services to society, communities, and external agencies, and learning teaching methods by working together with students and staff teams from various agencies to improve and make the teaching most effective. There was another target group that benefited from this teaching model, which were the service recipients, meaning the general public, communities, and society who watched the promotional media or educational media to understand and access quality and modern state services.

Discussion

Creating a Learning Model Through Social Service Combined With Experiential Learning in the Educational Communication Technology Program: Service Learning

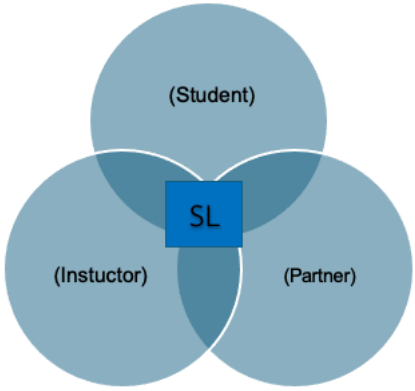

Figure 1: The Elements of Service-Learning (The Science Education Resource Center, 2018)

Service-Learning is a form of learning that integrates classroom education with community service activities. The objective is for students to apply the knowledge and skills they have learned to solve real problems in the community or for community development. At the same time, they gain additional experiences and knowledge from practical implementation. This type of learning usually emphasizes student participation, development of social skills, and fostering a sense of social responsibility. The key elements of Service-Learning include meaningful community service, linking to education, reflection, and evaluation. Service-Learning is considered an effective way of learning because students learn from practical experience, develop social skills, and cultivate a sense of participation and responsibility towards society.

The Experiential Learning model means learning occurs through the work cycle of students collaborating with others, and the reflective outcome is that students gain deeper skills and understanding about the real needs of the community. Service-learning instruction is a flexible form of teaching that can be used in both classrooms and diverse communities. The main drivers are the students, the community where students implement their projects, and the instructors, working together to develop effective learning projects and service activities. Learning is linked to the course content, with clearly defined learning goals. Service activities with meaning that respond to the needs identified by the community help students learn from real experiences. In organizing projects, students enjoy working in teams and dedicate time fully to learning the course lessons, as they recognize technology's important role in the work. Service-learning allows students to develop connections between theoretical education, research, and actual practice in the community - a broader perspective than just classroom learning. Aligning with Mehra's (2004) research, service-learning helps empower students, leading to calls for schools to incorporate it into curricula to instill consciousness in students for participating in participatory action research (PAR), service learning, and community informatics monitoring (CI). Clearly and tangibly linking PAR, CI and information and communication technologies (ICTs) in the networked information society will enhance community empowerment and social equity. In library and information science education in the US, there have been joint efforts by department instructors and universities to support PAR and create CI curricula at the graduate level to facilitate and model connecting students

with community stakeholders through service learning. This approach leads to 1) establishing social justice, 2) systematic library and information science education coupled with community development research, 3) raising awareness and credibility of the library/information profession as a community representative, and 4) learning about equity and empowering people to coexist through mutual learning projects (Gurstein, 2000).

Service-learning combined with Experiential Learning sets clear goals for learning and community engagement. The learning management process is as follows:

Figure 2: The Learning Process of LMISEL Model

This aligns with Furco (1996), who stated that purposeful Experiential Learning uses an academic context to design service projects, learning through service activities. Such learning occurs when both the service provider and recipient benefit from the activities. Eyler & Giles (1999, p.5) stated that in the experiential education model, learning takes place through the work cycle of students collaborating with others, and the reflective outcome is that students gain deeper skills and understanding about the real needs of the community. Osman & Petersen (2013, pp. 4-7) stated that student-centered teaching, participatory teamwork, hands-on practice, communication dialogues, finding suitable spaces for engaging with diverse communities allow students to see different perspectives and use independent reasoning in decision-making. This teaching approach enhances student effectiveness, producing quality graduates and good global citizens.

Service-learning instruction is a flexible form of teaching that can be used in both classrooms and diverse communities. The main drivers are the students, the community where students implement their projects, and the instructors, working together to develop effective learning projects and service activities. Learning is linked to the course content with clearly defined learning goals. Service activities with meaning that respond to the needs identified by the community help students learn from real experiences in organizing projects.

The Science Education Resource Center (SERC) at Carleton College (2018) summarizes that service-learning is purposeful, real Experiential Learning that designs service projects linked

to the course content being studied. The projects are evaluated periodically, and students, community, instructors and those involved all learn and benefit from the community service projects.

Summary

Importance of Community Service and Experiential Learning

I. Integrating community service and Experiential Learning allows students not only to learn theory, but also to practice, providing beneficial experiences that can be applied to their future work life and daily life.
II. Community service helps foster social responsibility and makes students feel more connected to the community.
III. Impact on Future Teaching and Learning
IV. This learning model can serve as a model for other curricula to adopt and enhance the effectiveness of teaching and learning.
V. It can help reduce rote learning problems and increase hands-on learning, equipping students with comprehensive skills to take on future challenges.

Recommendation for Future Research

I. Further research should evaluate the long-term impacts of this learning model on student skill development.
II. This learning model should be continuously improved and developed to align with changing technologies and societal needs.

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Contact email: punsa.ekp@kmutt.ac.th

Integrating Generative AI and Progressive Guided Scaffolding Mechanisms in Educational Games to Facilitate Research Design and Statistical Learning

Yu-Kai Chu, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
The teaching of quantitative research design in the social sciences is crucial, but learners' learning motivation are limited and there is a lack of more case studies and timely diagnostic guidance. Utilizing case scenarios and giving scaffolding guidance helps to address these limitations. In this study, we designed an educational game that combines case studies and progressive guidance on the Generative AI (GAI) scaffolding. This study develops an innovative scaffolding guidance module for GAI scripts. When a player asks a question, the player will not be told the answer directly. Instead, it gradually guides the player to find the research design problem and think in the direction of appropriate analytical methods. Learners play the role of an anxious graduate student facing a research bottleneck. For a limited time, he can have a discussion with the scaffolding guide to the NPC played by GAI. A total of 18 people participated in the empirical evaluation of this study. The study found that learners had high flow, low anxiety, found the game fun during the game, and had a desire to play again. (All scores are significantly higher than 3, i.e., the median of the scale.) Learners felt that this game enhanced research design thinking more than the conventional curriculum. 72% of the participants felt that the game helped in understanding the concepts of the research design. 78% of the participants felt that the NPC characters would give guiding hints to help learners find the information they need to solve problems online.

Keywords: Educational Game, Generative AI, Scaffolding, Progressive Guided, Quantitative Research Design

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Introduction

The teaching of quantitative research design and statistical learning in the social sciences is critical to the development of researchers. In terms of quantitative research design, students and academics often find the units of quantitative research methodology not only challenging but also anxiety-provoking. In a study by Navodya and colleagues (2022), difficulties in writing research papers and deficient statistical knowledge were shown to be the two main reasons for learners' poor performance. In the study of statistics, there is now a greater demand for statistics teaching and expertise in higher education than ever before, but there is a general lack of motivation among students to learn and a feeling that they do not have the necessary skills (Bromage et al., 2021). In addition, there are other limitations, such as limited teaching time, lack of more case studies and timely diagnostic guidance. Many studies have indicated that the use of game-based learning is an effective teaching strategy (Chien et al., 2024). Generative AI is characterized by Large Language Models (LLMs), which are progressive and adaptive to generate interactive conversations. This advantage is combined in the teaching strategy of contextualized games, and then with the use of case scenarios of story scripts, not only can the Generative AI as a scaffolding for immediate feedback, but also guide learners to discover the problem and search for knowledge, resulting in a flow status, which is expected to improve the learning motivation and learning effectiveness.

However, if learners are passive and get their answers directly from the scaffolding, students will not have the opportunity to think cognitively at a high level and select appropriate analytical methods. According to Limbach and Waugh (2010), active learning, appropriate questioning techniques, and structured feedback enable students to higher level thinking and enjoy it. Chien and colleagues (2024) suggest that Generative AI can provide more realistic scaffolding feedback and guidance if it is used as an NPC (Non-Player Character) in role-playing educational games with contextualization. In this study, we design a Generative AI educational game that combines contextual cases with feedback scaffolding. When players ask questions in the game, the Generative AI will not directly tell the players the answers, but rather progressively guide the players to find the questions in the research design and think in the direction of appropriate analytical methods.

Methods

A total of 18 participants were involved in the initial empirical evaluation of this study. The participants were master's degree students from different universities in Taiwan, and they were all over 22 years old. As shown in Figure 1, learners play the role of an anxious graduate student facing a research bottleneck. For a limited time, he can discuss a flawed research design with the scaffolding guide to the NPC played by GAI, then propose a modified research proposal on Google Forms and pass the professor's assessment. As shown in Figure 2, the NPC will not give the player the answer directly, but is only responsible for the role of guidance, the player needs to go to the Internet to check, find the correct information and then confirm with the NPC, the player will get more feedback and confirm the thinking. In this game, players must also utilize their communication, data search and problem solving skills to learn statistical knowledge related to quantitative research design until the end of the game.

Figure 1: GAI Contextualized Game Platform and Google Form Interactive Feedback Mechanisms

Figure 2: Generative AI Progressively Guided Conversations With Feedback Scaffolding

Results and Discussion

Participants in this study completed post-test questionnaires after the completion of the game, including questionnaires on flow status (Table 1), activity anxiety, game acceptance, usefulness and ease of use, and elements of the game (Table 2), and qualitative analyses, and descriptive statistical analyses were conducted using a single-sample t-test. Table 1 shows the descriptive statistical analysis of the learners' flow status after completing the task. The overall flow (M=4.07, SD=0.65) is significantly higher than the median of the scale (i.e., 3). Flow antecedents (M=4.05, SD=0.75), flow experience (M=4.08, SD=0.73), and other flow average dimensions are all high at a median of the scale (i.e., 3). Most of the sub-dimensions had mean scores higher than 4. In the sub-dimension of flow status, learners scored higher on the items of control (M=4.36), playability (M=4.31) and autotelic experience (M=4.31). This indicates that the contextualized design of the GAI educational game enables the learner to have a high sense of self-control and sufficient playability, in addition to which the player is able to participate in the activity from the heart and will feel that the activity itself is sufficiently satisfying to constitute a reward, and will be immersed in the game in order to actively participate in the game tasks and complete the goals.

Table 1: The Mean and Standard Deviation of Learners' Flow

(n=18)

	M	*SD*	*Z*	Sig.
Overall Flow	4.07	0.65	3.57^{***}	0.000
Flow antecedents	4.05	0.74	3.42^{***}	0.000
Challenge-skill balance	3.61	1.12	2.09^{*}	0.037
Goals of an activity	4.19	0.89	3.40^{***}	0.000
Unambiguous Feedback	3.78	1.07	2.58^{*}	0.010
Control	4.36	0.87	3.51^{***}	0.000
Playability	4.31	0.82	3.47^{***}	0.000
Flow experience	4.08	0.73	3.51^{***}	0.000
Concentration	4.15	1.11	3.00^{**}	0.003
Time distortion	4.14	0.94	3.28^{**}	0.001
Autotelic experience	4.31	0.62	3.64^{***}	0.000
Loss of self-consciousness	3.44	1.25	1.46	0.145

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table 2 shows the descriptive statistical analysis of learners' game anxiety, game acceptance and game elements. Overall anxiety (M=2.29, SD=0.91) was lower than the median of the scale (i.e., 3) and reached significance. Moderately low anxiety is an important indicator of sustained flow during gaming activities. In addition, overall game acceptance (M=4.20, SD=0.50), game usefulness (M=4.21, SD=0.61), game ease of use (M=4.19, SD=0.70), and game elements (M=4.16, SD=0.85) were also significantly above the median (i.e., 3) of the scale.

Table 2: The Mean and Standard Deviation of Learners' Game Anxiety, Game Acceptance, and Game Elements

(n=18)

	M	*SD*	*Z*	Sig.
Game Anxiety	2.29	0.91	-2.63**	0.009
Game Acceptance	4.20	0.50	3.73***	0.000
Game Usefulness	4.21	0.61	3.60***	0.000
Game Ease of Use	4.19	0.70	3.59***	0.000
Game elements	4.16	0.85	3.40***	0.000

Conclusion and Limitations

"Senior Sister Help Me" is an educational learning game developed by this study that lets the player take on the role of an anxious graduate student through the use of GAI progressively real-time feedback and case scenario simulation, with an emphasis on training in research methodology and statistical analysis. It also allows learners to use their communication, information-seeking and problem-solving skills to complete tasks and develop higher-level cognitive thinking skills. The study found that learners had high flow, low anxiety, found the game fun during the game, and had a desire to play again. (All scores are significantly higher than 3, i.e., the median of the scale.) Learners felt that this game enhanced research design thinking more than the conventional curriculum. 72% of the participants felt that the game helped in understanding the concepts of the research design. 78% of the participants felt that the NPC characters would give guiding hints to help learners find the information they need to solve problems online. Future research could increase the sample size and include a control group to compare and analyze the progressively scaffolding-oriented NPC conversational feedback mechanism with the contextualized game using the GAI mechanism, and to explore more deeply the differences in learning effectiveness and higher-level cognitive thinking skills between the research methods and statistical analyses.

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Contact email: hthou@mail.ntust.edu.tw

Emotional Responses of Taiwanese English Major Students to EMI Courses Taught by Native English-Speaking Teachers

Chin-Hui Chen, National Pingtung University of Science and Technology, Taiwan
Zih-Ying Chen, National Pingtung University of Science and Technology, Taiwan
Shu-Wen Lan, National Pingtung University of Science and Technology, Taiwan

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Abstract
With the drive for increased internationalization, the Taiwanese government has expanded English as a Medium of Instruction (EMI) courses in higher education. English major students are particularly exposed to these courses. To understand their emotional responses, the authors conducted a survey completed by 200 Taiwanese English major students for the purpose of examining their feelings towards EMI courses and how their past English learning experiences influenced their positive and negative emotional reactions. The findings suggest that participants generally experienced more positive than negative emotions towards EMI. Students who majored in English in senior high school and had previous EMI course experience perceived EMI more positively and less negatively compared to those who did not. Additionally, students who had been taught by native English-speaking teachers showed stronger positive and negative emotions towards EMI than those who had not. These findings have implications for EMI teachers, suggesting they should consider students' past learning experiences to better address their emotional responses.

Keywords: English Major Students, EMI, Emotional Responses

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Introduction

In the context of increasing global internationalization, the acquisition of foreign languages, particularly English due to its role as a global lingua franca, is considered essential for promoting educational internationalization and fostering global citizenship. Consequently, there is a growing global trend toward implementing bilingual or multilingual policies (Fantini, 1991; Singh et al., 2012).

Responding to this trend, the Taiwanese government introduced the “2030 Bilingual Nation Policy Development Blueprint” in December 2018. By September 2021, the Ministry of Education (MOE) launched the "Higher Education Bilingual Learning Program." This initiative seeks to equip students with international expertise in their respective fields, enhancing their ability to communicate, collaborate, and engage with global professionals (National Development Council, 2018).

The program is centered on two key pillars: “Key Cultivation” and “Widespread Enhancement.” It emphasizes strengthening students' English proficiency and expanding English-Medium Instruction (EMI) courses, with the overarching goal of enhancing the international competitiveness of Taiwan's higher education sector (Ministry of Education, 2021).

The expansion of English-Medium Instruction (EMI) in Taiwan is evident in the significant increase in EMI courses: from 16,450 courses in the 2009 academic year to 24,077 courses in 2015 (MOE, Taiwan, 2015, as cited in Tsou & Kao, 2017, p. 11). Many universities have actively promoted EMI programs and courses, creating a trend aimed at advancing English proficiency through EMI pedagogy. This movement is guided by five key principles: "enhancing students' competitiveness in the job market, helping students build foundations for advanced studies, attracting international students, improving the quality of higher education, and fostering a multicultural environment" (Tsou & Kao, 2017, p. 11).

To gain a deeper understanding of how EMI impacts students' learning experiences, this study explores the experiences of local university students in Taiwan when English-speaking foreign instructors deliver courses in English. Specifically, it examines the emotional responses of English majors in EMI courses taught by native English-speaking teachers.

Literature Review

This section reviews previous studies on students' emotional responses to EMI courses across different countries.

Chien and Valcke (2020) found that certain learning activities in EMI courses may induce anxiety and a sense of alienation if the instructor does not clearly communicate the purpose or function of the activities. However, when instructors are friendly and supportive, students tend to feel more at ease, making them more inclined to engage in discussions. Additionally, providing students with more waiting time and pauses during questioning can reduce stress levels in EMI courses. For students with lower English proficiency, the use of their first language (L1) by instructors can also alleviate anxiety and foster greater participation in learning activities.

Huang (2015) identified insufficient English proficiency as the primary source of anxiety among participants. Learning anxiety, motivation, and a sense of achievement were inversely related, with participants experiencing the highest levels of anxiety due to their perceived lack of English proficiency. The study revealed significant differences in anxiety levels between local and international students, with local students reporting higher anxiety levels. This was attributed to difficulties in understanding course content and the pressure of competing with peers, all of which were exacerbated by their perceived lower proficiency in English.

Similarly, Hillman and colleagues (2023) found that students from non-majority language schools and similar linguistic backgrounds frequently experienced feelings of frustration, anxiety, disappointment, shame, and embarrassment in EMI courses due to their inadequate English proficiency. These emotions also affected their sense of belonging in the university environment. Conversely, students from EMI schools and higher socioeconomic backgrounds felt more confident in their EMI experiences. On the other hand, students from Nepali-medium schools and lower socioeconomic backgrounds expressed a lack of confidence in English, which led to feelings of frustration, disappointment, and embarrassment.

Yuan and colleagues (2023) explored the emotional experiences of graduate students from China enrolled in an EMI teacher education program in Macau. Initially, students felt positive emotions such as hope and excitement as they entered the program with high expectations. However, as time progressed, emotions like anger, boredom, and disappointment emerged, leading to feelings of marginalization and confusion.

Hopkyns and Gkonou (2023) highlighted that EMI courses present both opportunities and challenges, often provoking mixed emotions. Participants reported positive emotions, including confidence and pride, but also negative emotions such as anxiety, guilt, shame, and a sense of (un)belonging. While EMI courses tend to evoke more negative emotions overall, individual experiences vary. In particular, female students, regardless of their performance, identity, or sense of belonging, experienced emotions tied to language use in EMI contexts. While most students expressed neutral emotions towards translanguaging practices in EMI settings, about one-third reported negative feelings toward these practices.

Adamson (2022) identified shame as a predominant emotion among students in EMI secondary classrooms in Tanzania. Fear and shame were commonly experienced, particularly when one student's persistent silence during class led to others becoming reluctant to speak English. In over 50 classroom observations, nearly 30 instances revealed students visibly expressing discomfort through body language. Fear and shame were often discussed together and linked to low self-esteem and confidence, with students indicating that their fear stemmed primarily from the anticipation of shame. It is speculated that this may be due to the public nature of classroom activities, where high visibility may trigger feelings of shame and humiliation.

Based on the above review of relevant literature, it is evident that EMI courses have a substantial impact on students' emotions. These effects may include positive emotions related to language learning, such as confidence, pride, a sense of achievement, and interest. However, EMI courses can also evoke negative emotions, including anxiety, shame, anger, boredom, and a sense of not belonging.

To build upon the existing literature, this study seeks to explore the various factors that may influence English major students' emotional responses to EMI courses taught by native English-speaking teachers in Taiwan. The factors under consideration include gender, academic major, prior EMI course-taking experiences, and previous interactions with native English-speaking teachers. The research questions are as follows:

- RQ1: To what extent do the participants agree with the various emotional reactions experienced in EMI classes taught by native English-speaking teachers?
- RQ2: Does gender (male or female) make a difference in the extent to which the participants respond emotionally to EMI courses?
- RQ3: Does their past major (in English or not) make a difference in the extent to which the participants respond emotionally to EMI courses?
- RQ4: Do their past EMI experiences (yes or no) make a difference in the extent to which the participants respond emotionally to EMI courses?

Methodology

The primary participants of this study were university students majoring in English. The research specifically focused on students who had experienced English instruction delivered by foreign instructors, selected through convenience sampling.

The questionnaire was divided into three sections and collected basic demographic information about the participants. The survey aimed to explore participants' emotional experiences in English-medium instruction (EMI) and examine how their demographics, along with past learning experiences, influenced their emotional responses to EMI courses taught by native English-speaking teachers.

What follows presents the items in the survey:

1. Gender：□ Male □ Female
2. Was your senior high school major applied foreign languages? □ Yes □ No
3. Did you have classes taught by foreign teachers before university? □ Yes □ No

Ranking to indicate the extent of agreements	1	2	3	4	5
4. I feel proud in the classroom.					
5. I feel confident in the classroom.					
6. I look forward to the next class in the classroom.					
7. I am satisfied with the EMI course.					
8. I find the EMI course interesting.					
9. I feel scared in class.					
10. I feel ashamed in class.					
11. I feel confused in class.					

12. I feel frustrated in class.					
13. I feel uncomfortable in class.					

The survey items were distributed as an online questionnaire to the participants who were approached on social media platforms popular with Taiwanese university students, namely, Dcard in February, 2024. 150 valid questionnaires were successfully collected.

An independent sample t-test is a statistical method used to compare whether there are statistically significant differences in the means between two independent groups. In this study, we have two independent samples composed of different participants, such as males and females, those who majored in English and those who did not. Through this test, the researcher can assess whether there are statistically significant differences in the extent of emotional responses to EMI courses between these groups. This is an appropriate choice because it allows for comparisons in the study and determines if there are significant differences between different subgroups.

Findings

Findings for RQ1: To what extent do the participants agree with the various emotional reactions experienced in EMI classes taught by native-speaking instructors?

As shown in Table 1, participants generally expressed stronger agreement with positive emotional responses compared to negative ones, as indicated by the respective mean values. The average mean for positive emotions was 3.38, while the average mean for negative emotions was 2.59.

In terms of positive emotional responses, participants showed the highest agreement with the emotion "Satisfied" (Mean=3.65), followed by "Interested" (Mean=3.62), and "Looking forward to the next class" (Mean=3.42). The least endorsed positive emotion was "Confident" (Mean=3.09).

Regarding negative emotional responses to EMI courses, the emotions ranked highest by participants were "Scared" (Mean=2.72), followed by "Confused" (Mean=2.69), and "Frustrated" (Mean=2.55). The least chosen negative emotional response was "Uncomfortable" (Mean=2.24).

Table 1: Emotional Reactions Towards EMI Classes

Descriptive Statistics				
Emotions		N	Mean	Average
Positive Emotion	Satisfied	150	3.65	3.38
	Interested	150	3.62	
	Looking forward to the next class	150	3.42	
	Proud	150	3.11	
	Confident	150	3.09	
Negative Emotion	Scared	150	2.72	2.59
	Confused	150	2.69	
	Frustrated	150	2.55	
	Ashamed	150	2.38	
	Uncomfortable	150	2.24	

Findings for RQ2: Does gender (male or female) make a difference in the extent to which the participants respond emotionally to EMI courses?

As indicated in Table 2, independent-samples t-tests revealed no significant differences in participants' emotional responses to EMI courses based on gender.

However, in terms of mean values, male students showed slightly higher endorsement than female students in two positive emotions: "Proud" (Mean for males=3.22; Mean for females=3.04) and "Confident" (Mean for males=3.17; Mean for females=3.03), as well as in two negative emotions: "Ashamed" (Mean for males=2.43; Mean for females=2.34) and "Uncomfortable" (Mean for males=2.25; Mean for females=2.23). Despite this, the average mean values of positive emotions were identical for both genders (Average Mean for males=3.38; Average Mean for females=3.38).

Conversely, female students showed slightly higher endorsement than male students in three positive emotions: "Looking forward to the next class" (Mean for females=3.46; Mean for males=3.37), "Satisfied" (Mean for females=3.70; Mean for males=3.57), and "Interested" (Mean for females=3.66; Mean for males=3.57). Additionally, females reported higher levels of three negative emotions: "Scared" (Mean for females=2.80; Mean for males=2.60), "Confused" (Mean for females=2.82; Mean for males=2.50), and "Frustrated" (Mean for females=2.66; Mean for males=2.40). In terms of the average mean values for negative emotions, females demonstrated slightly higher levels of negative emotional responses compared to males (Average Mean for males=2.44; Average Mean for females=2.57).

Table 2: Emotional Responses to EMI Courses by Gender

Group Statistics					Independent Samples Test		
Gender			N	Mean	t	df	Sig
Positive Emotion	Proud	Male	60	3.22	1.210	148	0.228
		Female	90	3.04			
	Confident	Male	60	3.17	0.923	148	0.358
		Female	90	3.03			
	Looking forward to the next class	Male	60	3.37	-0.618	148	0.538
		Female	90	3.46			
	Satisfied	Male	60	3.57	-0.956	148	0.341
		Female	90	3.70			
	Interested	Male	60	3.57	-0.627	148	0.532
		Female	90	3.66			
Average Mean of positive emotions for male: 3.38 Average Mean of positive emotions for female: 3.38							
Negative Emotion	Scared	Male	60	2.60	-1.222	148	0.224
		Female	90	2.80			
	Ashamed	Male	60	2.43	0.586	113	0.559
		Female	90	2.34			
	Confused	Male	60	2.50	-1.932	148	0.055
		Female	90	2.82			
	Frustrated	Male	60	2.40	-1.540	148	0.126
		Female	90	2.66			
	Uncomfortable	Male	60	2.25	0.110	148	0.913
		Female	90	2.23			
Average Mean of negative emotions for male: 2.44 Average Mean of negative emotions for female: 2.57							

Findings for RQ3: Does their past major (in English or not) make a difference in the extent to which the participants respond emotionally to EMI courses?

As shown in Table 3, independent-samples t-tests revealed several significant differences in emotional responses based on whether students' past major was English or not.

In terms of mean values, students who had majored in English during senior high school generally exhibited stronger endorsement of positive emotions and lower endorsement of negative emotions compared to those who did not major in English. For example, the average mean value for positive emotions among students who had previously majored in English was 3.45, while it was 3.29 for those who did not. Similarly, the average mean value for negative emotions was 2.35 for students who had majored in English, compared to 2.71 for those who had not.

Table 3 also highlights that students who majored in English in senior high school differed significantly in their emotional responses to EMI courses compared to those who did not, particularly in relation to four negative emotions: "Scared" ($t(148)=-2.294$, $p=0.023$*), "Ashamed" ($t(148)=-2.937$, $p=0.004$**), "Frustrated" ($t(148)=-2.370$, $p=0.019$*), and "Uncomfortable" ($t(148)=-2.412$, $p=0.017$*).

The mean values further indicated that students who had previously majored in English showed significantly lower endorsement of negative emotions towards EMI courses. For instance, the mean values for "Scared" (2.55), "Ashamed" (2.19), "Confused" (2.55), "Frustrated" (2.38), and "Uncomfortable" (2.08) were lower compared to those who did not major in English, whose mean values were "Scared" (2.91), "Ashamed" (2.60), "Confused" (2.86), "Frustrated" (2.76), and "Uncomfortable" (2.43).

Table 3: Emotional Responses to EMI Courses by Past Majors

Group Statistics					Independent Samples Test		
English major or not in senior high school			N	Mean	t	df	Sig
Positive Emotion	Proud	Yes	80	3.19	1.136	148	0.258
		No	70	3.03			
	Confident	Yes	80	3.21	1.918	148	0.057
		No	70	2.94			
	Looking forward to the next class	Yes	80	3.53	1.605	148	0.111
		No	70	3.30			
	Satisfied	Yes	80	3.71	1.031	148	0.304
		No	70	3.57			
	Interested	Yes	80	3.63	0.077	148	0.939
		No	70	3.61			
Average Mean of positive emotions for those with English major: 3.45 Average Mean of positive emotions for those without English major: 3.29							
Negative Emotion	Scared	Yes	80	2.55	-2.294	148	0.023*
		No	70	2.91			
	Ashamed	Yes	80	2.19	-2.937	148	0.004**
		No	70	2.60			
	Confused	Yes	80	2.55	-1.874	148	0.063
		No	70	2.86			
	Frustrated	Yes	80	2.38	-2.370	148	0.019*
		No	70	2.76			
	Uncomfortable	Yes	80	2.08	-2.412	148	0.017*
		No	70	2.43			
Average Mean of negative emotions for those with English major: 2.35 Average Mean of negative emotions for those without English major: 2.71							

Findings for RQ4: Do their past EMI experiences (yes or no) make a difference in the extent to which the participants respond emotionally to EMI courses?

As suggested in Table 4, students with experience in EMI courses showed positive emotions to a greater extent than those without, given the relative average mean values: 3.48 for those with EMI experience vs. 3.01 for those without. Conversely, students with experience in EMI courses showed negative emotions to a lesser extent than those without, given the relative average mean values: 2.40 for those with EMI experience vs. 2.96 for those without.

The results from independent-samples t-tests on this question showed several significant differences in emotional responses based on the experiences of taking EMI courses. Specifically, students with experience in EMI courses demonstrated significantly different endorsement levels of emotional responses compared to those without such experiences, in terms of five positive emotions: "proud" $t(148)=2.768$, $p=0.006^{**}$; "confident" $t(148)=3.526$, $p=0.001^{***}$; "looking forward to the next class" $t(148)=2.952$,$p=0.004^{**}$; and "interested" $t(148)=2.345$, $p=0.02^{*}$.

Among the aforementioned significant differences in endorsement levels of emotional responses, the relative mean values suggested that those with EMI course-taking experiences endorsed the following positive emotions to the following levels: means for "proud"=3.21; means for "confident"=3.21; means for "looking forward to the next class"=3.53; means for "satisfied"=3.73**;** and means for "interested**"=**3.70**.** All of these means are significantly higher than the corresponding mean values observed in those who did not have experience with taking EMI courses: means for "proud"=2.75**;** means for "confident"=2.63**;** means for "looking forward to the next class"=3.03**;** means for "satisfied"=3.34**;** and means for "interested"=3.31**.**

Table 4 also indicates that students without experience in EMI courses demonstrated significantly higher endorsement of five negative emotional responses, according to the independent-samples t-tests: "scared" $t(148)=-2.897$, $p=0.004^{**}$; "ashamed" $t(148)=-3.485$, $p=0.001^{***}$; "confused" $t(148)=-2.577$, $p=0.011^{*}$; "frustrated" $t(148)=-3.357$, $p=0.001^{***}$; and "uncomfortable" $t(148)=-2.995$, $p=0.003^{**}$.

The corresponding mean values observed in those without experiences in EMI courses are listed as follows: means for "scared"=3.16; means for "ashamed"=2.84; means for "confused"=3.09; means for "frustrated"=3.06; and means for "uncomfortable"=2.66. In contrast, the corresponding means for those who have experience with taking EMI courses are as follows: means for "scared"=2.60**;** means for "ashamed**"=**2.25**;** means for "confused"=2.58; means for "frustrated"=2.42; and means for "uncomfortable"=2.13**.**

Table 4: Emotional Responses to Experiences of Taking EMI Courses

Group Statistics					Independent Samples Test		
Experience with or without taking EMI courses			N	Mean	t	df	Sig.
Positive Emotion	Proud	Yes	118	3.21	2.768	148	0.006**
		No	32	2.75			
	Confident	Yes	118	3.21	3.526	148	0.001***
		No	32	2.63			
	Looking forward to the next class	Yes	118	3.53	2.952	148	0.004**
		No	32	3.03			
	Satisfied	Yes	118	3.73	2.344	148	0.02**
		No	32	3.34			
	Interested	Yes	118	3.70	2.345	148	0.02**
		No	32	3.31			
Average Means of positive emotions for those with experiences taking EMI: 3.48 Average Means of positive emotions for those without: 3.01							
Negative Emotion	Scared	Yes	118	2.60	-2.897	148	0.004**
		No	32	3.16			
	Ashamed	Yes	118	2.25	-3.485	148	0.001***
		No	32	2.84			
	Confused	Yes	118	2.58	-2.577	148	0.011*
		No	32	3.09			
	Frustrated	Yes	118	2.42	-3.357	148	0.001***
		No	32	3.06			
	Uncomfortable	Yes	118	2.13	-2.995	148	0.003**
		No	32	2.66			
Average Means of negative emotions for those with experiences taking EMI: 2.40 Average Means of negative emotions for those without experiences taking EMI: 2.96							

p<.05 p<.01** p<.001**

Discussion and Conclusion

What comes next summarizes the main significant differences identified in this study in terms of the emotional responses demonstrated by different kinds of survey participants.

First, it appears that participants of the two genders held similar preferences for EMI courses, as no significant differences were found in independent-samples t-tests. However, in terms of the Mean values, females tended to feel more negative towards EMI courses than males, while both genders demonstrated positive emotions to the same extent.

Second, those who did not major in English in senior high school felt significantly more scared, ashamed, frustrated, and uncomfortable than those who did. Overall, those without English major experiences in senior high school felt more negative towards EMI courses than positive.

Third, those who had taken EMI courses felt significantly more proud, confident, interested, satisfied, and looked forward to the next class more than those without such learning experiences. Conversely, those who had no experience with EMI courses felt significantly more scared, ashamed, confused, frustrated, and uncomfortable than those who had taken EMI courses. In general, those with EMI course experiences felt more positive towards EMI than those who didn't, while those without EMI course experiences felt more negative towards EMI than those who did.

To compare the findings derived from this thesis to those in relevant studies in existing literature, it is found that this study identified similar patterns. For instance, the findings of the present study align with Hillman (2022) in terms of positive emotions, such as pride, in taking EMI courses. As seen in the present study, participants enrolled in EMI courses tended to feel prouder compared to those who weren't. The findings of the present study regarding participants not taking EMI (English-Medium Instruction) courses feeling more ashamed than those enrolled in EMI courses align with the studies conducted by Hillman and colleagues (2023) and Hopkyns and Gkonou (2023). Hillman and colleagues (2023) delve into the emotional impacts of educational settings, particularly focusing on negative emotions such as frustration and stress experienced by students in EMI in higher education. Hopkyns and Gkonou (2023) explore the complex emotional experiences of stakeholders in EMI, highlighting a range of emotions such as pride, confidence, anxiety, guilt, shame, and feelings of (un)belonging.

Furthermore, the findings of this study emphasize the importance of participants' EMI-related experiences and their non-EMI background in high school, which can profoundly influence their emotional reactions to EMI in college. As shown in the survey responses, participants with experiences of taking EMI courses felt more positive towards EMI than those who didn't. Conversely, those without experience in EMI courses felt more negative towards EMI than those who did. These findings resonate with prior research indicating that students' high school background and their unfamiliarity with EMI (e.g., not majoring in English or not being taught by foreign teachers in high school) serve as significant challenges during their transition to college-level EMI (e.g., Aizawa & Rose, 2020; Zhou & Rose, 2021).

Understanding these dynamics can provide valuable insights into the emotional journey of students navigating the shift to EMI environments, thereby informing strategies to support adjustment and well-being. It emphasizes the importance of understanding students' backgrounds in terms of their previous learning experiences to accommodate them appropriately and to be more aware of potential emotional responses, such as anxiety or fear. By recognizing and addressing these emotional aspects, educators and institutions can create a more supportive and conducive learning environment for all students.

Moreover, this study contributes to the existing literature by delving into the dimension of gender. The examination of gender differences reveals intriguing insights into the emotional responses of participants towards EMI courses. Specifically, the findings indicate that females tended to exhibit more negative emotions concerning EMI courses compared to their male counterparts. This gender discrepancy in emotional reactions underscores the need for a nuanced understanding of how individuals from different gender backgrounds perceive and engage with EMI learning environments. Furthermore, while females demonstrated a tendency towards negative emotions, it is noteworthy that both genders displayed positive emotions within EMI courses.

This finding suggests that despite potential gender differences in emotional responses, EMI environments have the capacity to evoke positive sentiments among students regardless of gender. Understanding these gender dynamics enriches our comprehension of the complex interplay between individual characteristics and emotional experiences in educational settings. In essence, the exploration of gender in this study not only expands upon existing research but also highlights the importance of considering gender as a relevant factor in understanding students' emotional responses to EMI courses. By acknowledging and addressing gender-specific emotional needs, educators and institutions can tailor support mechanisms to foster a more inclusive and supportive learning environment for all students, irrespective of gender.

Some limitations must be acknowledged in this thesis, based on which some future research suggestions can be proposed.

Firstly, concerning the survey, there is a possibility of self-report bias: participants' responses to the questions may tend to be more favorable (i.e., positive emotions are preferred), leading to potential bias in the results. It is suggested that future researchers employ a qualitative research approach to examine the same topics. For example, they can conduct interviews to explore potential triggering factors that explain participants' various emotional responses in English-taught courses, such as which particular teaching techniques employed by EMI teachers cause students' anxiety or stress in class.

Secondly, this study did not take into account the relationship between students’ English proficiency levels and their various emotional responses. Future research could collect such information to examine the correlation between students’ proficiency levels and their endorsement of emotional responses.

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Contact email: irenechen@mail.npust.edu.tw

The Use of Career Awareness Comic Book to Enhance English Language Learning for Primary School Students in the People's Republic of China

Li Yunchun, Rajamangala University of Technology Thanyaburi, Thailand
Metee Pigultong, Rajamangala University of Technology Thanyaburi, Thailand

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Abstract
In China, primary school serves as the initial phase of English instruction and career awareness education. Numerous issues in contemporary English language instruction have resulted in the ineffectiveness of English acquisition. Insufficient career awareness education will result in pupils' deficiency in life goal planning. This research enhances career awareness and English education while promoting English instruction through comic book. The research aimed to: 1) compare the learning achievement scores after using the career awareness comic book. 2) Identify the rate of effectiveness after using the career awareness comic book. The population consisted of 76 students of the 5th grade students of a primary school. Use English for the career awareness comic book. The statistics used to analyze and interpret the data included mean ($\bar{X}$), standard deviation (S.D.), t-test, and effectiveness index. The research result found that 1) the paired t-test of pre-test and post-test showed that there were differences at the statistical significance level of 0.05 (t=42.10, p=0.00). The results also revealed that the effectiveness index was .2205; in other words, the students had higher post-test scores of 22.05 percent of cognitive score improvement.

Keywords: Career Awareness, Comic Book, English Language Learning, English Learning Achieve Improvement

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1. Introduction

1.1 Research Background

Education is the foundation for talent cultivation and social development. In the present day, to cultivate innovative and multi-skilled talent who are able to adapt to global trade, continuous reform of the education system is needed, as well as the promotion of industry-education integration to train technological talent with international communication skills. English plays an important role in international exchange and cooperation, and the development of English education from a minority group's vocational training to universal education has become an important national strategy. However, for many primary school students, there are important difficulties and challenges in learning English well. Comic books, as a form of entertainment media, have attracted the attention of some readers with their strong visual impact and exaggerated artistic editing techniques (Wang & Zhang, 2023). This study focuses on the entertainment value of comic books and aims to explore new ways to promote English learning among primary school students.

1.2 Problem of Population

The difficulties and challenges faced by primary school students in learning English are varied. First, students have a serious exam-oriented education mentality, treating entrance exams as the main purpose of English learning (Hao, 2020). Second, Teachers' teaching strategies are outdated, the teaching content is monotonous, and They attempt to establish a teacher-centered knowledge-providing system. Third, students have not mastered the correct learning methods (Liu, 2021), and the rote learning method hinders students' autonomy in learning English. Fourth, primary School students lack the purpose and interest in learning English. Teachers lack interaction in teaching, and English education is not linked with personal experience. Fifth, this strong self-esteem forces them to avoid making mistakes, and when they do, they flinch. So in English learning, they are ashamed to talk with adults, especially with teachers.

1.3 Solution to Solve the Problems

At present, English teaching is undergoing continuous reform and innovation to make its teaching content closer to people's lives and the needs of social development. Based on the exploration of Wang Xiangping and other scholars on the ladder-style cultivation of students' career awareness (Wang et al., 2022), as well as the successful application of comic books in other subjects (Lin, 2023). This study attempts to design a vocational awareness comic book. based on vocational storylines for English teaching. By experimenting with Fifth-grade students from a primary school, this paper explores whether a career awareness comic book can promote primary school English learning.

1.4 Research Questions

This paper focuses on the following questions:

1) Can a career awareness comic book promote English learning for primary school students?
2) How effective are career awareness comic book in influencing the English learning of primary school students?

1.5 Research Objectives

1) To compare the learning achievement scores after using the career awareness comic book.
2) To identify about the rate of effectiveness after using the career awareness comic book.

2. Research Methods

The research population includes 200 Grade 5 students, the sample group includes 76 Grade 5 students in a primary school. The training time was two months. A questionnaire survey was conducted to conduct pre-training and post-training tests.

2.1 Research Design

This study explores the application of the career awareness comic book in English teaching through review, visit observation, material development, classroom experiments, and questionnaire surveys. To reflect the impact of the career awareness comic book on the English learning of primary school students, this study conducted experimental research using quantitative data analysis methods: the survey before and after the experiment formed a quantitative analysis model, namely pre-test (O_1), experimental (X), and post-test (O_2). The data sources for analyzing the effectiveness of the experimental activities are the tests before and after the experiment. The pre and post-test were conducted through questionnaire surveys of 76 fifth-grade students.

Pre-test	Activities	Post-test
O_1	X	O_2

O_1 Measurement of pre-test score
X Improving primary school students' English learning through the use of vocational awareness comic book
O_2 Measurement of post-test score

2.2 Research Instrument Development

This study divides the design of comic book content into four parts. The first part is about asking for directions, where students interact with traffic police, gain a basic understanding of urban architecture, and become familiar with the working environment of doctors through ambulances and hospitals. The second part is about seeking medical care. Students participate in situational experiences to deepen their understanding of doctors while also developing their communication skills and ability to express requests for help. The third part is our teachers, where students engage in dialogues and stories of teachers' daily lives to enhance their understanding of the teacher's role and develop their communication skills and abilities of the world around them. The fourth part is about the story of famous scientist Yuan Longping's research on hybrid rice, which allows students to learn about the spirit of scientific exploration and the awareness of resource conservation. The comic book page design size is 15CM*20CM, convenient for students to carry and read.

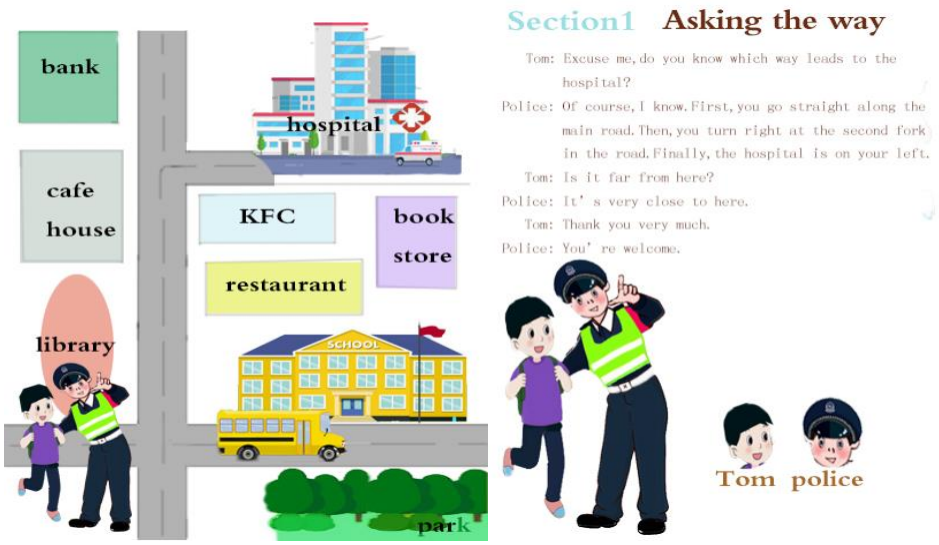

Figure 1: The Example of Career Awareness Comic Book Design

2.3 Implementation Period

The 76 students were divided into two classes, with 38 students in each class. Before the experiment, both classes were given an English test, and both groups were given the same questionnaire. At the beginning of the experiment, a career awareness comic book was used to teach English in two classes for 45 minutes per class, 3 classes per week for 2 months. The teacher dictated 10 words every week. The first 10 minutes of each class are for students' previews and one-on-one Q&A; the next 30 minutes are for teachers' lectures and interactions; and the last 5 minutes are for students' dialogue performances and discussions. If students discuss questions in the last 5 minutes of class, the teacher will answer them one-on-one in the first 10 minutes of the next class. Observe students every two weeks to learn about their classroom experience and to improve the classroom teaching plan. After the completion of the experimental teaching tasks, two classes of students conducted a questionnaire survey. During the experiment, the researcher will control the experimental conditions precisely, ensure the consistency of the experimental environment, teaching content, and teaching method, so as to reduce the interference factors in the experiment. The experimental process is shown in the following figures.

Figure 2: Implement the Teaching Process

Figure 3: Interview Observation

Figure 4: Pre-test Process

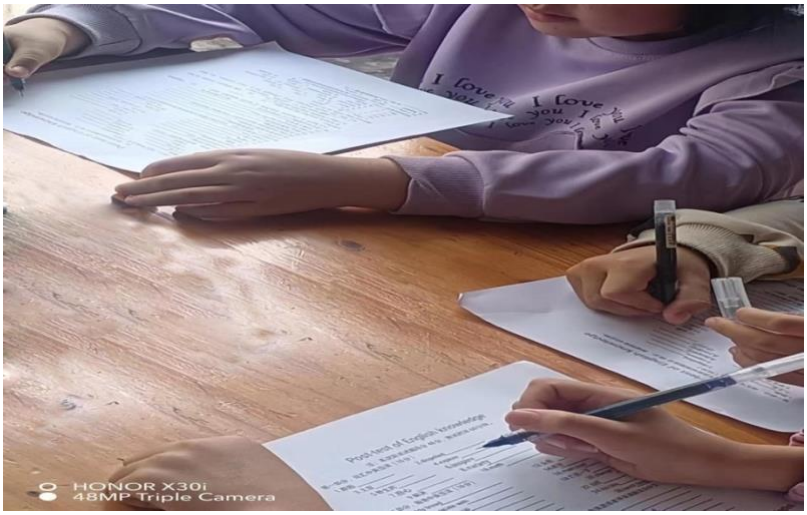

Figure 5: Post-test Process

2.4 Data Collection: Multiple methods are used for data collection, including observation visits, questionnaire surveys, etc., to obtain comprehensive research.

2.5 Data Analysis Method: Quantitative Data Analysis: Use statistical methods to analyze quantitative data on the promotion effect of career awareness comic book on English learning.

3. Research Results

1) Compare the learning achievement scores after using the career awareness comic book.

Table 1: Paired Samples t-Test of the Pre-test and Protest in Experimental Class

Items	Number of students	Difference of Mean	Std.	Std error of Mean	t-Test	df	Sig. (two-tails)
Post-test	76	6.05	1.25	0.14	42.10	75	0.00
Pre-test							

From Table 1, the paired t test of pre-test and post-test showed that there were differences at the statistical significance level of 0.05 (t=42.10, p=0.00), and the mean difference between the two tests was 6.05. This shows that the use of a career awareness comic book teaching model in a primary school grade 5 can indeed promote students' English learning.

2) Identify the rate of effectiveness after using the career awareness comic book.

Table 2: Statistical Table of the Results of Students' Post-test Results

Number of students	Total	P_2	P_1	Effectiveness index
76	3648	2022	1562	0.2205

P_1 = Pre-test
P_2 = Post-test
Total= Number of students × Total question score

From Table 2, the effectiveness index calculated from the above formula is 0.2205, which shows that the students had higher post-test scores of 22.05 percent of cognitive score improvement.

Conclusion

Through experimental teaching tests, it has been shown that the teaching method of the career awareness comic book is an interesting and practical teaching model that is close to students' real lives. It is very effective in cultivating students' interest and autonomy, promoting their English learning, and providing them with relevant professional knowledge experience in the process of learning English. Through experimental observation, it was found that some students are accustomed to reading career awareness comic book alone after class, so their

English learning is no longer limited to the classroom. Proper use of career awareness comic book with professional awareness can improve students' English learning outcomes. Some interviewees expressed that she is no longer afraid of expressing herself improperly and has confidence in learning English well.

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Contact emails: yun_c@mail.rmutt.ac.th
metee_p@rmutt.ac.th

Using Problem-Based Learning Activities to Enhance Systematic Thinking in Electrical Power Engineering Students

Priyaporn Ratsame, King Mongkut's University of Technology Thonburi, Thailand
Pakpoom Chansri, King Mongkut's University of Technology Thonburi, Thailand
Chamnan Ratsame, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
This research was prepared for Promote the ability to think systematically about drawing ladder diagrams in the Mable Logic Control program. The sample consisted of 18 3rd year vocational certificate students. The data collection method was simple random sampling using lots. The experimental research design used in the experiment was a study of a single experimental group. Measured only after the experiment. The single group, posttest-design.The tools used in the research include: Problem-based learning management activities Measurement of systematic thinking ability (after class). Steps for creating it: 1. Study teaching and learning problems in the classroom. 2. Study principles concepts and theories. 3. Determine the structure and steps. Teaching and learning innovation. 4. Create innovation. 5. Create measurement tools. Ready to find the quality of the tools. 6. Take the innovation to be evaluated by experts to check the quality. 7. Take the modified innovation and use it to teach with real sample groups. The results of the research found that it has a mean value of ($\bar{x}$=4.69, SD=0.48) considered consistent with the assumption that it is at the passing level. (Learners passed the criteria of 80 percent or more of all students). The results of the 1st and 2nd systematic thinking ability tests were overall at a better level (with a score of 7 and above). The number of 16 people is 88.88 percent and the number of 15 people is 83.33 percent, which is according to the assumptions made.

Keywords: Problem-Based Learning, Systematic Thinking, Programmable Logic Control

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Introduction

In an era marked by rapid changes in technology and innovation, systematic thinking skills have become essential for solving complex problems and decision-making processes across various disciplines, particularly in the field of electrical engineering, which necessitates analysis and design. Systems thinking helps students understand and analyze problems structurally, see relationships between system elements, and perform precise and systematic operations. This is because electrical engineering work involves the integration of knowledge from many fields and requires a thinking process that can consider all relevant factors thoroughly and carefully. However, the past evaluation of students' learning outcomes in the electrical engineering program revealed, based on past score statistics, that the programmable logic control course used pre-test and post-test to measure learning achievement. The test revealed an increase in the students' post-test scores. but when the students went out to practice their professional experience, they often had problems applying theoretical knowledge to real situations. They lacked the ability to connect problems and analyze them from various perspectives. These skills are important for the development and maintenance of complex electrical systems. There is a learning management method that emphasizes solving real problems through practice or problem-based learning. Over the past few decades, numerous new learning theories have emerged. However, the most popular learning theory among educators is the constructivist learning theory, which incorporates a concept that aligns with 21st-century education: the learning management model using PBL. The Faculty of Health Sciences at McMaster University initially developed it. Later, this method became a learning model. Teaching using the PBL model has begun to expand to other fields, such as engineering, science, and mathematics. Therefore, such a teaching model is an appropriate approach to developing students' systems thinking skills,as PBL emphasizes students' participation in the learning process through solving problems that are close to real situations. This allows students to practice problem analysis, information search, and knowledge integration to find answers, resulting in deeper and more sustainable learning. This research aims to study the use of PBL activities in the Programmable Logic Control: PLC course to enhance systems thinking skills in electrical engineering students. This course is crucial in training and developing basic knowledge about programming to control the operation of automatic systems, which is one of the essential skills for electrical engineers in the present era.

Based on the aforementioned problems, this research aims to enhance systems thinking skills in electrical engineering students by studying and applying PBL learning activities in the PLC subject, specifically in the sub-units of Writing Ladder Diagrams for Programmable Logic Control (LAB4: Traffic Signal Control, LAB5: Workpiece Distribution Station Control). The focus is on the learning process during the study rather than the traditional pre - and post-test assessment. Therefore, this research measured the development of students' skills during the study by administering two tests, a departure from the traditional assessment method that typically uses a pre-test and a post-test. This research employs a process-based assessment method to monitor the advancement of students' systems thinking throughout the study.

This research aimed to enhance the ability of systematic thinking in terms of analytical thinking and applied thinking by PBL activities in a lesson on writing ladder diagrams for PLC. The PBL learning management effectively and significantly developed analytical and applied skills for electrical engineering students. Furthermore, students can apply the concepts they gained from such activities to their future work.

Overview of the Research

Concepts and Theories of Problem-Based Learning (PBL) Management to Develop Systematic Thinking

Learning using PBL is a process that starts with presenting a problem situation for learners to connect their previous knowledge with new information, leading to knowledge creation and the development of analytical thinking skills. This type of learning emphasizes that learners practice solving problems systematically, searching for information by themselves, and enhancing their academic understanding through real situations instead of teaching by lecturing. In PBL, the teacher will be the facilitator and prepare questions that are consistent with the learning objectives, encouraging learners in small groups to participate in analyzing problems, forming hypotheses, testing, and summarizing new knowledge without providing direct information. There are three main aspects 1. activation of prior knowledge, 2. encoding specificity and 3. elaboration of knowledge. In this regard, teaching should focus on activities that allow learners to express and extend their knowledge.

The learning process using PBL, as illustrated in Figure 1 (Boom et al., 2010) consists of six main steps.

1. **Problem Identification:** The teacher divides students into groups to jointly identify problems and clearly define the scope of the problem according to the assigned task.
2. **Brainstorming:** Students in each group brainstorm, analyze, and break down problems by linking them to their prior knowledge to understand them from various perspectives.
3. **Problem Analysis:** The students analyze problems using reasoning, set learning objectives, and identify additional information necessary to explain them.
4. **Planning:** The students plan their research by dividing tasks and identifying the sources of information they need to use to collect new knowledge and related information.
5. **Learning and Application:** The students apply the new information and knowledge they have gained from their research to solve problems, using related concepts, principles, and theories to find possible answers.
6. **Summary and Report:** The students summarise their knowledge and present the results of problem solving by linking the concepts studied and showing the results obtained from applying the knowledge.

We will use the aforementioned PBL steps to assess learning outcomes, assisting learners in systematically developing critical thinking and problem-solving skills.

Figure 1: Learning Process Using PBL

The Concepts and Related Theories of System Thinking Encompass Both Analytical and Applied Thinking

System thinking refers to the ability to apply knowledge and analysis to solve problems in real situations effectively. This type of thinking allows learners to connect theoretical knowledge with real situations, which deepens applied thinking. In order to develop a problem-solving method that is consistent and appropriate for real situations, applied thinking takes into account both theoretical factors and the context of the problem at hand. For instance, when solving the problem of drawing a ladder diagram in an automatic control system, learners need to apply their knowledge of electrical circuit design and PLC operation to the functioning of a real, complex industrial system. Applied thinking helps learners to evaluate possible outcomes and decide on the most appropriate solution. This research uses system thinking, analytical thinking, and application thinking.

Analytical Thinking.

Analytical thinking, in the context of systems thinking, emphasizes the separation of elements within a system and the identification of relationships among them. This method of thinking enables learners to explore the intricacies of each element and uncover hidden patterns within the system. Analytical thinking also helps learners to consider the structure of the system and the factors that affect its operation systematically. For example, in analysing an electrical system, learners may start by breaking down the elements, such as voltage, current, and conductors, and then study how these elements work together in the system. Analytical thinking also helps learners to identify the causes of problems and the factors that affect their occurrence more clearly, which is an important foundation for effective problem solving.

Applied Thinking.

In the context of systems thinking, applied thinking refers to the capacity to effectively apply knowledge and analysis to solve problems in real-world situations. This type of thinking helps learners to connect theoretical knowledge with real situations, which deepens applied thinking. In order to develop a problem - solving method that is consistent and appropriate for the real situation, applied thinking takes into account both theoretical factors and the context of the problem at hand. For instance, in order to solve the problem of drawing a ladder diagram in an automatic control system, learners must apply their knowledge of electrical circuit design and PLC operation to the functioning of a real, complex industrial system. Applied thinking helps learners to evaluate possible outcomes and decide on the most appropriate solution.

Systems thinking, which combines analytical and applied thinking skills, enables learners to deal with complex problems, see holistic relationships, and carefully evaluate the impact of individual changes in a system. It prepares learners to effectively deal with challenging problems and adapt in an ever-changing environment.

The Process of Learning Management Design Involves Creating Ladder Diagrams With Programmable Logic Control Through PBL, Which Fosters System Thinking

The design of learning management, which is used in teaching the topic of writing programmable logic ladder diagrams using PBL to develop systematic thinking (analytical thinking and applied thinking), follows six steps:

- **Step 1: Problem Identification:** Learners will receive problems related to writing ladder diagrams with PLC for automatic system control, such as "Design a ladder diagram to control an electric motor to work according to specified conditions." The teacher will help explain the importance of writing ladder diagrams with PLC and ask questions to stimulate learners to think further.
- **Step 2: Brainstorming:** Divide into groups and discuss the given problem to understand its details, including the motor's function and various working conditions. Learners can use diagrams or notes to help analyze the problems they receive and the relationship between different devices.
- **Step 3: Problem Analysis:** In this step, learners are required to explore online resources for information on writing ladder diagrams, with the aim of comprehending the working principles of PLC and the structure of ladder diagrams. Learners should focus on studying the differences between devices and different control methods.
- **Step 4: Planning:** After studying and researching, learners must synthesise the obtained data to create a basic ladder diagram. Planning the diagram may involve creating a mind map or diagram flow to clearly illustrate the control steps. It is necessary to consider the relationship and priority of the devices used.
- **Step 5: Learning and application:** In this step, learners are required to summarize and assess the ladder diagram design they have created, either through a written report or a group presentation. Having friends assist in evaluating the correctness and reasonableness of the design fosters participatory learning.
- **Step 6: Summary and Report:** In the final step, each group of learners must present their ladder diagram writing results in front of the class. The teacher may either demonstrate the actual work or use software to simulate the operation of the PLC. The teacher will evaluate both the content and the presentation, including providing suggestions to learners for development next time.We conducted a test twice after organizing the learning of all 6 steps, utilizing problem-based learning to develop a systematic approach to creative and applied thinking, particularly in the area of writing ladder diagrams for programmable logic control.

Analysis of Data Results

The Quality Assessment of Learning Management Plans Yielded Results

Ability to foster systematic thinking through the use of PBL in organizing learning activities related to writing ladder diagrams with PLC as evaluated by three experts. We conducted the quality assessment using the activity quality assessment form, a questionnaire featuring a rating scale for five areas: 1. overall structure of the plan 2. learning objectives 3. learning activities 4. learning media and 5. measurement and evaluation. We analyzed the evaluation values obtained using Likert rating scales (Wratten et al., 2022). The analyzed values consisted of the mean and the standard deviation (SD). We determined the range of the mean values to interpret the meaning into 5 levels (Likert, 1932): (4.50-5.00=Very Satisfied), (3.50-4.49=Satisfied), (2.50-3.49=Neutral), (1.50-2.49=Dissatisfied), and (1.00-1.49=Very Dissatisfied), as shown in Tables 1 to 5.

Table 1: Results of the Study of the Quality of Learning Management Activities in the Overall Plan

Evaluation List	Mean	SD	Opinion Level
1.1 The plan covers all necessary elements.	5	0	Very Satisfied
1.2 The learning management plan is feasible for implementation.	4.67	0.58	Very Satisfied
1.3 The plan is designed to address the needs or solve the problems of learners by enhancing their thinking or higher-level abilities.	4.67	0.58	Very Satisfied
1.4 The plan is easy to understand, allowing others to teach it effectively.	4.67	0.58	Very Satisfied
1.5 Summarize the main ideas in a way that is consistent with the content to be taught.	4.67	0.58	Very Satisfied
Overview of Section 1	4.74	0.48	Very Satisfied

Overall Plan: The overall plan is at a Very Satisfied level: All 5 items are: 1.1 Behavioural objectives, content, teaching methods, materials or media, measurement and evaluation, and post -teaching records are all included. You can put the learning management plan into practice. 1.3 The plan aims to meet the needs of the learners or solve their problems in terms of high-level thinking or abilities. 1.4 The plan is simple to comprehend, allowing others to instruct in its place. Provide a concise overview of concepts that align with the intended teaching content. The average score is ($\bar{x}$=4.74, SD=0.48) for all 5 items, which indicates that the overall quality of the plan is appropriate and of high quality.

Table 2: Results of the Study of the Quality of Learning Management Activities in the Learning Objectives

Evaluation List	Mean	SD	Opinion Level
2.1 The learning objectives adequately cover the content/subject matter.	5.00	0	Very Satisfied
2.2 Learning objectives are derived from indicators.	4.33	0.58	Very Satisfied
2.3 Write behavioral objectives that are clear, measurable, and observable.	4.67	0.58	Very Satisfied
2.4 Learning objectives aim to develop learners' knowledge, skills, and processes that are important in the current era.	4.67	0.58	Very Satisfied
Overview of Section 2	4.67	0.44	Very Satisfied

In terms of learning objectives, the overall quality is at the Very Satisfied level: Three learning objectives are rated as very good, with the highest mean value being as follows: 2.1 Learning objectives cover the subject matter/content with the mean value of ($\bar{x}$=5.00, SD=0). 2.2 Learning objectives are derived from indicators with the mean value of ($\bar{x}$=4.33, SD=0.58). 2.3 Clearly write behavioural objectives that can be measured or actually observed with the mean value of ($\bar{x}$=4.67, SD=0.58).2.4 Learning objectives aim to develop learners in terms of knowledge and skills of processes that are important in the current era with the mean value of ($\bar{x}$=4.67, SD=0.58), which indicates that the learning objectives are appropriate and achieve the objectives.

Table 3: Results of the Study of the Quality of Learning Management Activities in the Learning Activities

Evaluation List	Mean	SD	Opinion Level
3.1 Learning activities are consistent with the objectives.	5	0	Very Satisfied
3.2 Learning activities are consistent with the content.	5	0	Very Satisfied
3.3 Activities are designed to train learners on indicators during the study and relate to the measurement of all indicators after the study.	5	0	Very Satisfied
3.4 Techniques for organizing learning activities are aligned with the behavioral objectives.	4.67	0.58	Very Satisfied
3.5 The plan includes all main steps of the process, clearly defining the introduction, teaching, and conclusion phases.	4.67	0.58	Very Satisfied
Overview of Section 3	4.89	0.23	Very Satisfied

Overall, the learning activities were Very Satisfied level: There was especially good learning in all 5 items: 3.1 learning activities of the program; 3.2 learning activities in the content area; 3.3 training activities for learners to be able to learn related to all outcomes after learning with the same intensity ($\bar{x}$=5.00, SD=0); 3.4 a technique for inheriting learning with a strategic approach; and 3.5 the main steps are detailed according to the original subject, making it clear that the leading step, the teaching step, and the conclusion step are all carried out equally ($\bar{x}$=4.67, SD=0.58). The activities involve learning.

Table 4: Results of the Study of the Quality of Learning Management Activities in the Learning Media

Evaluation List	Mean	SD	Opinion Level
4.1 Media and learning resources are easy to understand and help learners achieve their objectives more effectively.	4.33	0.58	Very Satisfied
4.2 The media used is consistent with the content.	4.67	0.58	Very Satisfied
4.3 The media is engaging and user-friendly.	4.67	0.58	Very Satisfied
Overview of Section 4	4.56	0.58	Very Satisfied

The overall quality of learning media is Very Satisfied level: item 4.2, where the media used is consistent with the content, meets the learning objectives at a very high level. 4.3, the media is interesting and easy to use, with an average value of ($\bar{x}$=4.67, SD=0.58), and item 4.1, the media and learning resources are easy to understand and help learners achieve their objectives more easily, at a good level, with an average value of ($\bar{x}$=4.33, SD=0.58), which indicates that the learning media is of good quality and appropriate for learners.

Table 5: Results of the Study of the Quality of Learning Management Activities in the Measurement and Evaluation

Evaluation List	Mean	S.D.	Opinion Level
5.1 Methods of measurement and evaluation are aligned with the behavioral objectives.	4.67	0.58	Very Satisfied
5.2 The questions for measurement and evaluation are clear.	4.67	0.58	Very Satisfied
5.3 The measurement tools and methods are appropriate for the learners' ability levels.	4.67	0.58	Very Satisfied
5.4 Multiple measurement opportunities are provided to allow learners to improve.	4.67	0.58	Very Satisfied
Overview of Section 5	4.67	0.58	Very Satisfied

In terms of measurement and evaluation, it is at a Very Satisfied level overall, with learning objectives that are at a very good level in all 5 items, namely: 5.1 The methods of measurement and evaluation align with the behavioural objectives. 5.2 The questions for measurement and evaluation are clear. 5.3 The measurement tools and measurement methods are appropriate for the learner's ability level. 5.4 There are multiple measurements that allow the learner to improve. The average values of all 5 areas are equal, with ($\bar{x}$=4.67 and SD=0.58) indicating that the measurement and evaluation aspects are appropriate.

The Results of the Measurement of the Ability to Think Systematically on the Topic of Drawing Ladder Diagrams With PLC

Results of the systematic thinking ability measurement on the writing of ladder diagrams with PLC for 18 electrical engineering students were evaluated using the 5-point rating scale Rubric score. (Wind, 2020) The criteria of the 5-level rating scale for the evaluation of the results include (5=excellent), (4=good), (3=average), (2=poor), and (1=very poor). We will evaluate it after learning through individually designed activities, based on the indicators of systematic thinking ability, analytical thinking ability, applied thinking ability, and overall thinking ability. We divide the results of the systematic thinking ability measurement into two categories: the first post-learning ability measurement (E1) and the second post-learning ability measurement (E2), both of which must pass the 80 percent criterion or receive a score of 4 or higher. The results are shown in Tables 6 and 7.

Table 6: Results of the First Systematic Thinking Ability Measurement

Opinion for Quality		Quantity	Percentage	Opinion for Quality		Quantity	Percentage
1.Analytical thinking ability (5 points)				**3.Applied thinking ability (5 points)**			
Pass	Excellent	18	100	Pass	Excellent	-	88.88
	Good	-			Good	16	
Failed	Average	-	-	Failed	Average	2	11.12
	Poor	-			Poor	-	
	Very Poor	-			Very Poor	-	
2.Ability to think systematically (5 points)				**Total score (15 points)**			
Pass	Excellent	4	77.78	Pass		16	88.88
	Good	9					
Failed	Average	5	22.22	Failed		2	11.12
	Poor	-					
	Very Poor	-					

From Table 6, the first systematic thinking ability measurement yielded results from the initial ability test. From the test results in the first indicator of the analytical thinking ability assessment, analytical thinking ability, there were 18 students in total, all of whom scored at the excellent level, accounting for 100 percent. The percentage of those who passed the criteria in the second indicator, ability to think systematically, had 4 students with excellent scores, 9 students with good scores, and 5 students with average scores. The number of those who passed the criteria was 77.78 percent, and the number of those who did not pass the criteria was 22.22 percent. In the third indicator, applied thinking ability, there were 16 students with good scores, 2 students with average scores, and those who did not pass the criteria were 88.88 percent and those who did not pass the criteria were 11.12 percent. When the scores of all 3 indicators in the first ability test were combined, it was found that 88.88 percent passed the criteria and 11.12 percent did not pass the criteria, as shown in Figure 2. The percentage of those who passed the criteria was consistent with both the hypothesis and the criteria. Significantly defined.

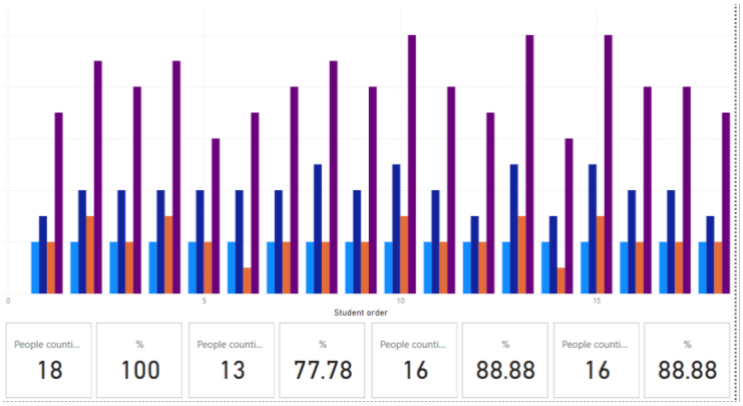

Figure 2: The Results of the First Systematic Thinking Ability Measurement

Table 7: Results of the Second Systematic Thinking Ability Test

Opinion for Quality		Quantity	Percentage	Opinion for Quality		Quantity	Percentage
1.Analytical thinking ability (5 points)				**3.Applied thinking ability (5 points)**			
Pass	Excellent	17	94.44	Pass	Excellent	8	83.33
	Good	-			Good	7	
Failed	Average	1	-	Failed	Average	3	16.67
	Poor	-			Poor	-	
	Very Poor	-			Very Poor	-	
2.Ability to think systematically (5 points)				**Total score (15 points)**			
Pass	Excellent	6	77.78	Pass		15	83.33
	Good	7					
Failed	Average	5	22.22	Failed		3	16.67
	Poor	-					
	Very Poor	-					

From Table 7, results of the first systematic thinking ability measurement from the first ability measurement test. From the test results in the first indicator of the analytical thinking ability assessment, analytical thinking ability, there were 18 students in total, with 17 students scoring at the excellent level and 1 student at the average level, accounting for 94.44 percent who passed the criteria and 5.56 percent who did not pass the criteria. In the second indicator, ability to think systematically, there were 6 students with excellent scores, 7 students with good scores, and 5 students with average scores. The number of students who passed the criteria was 77.78 percent, and the number of students who did not pass the criteria was 22.22

percent. In the third indicator, applied thinking ability, there were 8 students with excellent scores, 7 students with good scores, and 3 students with average scores. When the scores of all three indicators in the second ability measurement were combined, it was found that 83.33 percent passed the criteria and 16.67 percent did not, as shown in Figure 3. The percentage of those who passed the criteria was significantly consistent with the hypothesis. The number of students who passed the criteria was 83.33 percent and the number of students who did not pass the criteria was 16.67 percent.

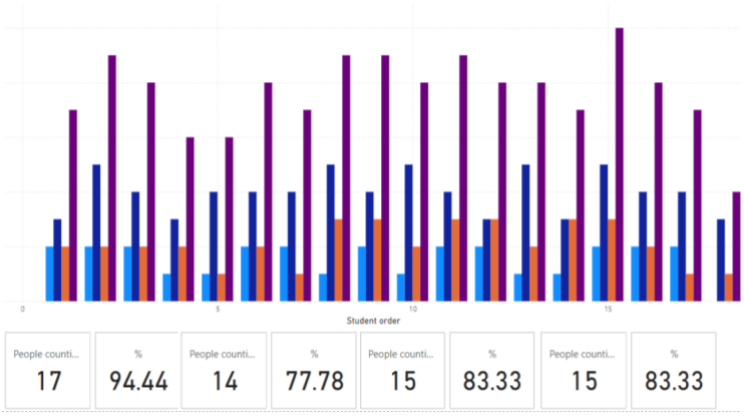

Figure 3: Results of the Second Systematic Thinking Ability Measurement Test

Conclusion

The study focuses on fostering systematic thinking skills in both creative and applied thinking, specifically in the area of ladder diagram creation in PLC, through the implementation of the PBL learning management method for electrical engineering students. The study evaluated the quality of the learning management plan. In the evaluation of the quality of the learning management activities in all five areas, the average evaluation result was ($\bar{x}$=4.69, SD=0.48). This suggests that the quality of the learning management plan is good and appropriate. This is consistent with the hypothesis in terms of learning objectives and learning activities. From the first systematic thinking ability assessment in calculating the total score of all three indicators, it was found that 88.88 percent passed the criteria. From the second systematic thinking ability assessment in calculating the total score of all three indicators, it was found that 83.33 percent passed the criteria, which is in accordance with the hypothesis that In the sample group, there must be those who pass the criteria with a score of at least good level, not less than 80 percent, for both the first systematic thinking ability test and the second systematic thinking ability test. However, the results of both assessments suggest that students can achieve learning objectives in line with the hypothesis and enhance their systematic thinking skills in the PLC subject. These skills will enhance their analytical thinking capabilities and enable them to apply them to real-world tasks in the future.

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Contact email: Priyapon.ratsame@hotmail.com

The Impact of Information Graphics on Fire Evacuation of Chinese Students: A Case Study of Sichuan University of Light Industry and Chemical Technology

Zhang Xia, Rajamangala University of Technology Thanyaburi, Thailand
Metee Pigultong, Rajamangala University of Technology Thanyaburi, Thailand

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Abstract
With the rapid advancement of technology, ensuring the safety of campus fire evacuations has become a significant focus. This empirical study was conducted at Sichuan University of Light Industry and Chemical Technology. The research aims to: 1. Explore the effectiveness of achievement scores after the use of information graphics for dormitory students. 2. Gather feedback on the use of these information graphics. The population for this study consisted of 50 dormitory students from Sichuan University of Light Industry and Chemical Technology. The research instruments included: 1. Information Graphics on fire evacuation 2. Achievement test papers 3. A questionnaire to assess students' satisfaction with the use of Information Graphics. The statistical methods used in this research included: 1. Mean ($\bar{X}$) 2. Standard deviation (S.D.) 3. Effectiveness index 4. Content analysis technique. The results indicate a comparison of students' pre- and post-test scores regarding fire safety awareness after using the Information Graphics for independent learning. The mean score on the pretest was 32.82, with a standard deviation of 2.26. After using the Information Graphics, students' performance significantly improved, achieving a mean score of 37.48 with a standard deviation of 2.23. The t-test results revealed a significant difference, showing a t-value of -32.229, which is statistically significant at the 0.05 level (t=-32.229, p=0.00). The effectiveness index was 0.38, indicating that students had a 38 percent improvement in their post-test scores. Feedback from students showed a high level of satisfaction with the use of Information Graphics for independent learning, which effectively enhanced their fire safety awareness.

Keywords: Information Graphics, Fire Evacuation, Dormitory Chinese Students, Training Effectiveness

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1. Introduction

1.1 Research Background

The training effectiveness of fire evacuation for Chinese students is directly related to their life safety and the quality of campus safety management. With the continuous development of technology, information graphics, as an intuitive and easy to understand tool for information transmission, are widely used in the field of safety, providing new possibilities for evacuation during disasters. The potential threat of fire to student accommodation has aroused deep concern from various sectors of society on how to improve the efficiency of fire evacuation. School administrators, fire departments, and students themselves need to take prompt and effective measures in the event of a fire to minimize potential risks. The application of information graphics as a visual means of conveying information in fire evacuation, especially in the environment of Chinese student dormitories, is a highly concerned topic.

1.2 Problem of Population

Currently, Chinese student fire evacuation faces a series of challenges, including a large number of personnel, complex evacuation routes, and uncertain student behavior. In this context, information graphics, as an intuitive and clear tool for information transmission, have the potential to play a positive role in improving the efficiency of student fire evacuation. However, in response to the actual situation of Chinese students, especially in large-scale student dormitories, there is still some uncertainty in the design and application of information graphics. Student accommodation safety has always been a concern for society and school administrators, especially in emergency situations such as fires, where rapid and orderly evacuation becomes crucial. Chinese universities, such as Sichuan University of Light Industry and Chemical Technology, not only have a large number of students but also complex and diverse student accommodation environments, including student dormitories, apartments, rental housing, etc. Therefore, improving the efficiency of student fire evacuation is crucial for ensuring student life safety.

1.3 Solution to Solve the Problems

Internationally, information graphics have been successfully applied to enhance public awareness and response capabilities in emergency situations. For example, in fire evacuation, clear information graphics can not only guide evacuation directions but also help students understand emergency situations more quickly. This intuitive way of information transmission is widely accepted internationally, providing new ideas and possibilities for improving the efficiency of student fire evacuation. Sichuan University of Light Industry and Chemical Technology, as a typical Chinese university, has a large student population and diverse accommodation environment. In this context, the issue of student fire evacuation is more complex and urgent. By taking Sichuan University of Light Industry and Chemical Technology as an example, we can gain a deeper understanding of the specific situation of fire evacuation among Chinese students, providing specific reference and inspiration for the design and implementation of information graphics. In the current context of student fire evacuation, this study focuses on the role of information graphics in Chinese student fire evacuation. Through a case study of Sichuan University of Light Industry and Chemical Technology, the aim is to explore the practical effects of information graphics on improving

students' fire safety awareness, guiding evacuation directions, and optimizing evacuation processes.

By comparing successful international experiences, feasible improvement suggestions are provided for the actual situation of fire evacuation among Chinese students in order to promote practice and research in the field of student fire evacuation. In this context, this study takes Sichuan University of Light Industry and Chemical Technology as an example to explore the practical impact of information graphics on the evacuation of Chinese student fires. As one of the most populous countries in the world, China has a huge student population. The safety of student accommodation has always been a concern of society, and fires, as a potential threat, pose serious safety hazards to student dormitories. Currently, schools and relevant management departments are committed to improving the safety evacuation ability of students in the event of a fire by establishing firefighting facilities and conducting regular drills. However, in emergency situations, the level of calmness and quick response of students remain key factors affecting evacuation training effectiveness.

1.4 Research Questions

(1) How is training effectiveness after use of the information graphics?
(2) What is the feedback of dormitory students for the next development on fire evacuation?

1.5 Research Objectives

(1) Explore of Training effectiveness after using the Information graphics of dormitory students.
(2) Explore the feedback of using the information graphics.

2. Research Methods

The research population were 50 students from the dormitories of Sichuan University of Light Industry and Chemical Technology. The training time was one month. A questionnaire survey was conducted to conduct pre-training and post-training tests.

2.1 Research Design

Selection of research methods: literature reference method, questionnaire survey method, learning process observation/interview, using independent training method. In the current era of continuous changes in education, independent learning has become an essential ability for students. It not only helps to improve students' comprehensive quality but also allows them to cultivate their innovative spirit in continuous exploration. As an efficient visual expression, information graphics can help students understand complex concepts more easily, thereby improving learning results. Therefore, it is of great significance to guide students to understand information graphics through independent learning.

Pre-test	Activities	Post-test
O_1	X	O_2

O_1 Measurement of pre-test score
X Self-learning and using information graphics
O_2 Measurement of post-test score

Preliminary investigation Conduct an investigation into the current situation of school fire evacuation, including fire equipment, evacuation routes, and past fire drills. And conduct a questionnaire survey on students to understand their understanding and experience of fire evacuation.

The questionnaire survey is mainly based on multiple choice questions. There are 45 questions in total, most of which are Single choice question questions. A small number of questions are multiple choice questions, and each question has 1 point. It covers the knowledge of fire safety awareness, escape self-rescue ability, fire safety psychology, etc.

The survey results show that students have a generally good grasp of fire safety knowledge. Most respondents expressed familiarity with the use of basic firefighting facilities and equipment, such as fire extinguishers, fire hydrants, etc. However, the level of understanding of more professional fire safety knowledge and skills, such as the correct methods of evacuation and escape, and the maintenance of firefighting facilities, is relatively low. This indicates that schools should strengthen their efforts in fire safety education, enhance students' awareness of fire safety and their ability to self-rescue and mutual aid.

2.2 Information Graphics Design and Implementation

Based on the preliminary survey results, design information graphics that are in line with the actual situation of the school. Practical application in key areas such as student dormitories.

In the context of student fire evacuation, the design of information graphics can provide clear evacuation guidelines for emergency situations, enabling students to respond more quickly and orderly. Its visual characteristics enable students to quickly understand evacuation routes and the location of safety exits even under pressure in emergency situations such as fires, thereby improving evacuation efficiency. As shown in the Figure 1.

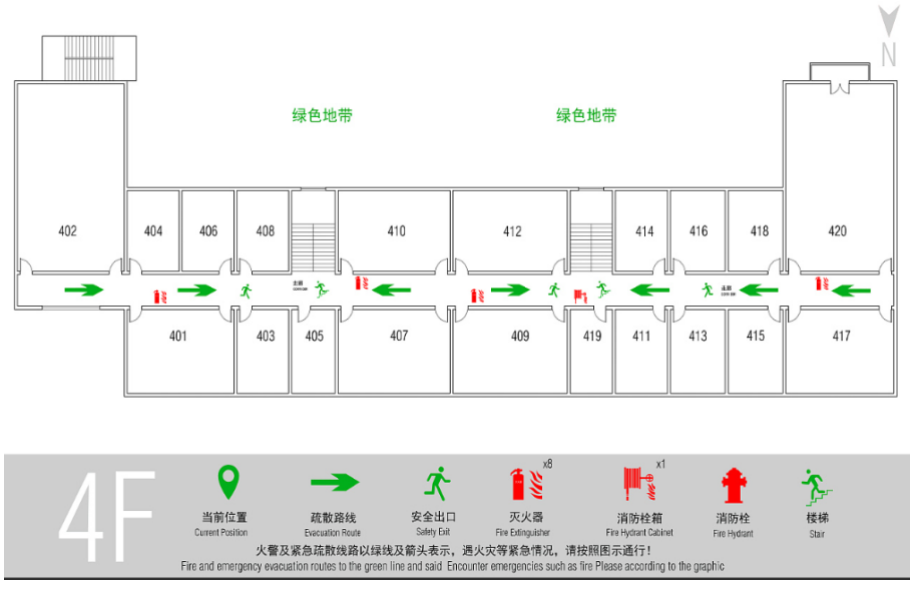

Figure 1: Evacuation Guidelines for Emergency Situations

The correct evacuation steps are crucial in the event of a fire. Here are some key evacuation steps:

- Stay calm: In the event of a fire, staying calm is the first step to successfully escaping. Don't panic, quickly analyze the situation on site and find the best escape route.
- Call the fire alarm number: Immediately call the fire alarm number 119 to report the location and situation of the fire, so that professionals can handle it in a timely manner.
- Determine the escape route: Determine the location of the fire point. If the fire is small, you can put out the fire yourself; if the fire is large, flee immediately.
- Use fire escape routes: Use fire elevators or stairs to escape and avoid using regular elevators as they may experience power outages or malfunctions during a fire.
- Cover your mouth and nose with a wet towel: Cover your mouth and nose with a wet towel, clothing, or other usable fabric to prevent inhaling toxic smoke.
- Low posture escape: Try to move forward in a low posture as smoke and toxic gases often accumulate in the upper part.
- Close the doors and windows that have not escaped: If it is not possible to escape immediately, the doors and windows should be closed, and wet towels, fabrics, etc. should be used to block the gaps between the doors and windows to prevent smoke from entering.
- Escape using ropes: If the escape route is blocked, homemade ropes such as bed sheets and curtains can be used to escape through windows.
- Don't be greedy for property: During the escape process, don't waste time trying to save property. Life safety is always the top priority.
- Seeking help: If unable to escape on your own, you should send out distress signals by tapping objects, waving clothes, etc., to attract the attention of rescue personnel.

2.3 Implementation Period

Conduct a period of practical application to monitor the performance of students during the fire evacuation process.

Through training observation, students are able to correctly use basic facilities such as fire hydrants and fire extinguishers, and their fire safety awareness and self-rescue and mutual aid abilities are gradually improving.

The steps for using a fire extinguisher are as follows:

- Lifting the fire extinguisher: Firstly, it is necessary to lift the fire extinguisher to ensure easy operation.
- Remove the safety pin: Find and remove the safety pin so that the fire extinguisher can be activated.
- Grasp the nozzle: Hold the nozzle with one hand and the handle with the other hand to ensure accurate spraying of the fire extinguishing agent.
- Aim at the root of the flame: Aim the nozzle at the root of the flame, which is the key position for extinguishing the fire and can more effectively extinguish the source of the fire.
- Press down the handle to spray: Finally, press down the handle to spray until the flame is completely extinguished. As shown in the Figure 2.

Figure 2: Using a Fire Extinguisher

2.4 Data Collection

Various methods are used for data collection, including observation records, student feedback, questionnaire surveys, etc., to obtain comprehensive research data.

2.5 Data Analysis Methods

Quantitative data analysis: Using statistical methods to analyze quantitative data on student evacuation efficiency**.** Qualitative data analysis: Conduct qualitative analysis on students' cognition and feedback on information graphics and explore deeper information through thematic analysis and other methods.

3. Research Results

3.1 Training Effectiveness After Using the Information Graphics of Dormitory Students

Achievement papers result as shown in Table 1.

Table 1: Shown the Pre-test and Post-test Scores of Using Information Graphics

Name	Pre-test (P1)	Post-test (P2)
Student 1	36	40
Student 2	30	37
Student 3	32	34
Student 4	29	35
Student 5	31	38
Student 6	33	36
Student 7	30	35
Student 8	35	41

Student 9	29	33
Student 10	30	35
Student 11	33	37
Student 12	32	37
Student 13	37	40
Student 14	33	37
Student 15	34	38
Student 16	32	36
Student 17	36	39
Student 18	30	34
Student 19	35	38
Student 20	32	36
Student 21	33	38
Student 22	32	35
Student 23	36	40
Student 24	29	35
Student 25	33	37
Student 26	32	38
Student 27	34	39
Student 28	34	40
Student 29	35	41
Student 30	30	35
Student 31	37	42
Student 32	33	37
Student 33	33	38
Student 34	34	39
Student 35	35	40
Student 36	30	35
Student 37	34	38
Student 38	36	41
Student 39	29	34
Student 40	32	36
Student 41	32	37
Student 42	35	40
Student 43	34	39
Student 44	33	37
Student 45	33	38
Student 46	32	37
Student 47	36	41
Student 48	31	36
Student 49	35	40
Student 50	30	35
sum	1641	1874

3.1.1 Effectiveness Scores

The calculation is as follows:

$$\frac{P2-P1}{Total-P1} = \frac{1874-1641}{(50\times45)-1641} = 0.38\times100\% = 38\%$$

P1= Pre-test
P2= Post-test

Total= Number of students × Total question score

The effectiveness index was .38 in other words, the students had higher post-test scores of 38 percent.

3.1.2 Comparison of Scores Before and After Testing

Comparison of scores before and after testing result as shown in Table 2.

Table 2: Comparison of Scores Before and After Testing

Items	n	$\overline{X}$	S.D.	t-Test	Sig.(2-tailed)
Pre-test	50	32.82	2.26	-32.229	0.00
Post-test	50	37.48	2.23		

P<0.05

Table 2 Show the comparison of students' fire safety awareness scores before and after test is displayed. The average score of the pre-test is 32.82, with a standard deviation (S.D.) score of 2.26. After using Information Graphics through self-directed learning, students' grades significantly improved, resulting in a high score of 37.48 and a standard deviation (S.D.) of 2.23. The t-test before and after the test showed a significant difference of -32.229, which is statistically significant at the 0.05 level.

3.2 The Feedback of Using the Information Graphics

The feedback of using the Information graphics as shown as Table 3.

Table 3: Satisfaction Assessment of Students Using Information Graphics Through Self-Directed Learning

Statement	Mean	S.D.	Result Interpretation
1. Are you satisfied with self-directed learning?	5.00	0.00	Very satisfaction
2. Are you satisfied with using fire evacuation information graphics?	4.96	0.20	Very satisfaction
3. Are you satisfied with the smooth flow of the safety exits?	4.96	0.20	Very satisfaction
4. Are you satisfied with fire safety awareness education?	4.94	0.24	Very satisfaction
5. Are you satisfied with the completeness of fire protection facilities?	4.92	0.27	Very satisfaction
6. Are you satisfied with the speed of fire response?	4.92	0.27	Very satisfaction
7. Are you satisfied with the school's fire safety management?	4.92	0.27	Very satisfaction
8. Are you satisfied with the effectiveness of the fire drill?	4.90	0.30	Very satisfaction
9. Are you satisfied with the lecture on fire safety knowledge?	4.90	0.30	Very satisfaction
10. Are you satisfied with the clarity of emergency evacuation signs?	4.88	0.33	Very satisfaction
Total	4.93	0.03	Very satisfaction

Table 3 the mean score ranged between 4.88 and 5.00, which was between averages to high levels. The highest mean score (5.00) was the item “Are you satisfied with self-directed learning?”. The lowest mean score (4.88) was the item “Are you satisfied with the claim of emergency evacuation signs?”. This indicates that students are very satisfied with the recognition of using Information Graphics through self-directed learning.

Conclusion

In the information age, Information Graphics, as an intuitive and efficient way of information transmission, have shown great potential in student fire evacuation. By comprehensively considering design principles, student feedback, and actual testing results, we can better apply information graphics to campus safety management, enhance students' self-rescue abilities in emergency situations, and thus better ensure campus safety.

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Contact email: xia_z@mail.rmutt.ac.th
metee_p@rmutt.ac.th

Documentaries as a Tool for Collecting and Disseminating Memories of Self-Initiated Community Practices: The Case of Workshop School

Mateus Carvalho, University of Minho, Portugal
Daniel Brandão, University of Minho, Portugal
Nuno Martins, Polytechnic of Cávado and Ave, Portugal
Bruno Silva, Polytechnic of Viana do Castelo, Portugal

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Abstract
The aim of the research presented in this paper was to observe and record in documentary form the human dimension intrinsic to self-initiated community practices in social neighbourhoods in V.N. Gaia, Portugal. This work was carried out as part of the research project "ECO: Echoing the Community Self". Of the practices identified by the ECO project, Workshop School (WS) was chosen as the object of analysis and intervention in this documentary work. This project adopted an action-research methodology and used audiovisual tools in order to respond to an identified problem: the lack of visibility of the impact that the activity developed by WS has on people. The work was divided into 3 stages: a) fieldwork to diagnose the problem; b) intervention (documentary film aimed at giving visibility to the people who directly benefit from the WS's activity: the trainees); and finally, c) evaluation of the result. In order to observe and diagnose the problem, it was also necessary to adopt an ethnographic methodology, using fieldwork techniques and methods to get closer to the object of study, the most important elements in the creation and development of self-initiated educational practices. This work informed the next stage, in which different mechanisms were adopted to record and construct an audiovisual narrative, based on the testimonies of the people involved in the learning processes mobilised by WS. In order to evaluate the results, they were presented with the intention of contemplating and analysing the reception and perception of the people portrayed in the project.

Keywords: Audiovisual Design, Communication Design, Ethnographic Documentary, Community Practices, Social Neighbourhoods

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Introduction

The aim of this work was to observe and record in documentary form the human dimension intrinsic to self-initiated community practices in social neighborhoods in Vila Nova de Gaia. This work was carried out as part of the exploratory research project "ECO: Echoing the Community Self: designing the dissemination and replication of self-initiated practices in underprivileged urban communities in a post-pandemic world". Of the practices identified by the ECO project, Escola Oficina (EO) was chosen as the object of analysis and intervention in this documentary work.

This project adopted an action-research methodology and used audiovisual tools in order to respond to an identified problem: the lack of visibility of the impact that the activity developed by EO has on people. The work was divided into 3 stages: a) fieldwork to diagnose the problem (study of information and informal conversations); b) intervention (documentary film aimed at giving visibility to the people who directly benefit from the EO's activity: the trainees); and finally, c) evaluation of the result (realising how the EO and the people portrayed in the documentary see themselves in it).

In order to observe and diagnose the problem, it was also necessary to adopt an ethnographic methodology, using fieldwork techniques and methods to get closer to the object of study, the most important elements in the creation and development of self-initiated practices: people in general, technicians, managers, students and trainers. This work informed the next stage, in which different mechanisms were adopted to record and construct an audiovisual narrative, based on the testimonies of the people involved in the learning processes mobilised by EO. In order to evaluate the results, they were presented with the intention of contemplating and analysing the reception and perception of the people portrayed in the project. This work sought to mobilise those involved in constructing an identity through documentary film as a memory device.

Main Objectives

The primary goal of this project was to explore the potential of the audiovisual format of documentary film as a tool for collecting and sharing testimonies related to the impact of the Escola Oficina (EO) on people's lives. To achieve this overarching goal, the following specific objectives were outlined:

- Conduct fieldwork to understand the dynamics of EO, recording testimonies from teachers, trainers, technical assistants, managers, and coordinators about their experiences at EO.
- Produce documentary cinema narratives based on the collected testimonies, highlighting their subjective, poetic, and authorial dimensions, distinguishing this genre from journalistic reportage.
- Experiment with various editing models using filmed and recorded sound material, maintaining technical rigor while exploring the experimental potential in interrelating these visual and auditory elements during the narrative construction process.
- Evaluate the impact and outcomes of using audiovisual tools in documentary creation to foster collective perception and recognition of EO's contributions.

The Origins of Documentary Cinema

As a starting point, it is pertinent to provoke more objective enquiries in relation to documentary as a film genre. First of all, even before giving a more detailed overview of the history of cinema, it's worth asking a simple question: what is documentary cinema?

In order to translate what documentary cinema means, we first need to understand how cinema emerged as a language medium. There is no closed consensus on who was able to promote the signature of the first cinematographic experiment, the information is tied to the end of the 20th century and is rather imprecise. What is a pertinent statement in this regard is that cinema was not born out of a purely technical and scientific need, very much due to the path that photography had already travelled in its artistic and conceptual dimension. It is possible to infer that the history of cinema began at the end of 1880, with the invention of the first film camera, and thus developed into an important communication and entertainment tool.

Formally, among Europeans and North Americans, there are more categorical discussions that defend the birth of cinema, as an entertainment tool, from the first known public screening in the world, held on 28 December 1895, by the brothers Auguste and Louis Lumière, at the Grand Café in Paris.

Considered one of the most influential intellectuals of the North American school of cinema today, Bill Nichols suggests that the Lumière brothers were the protagonists of the first popular cinema movement, which gave them the expression of the fathers of cinema (Nichols, 1997).

In its first practical performances, cinema was organised by capturing real images, events, places, objects and situations. According to critic Kristin Thompson, the images were short frames, no longer than two to three minutes, and mostly recorded images of everyday life. According to the author, the documentary was the first film genre to be created in the entire history of cinema (Thompson, 2002).

Given these preliminary considerations about the origins of documentary cinema and its first competences in society, its practical performances and inspirations, it is possible to suggest that cinema was born documentary. From the films of the Lumière brothers to the films of Dziga Vertov, cinema does not emerge as a simple vehicle for narrative transmission; it is born with the artistic purpose of re-signifying the viewer's hitherto unseen gaze on the moving image. It was later that cinema was appropriated as an entertainment tool to lead to other narrative constructions that were more technical, more refined and already heavily invested in.

As the capacity for technical reproducibility developed and consolidated, over the decades cinema was able to accompany a wide range of possibilities for artistic elaboration. Openings arose that were capable of advancing increasingly daring and innovative productions, according to the technological availability of each moment.

Documentary cinema, therefore, is mobilised and characterised through a model of direct narrative communication, comprising a number of codes and languages capable of reaching subjects who share the same impression of the ‘real’ captured by the filmmakers. In other words, documentary cinema proposes a dialogue with the subject being filmed. And it is from

this communication that identity, cultural and ethnographic elements multiply, both in those who are portrayed or observed, and in those who are spectators and perceive themselves as capable of sharing impressions, subjectivities, affections and experiences.

In general, those interested in documentary cinema were, and still are, those who value the connection between a pact of realities as a way of accessing knowledge, whether scientific, empirical, social, practical or technological. The scales at which these realities collide among viewers can work from distant or close points of view, the important thing is that they are realities that are connected by this bond of apparent capture of the imprecise moment, the unscathed and inapprehensible moment.

In its formal dimension, documentary cinema also encompasses an immense range of languages, from more essayistic styles to more objective and didactic systems.

We have therefore come to the conclusion that, when composing a narrative device in documentary cinema, it is advisable to emphasise both the communicative purpose of a documentary piece and the choice of a well-defined form in which to communicate.

The Relationship Between the Director and the Characters

The primary concern in this work, in terms of documentary recording, is the way in which the representations of elements of everyday life are assimilated by the viewer. A crossing that indicates ruptures not only in its narrative structure format, but also in its pact and mediation with the viewer, in its breakdown of expectations and the simulated connections proposed by contemporary mediatisation.

What Free Cinema and True Cinema called the real and put into dispute in the field of film language would therefore be, according to Comolli (2008), a layer of the world that is not apprehended in any narrative, that escapes all narratives that have already been formed. The real, therefore, would be that which demands a new narrative, or challenges the narrative that has already been put forward (Comolli, 2008, p. 100).

In short, the project was guided by a detachment from the more formal rules of narrative construction so common to the environment of journalistic description in order to grasp the elements of what is considered ‘real’ in documentary cinema. The project is evidently detached from these models, not only due to the unequivocal lack of financial resources, but essentially due to the forces of conviction in a cinema that is more aligned with experimental, creative, inclusive and, above all, activist issues.

It was necessary to move away from the journalistic model of representation, which corresponds to a way of constructing facts and subjects that sometimes doesn't hide its modulations of narrative genre according to an almost natural and discriminatory movement of exoticising the elements narrated due to a lack of knowledge of the world that is to be described, acted upon and starred in.

This is also how researcher Ana Clara Roberti ponders, in her doctoral thesis, on the potential of the authorial ethnographic documentary and how it behaves as an effective alternative to this exoticising lens: Writing, speaking or making films about the encounter with the other is different from saying who these others are. Assuming the experience and vulnerabilities of documentary filmmaking in the field, with due care, frees the work from the ethical dilemmas

of ethnographic and documentary science, such as the exoticisation of the object of study and the superiority complex of those who define it as such (Roberti, 2020, p. 42).

It is also important to highlight the work of Brazilian film director Eduardo Coutinho. Based on his cinematographic style, Coutinho doesn't care much if the characters he chooses characters present a testimony that corresponds to a status of truth or lie, fiction or reality, because what is at stake is not so much what is said, but a capacity to convince, a certain peculiar way of knowing how to rely on the memory of the present, mixing reason and sensitivity, revelation and imagination, fact and version (Bezerra, 2013, p. 404).

As a subjective and complementary justification, capable of referencing the intellectual framework of the practical activities to be carried out, the result of this proposed development was essentially characterised by the role of the spectator themselves.

Discussing, reflecting and trying to practice the game of positions where the film processes an exchange relationship, under the gaze of what we can call the emancipation of the spectator. Emancipation as the resumption of a relationship between human beings and themselves, a relationship lost in a process of separation (Rancière, 2011, p. 19).

This work functions as another search movement. An eternal search for human similarities, for linguistic singularities between the relationship with the other through the documentary. The search for a beauty uniquely contained in memory, based on testimony, for a moment of decompression and pact between director, spectator and filmed subject.

The Empirical Work

The first stage of this methodological research model focused on developing an initial action project plan. A document was required to summarise and highlight the primary foundational stages of the activities to be undertaken during the project. This document needed to include the methodological steps and their applications, along with corresponding work schedules aligned with the project's specific timeline.

The methodological guidance stages were structured according to the practical and theoretical design of the project itself. The planning process was, therefore, invaluable in delineating and organising the stages and phases between practical, theoretical, and reflective activities, as well as determining how and when these activities could interconnect.

The planning phase also proved critical in considering the availability of access to locations and individuals interviewed throughout the image capture process. It anticipated logistical interventions based on the availability of suitable dates for video recording at EO and individual interviews. Moreover, it facilitated a realistic temporal framework for drafting this report and allowed sufficient time to gather participants' feedback through a reception questionnaire about the project's results.

The subsequent stage of this empirical work was divided into three phases:

Phase I - Observation/Diagnosis
Phase II - Intervention
Phase III - Evaluation/Reflection

Conclusions

According to the initial objectives of this academic action project, several insights can be highlighted regarding the institutional and social role of self-initiated projects in Portugal, such as the case of EO. The researchers' engagement enabled them to outline the most prominent traits of a social action project that yields substantial benefits for an entire community, as reflected in the testimonies of the individuals interviewed during the process.

The core challenge and goal of this work revolved around the initial question: how could audiovisual media, through its applications and documentary cinema techniques, contribute to the collection and sharing of stories related to EO's impact on people's lives across its diverse layers and dimensions of activity? It is not possible to categorically assert whether the practical outcomes of this work provided definitive and objective answers. The methodologies employed for collecting results from the participants are insufficient to fully capture perceptions and measure the actual impact of this project's interventions. Nevertheless, through its scope and depth, and based on testimonies collected during visits and the feedback interview with participant Manuela Silva, the documentary indeed served as a powerful tool for memory collection and as complementary evidence of the transformative impact EO has had on those involved in its learning processes.

The power of the images, alongside Manuela's testimony about her reception of the film, is recognised by the researchers as unequivocal proof of how EO, as an institution, asserts the participation of these individuals as citizens within a collective whole.

The images function as empirical evidence of how a vocational training school can inspire and mobilise individuals within the social fabric to become protagonists of their own professional actions. They develop technical, social, and intellectual skills through structured and professional interactions with trainers, social action technicians, and mentors, offering a multifaceted and inclusive approach to creating new opportunities in the local labour market.

The images themselves hold layers of subjectivity woven into the complex relationships among trainees, the institution, trainers, physical learning spaces, the methodologies involved in the training processes, the teamwork dynamics developed by the students, and, finally, the interaction between the filmed subjects and the filmmaker.

The sequences captured reveal the richness of detail within these hubs of technical and professional knowledge at EO, which serve as the core of its role as a training entity. EO strives not only to provide professional guidance but also to foster new emotional connections and support individuals in overcoming personal challenges. The institution embraces dialogue with conflicting perspectives, tailors its approach to the personalised aspirations of trainees, and promotes voluntary collaboration as key features of a project that impacts the personal, professional, and subjective dimensions of the lives of all those involved in its various operational layers and phases.

One of the key conclusions of this project is rooted in the observation of how its audiovisual narrative format was capable of conveying the fundamental concept of self-initiated projects. These projects emerge as promising tools in addressing the country's current social realities and the processes deemed most significant in this context.

The practical outputs of this work provide an understanding of the general structural framework of this self-initiated project model, while also offering an opportunity for replication by other entities interested in working within the parameters outlined by the action project defended in this research.

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Development of the 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program

Saruit Wongdontri, King Mongkut's University of Technology Thonburi, Thailand
Naphatsanan Suwannawong, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
Augmented Reality (AR) offers numerous benefits across various fields by displaying the 3D models of complex structures as real objects in digital information. For improvement of the educational service for many undergraduate students per year at the Applied Computer Science-Multimedia Program in King Mongkut's University of Technology Thonburi, the 3D models in AR for educational equipment were created to improve the equipment borrowing service process. The AR media were made available through QR codes which students can simply scan with their mobile to make visualize understanding better than the 2D picture without the risk of real equipment damage. This approach not only aided in better visualization and understanding of complex equipment but also fosters a more efficient and informed decision-making for equipment selection. The 3D models of real objects were created using the 3D scanner and displayed with AR, which were assessed the qualities by three expert professors. The satisfaction after using AR media of all 3D models was then evaluated with a sample group of 30 undergraduate students in the Applied Computer Science-Multimedia Program, selected by simple random sampling. The tools in this study were the quality assessment form and the satisfaction assessment forms using 5-score rating. This study indicated that the overall qualities of the AR were rated as very good, and the satisfaction level of the sample group was high. Therefore, the implementation of 3D augmented reality media has significantly enhanced the equipment borrowing service for undergraduate students.

Keywords: Augmented Reality Media, 3D Models, Equipment Borrowing Service

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Introduction

The integration of immersive technologies like Augmented Reality (AR) has emerged as a transformative approach in various fields, including education. AR blends real-world environments with interactive digital content, providing an enhanced user experience that improves comprehension and engagement. By allowing users to visualize complex structures as 3D models in real-world contexts, AR offers significant advantages in terms of understanding and interaction. This capability makes it an invaluable tool in educational environments where visual learning and practical understanding are crucial.

At King Mongkut's University of Technology Thonburi, the Applied Computer Science-Multimedia Program serves hundreds of undergraduate students annually, many of whom rely on educational equipment for practical coursework and projects. However, traditional equipment borrowing processes often involve inefficiencies and risks, such as insufficient understanding of the equipment's functionality and potential damage due to improper handling. These challenges highlight the need for innovative solutions that enhance the borrowing process while ensuring the longevity of valuable resources.

This research aims to address these issues by developing 3D AR media to support the equipment borrowing service for undergraduate students. By integrating 3D models into AR applications, the project seeks to improve students' understanding of equipment through detailed visualizations that reduce reliance on physical handling. QR codes are employed to provide easy access to AR media, enabling students to scan and view the models directly on their mobile devices. This approach minimizes the risks of equipment damage while offering an interactive and engaging learning experience.

The study focuses on the development, quality evaluation, and user satisfaction assessment of the AR media. High-quality 3D models were created using a 3D scanner, designed to replicate real-world educational equipment accurately. The AR media's quality was evaluated by three expert professors specializing in multimedia and educational technologies, ensuring its effectiveness in meeting educational objectives. To measure user satisfaction, a sample group of 30 undergraduate students was selected through simple random sampling and surveyed using a 5-point Likert scale.

The findings of this study indicate that the developed AR media significantly improves the equipment borrowing service by enhancing students' understanding and decision-making capabilities. The AR models were rated as very good by experts, and the satisfaction level among users was high, demonstrating the effectiveness of this innovative approach. This research not only highlights the potential of AR in revolutionizing educational services but also provides a foundation for future applications of immersive technologies in academic settings.

Objectives

1) To develop 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program.
2) To evaluate the quality of 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program.

3) To assess the satisfaction of the sample with 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program.

Literature Review

Augmented Reality Media

Augmented Reality (AR) is a transformative technology that superimposes virtual elements onto the real world, enhancing the viewer's experience. (Mujumdar, 2022) by providing additional valuable information. It is applied across various fields, including education, to enrich learning through interactive virtual objects (Permana et al., 2023) and improving the educational process for students, making AR a valuable tool in education, marketing, and healthcare (Salmiyanti et al., 2023). Augmented Reality (AR) media has emerged as a transformative tool in educational settings, enhancing engagement and understanding across various subjects. The integration of AR into learning environments allows for interactive experiences that can significantly improve student outcomes (Shi, 2024). Effectiveness in Learning, AR-based learning media has shown substantial improvements in student understanding. AR has been successfully applied in various subjects, including economics, where it simplifies complex concepts, leading to significant learning gains (Panjaitan et al., 2024). In creative fields, AR enhances traditional poster-making by providing interactive elements that enrich the learning experience (Multazam et al., 2024). Technological Integration, the incorporation of AI and computer vision into AR systems allows for more intuitive user interactions, enhancing the overall educational experience. This integration supports real-time data processing and contextual awareness, making learning more personalized (Shi, 2024).

3D Models

3D modeling is a dynamic and essential process in various fields, enabling the creation of virtual representations of objects and environments. This technology encompasses a range of techniques and applications, from animation and gaming to architecture and product design. Fundamental Components of 3D model include Vertices, Edges, and Faces: These are the building blocks of 3D models, forming meshes that define geometry (Ghuge, 2023). 3D models play a crucial role in enhancing Augmented Reality (AR) experiences across various domains, from education to assembly instructions. By integrating real-world imagery with computer-generated models, AR creates interactive environments that engage users in unprecedented ways (Bhuvaneswari et al., 2024). 3D models for equipment borrowing services can enhance user experience and operational efficiency in various contexts. These models facilitate self-service interactions, allowing users to borrow and return items seamlessly (Tu et al., 2021). In this research, 3D models of borrowing equipment play a crucial role in guiding users through the borrowing process.

Equipment Borrowing Service

The equipment borrowing service encompasses various systems and methods designed to facilitate the lending and returning of equipment efficiently. These services leverage technology to streamline processes, enhance user experience, and ensure accountability (Ashar & Iqbal, 2024). The equipment borrowing service in educational institutions is a critical support system that ensures students have access to necessary tools and resources.

Traditional systems often face challenges such as inefficiency, lack of clarity, and user dissatisfaction (German et al., 2021). Incorporating AR and 3D models into the borrowing service can address these issues by providing clear instructions, real-time guidance, and an engaging user interface. Research demonstrates that digital solutions like AR can streamline service operations and improve overall user satisfaction by reducing confusion and enhancing the efficiency of transactions.

Research Method

The researchers divided the research method into 3 phases.

Phase 1 System Development. The system development process follows the ADDIE model that include 5 steps as follows 1) Analysis 2) Design 3) Development 4) Implementation and 5) Evaluation.

1) Analysis: Identify user requirements, challenges in the existing equipment borrowing process, and the feasibility of AR technology in addressing these challenges.
2) Design: Develop storyboards, 3D models, and AR interactions for the system. Key features include a virtual catalog of equipment, step-by-step borrowing guidance, and real-time status updates.
3) Development: Utilize tools or similar platforms to build the AR media system. Incorporate feedback from stakeholders to refine the system.
4) Implementation: Deploy the system in a controlled environment for pilot testing with target users.
5) Evaluation: Assess the system's quality using expert reviews and user feedback.

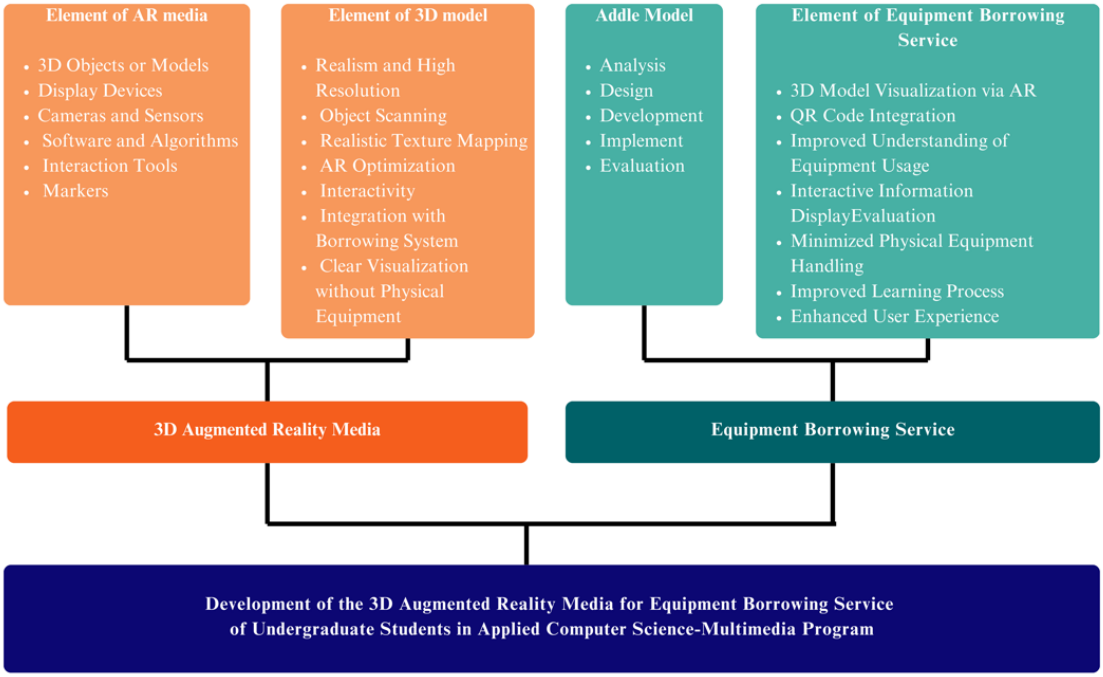

Figure 1: Conceptual Framework

The development of the 3D Augmented Reality (AR) media for the equipment borrowing service is a significant step toward improving the borrowing process and enhancing the educational experience for undergraduate students in the Applied Computer Science-Multimedia Program. This research combines advanced AR technology with 3D modeling to

create a system that is interactive, user-friendly, and highly efficient. The following is an in-depth exploration of the elements and processes involved in this innovative system.

1) Elements of AR Media key elements include 3D Objects or Models, which are used to create realistic and accurate visual representations of the equipment. Display Devices such as smartphones or tablets, which serve as the primary interface for users to interact with AR media. Cameras and Sensors that detect markers or QR codes, facilitating the activation and visualization of AR content. Software and Algorithms that process data and create AR experiences. Interaction Tools allowing users to explore the media interactively. Markers, such as QR codes, that connect the physical and digital worlds, enabling quick access to the AR system. These elements work together to create a robust and efficient system that bridges the gap between physical equipment and digital representation.

2) Elements of 3D Models key elements include the 3D models are designed with realism and high resolution, providing detailed and lifelike representations of the equipment. Object scanning is employed to capture the physical characteristics of the equipment and translate them into digital models. This process is further enhanced by realistic texture mapping, which adds depth and authenticity to the models. To ensure optimal performance, the system undergoes AR optimization, which ensures that the media is responsive and user-friendly. It also supports interactivity, allowing users to engage with the models dynamically. Furthermore, the AR media is designed for integration with the borrowing system, enabling smooth transitions between viewing equipment and completing the borrowing process. Importantly, the system offers clear visualization without physical equipment, reducing the need for students to handle real devices, thereby minimizing potential damage.

3) ADDIE Model for System Development key elements include 5 steps as follow 1) Analysis: Identifying problems in the existing borrowing system and defining user requirements. 2) Creating: a blueprint for the AR media, including the design of 3D models and user interfaces. 3) Development: Building the 3D models and integrating them into the AR system, ensuring functionality and user-friendliness. 4) Implementation: Deploying the system in a real-world setting for users to test and experience. And 5) Evaluation: Assessing the system's performance, identifying areas for improvement, and ensuring that it meets user expectations. This model ensures that the system is well-designed, thoroughly tested, and aligned with the needs of the users.

4) Elements of the Equipment Borrowing Service key elements include 3D Model Visualization via AR, enabling users to view realistic representations of equipment through their devices. QR Code Integration, which simplifies access to AR content and makes the process more efficient. Improved Understanding of Equipment Usage, as the detailed 3D models and interactive displays provide students with better insights into how to use the equipment. Interactive Information Display, allowing users to engage with the content dynamically. Minimized Physical Equipment Handling, reducing the likelihood of damage to real devices. Improved Learning Process, as students can learn about the equipment in a more engaging and interactive way. And Enhanced User Experience, which makes the borrowing process more intuitive and enjoyable.

The second phase involves assessing the quality of the quality of 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program. This is conducted through in-depth interviews with 3 experts specializing in multimedia and information technologies. The process includes detailed

reviews of the steps and methodologies applied during development. Experts evaluate the system using a 5-point Likert scale to determine its alignment with 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program. Basic statistical methods, such as mean and standard deviation calculations, are employed to analyze the feedback from expert evaluations. The quality of the system is evaluated based on ISO 9241-210 focuses on user ease of use, convenience, and satisfaction. 1) Design quality: The scanned object or model is clear, the objects themselves are realistic and interesting, Objects can provide a unique experience from use, The object is easy to use and consistent in use and the objects themselves can help increase awareness and understanding of equipment. 2) Content quality: The content of the object is accurate and reliable, the content of the object is clear and easy to understand, the amount of content conveyed is appropriate, the ordering of content is appropriate and The content of the object can help increase awareness and understanding of the device. Data collection involves expert reviews. Evaluation tools is questionnaires.

The third phase evaluates the satisfaction of the sample group with 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program. The sample comprises 30 undergraduate students from the Bachelor of Science program in Applied Computer Science-Multimedia, selected through voluntary participation. A 5-point Likert scale is used to measure their satisfaction levels regarding the AR media. Basic statistical analyses, including mean and standard deviation calculations, are applied to interpret the feedback from the sample group. The survey assesses as follows 1) Satisfaction with media design: The object or model is interesting to use, The objects are realistic and easy to use, The object can provide a unique experience from its use, The objects have proper interaction and are easy to use, The objects have proper interaction and are easy to use and The object itself can help increase awareness and understanding of the device. 2) Content satisfaction: The content of the object is accurate and reliable, the content of the object is clear, concise and easy to understand, the amount of content conveyed is appropriate, the content order is appropriate and The content of the object can help increase awareness and understanding of the device.

Results

3D Model

In this research, the researcher conducted an experimental process using 3D model to create a realistic 3D model that can be used effectively in the device lending system. The experimental process can be described as follows: 1) Scanning objects with a 3D scanning application on a mobile phone. The researcher began by using a 3D scanning application on a mobile phone to scan real devices used in the lending system, such as cameras or other multimedia devices. 2) Customizing and increasing the clarity of the 3D model After obtaining a basic model from the scan, the researcher imported the model file into a 3D design program to improve the quality to be clear, including editing the textures and increasing the resolution of the model to make it look more realistic and detailed.

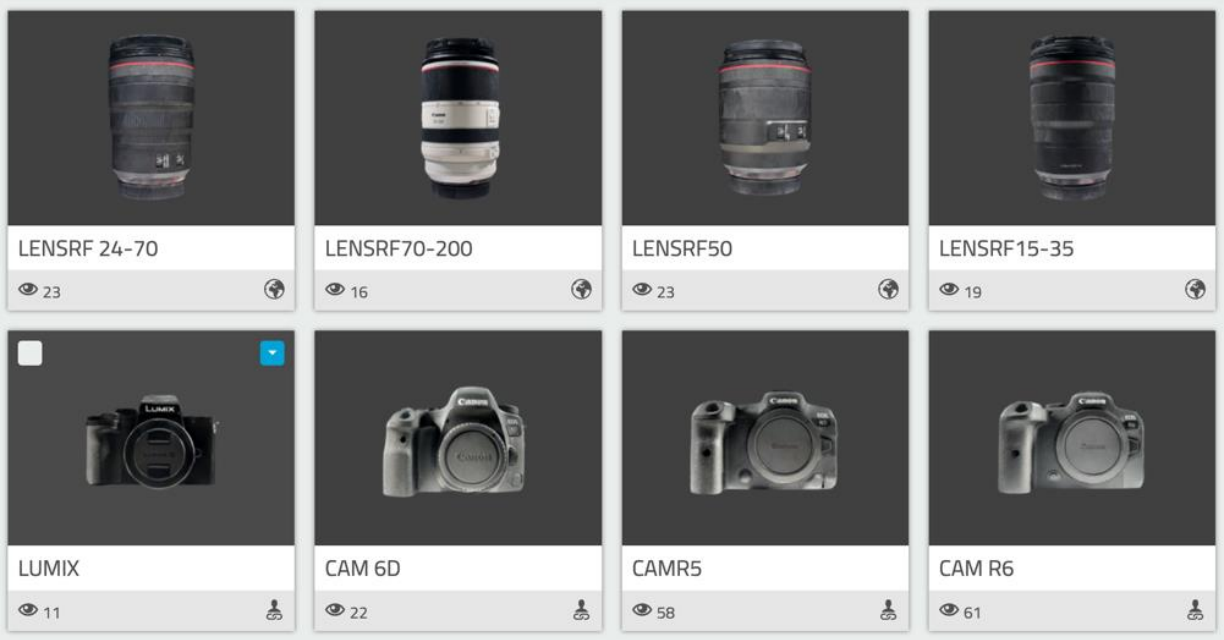

Figure 2: Images of 3D Model Scanning

Augmented Reality

In this research, the researcher conducted an experimental process using AR Augmented Reality to create a realistic AR Augmented Reality that can be used effectively in the device lending system. The experimental process can be described as follows: 1) The completed 3D model is imported into the AR application or platform to create media that displays the 3D model in augmented reality. The AR system is designed to display the 3D model through the smartphone or tablet screen, so that students can see the image realistically. 2) Linking the AR system to the QR Code The researcher created a QR Code linked to the AR model so that students can scan the QR Code and easily access the 3D model via their mobile devices. The use of QR Code reduces the complexity of access and allows students to learn about the information of the device without touching the actual device. 3) Integrating AR into the device lending system AR media is integrated into the device lending system so that students can see details such as the size, structure, and how to use the device before borrowing it, which will help students understand the device more clearly, reduce errors in use, and reduce damage to the actual device.

Figure 3: Images of Augmented Reality Scanning

Results of Media Quality Assessment

The results of media quality assessment by 3 experts in the field of Development of the 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program are as follows:

Table 1: The Results of Media Quality Assessment

Item	**Quality assessment level**		
	X	**S.D.**	**Interpretation**
Design quality			
The scanned object or model is clear.	4.67	0.58	very good
The objects themselves are realistic and interesting.	4.33	0.58	good
Objects can provide a unique experience from use.	4.33	0.58	good
The object is easy to use and consistent in use.	4.00	0.00	good
The objects themselves can help increase awareness and understanding of equipment.	5.00	0.00	very good
Content quality			
The content of the object is accurate and reliable.	5.00	0.00	very good
The content of the object is clear and easy to understand.	4.67	0.58	very good
The amount of content conveyed is appropriate.	4.00	0.00	good
The ordering of content is appropriate.	4.33	0.58	good
The content of the object can help increase awareness and understanding of the device.	5.00	0.00	very good
Total	**4.53**	**0.51**	**very good**

From Table 1, The result of overall quality of the media is at a very good level. The mean was 4.53 and the standard deviation was 0.51. When considering each topic, it was found that the topics The objects themselves can help increase awareness and understanding of equipment, The content of the object is accurate and reliable, the content of the object can

help increase awareness and understanding of the device had a very good level of quality. The mean was 5.00 and the standard deviation was 0.00. Topics: The scanned object or model is clear; the content of the object is clear and easy to understand. The quality level is very good. The average is 4.67, the standard deviation is 0.58. The objects themselves are realistic and interesting, Objects can provide a unique experience from use, The ordering of content is appropriate has a good quality level. The topic has a mean of 4.33 and a standard deviation of 0.58. The object is easy to use and consistent in use, The amount of content conveyed is appropriate has a mean of 4.00 and a standard deviation of 0.00.

Results of Satisfaction Assessment

The Assessment of satisfaction with 3D Augmented Reality Media for Equipment Borrowing Service of Undergraduate Students in Applied Computer Science-Multimedia Program by 30 undergraduate students in the Bachelor of Science program, Applied Computer Science-Multimedia by voluntary selection method are as follows:

Table 2: The Results of Satisfaction Assessment of Students

Item	Satisfaction assessment level		
	X	S.D.	Interpretation
Satisfaction with media design			
The object or model is interesting to use.	4.73	0.45	highest
The objects are realistic and easy to use.	4.77	0.43	highest
The object can provide a unique experience from its use.	4.70	0.47	highest
The objects have proper interaction and are easy to use.	4.60	0.56	highest
The object itself can help increase awareness and understanding of the device.	4.67	0.55	highest
Content satisfaction			
The content of the object is accurate and reliable.	4.87	0.35	highest
The content of the object is clear, concise and easy to understand.	4.57	0.57	highest
The amount of content conveyed is appropriate.	4.70	0.53	highest
The content order is appropriate.	4.57	0.57	highest
The content of the object can help increase awareness and understanding of the device.	4.73	0.52	highest
Total	**4.69**	**0.50**	**highest**

From Table 2, The result of overall satisfaction is at the highest level with an overall mean of 4.69 and a standard deviation of 0.50. When considering each topic, it was found that the topic The content of the object is accurate and reliable had a highest level of satisfaction. Has a mean of 4.87 and a standard deviation of 0.35. Topic: The objects are realistic and easy to use. There is a highest level of satisfaction. The average was 4.77 and the standard deviation was 0.43. The topic the object or model is interesting to use had a highest level of satisfaction. The mean was 4.73 and the standard deviation was 0.45. The topic the content of the object can help increase awareness and understanding of the device had a highest level of satisfaction. The average was 4.73 and the standard deviation was 0.52. The object can provide a unique experience from its use had a highest level of satisfaction. The mean was

4.70 and the standard deviation was 0.47. The topic the amount of content conveyed is appropriate had a highest level of satisfaction. The average was 4.70 and the standard deviation was 0.53. The topic the object itself can help increase awareness and understanding of the device had a highest level of satisfaction. has a mean of 4.67 and a standard deviation of 0.55. The topic the objects have proper interaction and are easy to use has a highest level of satisfaction. It has a mean of 4.60 and a standard deviation of 0.56. And the topic the content of the object is clear, concise and easy to understand, the content order is appropriate had the highest level of satisfaction. has a mean of 4.57 and a standard deviation of 0.57.

Discussion and Conclusion

This research aims to address the challenges associated with the equipment borrowing process for undergraduate students by developing a 3D Augmented Reality (AR) media system. The project integrates 3D models into an AR application to enhance students' understanding of the equipment through detailed visual representation, minimizing the reliance on physical handling. By leveraging AR technology, students can interact with accurate 3D visualizations of the equipment, which helps bridge the gap between theoretical knowledge and practical usage without the risk of damaging real equipment.

The system incorporates QR codes as an easy access point to the AR media. Students can scan these codes using their mobile devices, instantly displaying the 3D models on their screens. This approach not only simplifies the process of learning about the equipment but also fosters a more interactive and engaging learning environment. Additionally, the system serves as a valuable tool for decision-making during the borrowing process, enabling students to better understand the functionality and specifications of each piece of equipment before physical use.

To ensure the practicality and effectiveness of the system, the 3D models were created using advanced 3D scanning technology to achieve high accuracy and realism. The quality of the AR media was evaluated by a panel of expert professors, ensuring it meets educational standards. A user satisfaction study was conducted with a group of 30 undergraduate students selected through simple random sampling. The evaluation focused on both the quality of the AR media and its usability in improving the equipment borrowing process.

The findings indicated that the AR system significantly enhanced the borrowing service, providing students with a better understanding of the equipment while reducing the risk of misuse and damage. Moreover, the interactive nature of the AR media encouraged higher engagement and satisfaction among users. The research demonstrates that 3D AR media is not only an effective educational tool but also a practical solution for resource management in educational institutions.

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Contact emails: saruit.wongd@kmutt.ac.th
naphatsanan.suwa@kmutt.ac.th

Can Individuality Be Taught? The Paradox of Self-Identity and Autonomy in a Pragmatic Society

Venus Ke Xin Pei, Nanyang Technological University, Singapore
Xin Er Lin, Nanyang Technological University, Singapore

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Abstract
Can individuality be taught? This paper explores the paradoxical relationship between Singapore's holistic education model and the culture industry's impact on Singapore in today's digital age. Education in Singapore has evolved from a largely pragmatic curriculum in the nation building years to a more holistic framework in recent years. Even though this is the case, does holistic education necessarily mean a less pragmatic one? This holistic approach encompasses the nurturing of character, creativity, and critical thinking skills alongside strong academic foundations. However, how much of our holistic education system focuses on cultivating a strong sense of self and identity among students? This paper investigates how these seemingly contrasting forces– a holistic education system and a commercially-driven pragmatic society and the pervasive influence of the digital age – coexist in Singapore and the potential impact this has on young minds. Rigid definitions of success limit individuals' critical thinking skills, binding them to conform to uniformity, stunting creativity in the long run. The paper concludes with recommendations for enhancing the current educational landscape. It advocates strategies that promote individual autonomy in critical thinking and foster a sense of ownership in students' learning journey, thereby creating dynamic learning spaces where creativity flourishes.

Keywords: Creativity, Individuality, Pragmatism, Holistic Development, Digital Age

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Introduction

Individuality and pragmatism have been falsely pitted against one another as antonyms. The idea that creativity cannot exist in the realm of pragmatism is a logical fallacy. Yet, when one thinks of Singapore's education system, some may think of pragmatism and academic achievement rather than a knack for promoting deeply introspecting students who are creative and have a strong sense of self (Hardy et al., 2021). This is unsurprising given that Singapore is ultimately a collectivist society. Nonetheless, the Singapore education system has introduced a system of holistic education to respond to the needs and demands of the 21st century (Lee & Low, 2013). Given that digitisation is at the forefront of our globalised world, it is of utmost salience that Singapore's education system remains relevant and rigorous in meeting the demands and needs of the global economy. Given that human capital is the most lucrative resource that supports our economy (Lee & Low, 2013), the value of individuality, thus takes a backseat in relation to developing a holistic education system in comparison to the produced value generated by students when they eventually enter the workforce.

Contextualising Holistic Education in Singapore

While there are studies which focus on the holistic learning and educational policies of Singapore, they largely focus on the costs of education training and the upgrading of skills such that these skills can later be monetised rather than focusing on the personal development of each student, which helps to shape one's sense of self, identity and autonomy. The idea of pragmatism is deeply ingrained in the way policies are crafted in Singapore, education is no different. Schleicher (2013) posits that "education policy needs to respond by improving the quality of learning outcomes, putting the premium on skills-oriented learning throughout life instead of qualifications-focused education upfront. This is about fostering demand-sensitive and relevant learning." and "However, skills development will be far more effective if the world of learning and the world of work are linked." (p. 46). These insights show an inherently pragmatic way of viewing the design of educational policy. This can be problematic to the personal growth of individuals as they are taught to hit targets set for them. The shift from academic focus to skill-based educational policies can help to shape students into better workers, however, true introspection may not be given enough room in the equation. This is because it makes more sense for the curriculum to be standardised such that we meet the country's need to produce a more economy and work oriented educated populace, after all, "Singapore is a small country with limited resources. Our people are our most important resource, and we invest heavily in building up our human capital in order to secure Singapore's future" (Lee & Low, 2013).

In fact, the framework of holistic education is largely based on skill rather than the promotion of discovering oneself. The need for measurable outcomes is often prioritised (Hardy et al., 2021). Another evidence of holistic education being based on monetizable skills rather than focusing on individualism is how the holistic education framework is created based on 21st Century Competencies which are essentially a list of skills a student is expected to develop alongside five or more academic subjects at the secondary level. Lee and Low (2013) have written that "An in-depth review of 21st century competencies (21CC) became topical when governments began to map education outcomes to workforce skills and competencies.". It is notable that many of these skills and competencies are directly related to the development of an individual and by extension, their self-identity.

The Supposed Paradox of Holistic Education and Pragmatism

Holistic education, with its emphasis on personal growth, critical thinking, and well-rounded development, often juxtaposes the commercial culture industry, which is driven by profit maximisation, consumerism, and standardised content. In today's digital age, this paradox becomes even more pronounced due to the pervasive influence of social media, advertising, and digital entertainment on young minds. Yet, Singapore's holistic education framework weaves in the skills required of students. Ng (2017) posits that Singapore, a nation of constant evolution, upholds certain core values to anchor its people amidst rapid change. While deeply committed to a meritocratic system, the country is also striving to support students who face challenges in achieving academic success within its highly competitive environment. As discussed earlier, personal growth, critical thinking and well-rounded development are only important to the extent that it makes them viable human capital and assets in the country's economy. Although this version of holistic education helps to promote the development of in-demand skills among students, it may not give them space necessary to explore their individuality beyond the confines of a future career path. Hung and Johannis (2023) assert that "learning cannot be divorced from self-identity", which would entail that regardless of what subjects and activities undertaken by students in the process of learning, one's identity would be shaped. Yet, if the programmes in school are largely standardised and curriculum is mostly designed with students as human capital in mind, the process of meaning-making would be confined to how one can monetise the skills they have picked up or become a second thought after the need to excel academically. To address this tension, it is essential to reconsider the role of critical thinking and creativity within Singapore's holistic education framework and how it shapes an individual's mindset and sense of self. While these skills are undoubtedly valuable for the workforce, they can also empower students to challenge societal norms, question dominant narratives, and develop a more nuanced understanding of the world and allow for more introspection that can help them navigate the challenges, both personal and otherwise that they may face in the digital age.

Why Does Individuality Matter?

This question will be discussed in two ways: firstly, why does individuality matter, in terms of the goals of Singapore education? Secondly, why does individuality matter for the students?

Individuality can be understood as personal identity formed by one's constant reflection upon experiences in life and external influences, such as societal traditions, surrounding the individual (Hinchman, 1990, p. 759). Individuality "imports ethical being" (Lindsay, 1920, p. 423), signalling its importance since it precedes agency and autonomy. The Ministry of Education has listed "self-awareness" and "responsible decision-making" as two out of five "social-emotional competencies" students should acquire under the 21st Century Competencies framework (MOE, 2022a), suggesting that the education system recognises the importance of students understanding that they are individuals so that they can make responsible choices. However, as mentioned above, they are not given the space to explore their individuality beyond what makes them a contributing member to the community. Co-Curricular Activities (CCAs) in school are used to emphasise what the students have contributed to the school, as seen in the measures to evaluate students' abilities by having School Graduation Certificates include "non-academic achievements" and "broadening" CCAs to acknowledge student efforts in "student-initiated… and community-based activities" (MOE, 2022b). Students are expected to make an impact during non-academic activities, like

representing the school in national tournaments or initiating projects to provide community service. Arguably, the success of a student's time in school can be perceived through these certifications and testimonials for their character and contributions to the community. Although the system encourages students to do this in order to build strong character, Singapore's high-stress and highly competitive culture has turned "non-academic achievements" into one of the criteria for success, on top of academic achievements.

Rather than on why individuality matters, the question derived from the framework for holistic education thus becomes: how am I disadvantaged if I do not showcase my individuality in terms of non-academic contributions and achievement? Singapore is known for kiasu culture: a colloquial term that means "fear of losing out". A study was conducted on kiasuism among Singapore undergraduate students to conceptualise the term (Bedford & Chua, 2017). The study's findings determined kiasu to indicate behaviour that is perceived to be motivated by the fear of losing out to others. Kiasu behaviour is characterised by constant comparison with others, and the perception of needing to gain something that others are getting despite not actually caring for it. The two mindsets discussed in the study apply: not wanting to "miss out on a potential benefit or common good" and not "fall(ing) behind peers academically". Certificates including non-academic achievements become another measure for comparison between peers, even if the original intentions behind initiating a community project, for example, came from a genuine desire to help others. The value of the project becomes quantifiable; it becomes a question of how much more this student has done for the community as compared to others. The idea of missing out on a potential benefit could spur students to take up leadership roles in CCAs not for the valuable experience of being a leader, but instead, for the title held and having it listed as an achievement. When the majority of students work hard to add to their list of non-academic achievements, the pressure to showcase one's individuality and contribution to the community for a better chance at entering a good school or finding a good job in future increases. In this case, individuality becomes a by-product of one's activities and experiences, what makes them stand out as an individual becomes a metric to pit themselves against their counterparts in a web of limited opportunities. Individuality matters to the extent that it can demonstrate why one is a better candidate than others, rather than simply being a unique individual.

This brings the discussion to the second question: why does individuality matter for the students? On a philosophical level, individuality is seen as the foundation of "all practical interest" (Jordan, 1921, p. 566). This means that one's personal identity, which is separate and distinguishes the self from the others, gives reason for action. However, kiasuism places the distinguishing of self from others as *the* reason for action. When the notion of individuality is centred around comparison with one's peers, the pressure to succeed can become overwhelming. In recent years, there has been rising concern for the mental health of Singapore's youths. The Institute of Mental Health (IMH) conducted the first National Youth Mental Health Study, which found about one in four youths felt "severe or extremely severe" anxiety symptoms, particularly those who are in the 15 to 24 age group as compared to those aged 30 to 35 (2022). Excessive use of social media is cited as a reason, whereby youths are exposed to "constant comparisons" (Verma & Subramaniam, 2024) with what they see on the screen. Not only that, academic stress stems from the students' "own expectations" and expectations from parents and teachers (Tan, 2022). This suggests that students in Singapore form their sense of self through comparing themselves with their peers, which parallels the findings from studying kiasuism. A person's worth is hinged upon one's achievements in comparison to their peers'. Individuality then, as the notion that it provides reason for action, matters because individuality conceptualised via kiasuism has led to poorer mental health

amongst youths in Singapore. In encouraging students to gain a sense of individuality beyond their value for the workforce, they may feel less of a need to compare themselves to and compete with their peers in order to get a better job or higher pay.

How Is Individuality Taught?

In Singapore's education system, the first primary school Character and Citizenship Education (CCE) syllabus that is based on the 21st Century Competencies framework lists "Identity" as one of the Three Big Ideas, and the curriculum attempts to teach students how to have "perception of self". The focus centres around "Being who I am and Becoming Who I can be" (MOE, 2012, p. 13). However, guiding students to form a conception of the self as an individual is subsidiary to the greater objectives of the CCE curriculum, in which students are to form a sense of responsibility for the greater society. Identity is discussed mainly because being "good individuals" must come before becoming "useful citizens" (p. 1). In teaching critical thinking skills for students to be "inquisitive learners" and "critical thinkers" (Sng, 2023), students are indeed provided the space to maintain, in Dewey's words, "healthy scepticism" (1909). According to a paper from NIE, creative and critical thinking push students to apply and adapt knowledge to problem-solve, and sometimes it is done by breaking "established symbolic rules and procedures" (Chiam et al., 2014, p. 35). In encouraging students to judge a problem and find alternative ways to resolve problems, it provides them the space to think for themselves and break away from the uniformity of previously established rules. This is limited to problem-solving, however, and ultimately gears students towards becoming useful citizens and talents in the nation's workforce. Arguably, individuality is not being taught in the way that gives students a sense of their worth as true individuals, but rather, an individual whose identity is valued only as part of the larger construct of society. That said, schools do have time and available resources to enable students to find their sense of individuality.

Recommendations and Conclusion

It is important to recognise that individuality and collectivism are not mutually exclusive. While Singapore's collectivist culture emphasises harmony and cooperation, it does not necessarily suppress individual expression. However, the way that individuality is treated as a by-product or an innate result of holistic education is one that does not lead to students becoming more in tuned with their needs and sense of self. While students are given plenty of opportunities to partake in various activities to cultivate interests and skills, as well as take up multiple enrichment classes within the holistic framework of education, individuality as a concept is more of an educational by-product than a goal in and of itself. More emphasis should therefore be placed on encouraging individual expression, as a strong sense of self-identity helps students gain a clearer understanding of themselves, and thus they become more likely to be motivated and engaged in their studies (Johannis & Hung, 2023). Instead of solely focusing on learning subject matter and seeking immediate opinions, schools should prioritise self-discovery through activities like exploring hobbies and interests. This provides them with the space to explore what they like to do within imposing boundaries based on what the school is able to provide the student. Some hobbies may not be readily accessible to students; however, this should not limit them from learning more about the subject matter through resources available such as the school library and the internet, which democratises a large amount of information regarding a diverse array of hobbies. Search activities and guidelines can be issued to students to ensure that they stay on track in terms of viewing and accessing content which is age appropriate. Even if they are not able to carry out their activity

of interest first hand, learning about components of the hobbies can help students understand themselves better, not for the sake of pursuing a plausible career out of their discovery (even though, this can be a part of their search for an interest or hobby). The core of this approach is stemmed in the discovery of the self. This approach allows students to develop a stronger foundation for understanding themselves before engaging with external knowledge. Moreover, schools can consider including a monthly check in in terms of understanding how well students are coping. Currently, the issues of mental health, although greatly de-stigmatised as compared to a decade ago, continues to be a sensitive issue that schools have to skirt around. This is evidenced by how youths in Singapore tend to associate terms of "mental illness" with pejorative words (Pang et al., 2017). Even though there are helplines and resources available for students, they may not feel comfortable to seek out these resources themselves and may not know how to go about approaching their emotions. To ensure that students are well-adjusted given the rise in symptoms of poor mental health, schools must do more to normalise the expression of one's emotions through regular check in sessions. The issues of societal pressures can be discussed openly rather than swept under the rug, so students are more likely to open up about their troubles and relate to one another, providing effective peer support (Richard et al., 2022) given their shared experience of learning in a high-stress and competitive environment. This not only allows students to become more empathetic towards one another, it helps them to reconcile their emotions of stress and uncertainty, which when left unchecked may lead to detrimental outcomes for the overall mental health of the student population. Through a more extensive curriculum that focuses on the core of self-discovery for self-discovery's sake and a more introspective approach in dealing with issues of mental health, students can better manage stress, build resilience, and develop healthy coping mechanisms that leads to a more holistic assessment of the self, thus enriching the learning experiences of students in Singapore. Future studies can look into how educators can create a learning environment where students feel empowered to express their unique ideas and perspectives around topics which require a higher level of introspection and sense of self. Individuality, as we have discussed, cannot be taught. It ought to be discovered through consistent introspection and participating in activities of interest. The notion of individuality remains at the heart of what makes a person, and within the ten years of compulsory education in Singapore, students should be provided the space to ascertain what makes them who they are.

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Development of Online Video Learning Media on Paper Box Packaging Production Process

Ratsamee Narktaptim, King Mongkut's University of Technology Thonburi, Thailand
Sasita Thakerngsri, King Mongkut's University of Technology Thonburi, Thailand
Sirinuch Khaebamrung, King Mongkut's University of Technology Thonburi, Thailand
Yathana Pakawattanakoson, King Mongkut's University of Technology Thonburi, Thailand
Suchapa Netpradit, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
Nowadays, many products require box packaging to protect them during transportation, handling, and storage, making mass production for many industries. To provide important knowledge for paper box production, online learning using VDO media should be created to enhance understanding for the relevant persons. The objective of this project was to develop video learning media, especially for staffs and customers on the paper box packaging production process as the requirement of a manufacturer. The video materials of five learning modules were created using the InShot program and the qualities of online video learning material were then evaluated. The learning effectiveness and satisfaction of the sample group were assessed using 25 learner participants, including new staffs of the manufacturer, undergraduate students of a packaging program, and interested persons. The tools included a quality assessment form, a pre-test and post-test consisting of 20 multiple-choice questions, and satisfaction evaluation form using 5-score rating. The results indicated that the overall content quality was good (mean=3.96) and the media quality was good (mean=4.37). The learning effectiveness determined from the test scores showed that the post-test was 44.2% higher than the pre-test, statistically significant at the .05 level. The average normalized gain (N-gain) was 0.64, indicating as a medium level of learning effectiveness. The sample group expressed a high satisfaction with the learning materials (mean=4.12). Therefore, this learning material can effectively be applied to provide an online learning platform for the manufacturer to improve the packaging production process and company marketing.

Keywords: Online, Offset Printing, Paper Box Packaging, Video Learning Media

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Introduction

Many products require packaging to protect them during transportation, handling, and storage, making mass production for many industries. The demand for sustainable and Eco-friendly packaging solutions has surged, leading to a significant rise in the popularity of paper box packaging. The paper boxes are biodegradable, recyclable, and made from renewable resources, making them an excellent choice for businesses aiming to reduce their carbon footprint. The production of a paper packaging box is a meticulous process that requires careful attention to detail at every step. From initial design considerations to the final quality check, each stage plays a crucial role in creating a packaging solution that meets industry standards and customer expectations. To control the qualities of products, the manufacturer must provide the learning media for upskilling or training process that helps employees develop new or higher-level skills to improve their work performance. It can also help employees prepare for new opportunities within their company.

The advancing technology and improved internet access increased use of online learning which significantly enhance learning engagement and motivation. Since the digital devices such as computers, tablets or smartphones allow easy access to resources for self-learning, online learning becomes flexible and enable learning in anytime and anywhere. To provide important knowledge for paper box packaging production, online learning using VDO media should be created to enhance understanding for the relevant persons. The objective of this project was to develop video learning media, especially for staffs and customers on the paper box packaging production process as the requirement of a manufacturer (UL Printing and Packaging Co., Ltd.).

Methodology

The online video learning media on the paper box packaging production process were created as the requirement of UL Printing and Packaging Co., Ltd. as an offset printing house using the InShot program. The online learning unit in the model of VDO included of 5 units was applied to provide knowledge especially for staffs and customers of the company.

The qualities of learning media on contents and design were evaluated by 6 experts, 3 experts in contents and 3 experts in media. The learning achievement and satisfaction of the sample group were assessed by new staffs of the manufacturer, undergraduate students of a packaging program, and interested persons. The tools of a quality assessment form was 5-point rating scale using the Google Form. The learning achievement of the learners was determined from a difference of pre-test scores and post-test scores and normalized gain with 20 multiple-choice questions. The satisfaction evaluation form was also used with 5- point rating scale created in the Google Form. The Criteria of 5-point rating scale for evaluation are shown in Table 1.

Table 1: The Criteria of 5-Point Rating Scale for Evaluation

Scale	Scale Interval	Opinion for Quality	Description for Satisfaction
5	4.50-5.00	Excellent	Very Satisfied
4	3.50-4.49	Good	Satisfied
3	2.50-3.49	Average	Neutral
2	1.50-2.49	Poor	Dissatisfied
1	1.00-1.49	Very Poor	Very Dissatisfied

The quiz for pre-tests and post-tests of each unit was created with Google Forms using optimal multiple-choice questions for a module with IOC and difficulty level analysis as Eq. 1.

$$\text{Difficulty Index (P)} = R/T \quad \text{(Eq. 1)}$$

Where R is the number of correct responses and T is the total number of responses in the sample group

The appropriate difficulty is 0.20-0.80 because the exams that were too difficult (<0.20) or too easy (>0.80) were unable to classify the learning outcome.

The learning achievement was analyzed by comparison between the average scores of pre-tests and post-tests before and after self-learning the VDO media and using t-statistics (T-test dependent samples) with statistical significance at the 0.05 level. The normalized gain (N-gain) was also found and analyzed, as shown in Table 2.

Table 2: The Classification of Normalized Gain Values

Gain Score	Interpretation
$g > 0.7$	High
$0.3 < g \leq 0.7$	Medium
$g \leq 0.3$	Low

Results and Discussion

The topic, learning objective and video clip duration of each unit are shown in Table 3.

Table 3: Lesson Modules of the Online VDO Learning

Unit	Topic	Learning Objective	Duration (min)
1	Process of Producing Foldable Paperboard Packaging	To gain more knowledge for learners about special coating techniques, paper selection for boxes and graphic design.	01:52
2	Pre-press process	To gain more knowledge for learners about preparing work files, lay-out of the box, plates, die-cut, boxes, paper cutting for print, etc.	01:07
3	Press process	To gain more knowledge for learners about paper loading into the press, ink system and print quality inspection.	0:49
4	Post-press process	To gain more knowledge for learners about die-cutting of printed sheets, quality checking of workpieces, gluing the box and Packaging	01:17
5	Consideration for Producing Foldable Paperboard Packaging	To gain more knowledge for learners about design, packing products into boxes, choosing to use a different type of paper, distribution, import-export, and special color selection	01:34

The examples of pictures capturing from 5 unit of the learning media which create as multimedia are shown in Fig. 1-5.

Figure 1: The Examples of Video Media in Unit 1

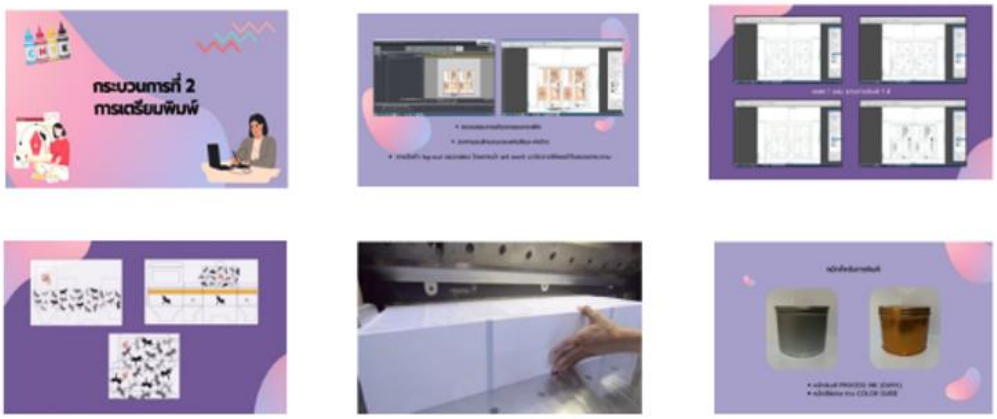

Figure 2: The Examples of Video Media in Unit 2

Figure 3: The Examples of Video Media in Unit 3

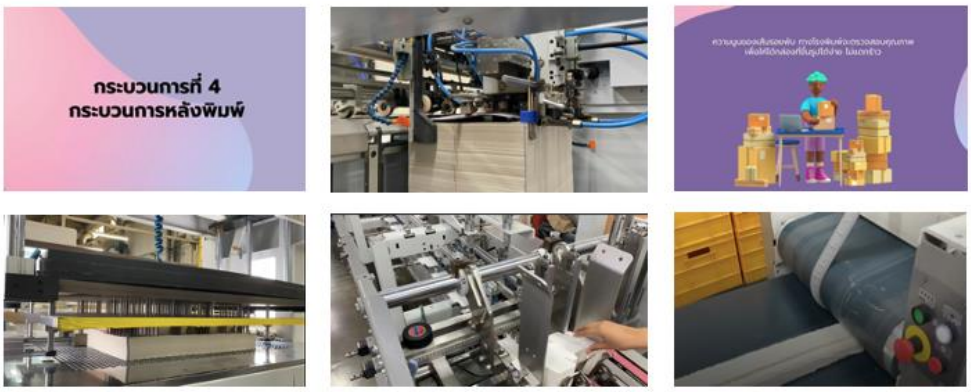

Figure 4: The Examples of Video Media in Unit 4

Figure 5: The Examples of Video Media in Unit 5

The quality of the video learning media was assessed by 6 experts, 3 experts in contents and 3 experts in media. The content quality assessment results of video production show in Table 4. The results of media quality assessment of video production show in Table 5.

Table 4: The Quality Assessment for the Content of Video Media

Appropriateness Evaluation	**Evaluation Results**		
	Mean Score	**S.D.**	**Level**
1. Alignment with objectives	4.00	1.00	good
2. Accuracy	4.00	1.00	good
3. Appropriateness of arrangement	3.67	0.58	good
4. Relevance and currency	4.00	1.00	good
5. Categorization	4.33	0.58	good
6. Appropriateness of amount	3.67	0.58	good
7. Appropriateness of sentence used	4.00	0.00	good
8. suitability for the target learners	4.00	1.00	good
9. Matching of Illustrations or video	4.00	0.00	good
Total Average Scores	3.96	0.41	good

The overall content quality was at good level. The standard deviation is at a level where the differences are small (M=3.96, S.D.=0.41). A total of 9 items, the content categories achieved the highest quality level. The appropriateness of content organization, the appropriateness of the content volume achieved the lowest quality level.

Table 5: The Quality Assessment for the Design of Video Media

Appropriateness Evaluation	**Evaluation Results**		
	Mean Score	**S.D.**	**Level**
1. Background color	4.33	0.58	good
2. Font style, color, and size	4.00	1.00	good
3. Screen layout and composition	3.67	0.58	good
4. Background music	4.00	1.00	good
5. Illustrations align with the content	5.00	0.00	Very good
6. Visibility of Illustrations and videos	4.67	0.58	good
7. Loudness and clarity of Audio	5.00	0.00	Very good
8. Learning engagement and promotion	4.33	0.58	good
9. Suitable for distribution	4.33	0.58	good
Total Average Scores	4.37	0.36	good

The overall media qualities were at good level. A standard deviation indicating minimal differences (S.D.=0.36). Illustrations were consistent with the content and the audio in the video was clear, achieved the highest quality level or very good. The screen layout and composition got the lowest quality level. and the total qualities were at good level.

The total sample group of learners for evaluation of learning achievement consisted of 25 persons divided into three groups, as follows:

Group 1. Company Employees for 14 persons.
Group 2. Students studying printing and packaging for 5 persons.
Group 3. General Students Interested in Packaging for 6 persons.

Table 6: Learning Achievement Outcomes of 25 Learners

Quiz	**Sample number**	**Scores**	**Total scores**	**Mean**	***X***	**S.D.**	**t**	**Sig. (1-tailed)**
Pre-test	25	20	141	5.54	5.64	1.38	33.95	0.0000
Post-test			399	15.96	15.96	1.79		

For Pre-test, the learners have an average score of 5.64 points=28.2%. For Post-test, the learners have an average score of 15.96 points = 79.8%. It indicated that the score increased by 51.6%, with N-gain=0.72, which was at the moderate level. Results of the satisfaction evaluation of the sample group consisted of 25 persons regarding the video media are shown in Table 7.

Table 7: Results of the Evaluation of the Sample Group's Satisfaction with the Video Media

Appropriateness Evaluation	**Evaluation Results**		
	$\overline{X}$	**S.D.**	**Level**
1.The content is understandable for learning.	4.16	0.75	good
2. The content is arranged in an easy-to-understand order	4.20	0.65	good
3. The language used is appropriate to the content	3.69	0.84	good
4.The illustrations are consistent with the content.	4.32	0.69	good
5. The picture and sound in the video are clear.	3.92	0.86	good
6. The video media is interesting and engaging for learning.	4.16	0.75	good
7. The video media is appropriate for distribution	4.12	0.83	good
Total Average Scores	4.12	0.08	good

It was found that viewers were highly satisfied. The standard deviation is at a level where the differences are minimal (M=4.12, S.D.=0.08). The illustrations are highly consistent with the content, The level of satisfaction is very high. The language used is appropriate for the content, The lowest level of satisfaction.

Conclusion

The video media on paper box packaging production process of 5 units has been produced with good content qualities which can be used for online learning or training. The Illustrations were consistent with the content and the audio in the video was clear, achieved the highest quality level or very good. The learning effectiveness determined from the test scores showed that the post-test was 51.6% higher than the pre-test, statistically significant at the .05 level. The N-gain was 0.72, which was within the medium level of learning achievement. The sample group has a high level of satisfaction with the produced video media, the illustrations are consistent with the content. Therefore, this learning material can be applied to provide an online learning platform for the manufacturer to improve the packaging production process.

Acknowledgments

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Gap Analysis Between Program Expectations and Competency Outcomes of Students in Industrial Education of Electrical Engineering for Curriculum Improvement

Wannarat Kaewthong, King Mongkut's University of Technology Thonburi, Thailand
Komkrit Chomsuwan, King Mongkut's University of Technology Thonburi, Thailand
Suchapa Netpradit, King Mongkut's University of Technology Thonburi, Thailand

The Asian Conference on Education 2024
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Abstract
To provide a good curriculum for producing valuable graduated students as technician teachers, the specific skills in engineering, professional teaching ethics, and teacher certification were integrated as the requirements of stakeholders. This study focused on the gap analysis for competency of undergraduate students in the 4th year of Bachelor of Industrial Education program in Electrical Engineering at KMUTT. The questionnaire for self-evaluation with 4-level rubric scales was created to determine the qualitative and quantitative data in 3 domains for a sample group of 39 students For the first domain, teaching management skills with 8 indicators showed that the average scores were at a moderate level (mean=3.13), with weaknesses in competencies of lecturing/explaining, learning outcome assessment and problem-solving which needs to be urgently improved. The second domain related to specific electrical engineering skills with 19 indicators showed that the current competencies were below the expected levels in some skills (mean=2.95) but the students were very good in problem identification. The third domain was related to some important characteristics and professional ethics for teachers with 15 indicators. The students' current competencies were at a good level (mean=3.46), with strength points in honesty and professional responsibility but the areas for improvement were leadership and emotion control. Therefore, the gap of student competencies determined with radar charts were effectively applied for curriculum improvement by applying outcome-based education module (OBEM) and create short courses to match the competencies you want to enhance in various skills.

Keywords: Gap Analysis, Competency Assessment, Industrial Education, Curriculum Development

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Introduction

In the 21st century, the Thai population is experiencing rapid changes in politics, the economy, resources, communications, and industrial technology. These developments are happening continuously and play a significant role in our daily lives. They are also key factors in driving the economy toward meeting national development goals. People widely recognize the need to improve and develop education to equip graduates with skills that match the competencies demanded by the labor market and workplaces. Skills gained from vocational or higher education are an important element in determining the structure of the country's workforce. The process of producing and developing industrial labor skills comes from education management, especially vocational education under the Office of the Vocational Education Commission, Ministry of Education. As the main force in education management that focuses on producing personnel by providing knowledge and practical skills to be tools for future careers, it is also a group of labor that the industrial sector needs a lot. Therefore, there is an education management policy to promote more learners in vocational fields, such as organizing dual education programs in collaboration with the industrial sector, enhancing skills in integrating learning with work. Upon graduation, they can immediately work in the workplace, reducing the time spent on teaching and selecting new employees with experience for the workplace. In addition, there is a guideline for developing teaching content to be consistent with the production and development of manpower according to the country's needs. Therefore, industrial teachers are an important cog in the mechanism for producing industrial technicians with sufficient competence to work in the industrial sector. Therefore, technical teachers must have good academic quality, meet standards according to the professional standards of vocational teachers and teacher competence, be knowledgeable in basic skills, specialized skills and being a teacher, which will lead to the effective transfer of knowledge and practice to students in their own educational institutions when they enter the real workforce. Based on the significance and background of the problem, this research aims to study the capability gaps of industrial technical teachers by analyzing the competencies and skills of fourth-year students in the Bachelor of Industrial Education (B.I.Ed.) program, majoring in Electrical Engineering. The study employs McKinsey's Three Horizons of Growth concept, which divides learner competencies into three time periods: Horizon One (current state), Horizon Two (gap between present and future), and Horizon Three (future goals).

The research utilizes questionnaires/interviews to assess students' current competencies and expected competencies, targeting three groups: 1) Fourth-year B.I.Ed. students majoring in Electrical Engineering at KMUTT, and 2) Teachers from the Electrical/Power Engineering departments under the Office of Vocational Education Commission (OVEC).

The research instruments are categorized into three areas consist of core competencies, functional competencies, and discipline, morality, ethics, and professional conduct. Experts validate the instruments' quality through content validity assessment before collecting data from the sample groups.

Upon obtaining the results of current student competencies and expected competencies, a 'competency gap' will be identified, which refers to the distance between the current state and the desired state. The gap analysis begins with setting target goals for development. Next, the current status is analyzed by collecting relevant data through various methods such as questionnaires and interviews.

Once the current and future competency results are obtained, this leads to explaining the gaps that emerge and the factors causing these gaps. Finally, this information is used to formulate recommendations, leading to planning and enhancing the development of personnel capabilities. The goal is to ensure strong academic knowledge that meets vocational education teacher professional standards and teacher competencies.

This involves the development of educational management approaches, the design of training curriculum content, and the creation of student development activities, among other essential tasks for industrial technical teachers. The ultimate goal is to enhance potential through the filling of competency gaps, resulting in the development of authentic knowledge for performing duties as high-quality technical teachers who can propel the nation forward.

Methodology

Beginning with the study of the Bachelor of Industrial Education program in Electrical Engineering (5-year program), the 2020 revised curriculum focuses on specific curriculum content such as philosophy, significance, objectives, and program-level learning outcomes. Two online questionnaires were designed: Set 1 for fourth-year students to self-assess their current competencies and Set 2 for vocational institution teachers to evaluate expected competencies of program graduates, selected through purposive sampling from schools where students practice teaching and who work closely with students (such as mentor teachers and department heads). This is crucial as program graduates will be key intermediaries in developing a workforce (vocational students) for future labor markets. After tools were validated (IOC) by experts using a 4-level rubric scale and analyzed through radar charts, three competency areas were evaluated: 1) Teaching management (8 indicators), 2) Electrical engineering-specific skills (19 indicators), and 3) Essential characteristics for teacher professional ethics (15 indicators), with scoring criteria and interpretations.

Table 1: Quality Assessment Criteria and Descriptions

Scale	Opinion for Quality	Description	
4	Excellent	You should be a role model and expect the most	Should set an example, strive for excellence, integrate your knowledge, tackle intricate issues, instruct others, or offer guidance to others.
3	Good	Expect a lot	Analyze or distinguish, visualize connections, practice, and solve simple problems
2	Fair	Expect moderate	Use your knowledge to solve problems, practice, and adhere to the methods and steps independently.
1	Need to develop and improve	Expect very little	Be mindful, keeping in mind your previous studies or experiences. Organize knowledge to be easy to understand, follow the methods and steps clearly, and be supervised.

When analyzing the stakeholder group consisting of 39 fourth-year students and 23 vocational institution teachers, the capabilities were categorized into subgroups as follows:

Interm of teaching management is divided into 2 subgroups:
1. Teaching design and management
2. Assessment and teacher development

Interm of electrical engineering professional skills, divided into 3 subgroups:
1. Basic Electrical and Electronics
2. Computer & Technology
3. Professional Skills and Problem Solving

Interm of essential characteristics for teacher professional ethics:
1. Teaching and Learning Management
2. Professional Ethics and Conduct
3. Collaboration

Result and Discussion

The analysis of competency gaps among fourth-year Industrial Education students in Electrical Engineering revealed significant findings across three areas: teaching management, electrical engineering professional skills, and professional ethics. Through comprehensive data analysis utilizing radar charts and statistical methods, several notable patterns emerged regarding students' current competencies and stakeholder expectations.

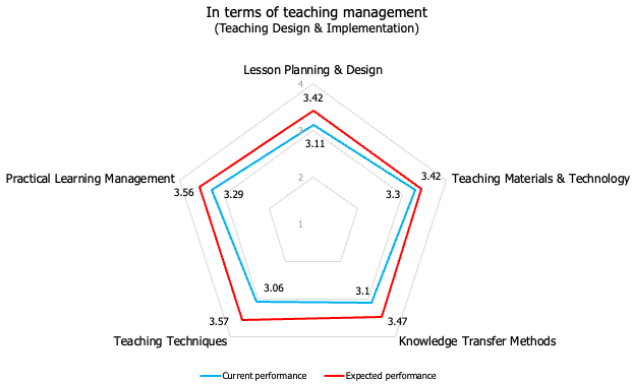

Figure 1: Teaching Design and Management

As shown in Figure 1, the radar chart analysis of teaching design and management competencies reveals distinct patterns between current and expected competencies. The data demonstrates that students exhibit the strongest performance in media/technology usage (3.30) and practical learning management (3.29). However, the most significant gap appears in teaching skills, where current competency (3.06) falls notably below the expected level (3.57), resulting in a gap of 0.51. This visualization effectively highlights areas requiring immediate attention in the curriculum.

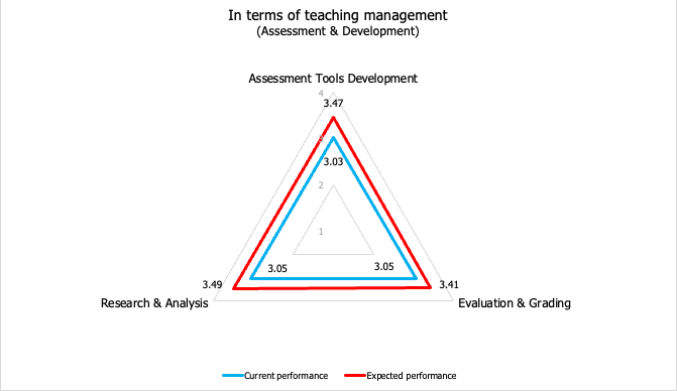

Figure 2: Assessment and Teacher Development

Figure 2 illustrates the assessment and teacher development competencies, where the average current competency (3.04) falls below the teaching design metrics. Notably, while students show relative strength in assessment result analysis (3.05), they demonstrate lower proficiency in assessment tool development (3.03). The radar chart particularly emphasizes the substantial gap in research and analysis capabilities.

In teaching management, the study revealed that students demonstrated generally satisfactory performance with a mean score of 3.17, which fell short of stakeholder expectations (mean = 3.49). Within this domain, students exhibited particularly strong capabilities in media and technology usage (3.30) and practical learning management (3.29), suggesting the successful integration of modern educational tools into their teaching practice. However, a significant gap emerged in fundamental teaching skills (0.51), indicating a need for enhanced pedagogical development. The assessment and teacher development component showed lower overall performance (mean = 3.04) compared to teaching design, with research and analysis capabilities presenting the most substantial gap (0.52).

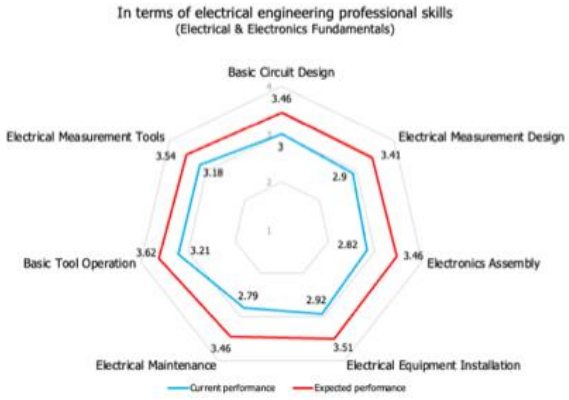

Figure 3: Basic Electrical and Electronics

In Figure 3, the analysis of basic electrical and electronics skills presents a concerning pattern. The visualization clearly shows that while students demonstrate competency in basic tools usage (3.21) and electrical measurement tools (3.18), there is a significant weakness in maintenance skills (2.79). The radar pattern suggests a need for enhanced practical training in equipment maintenance and handling.

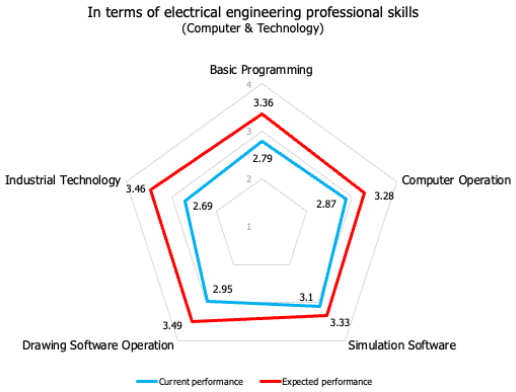

Figure 4: Computer and Technology

Next, figure 4's representation of computer and technology skills indicates a current competency average of 2.88, with virtual program usage emerging as a relative strength (3.10). The chart effectively demonstrates the gap between current capabilities and industry expectations, particularly in advanced industrial technology applications.

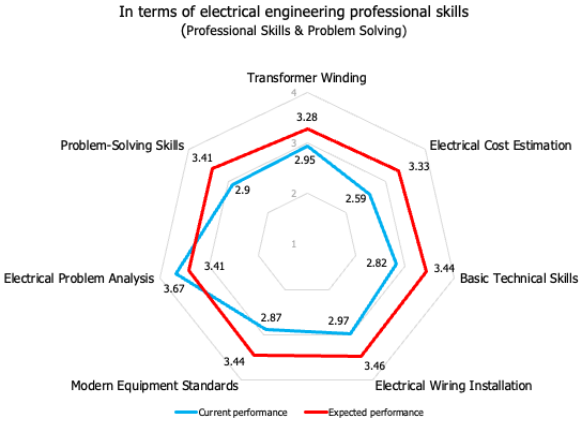

Figure 5: Profrssional Skill and Problem Solving

As depicted in Figure 5, professional skills and problem-solving competencies show an interesting distribution. The radar pattern highlights exceptional performance in problem identification (3.67), while revealing significant gaps in blueprint reading and cost estimation (gap: 0.74). This visualization effectively demonstrates the disparity between analytical and practical implementation skills.

The evaluation of electrical engineering professional skills revealed more concerning gaps in technical competencies. Basic electrical and electronics skills showed a current competency mean of 2.97 against an expected level of 3.49. While students demonstrated proficiency in basic tools usage (3.21), equipment maintenance skills (2.79) fell significantly below stakeholder expectations. Computer and technology skills presented a similar pattern, with a current competency mean of 2.88 against expected levels of 3.38. Notable strength was observed in virtual program usage (3.10), though advanced industrial technology applications showed substantial room for improvement.

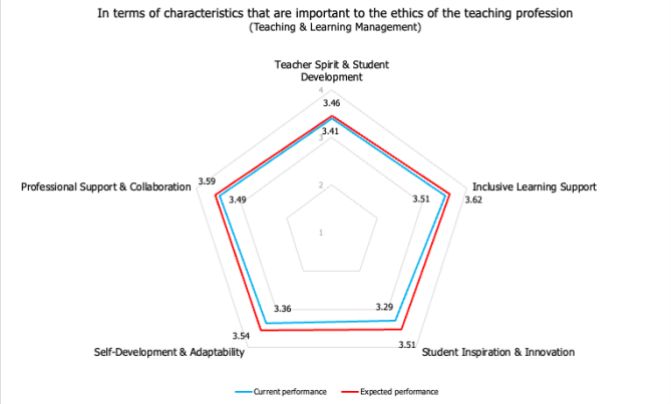

Figure 6: Teaching and Learning Management

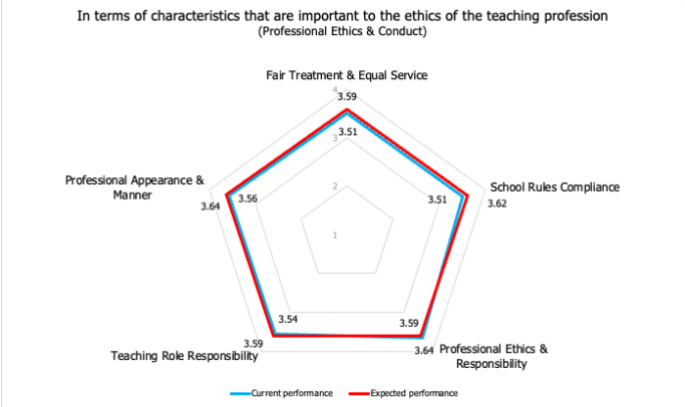

Figure 7: Professional Ethics and Conduct

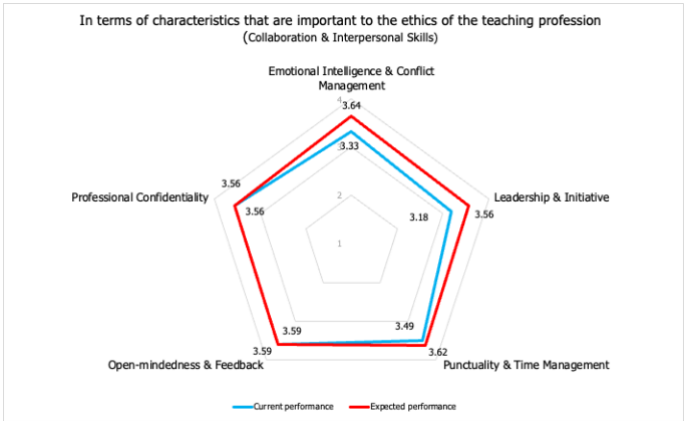

Figure 8: Collaboration and Interpersonal Skills

Figures 6, 7, and 8 present the analysis of professional ethics and characteristics, revealing the strongest overall performance among all domains. Figure 6 demonstrates that teaching and learning management competencies ranged from 3.26 to 3.51 (mean=3.41), with particularly strong showings in learning promotion and diversity acceptance. The radar pattern in Figure 7 displays notably high performance in professional ethics and conduct (mean=3.55), while Figure 8 illustrates strong collaboration skills with some room for improvement in leadership capabilities. Professional ethics and conduct demonstrated the highest performance (mean=3.55) with the smallest gap (0.06) between current and expected competencies, highlighting students' strong foundation in professional integrity and ethical

practice. Collaboration and leadership skills showed robust development (mean=3.48), with particular strength in receptiveness to opinions (3.59), though leadership capabilities presented growth opportunities (gap=0.38).

Conclusions and Implications

The comprehensive analysis of student competencies has revealed a clear hierarchical pattern in performance levels, with professional ethics emerging as the strongest domain (mean=3.55), followed by teaching management (mean=3.17), and technical skills (mean=2.97) requiring the most significant development. This pattern suggests that while the program has successfully instilled strong professional values and basic pedagogical capabilities, technical skill development requires additional attention in the curriculum.

Based on these findings, the curriculum revision implements an Outcome-based education module (OBEM) framework structured around four key components. The Technical Skills Enhancement Module focuses on developing mastery in basic operations, maintenance, and advanced technological applications through intensive laboratory practice and industry-based learning experiences. The Industrial Technology Integration Module addresses the need for modern industrial system understanding and digital transformation competencies through industry collaboration projects and technology simulation exercises.

The implementation of these modules is supported by a robust assessment framework that emphasizes authentic evaluation methods, including practical demonstrations, project-based assessments, and industry partner feedback. This comprehensive approach ensures that assessment practices align with both academic standards and industry requirements.

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Needs Analysis of English Skills Development for Agripreneur of Thai Students in Higher Education

Alisa Injan, Maejo University Phrae Campus, Thailand

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Abstract
Over the past decade, agripreneurship has emerged to increase the potential of agricultural sector. Many universities have advanced the vision of agripreneur development for students. There is still a limited number of English for agripreneur textbooks worldwide. The aim of this study was to critically investigate the needs analysis of Thai students in higher education to develop English language skills for agripreneur. This study was carried out on a group of thirty agricutural students at Maejo university, Phrae campus, in Northern Thailand. The research instruments included a questionnaire and interviews for developing the six skills of English language learning. Descriptive statistics and the modified Priority Need Index (PNImodified) were used for the needs assessment. The results indicated that the students had moderate level of English language proficiency. Most students ranked reading as their best skill ($\bar{X}$=3.13) and grammar as their weakest skill ($\bar{X}$=2.53). Another important finding was that the students extensively needed to improve the English skills, especially in speaking, with pitching identified as the most critical task to be an agripreneur (PNImodified=1.70). This was followed by listening, writing, vocabulary, and reading, respectively. An unanticipated finding was that the students still rated grammar as the least skill needed, particularly regarding relative pronouns (PNImodified=0.52). The results of this study will contribute to the course syllabus for the development of an English for agripreneur textbook tailored to the needs and knowledge of Thai agricultural students with Thai-context culture, enhancing sustainable learning in English for specific purpose.

Keywords: Needs Analysis, English Skills Development, Agripreneur, English for Specific Purpose, Higher Education

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Introduction

In the World Digital Competitiveness Ranking 2023, published by the International Institute for Management Development, Thailand ranked 30th out of 64 countries for overall performance (IMD, 2023). Notably, Training and Education ranked even lower at 52nd. A deeper analysis of Thailand's educational performance revealed that the country consistently occupies lower-tier rankings, particularly in English language skills tailored to meet the demands of employers. This finding aligns with a report by the Thailand Productivity Institute (2015, as cited in Pinkaew & Sirinuphong, 2017), indicating that Thai officers had very low English proficiency and needed to improve their English skills. This has raised the need for undergraduate students to acquire English for Specific Purpose (ESP) in order to prepare themselves to enter the workforce. ESP aims to equip learners with the ability to use English effectively in academic and professional areas, underscoring the necessity for course developers to understand learner needs (Basturkmen, 2006, 2010; Brown, 1995; Dudley-Evans & St. John, 1998; Hutchinson & Waters, 1987; Rahman, Ming, Aziz, & Razak, 2008, as cited in Chatsungnoen, 2015). Higher education institutions have thus recognized the importance of enhancing the quality of graduates to meet labor market demands (Mansakorn, 2007). This awareness has highlighted the necessity of ESP instruction, aiming to produce graduates equipped with English language skills that align with professional standards.

Furthermore, students in Thailand, both at the basic and higher education levels, often face obstacles in learning English that do not align with practical objectives or meet employer expectations. One significant issue is the reliance on textbooks or materials from renowned international publishers that, while adhering to global standards, are not designed to address the specific needs of various professional contexts. This observation is consistent with Griffiths & Keohane (2000), who stated that textbooks frequently failed to achieve a meaningful level of engagement from learners; education should not be limited to the classroom with set textbooks and exercises. Suntornsawate (2018) also noted that most English instruction in Thailand focuses on everyday communication rather than workplace-specific applications. Learners must therefore acquire English tailored to their particular professional purposes.

In recent years, there has been an increasing interest in entrepreneur around the world. As a result, Maejo University where has the renown for agriculture in Thailand has advanced the vision in agripreneurship development for students and community. Throughout this research, the term agripreneurship will be referred to entrepreneurship in agriculture. Entrepreneurship is a concept that encompasses transforming an idea or vision into a "new business or new venture creation, or the expansion of an existing business, by an individual, a team of individuals, or an established business" (Reynolds et al., 2000). Quite similar, Agripreneur is an individual who starts, organizes and manages a business venture focusing on the agricultural sector (Mukhopadhyay, 2020). To keep pace with contemporary needs, the university has revised its ESP curriculum, introducing new courses, namely English for Creative Agripreneurs. Jordan (1997) indicated that needs analysis is the initial step in course design, teaching methodologies, and the development of relevant educational materials. This aligns with Chatsungnoen (2015), who stated that ESP programs often lack clear course objectives due to the absence of a prior needs analysis. Only a small portion of these have involved in agripreneurship and investigated the link between the needs of English skills development and agripreneurs. In light of these challenges, the researcher, as a lecturer, is responsible for teaching fundamental English courses and designing ESP courses at Maejo University Phrae Campus. To ensure effective and efficient development of English skills in

alignment with the university's mission, the research team has adopted the theoretical framework of Needs Analysis (NA) to identify the English skills necessary in accordance with the attributes of agripreneurs.

Therefore, due to the absence of research on the needs analysis for English skills development specifically for agripreneur, this study aimed to explore this need based on the perceptions of agricultural students. In order to address this question, the needs analysis of English skills development for agripreneur of Thai agricultural students will be discussed in detail. The research results will contribute to the course syllabus for the development of an English for Agripreneur textbook, tailored to the specific needs and knowledge of Thai students at Maejo university Phrae campus, and as related programs in institutions offering courses for agripreneurs to enhance sustainable learning in English for Specific Purposes.

Research Methodology

This study employed mixed methods between qualitative and quantitative techniques. Purposive sampling was employed to select 30 student participants. They were the sophomore students enrolling in the English for Creative Agripreneur subject in the academic year 2023. Data were collected through questionnaire surveys for the quantitative component. The participants were asked to complete four tasks, as follows:

1. Background Information
2. Self-assessment of English proficiency level
3. The needs of English skills development for Agripreneur
4. Suggestion

According to the self assessment questions, a 5-point Likert scale was used, ranging from low competency (1) to high competency (5). For the need questions, a 5-point Likert scale was also adapted ranging from the least needed (1) to the most needed (5). The data were then analyzed using descriptive statistics and Modified Priority Needs Index ($PNI_{modified}$). The $PNI_{modified}$ was used to compare the differences between the needs level and the existing state using formula as presented in Eq. (1):

$$PNI_{modified} = (I-D)/D \quad (1)$$

Where I refers to the needs level, and D refers to the existing state (Wongwanich, 2007).

Additionally, the participants were interviewed using a semi-structured format in focus groups, lasting approximately 30 minutes to 1 hour, to collect qualitative data. The interviews were conducted with two low-achieving, two medium-achieving, and two high-achieving students regarding to their grades in the Fundamental English course. Content analysis was prepared by adapting the procedure outlined by Chatsungnoen (2015).

Findings and Discussion

This section discusses the results obtained from both questionnaire surveys and semi-structured interviews conducted with Thai agricultural students regarding their needs for developing six English skills essential for agripreneurship: speaking, listening, reading, writing, grammar, and vocabulary.

Questionnaire Surveys

The students' self-assessment of English proficiency was at a moderate level. When ranked according to average scores from highest to lowest, the results revealed that reading skills had the highest average score of 3.13. Following this, writing and vocabulary were determined to have equivalent average of 2.90, while speaking, listening, and grammar recoreded average scores of 2.80, 273, and 2.53, respectively. Moreover, the survey findings concerning students' need to enhance their English language skills indicated a significant need, with eighty-eight percents expressing a strong desire for improvement. The primary focus for development was on speaking, followed by listening, writing, vocabulary, reading, and grammar, in that order. It is of particular interest that Thai students exhibited the lowest proficiency in grammatical knowledge; however, they rated grammar as the least needed skill. It has been argued that effective communication in English relies primarily on a strong understanding of grammar, as it enables the clear and comprehensible construction of sentences (Kumduang, 2019). This situation was further examined through interviews, as indicated in the following excerpts:

> We don't need to be perfect in grammar, as long as we can communicate what we want, it should be fine. (Excerpt from medium-achieving student)
>
> If it's speaking, we don't need to worry too much about grammar. (Excerpt from low-achieving student)

Most Thai undergraduate students had the same voice that grammar was difficult to understand due to their struggles with its complex structure. They frequently gave up on learning. This led them to focus more on speaking to facilitate communication rather than comprehension (Carrió-Pastor & Mestre Mestre, 2014). Except for high-achieving students, they indicated that the more difficult grammar was perceived to be, the more they felt the need to improve.

In addition, another finding related to students' needs for the development of English sub-skills relevant to agripreneur. The findings are illustrated in Table 1 to Table 6 from the most needed skill to the least needed skill.

Table 1: The Needs for Speaking Tasks of 30 Agricultural Students

Tasks	Importance (I)	Degree of success (D)	PNImodified = I-D/D	Rank
1. Pronunciation	4.33	2.97	0.458	7
2. Daily speaking	4.37	2.63	0.662	3
3. Asking and answering questions	4.30	2.83	0.519	6
4. Stating opinions or ideas	4.23	2.67	0.584	5
5. Giving a presentation	4.67	2.80	0.668	2
6. Pitching	**4.23**	**2.53**	**0.672**	**1**
7. Negotiating	4.20	2.53	0.660	4
Total	4.33	2.71	0.603	

Note: "I" may refer to the needs level, while "D" refers to the existing state. Both variables vary from 1 (the lowest) to 5 (the highest).

The results show the 30 agricultural students rank the speaking tasks from "the least needed" to "the most needed", with no additional speaking tasks suggested. According to the

$PNI_{modified}$ values as presented in Table 1, the prominence of "pitching" is striking, with a rating of 0.672. This result is consistent with a study by Rimkeeratikul (2022), who reported that a sales pitch was identified as a critical skill, which distinguished it from a general presentation in English for International Business course. Most students express an extensive need for "giving a presentation", followed closely by "daily speaking", and "negotiating" at the rate of 0.668, 0.662, and 0.660, respectively.

In contrast, the tasks of "stating opinions or ideas", "asking and answering questions", and "pronunciation" are perceived as the least needed, with the scores of 0.584, 0.519, 0.458, respectively.

Table 2: The Needs for Listening Tasks of 30 Agricultural Students

Tasks	Importance (I)	Degree of success (D)	PNImodified = I-D/D	Rank
1. Listening for gist	4.30	2.80	0.536	2
2. Listening for details	4.27	2.87	0.488	4
3. Listening to discussions	**4.17**	**2.63**	**0.586**	**1**
4. Listening to conversation	4.23	2.90	0.459	5
5. Listening to social media	4.20	3.00	0.400	6
6. Receiving spoken instructions	4.03	2.67	0.509	3
Total	4.20	2.81	0.496	

Note: "I" may refer to the needs level, while "D" refers to the existing state. Both variables vary from 1 (the lowest) to 5 (the highest).

As demonstrated in Table 2, the highest $PNI_{modified}$ value is attributed to "listening to discussions", which received a rating of 0.586. This result is in line with Tham-ngarn & Chaiwong (2020), revealed that most students preferred the teacher used English as a medium language in class to practice their listening skills. Besides, The students express the greatest need to develop "listening listening for gist", "receiving spoken instructions", and "listening for details", with $PNI_{modified}$ values of 0.536, 0.509, and 0.488, respectively. Conversely, the students indicate a lower need to improve "listening to conversation" and "listening to social media", with ratings of 0.459 and 0.400, respectively.

Table 3: The Needs for Writing Tasks of 30 Agricultural Students

Tasks	Importance (I)	Degree of success (D)	PNImodified = I-D/D	Rank
1. Mind mapping	4.27	2.80	0.525	7
2. Writing product descriptions	**4.27**	**2.47**	**0.729**	**1**
3. Writing brief business descriptions	4.27	2.63	0.624	5
4. Writing Agribusiness canvas	4.27	2.53	0.688	2
5. Writing for pitching	4.30	2.63	0.635	4
6. Creating pitch deck	4.17	2.60	0.604	6
7. Writing instructions	4.27	2.60	0.642	3
Total	4.26	2.61	0.635	

Note: "I" may refer to the needs level, while "D" refers to the existing state. Both variables vary from 1 (the lowest) to 5 (the highest).

The $PNI_{modified}$ value obtained for the writing needs evaluation from Table 3 is 0.635, which is the highest score of all tasks. This is due to the significant gap between the current level of

English proficiency and the needs of the students. Thus, writing skills represent an urgent need for improvement to enhance overall performance. "Writing product descriptions" has the highest $PNI_{modified}$ value of 0.729, ranking as the top priority. This concurs with the findings of Chatsungnoen (2015), who mentioned that the ESP course should teach language functions related to business English such as writing product descriptions or e-mails. The second highest priority is "writing an agribusiness canvas", with a value of 0.688. This is followed by "writing instructions", "writing for pitching", "writing brief business descriptions", and "creating a pitch deck", with $PNI_{modified}$ values of 0.642, 0.635, 0.624, and 0.604, respectively. The lowest priority is "mind mapping", which has a $PNI_{modified}$ value of 0.525. In contrast, Yunus and Chien (2016) found that undergraduate students in Malaysia employed mind-mapping strategies in their writing planning, which not only helped them gain a deeper understanding of the topic but also fostered creativity in their written work.

Table 4: The Needs for Vocabulary Tasks of 30 Agricultural Students

Tasks	Importance (I)	Degree of success (D)	PNImodified = I-D/D	Rank
1. General Vocabulary	4.13	3.17	0.303	3
2. Agribusiness Vocabulary	**4.23**	**2.73**	**0.549**	**1**
3. Guessing Vocabulary in context	4.20	3.00	0.400	2
Total	4.19	2.97	0.417	

Note: "I" may refer to the needs level, while "D" refers to the existing state. Both variables vary from 1 (the lowest) to 5 (the highest).

Table 4 outlines the needs for vocabulary sub-skills by the agricultural students. The students identifies a need to develop "agribusiness vocabulary" ($PNI_{modified}$=0.549), as the highest priority, followed by "guessing vocabulary in context" ($PNI_{modified}$=0.400) and "general vocabulary" ($PNI_{modified}$=0.303), respectively. Fraser (2005) emphasized that technical vocabulary can be vast and should not be neglected in ESP instruction. It is essential to support learners in navigating and understanding unfamiliar technical terms.

Table 5: The Needs for Reading Tasks of 30 Agricultural Students

Tasks	Importance (I)	Degree of success (D)	PNImodified = I-D/D	Rank
1. Searching the Internet English Resource	4.27	3.00	0.423	6
2. Reading for gist	4.27	2.93	0.457	5
3. Reading for specific details	4.23	2.83	0.495	4
4. Inferential reading	4.33	2.83	0.530	2
5. Reading case study of successful agripreneur	**4.30**	**2.57**	**0.673**	**1**
6. Reading product descriptions	4.27	2.83	0.509	3
Total	4.28	2.83	0.515	

Note: "I" may refer to the needs level, while "D" refers to the existing state. Both variables vary from 1 (the lowest) to 5 (the highest).

The needs for reading sub-skills are provided in Table 5. The highest priority within this category is assigned to "reading case study of successful agripreneur", with $PNI_{modified}$ values of 0.673. It has been observed that applying case studies in instructions can increase students' engagement both their academic performance and sense of belonging within the learning community. (Ni Chochlain, 2021). This reading sub-skill is expected to be developed in an undergraduate programme to offer students comprehensive understanding of agripreneurship, while also drawing inspiration from the success stories of prominent individuals in this field.

The second highest priority is "inferential reading", with a value of 0.530. This is followed by "reading product descriptions", "reading for specific details", and "reading for gist", which received ratings of 0.509, 0.495, and 0.457, respectively. The lowest priority is given to "searching the internet English resources", which has a $PNI_{modified}$ value of 0.423.

Table 6: The Needs for Grammar Tasks of 30 Agricultural Students

Tasks	Importance (I)	Degree of success (D)	PNImodified = I-D/D	Rank
1. Verb tenses / Modal Verb	4.23	2.67	0.584	2
2. Relative pronouns / Relative clause	4.27	2.80	0.525	4
3. Conditional Sentences	4.17	2.70	0.544	3
4. Comparative Structures	4.23	2.67	0.584	2
5. Business Phrasal Verb	**4.17**	**2.60**	**0.604**	**1**
Total	4.21	2.69	0.568	

Note: "I" may refer to the needs level, while "D" refers to the existing state. Both variables vary from 1 (the lowest) to 5 (the highest).

The majority of students, as shown in Table 6, express a strong need to improve their understanding of "business phrasal verbs" as the grammar sub-skill, with a $PNI_{modified}$ value of 0.604. Besides, the students identify a need to develop "verb tenses/modal verbs" and "comparative structures", both of which share a $PNI_{modified}$ value of 0.584. Next, "conditional sentences" and "relative pronouns/relative clauses" are considered as the lower need to improve, with ratings of 0.544 and 0.525, respectively. These results further support the idea that relative clause has been identified as one of the most problematic and difficult areas of English learning for ESL/EFL learners (Marefat & Rahmany, 2009). As mentioned above, the participants in this study negatively need to learn the difficult or complex construction. According to some studies, relative clauses were found avoidance strategies when non-native speakers produced English relative clauses; Japan (Miura, 1989), Korea (Park, 2000), China (Chang, 2004), and Bangladesh (Maniruzzaman, 2008).

Interviews

The six participants who responded to the questionnaire were invited to an interview based on the needs analysis model. The most compelling finding was they all extensively needed to develop the English skills for Agripreneur. The overall response to the importance of English language was similar. A common view amongst interviewees was that English serves as a bridge for communication and appears in textbooks of core subjects. Only one high-achieving students highlighted its significance in conducting research and surfing the cutting-edge information. The next session focused on the difficulties in learning each of the six English skills. Beginning with listening and speaking, students lacked of opportunity to communicate with native English speakers and lacked of consistency in their practice. Low-achieving students also struggled with the speed and varying accents as illustrated in the following excerpt:

> I think it quite challenging to understand foreigners due to their accents, and sometimes they speak too fast. Each country has its own accent. When I cannot get what they said, I find it difficult to speak as well.

In terms of reading and writing skills, the students indicated that they were involved with reading only in students' workbook, while writing occurred solely in the classroom. They

predominantly relied on Google Translate for assistance outside the classroom. Furthermore, the low achievers reported that they could read but they faced difficulties translating texts into Thai, as reflected in the following excerpt:

> I can read but translate only word by word. I cannot connect phrases or translate in complete sentences. If I cannot read the passage thoroughly, I struggle to express what I want to write.

Regarding grammar knowledge, every participant indicated that it was the most challenging skill of all. The primary reason is owing to the complex structure of English, which differs significantly from Thai sentence structure, as can be seen in the following excerpts:

> Grammar is difficult because of its complex structure, and I, myself, have limited basic knowledge in this area. (Excerpt from high-achieving student)

> There are twelve sentence structures and each sentence is not fixed. For example, in responding to questions, one can provide both short and long answers. Subject-verb agreement is also confusing. (Excerpt from medium-achieving student)

> I never understand grammar. I am always confused by verb tenses. In Thai, we don't change verbs according to subjects; we simply use other words to indicate time expressions. (Excerpt from low-achieving student)

When discussing vocabulary knowledge, high achievers reported having a limited range of lexical items and exerting less effort to acquire new vocabulary. In contrast, medium achievers indicated that certain words lacked clear associations in Thai culture, making it difficult for them to form mental images of their meanings. This often led to the belief that the words were difficult to learn, resulting in poor retention. Low achievers, on the other hand, mentioned that some polysemous words left them uncertain about which meaning is appropriate in a given context. The last session focused on addressing these challenges by designing classroom activities aimed at enhancing English skills acquisition. High achievers preferred both collaborative group work or independent tasks to unleash their potential. They also needed out-of-class activities that facilitate direct engagement with the language or teaching by example. Meanwhile, one medium achiever favored out-of-class activities and group brainstorming sessions to develop effective ideas. Another medium achiever required interactive games and opinion sharing in class. Low achiever demonstrated a preference for group work and examination to revise lessons. Another low achiever requested fieldwork and agripreneurial workshops. In short, all students shared common needs for out-of-class activities and group work. These results are in accord with Guo (2011) studies suggesting that an out-of-class activity can enhance students' exposure to English in familiar and real contexts. Besides, Active student engagement in group work is a crucial learning objective for all higher education courses (Elgort et al., 2008).

Conclusion and Suggestion Implication

Since agripreneur is a groundbreaking career, the study of English for Agripreneur is still remains limited. This research paper has provided an overview of Thai agricultural students' needs in developing English language skills for agripreneur in tertiary education. The proposed syllabus for an "English for Agripreneur" course should include the following key components: 1) Pitching skills 2) Listening to discussions 3) Writing product descriptions 4)

Acquiring agribusiness vocabulary 5) Reading a case study of successful agripreneur and 6) Mastering business phrasal verbs. Additionally, supplementary contents for each English skills are recommended as follows: 1) Delivering presentation and daily conversation 2) Listening for gist and instructions 3) Designing agribusiness model canvas and instruction 4) Guessing Vocabulary in context 5) Product descriptions and Inferential reading and 6) Using comparison, verb tenses, and modal verbs accurately. Classroom activities which meet the needs of the students are group work and out-of-class activities, emphasizing the importance of collaborative and experiential learning opportunities in enhancing English language acquisition.

This finding has important implications for those who are engaged in enhancing students' development and utilize these results to design a specific course relevant to agripreneurship for their institutions to foster undergraduate students' English skills that are essential for the future workforce. More broadly, future research is also needed to explore effective instructional models tailored to the development of each English language skill required for agripreneurship. A further study could apply this research methodology to identify necessary language skills in other fields, thereby contributing to the design of more targeted English curricula across various disciplines.

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Contact email: alisa.ij59@gmail.com

Computational Thinking in Agricultural STEM-Based Project: A Case Study on the Impact of the Magnetcode Application Among Zambian Educators

Sanura Jaya, SEAMEO RECSAM, Malaysia
Phiri Cornelius, Malcolm Moffat College of Education, Zambia
Parvinder Singh Amar Singh, SEAMEO RECSAM, Malaysia
Azman Jusoh, SEAMEO RECSAM, Malaysia

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Abstract
In the rapidly evolving landscape of education, the integration of computational thinking (CT) into STEM (Science, Technology, Engineering, and Mathematics) curricula has emerged as a pivotal strategy for enhancing educators in teaching and learning and preparing future generations for the demands of the 21st-century workforce. This study investigates the impact of the Magnetcode application on enhancing computational thinking (CT) skills among educators in Zambia. Open-ended interview, pre-test and post-test designs were employed to measure the impact and the effectiveness of computational thinking in agricultural STEM-based projects to Zambian educators in terms of knowledge and understanding of CT elements, basic design coding, circuit simulation, and the application of Magnetcode Microcontroller in STEM project. The results demonstrated significant improvements in all assessed areas. The percentage improvement ranges from 1.31% to 2.5%, with the highest improvement observed in the application of the Magnetcode microcontroller. The mean for the pre-test was significantly different from the test value of 0, with a mean difference of 27.69 and a 95% confidence interval of 25.39 to 29.99, supported by a t-value of 25.66 ($p < .001$). Integrating computational thinking and coding into STEM educational curricula can enhance teachers' understanding and skills in implementing STEM education in Zambia.

Keywords: Computational Thinking, Magnetcode Application, Microcontroller, STEM Education

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Introduction

Computational thinking has become a vital skill in education, especially in the fields of science, technology, engineering, and mathematics (STEM)(Kong & Abelson, 2019; Thissen, 2022). With the increasing demand for digital literacy and problem-solving abilities, educators need to integrate computational thinking into their teaching practices (Ezeamuzie, 2023).

The African Union's Agenda 2063 emphasizes the critical role of STEM (Science, Technology, Engineering, and Mathematics) and ICT (Information and Communication Technology) in driving socio-economic transformation across its member states. The Southern African Development Community (SADC) countries have held multiple forums to identify areas of cooperation aimed at enhancing the status of STEM education for the collective benefit of all member states. This collaborative approach is essential for fostering innovation and economic growth across the region [5].

The development of the STEM Education curriculum in Zambia commenced in December 2019, following the Ministry of General Education's receipt of cabinet approval to implement the curriculum in 52 pilot secondary schools (Oliver et al., 2022). A transitional curriculum was designed based on the 2013 Zambia Educational Curriculum Framework. The primary rationale for establishing STEM schools in the contemporary education system and industry is that it provides students with holistic worldviews, fosters innovation, and drives the creation of new products and processes crucial for economic sustainability. According to Phiri (2022), STEM education is crucial for facilitating economic development, enhancing international competitiveness, and fostering innovation. By emphasizing hands-on experimentation, STEM education enables learners to transition from abstract concepts to real-world applications (Oliver et al., 2022; Phiri et al., 2022).

The current state of STEM education in Zambia is not ideal, with limited resources and trained professionals. Many educators struggle to engage students in these subjects, leading to a lack of interest and poor academic performance (DeGhetto et al., 2016). This has created a demand for new and innovative teaching methods that can make STEM education more accessible and engaging for students (Imms & Kvan, 2021) . According to Oliver (2022), teachers in Zambia have improper training in STEM curriculum and a lack of understanding of how to integrate teaching and learning materials such as coding and programming in STEM education (García-Peñalvo, 2018).

Therefore, integrating computational thinking into STEM education is essential for helping teachers develop critical skills needed for success in a technology-driven world. According to Mulenga and Kabombwe (2019), Zambian teachers are willing to participate in STEM curriculum training development and a need for more inclusive processes in STEM curriculum development to ensure effective implementation and teacher engagement (Mulenga & Kabombwe, 2019). This includes skills such as logical reasoning, algorithmic thinking, and problem-solving, which are crucial in STEM fields such as engineering, computer science, and data analysis (Meseguer & Serrano, 2024; Rabiee & Tjoa, 2017). Therefore, this research aims to investigate the impact of the Magnetcode application on enhancing computational thinking skills among Zambian educators and to understand its effectiveness in integrating computational thinking into STEM education.

Research Objective

To evaluate the impact of the Magnetcode application on enhancing computational thinking skills among Zambian educators and to understand its effectiveness in integrating computational thinking into STEM education.

Research Question

How does the use of the Magnetcode application influence the computational thinking skills of educators in Zambia, and how effective is it in facilitating the integration of computational thinking into STEM education?

Literature Review

Computational thinking (CT) skills involve systematically solving sub-problems through decomposition, allowing for efficient abstraction, planning, and coding processes that follow a linear path towards a solution (Shute et al., 2017). The Magnetcode application utilizes block-based programming languages, enabling users to design programming algorithms by dragging and dropping program chunks, known as blocks (Weintrop & Wilensky, 2015). Through the process of learning programming and coding, educators can expose students to computational skills that involve critical thinking and creative problem-solving. Coding is widely believed to enhance problem-solving abilities, especially in STEM projects (Grover & Pea, 2017; Thissen, 2022; Voon et al., 2023). According to Matsuzawa and colleagues (2017), block-based languages offer an advantage in understanding text-based languages, allowing teachers to encourage students to focus more on high-level algorithm creation using coding. By improving their knowledge of computational thinking (CT) skills, teachers can better guide students in developing these essential abilities in teaching and learning.

Figure 1 illustrates the consolidation of the integration of computational thinking skills in an Agricultural STEM-based project, highlighting a process that educators in Zambia can employ. It begins with identifying a complex problem within the agricultural STEM domain. This problem is then addressed through the process of abstraction and decomposition, which involves simplifying the problem by focusing on its essential features and iteratively breaking it down into more manageable sub-problems. This spiral process of abstraction and decomposition helps in systematically understanding and approaching the problem.

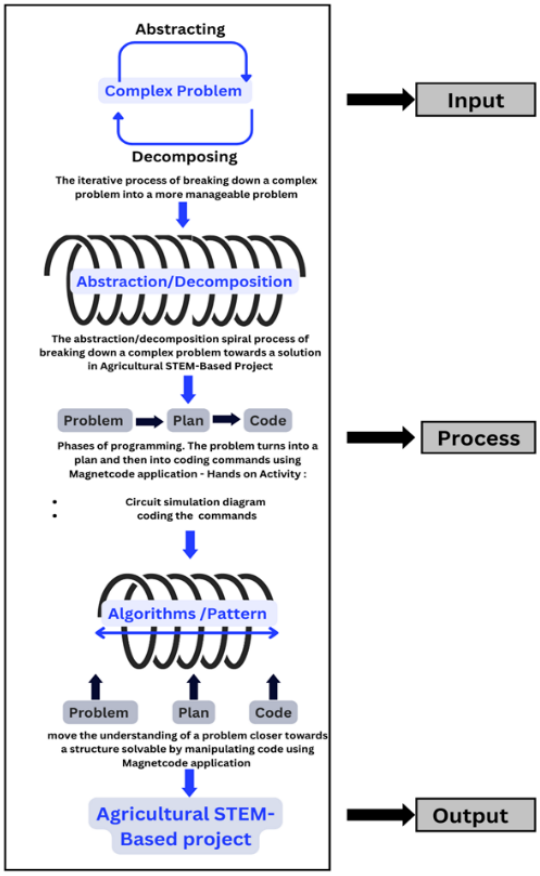

Figure 1: Consolidation of the Integration Computational Thinking Skills in Agricultural STEM-Based Project

The problem-solving phases are divided into three steps: defining the problem, developing a step-by-step plan, and translating the plan into actionable commands or code. Tools like Magnetcode can be used for practical hands-on activities such as circuit simulation and coding commands. Figure 2 shows the flow chart to recognize patterns and develop algorithms to solve the problems. In this phase, the educators are involved in continuous refinement and iteration of the problem-solving process to enhance understanding and find effective solutions.

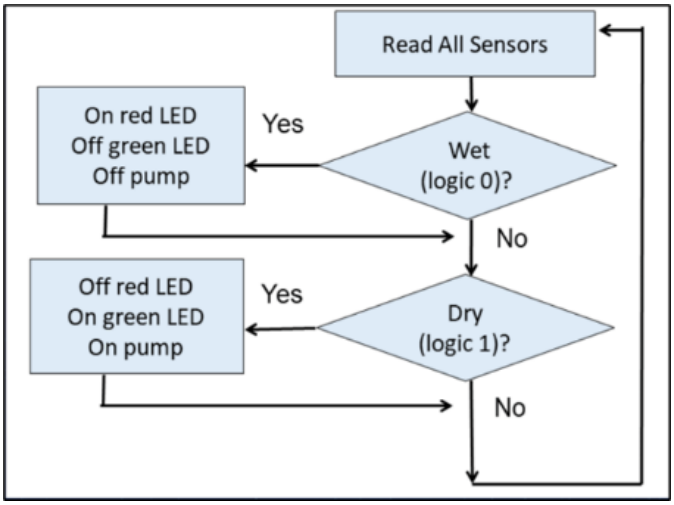

Figure 2: Smart Irrigation Flow Chart

The process of abstraction and decomposition involves simplifying a complex problem by focusing on its essential features and then iteratively breaking it down into more manageable sub-problems. The coding process using Magnetcode applications using block-based language is easy to use (Wan Nurlisa et al., 2023). The block-based language has a lower barrier to programming compared with text-based language (Glushkova, 2016). The block-based command for agricultural STEM-based projects is shown in Figure 3.

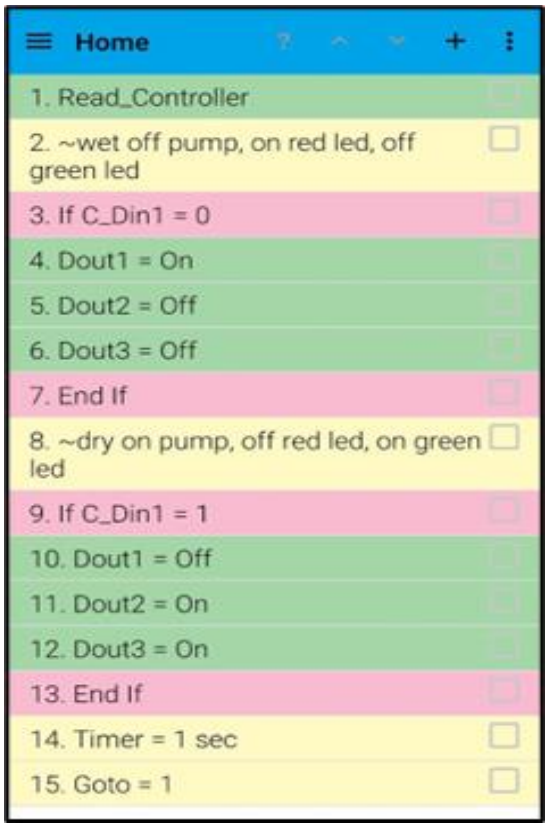

Figure 3: The Coding Command for Smart Irrigation System in Agricultural STEM-Based Project

This spiral approach in Figure 1, allows for a systematic and comprehensive understanding of the problem. The problem-solving phases within this process include defining the problem clearly, developing a detailed plan or strategy to address it, and translating the plan into a simulation diagram in Magnetcode application. Figure 4 shows the circuit simulation and command coding for the whole system of the smart irrigation system project. Through this iterative cycle of abstraction, decomposition, planning, and coding, complex problems become more approachable and solvable and suitable for the integration of computational thinking in STEM education.

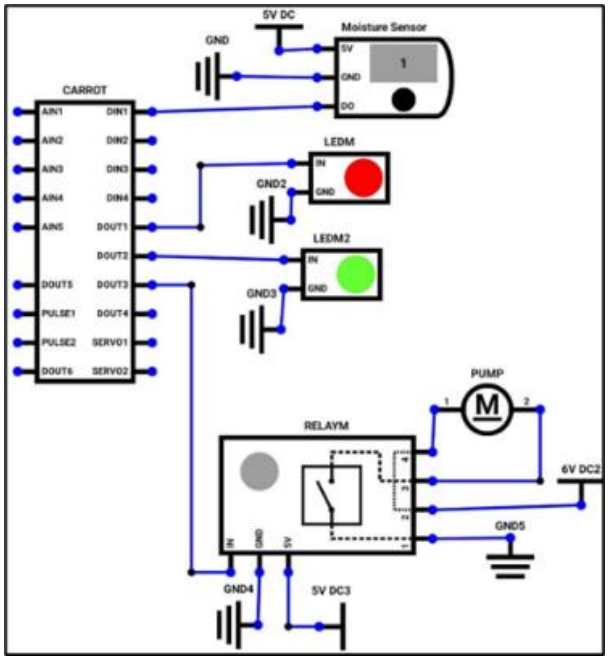

Figure 4: The Circuit Simulation for Smart Irrigation System in Agricultural STEM-Based Project

Methodology

This study used a quantitative and qualitative approach with a case study design. The researcher employed a one-group pre-test and post-test design and open-ended interview to evaluate the effectiveness of the Magnetcode application in enhancing computational thinking skills among educators at Malcolm Moffat College of Education. The researcher used purposive sampling to select 16 educators who teach STEM subjects, ensuring the participants are directly involved in the areas most likely to benefit from the integration of computational thinking. The intervention consists of a workshop focused on the practical application of coding and programming through Magnetcode for agricultural STEM-based hands-on projects.

To assess the impact of integration CT using the Magnetcode application, the researcher measured the computational thinking skills of the educators before and after the workshop using standardized pre-tests and post-tests. Five-point Likert scale was used to gather the mean for the pre-test and post-test. The analysis of the data involved calculating the percentage difference between the pre and post-test results to quantify the improvement in knowledge and skills. The researcher also applied one sample t-test to these results to determine if the observed changes were statistically significant. The open-ended interview was employed to measure the impact and effectiveness of the Magnetcode application in integrating computational thinking into agricultural STEM-based projects in STEM education.

Findings and Discussion

This study investigates the impact of the Magnetcode application on enhancing computational thinking (CT) skills among educators in Zambia**.** The findings ought to answer the research objective and research question in this study. Table 1 shows the findings from

the pre-test and post-test related to the knowledge and understanding of computational thinking in STEM projects using the Magnet code application.

Table 1: Knowledge and Understanding in Computational Thinking in STEM Project Using Magnetcode Application

Knowledge and understanding	N	Mean Pre-Test	Standard Deviation (SD)	Mean Post-Test	Standard Deviation (SD)	% Difference
1. Computational Thinking elements in teaching and learning.	16	2.44	0.89	3.75	0.75	1.31
2. Basic design coding in teaching and learning for STEM activities.	16	1.94	0.77	4.00	0.73	2.06
3. Circuit simulation through Computational Thinking Skills with STEM activities.	16	2.00	0.73	3.81	0.83	1.81
4. The application of Magnetcode Microcontroller in STEM projects.	16	1.56	0.63	4.06	0.77	2.5
5. The application of Magnetcode in pedagogical strategies for STEM projects.	16	1.94	0.77	4.06	0.77	2.12
6. The application of Magnetcode in teachers' activities for STEM projects.	16	1.00	0.00	4.06	0.93	3.06
7. The application of Magnetcode input Transducer (Sensor) for STEM projects.	16	1.00	0.00	3.56	0.89	2.56
8. The application of Magnetcode Output Transducer (Actuator) for STEM projects.	16	1.00	0.00	3.56	0.81	2.56

The results indicate substantial improvements in educators' understanding and application of CT elements, basic design coding, circuit simulation, and the use of microcontrollers. These enhancements are crucial for integrating CT into STEM education in Zambia. A strong foundation in CT allows educators to design and implement STEM projects that foster critical thinking, problem-solving, and algorithmic reasoning. Figure 5 shows STEM educators applying basic coding in agricultural STEM-based projects using the Magnetcode application, sensor and actuator.

Figure 5: STEM Educators Applying Computational Thinking Skills Using the Magnetcode Application, Sensor and Actuator in Agricultural STEM-Based Project

The findings also illustrated the notable increase in basic design coding skills, from the mean value of 1.94 to 4.00, underscores the application's effectiveness in providing practical coding experience, which is vital for creating engaging and interactive lessons. Figure 6 illustrates the outcome of the workshop in coding and circuit simulation diagrams. The STEM educators are able to design their own circuits using the Magnetcode application before they create the real project.

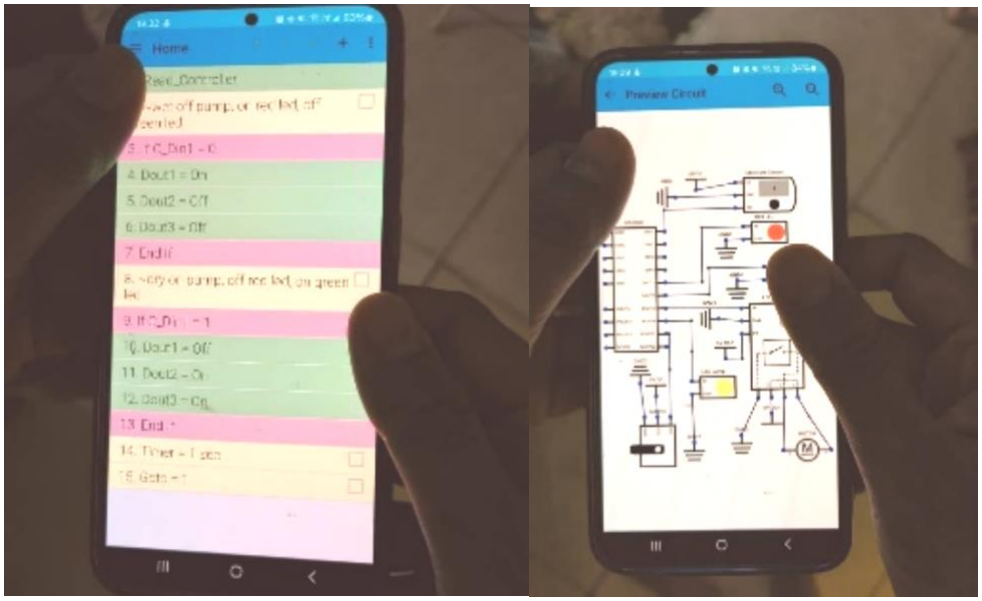

Figure 6: Coding and Circuit Simulation Diagram for Smart Irrigation Project

Furthermore, the improvement in circuit simulation skills, with mean value rising from 2.00 to 3.81, equips educators to better prepare students for real-world engineering and technology challenges. The most significant gain was in the application of the Magnetcode Microcontroller, with value increasing from 1.56 to 4.06, indicating a substantial boost in hands-on experience and confidence in using advanced STEM tools. Figure 7 shows the outcomes from the workshop where the STEM educators were able to integrate computational thinking skills in their agricultural STEM-based project using the Magnetcode application.

Figure 7: Functioning Prototype for Smart Irrigation Project

The researcher also analyses the results of the workshop with one sample t-test. Table 2 shows the result obtained.

Table 2: One-Sample t-Test

	t	df	Significance		Mean Difference	95% Confidence interval of the Difference	
			One-Sided p	Two-Sided p		Lower	Upper
Mean Pre-Test	25.66	15	<.001	<.001	27.69	25.39	29.99
Mean Pre-Test	30.40	15	<.001	<.001	48.69	45.27	52.10

The t-test results indicate a significant impact of the integration of computational thinking in agricultural STEM-based projects among Zambian educators. The mean for the pre-test was significantly different from the test value of 0, with a mean difference of 27.69 and a 95% confidence interval of 25.39 to 29.99, supported by a t-value of 25.66 ($p < .001$). These results indicated that before the workshop, educators had a moderate understanding of computational thinking and integration of the Magnetcode application in the agricultural STEM-based project. However, the mean for the post-test shows an even larger difference of 48.69 with a 95% confidence interval of 45.27 to 52.10, supported by a t-value of 30.40 ($p < .001$). Both one-sided and two-sided p-values for both tests are less than 0.001, indicating that the results are statistically significant. These results indicate the Magnetcode application had

a profound impact on enhancing the educators' computational thinking skills especially for the integrating the STEM project into subject-based contents.

The open-ended interview findings also supported the impact and the effectiveness of computational thinking in agricultural STEM-based projects using Magnetcode application as summarized in Figure 8.

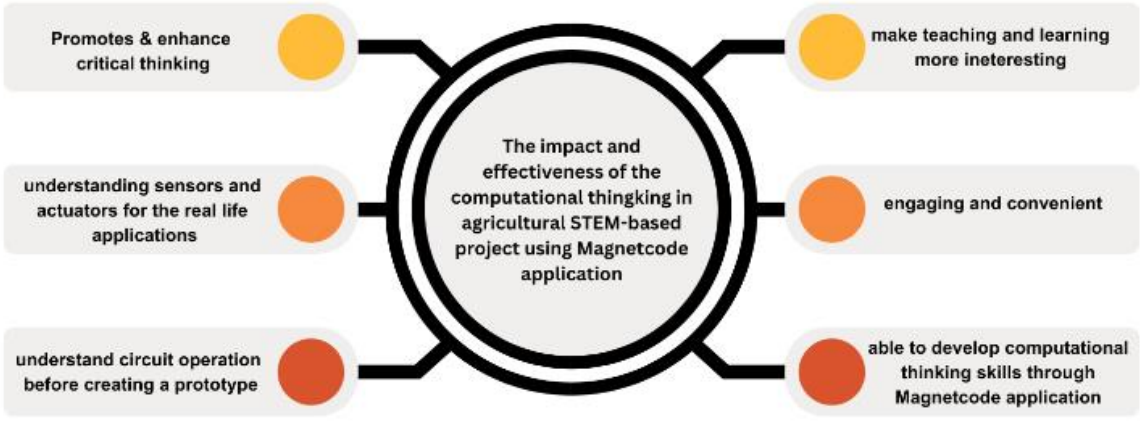

Figure 8: Findings From the Open-Ended Interview

The open-ended interview findings showed that the Magnetcode application in agricultural STEM-based projects can promote and enhance critical thinking especially in understanding circuit operation before creating a project. The indicators reported from open-ended interviews for Respondent 1, Respondent 2, Respondent 3 and Respondent 4 as stated below:

> *R1: "Magnetcode promotes critical thinking"* ***Interview: 26.02.24***
> *R2: "It's enhances critical thinking"* ***Interview: 26.02.24***
> *R3:* ***"****Magnetcode simulation is interested in that it enables students understand the operation of the circuit before the prototype is made"* ***Interview: 26.02.24***

The findings imply that the participants agreed the Magnetcode circuit simulation in Agricultural STEM-based project activities had an impact on their knowledge and skills in computational thinking. Thus, the findings illustrated that integrating computational thinking in agricultural STEM-based projects promotes critical thinking and makes teaching and learning more interesting.

The effectiveness of integrating computational thinking in Magnetcode features was also reported from the indicators from open-ended interviews from R1, R2, R3 and R4 as below:

> *R1: "enables me to understand the impact of transducers in everyday life"* ***Interview: 26.02.24***
> *R2: "to understand the real life application of various examples of transducers"* ***Interview: 26.02.24***
> *R3: "enables learners to develop the skills of programming which is the basis of CT"* ***Interview: 26.02.24***
> *R4: "ideal for programming / coding. This enhances CT as it is done easily on phone"* ***Interview: 26.02.24***

The open-ended interview findings also revealed that the integration of computational thinking in Magnetcode application can develop the understanding of the transducers and actuators for STEM projects. The participants agreed that Magnetcode features are relevant in pedagogical strategies for agricultural STEM-based projects and have an impact on their knowledge and skills in integrating computational thinking in teaching and learning. The findings illustrated the effectiveness of using the application in developing computational thinking, which is foundational for critical thinking and ease of programming on a smartphone.

Conclusion

Integrating computational thinking skills among STEM educators is vital in creating a new teaching strategy in STEM education. The application of Magnetcode as a computational thinking tool in STEM subject-based content such as science, agricultural science, engineering and mathematics, thereby broadening students' understanding and interest in STEM fields. Overall, the study highlights that by enhancing educators' CT skills through tools like Magnetcode, the quality of STEM education in Zambia can be significantly improved, preparing students for future innovations and problem-solving in the STEM landscape.

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Analysis of the Readability of Health Education Texts for Elderly Readers: An Eye-Tracking Experiment

Hui-Xin Chen, National Taiwan University of Science and Technology, Taiwan
Hou-Chiang Tseng, National Taiwan University of Science and Technology, Taiwan
Yao-Ting Sung, National Taiwan Normal University, Taiwan

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Abstract
Health literacy refers to the ability to understand, evaluate, and apply health information. Individuals with higher health literacy are able to comprehend the content of health education materials. In contrast, those with lower health literacy may struggle to understand the information, potentially leading to worsening health conditions. As the global population aged 65 and above continues to grow rapidly and cognitive abilities decline, providing more readable texts can enhance reading comprehension. Thus, assessing the readability of health education texts has become an important research topic. To improve reading comprehension, different countries have established their readability guidelines. For example, the United States recommends texts suitable for a 5th to 6th-grade reading level. However, Taiwan currently lacks similar guidelines for health education texts. Given this research gap, the present study employs eye-tracking experiments to gather physiological data from the reader's perspective. This approach helps verify the reading process and comprehension performance, ensuring that the content is effectively understood. In the analysis, the eye-tracking data from 11 participants were used, focusing on five commonly studied eye-tracking indicators. The results showed that the regression in count for diabetes proper nouns reached a significant level. This study recommends that the difficulty of health education texts should not exceed a 6th-grade reading level.

Keywords: Elderly, Education Materials, Reading Ability, Readability, Eye Movements

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1. Introduction

With the continuous advancement of medical technology, health literacy has increasingly become an important evaluation indicator. Health literacy refers to an individual's ability to understand, evaluate, and apply health information in daily life (Sørensen et al., 2012). Individuals with high health literacy can quickly comprehend health information, which helps to enhance their personal capabilities and eliminate doubts regarding health-related information (Kickbusch et al., 2013; Rudd, 2013). For example, during the COVID-19 pandemic, healthcare institutions commonly used online methods to disseminate information. However, the content presented in these texts was often too complex for the general public, leading to a lack of full comprehension and missed opportunities for self-protection (Szmuda et al., 2020). It can be concluded that providing easily understandable text content can effectively address these issues and help individuals find more suitable treatment options (Brown et al., 2004; Howell et al., 2017).

In fact, even without the pandemic, the readability of texts is crucial for older adults. With the growing proportion of the global population aged 65 and above, the demand for healthcare services has also increased (McNicoll, 2002). For example, there is greater emphasis on oral health care and hearing care (Lee et al., 2020; Wallhagen & Strawbridge, 2017). Providing written materials or pamphlets can assist older adults in recalling important information and allow them to learn at their own pace (Bernier, 1993). Goodman and Lambert (2023) and Pearman and Storandt (2005) further pointed out that the decline in cognitive function among older adults should be considered when assessing their ability to understand texts. Providing easily understandable medication information for older adults can help reduce side effects caused by improper medication use (Liu et al., 2014).

To provide suitable reading materials, the American Medical Association (AMA) and the U.S. Department of Health and Human Services (USDHHS) recommend that the difficulty of texts should be kept at the level of 5th to 6th grade (Kutner et al., 2006). In the UK, guidelines recommend that health education materials for older adults should not exceed a readability level of 12 (Petterson, 1994), corresponding to the 11th-grade level in the U.S. (Gunning, 1952). In Australia, the SA Health agency recommends that texts should be at an 8th-grade reading level to ensure comprehension (Cheng & Dunn, 2015).

In summary, Western countries have established guidelines for the grade level at which texts should be understandable. Whether on the website or on paper, there are standards that can be referenced. In contrast, there is relatively little research in Taiwan that explores the appropriate grade level for health education texts. Therefore, the purpose of this study is to explore the level of difficulty in health education texts that are most suitable for older adults to read. Eye-tracking experiments will be conducted from the readers' perspective to understand their reading process and reading comprehension levels.

2. Literature Review

Readability is the extent to which readers can understand the text (Dale & Chall, 1949; Klare, 1963, 2000; McLaughlin, 1969). Readable text allows readers to understand and absorb content more effectively (DuBay, 2007). For example, using easily understood vocabulary, simpler sentence structures, and appropriate article length can enhance readability (Klare, 2000; Van Den Broek & Kremer, 2000). Therefore, when evaluating the readability of a text, it is essential to consider the reader’s ability and strive to minimize cognitive load.

In previous research, readability assessments typically employed readability formulas. Especially in English-speaking countries, these formulas provide a standardized quantitative metric, allowing the difficulty of a text to be measured and evaluated directly (DuBay, 2007). Traditional readability formulas are primarily used to assess the complexity of sentence or word structures in a text (Pruthi et al., 2015). By calculating indicators such as word length, sentence length, and the proportion of difficult words, the readability grade level of the text can be determined. This value indicates the appropriate grade level for reading the text. Common readability formulas are shown in Table 1.

In addition to using readability formulas to assess text difficulty, some researchers have employed eye-tracking experiments to confirm participants' reading processes and reading comprehension strategies. During these experiments, eye-tracking data offer insights into what readers focus on, the order in which they read the text, and the time they spend on different sections (Holsanova et al., 2009). In addition, eye-tracking experiments can be used to identify individual differences between readers. For example, students with adequate prior knowledge tend to experience a lower cognitive load when learning specific domain content. Therefore, this results in better learning outcomes (Jarodzka et al., 2010). Thus, eye-tracking experiments can help us understand differences in text comprehension among readers with varying levels of reading ability.

To gain deeper insights into participants' comprehension patterns, eye-tracking indicators can be subjected to analysis. These indicators derived from different types of eye movements, include Total Fixation Duration (TFD), Total Fixation Count (TFC), Percentage of Fixation Duration, First Fixation Duration, Number of regressive saccades, and so forth. Common eye-tracking indicators are detailed in Table 2. By analyzing several common eye-tracking indicators, the aim is to understand the reading comprehension and reading performance of older adults and to provide them with appropriate texts to read.

Table 1: Common Readability Formulas and Indicators

Formula name	Calculation formula	Indicators
Flesch Reading Ease （Flesch, 1948; Flesch, 1979）	Reading Ease = 206.835 –（1.015 × ASL）–（84.6 × ASW）	Average Sentence Length、Average Number of Syllables per Word
Gunning FOG （Gunning, 1952）	Gunning Fog Index = （ASL + PHW）×0.4	Average Sentence Length、Percentage of Hard Words
SMOG （Mc Laughlin, 1969）	SMOG Grade = 1.0430 $\times\sqrt{\text{number of polysyllables} \times (\frac{30}{\text{number of sentences}})}$ + 3.1291	Number of polysyllables、Number of sentenced

Table 2: Common Eye-Tracking Indicators

Eye-tracking Indicators	Definition/Measurement	References
Total fixation duration	The total time spent on all fixation points, with longer durations indicates a greater cognitive processing load.	Hannus & Hyönä, (1999); Hegarty & Just, (1993)
Total fixation count / the number of fixations	The number of fixations within all AOI. Areas with more fixations require more time for cognitive processing.	Eitel, (2016); Schnotz & Wagner, (2018)
Percentage of fixation duration	The fixation duration within the AOI / the total fixation duration on the screen. It reflects the reader's attention allocation to each text segment.	Alemdag & Cagiltay, (2018)
First fixation duration	The duration of the reader's first fixation on a word reflects the degree of selective attention given to the word.	Alemdag & Cagiltay, (2018); Lai et al., (2013); Scheiter & Eitel, (2015)
Number of regressive saccades	It is the total number of times the eyeball jumps from the position of the rear text to the front, reflecting the reader's late processing of single words. When readers encounter words or sentences they don't understand, they will look back more often.	Jian et al., (2013); Mason et al., (2016)

3. Method

This study conducts eye-tracking experiments focused on older adults. The objective of this study is to examine how text difficulty influences the reading comprehension of older adults with varying reading abilities. Eye-tracking indicators can reflect readers' cognitive processing and learning performance of text. For example: dwell time, total fixation count, dwell time %, first fixation duration, and regression in count. In addition, by asking participants to complete the Diabetes Knowledge Questionnaire (DKQ), it can be further investigated whether eye movement performance is related to the knowledge background of the reader or is caused by differences in individual reading ability.

3.1 Participants

For this study, 15 participants aged 65 and older were recruited. They lived in Taipei City. All participants were native Chinese speakers, and it was confirmed that their vision was either normal or corrected to a level that would be considered normal. Four older adults were excluded from the study due to not meeting the age criteria or failing to record eye-tracking data. Ultimately, 11 participants were included in the analysis.

3.2 Apparatus

The experiment used the SR Research Eyelink 1000, which recorded eye movements at a sampling rate of 1000 Hz. A chin bar was used to stabilize the participants' heads. The reading text was presented on a 24-inch LCD monitor with a resolution of 1920 x 1200

pixels. The text size was set to 28, and the distance between the monitor and the participants was 65 cm.

3.3 Experimental Materials

This experiment focused on the topic of diabetes due to the continuous global increase in the number of diabetes patients, particularly among older adults. A review of the statistical data shows that the worldwide prevalence of diabetes is expected to rise to 642 million by 2040, with the largest increase projected among individuals aged 60 to 79 (Ogurtsova et al., 2017). In Taiwan, the incidence of diabetes and cancer is also on the rise. According to the 2023 statistical data from the Ministry of Health and Welfare on the ten leading causes of death, malignant neoplasms (cancer) ranked first, accounting for 25.8% of total deaths, while diabetes was ranked fifth. The primary causes of death among diabetes patients are closely related to malignant tumors, cardiovascular diseases, and other conditions. Notably, 87% of cancer-related deaths occur in individuals aged 55 and above. Providing health education texts that are suitable for reading can significantly reduce the cognitive load of the elderly, help them understand the disease more deeply, and take appropriate measures according to the symptoms and risks (Conner et al., 2019; Ebaid & Crewther, 2019). In light of this, the study selected diabetes as the theme and categorized the texts read by participants into three levels of difficulty: easy (6th grade), medium (9th grade), and Hard (12th grade). The texts were authored by six professional teachers, verified for readability, and reviewed by professional doctors to ensure content accuracy.

3.4 Reading Ability Test

Given the dearth of knowledge regarding the range of reading abilities among Taiwanese elders, this study employed the Diagnostic Assessment of Chinese Competence (DACC) to gain insight into the comprehension abilities of older adults across varying reading ability levels. Through computerized adaptive tests, participants' reading abilities are assessed in five aspects: word recognition, superficial meaning comprehension, textual meaning integration, inferential comprehension, and analysis and evaluation. The test results showed that the participants' reading abilities ranged from second to twelfth grade (Lee et al., 2021). Based on the DACC test results, this study categorized participants into two groups for further analysis: low reading comprehension (below 7th grade) and high reading comprehension (above 8th grade).

3.5 Diabetes Knowledge Questionnaire

To determine whether differences in participants' eye movement behaviors stem from their background knowledge of diabetes or their reading abilities, this study first had participants complete the Diabetes Knowledge Questionnaire (DKQ). This questionnaire assesses their understanding of diabetes knowledge and serves as a reference indicator during the reading experiments. The DKQ is a commonly used tool for measuring diabetes knowledge, with good internal consistency, indicated by a Cronbach's α coefficient of .78 (Garcia et al., 2001). A staff member with a bachelor's degree in English translated the DKQ, which was subsequently reviewed by two experts: a psychometrician and a physician certified in diabetes education. The translation process also referenced the simplified Chinese version developed by Hu and colleagues (2013), which reported a Cronbach's α coefficient of .89. The questionnaire consists of 24 brief statements, with each item offering three response

options: true, false, or unsure. The total score ranges from 0 to 24, with higher scores indicating a greater understanding of diabetes knowledge among the participants.

According to the results in Table 3, individuals with low reading comprehension abilities had an average score of 15.00 on the questionnaire, while those with high reading comprehension abilities had an average score of 16.67. Individuals with high reading comprehension abilities performed better than those with low reading comprehension abilities. Additionally, the standard deviation for high reading comprehension participants is 2.73, which is higher than the 2.00 for low reading comprehension participants. The *t*-value is -1.13, with a *p*-value of .29, indicating that the results are not statistically significant.

Reading comprehension is closely linked to vocabulary mastery and reading fluency (Ehri, 2014). Individuals with better reading comprehension are generally more skilled at understanding the vocabulary within the text, which helps them integrate and infer the content while adapting their reading strategies (Cain et al., 2004; Connor et al., 2015; Zargar et al., 2020). Moreover, readers with relevant background knowledge can better synthesize the meanings of sentences, thereby enhancing their reading comprehension skills (Mayer, 2005; Perfetti & Stafura, 2014; Schnotz & Bannert, 2003; Schnotz et al., 2014). Therefore, to investigate whether eye movement behavior is influenced by the reader's background knowledge, this study employs independent samples *t*-tests to examine the relationship between participants' performance on the knowledge questionnaire and their reading comprehension across different reading abilities. In statistics, independent samples *t*-tests are commonly used to explore differences between two distinct groups, such as comparing the performance of experts and novices in solving math problems (Chen & Wen, 2023). However, according to the results, both groups have a similar level of diabetes knowledge, which does not significantly affect their comprehension of diabetes-related texts.

Since the scores on the diabetes knowledge questionnaire did not show statistically significant differences, the subsequent eye-tracking analysis excluded the influence of diabetes background knowledge. This allows for an exploration of whether there are differences in eye movement comprehension performance among participants with varying reading abilities. The analysis uses eye-tracking indicators to examine the cognitive processes of participants with different reading abilities as they read texts of varying difficulty, thereby facilitating further inferences.

Table 3: *t*-Test Analysis of Correct Responses on the Questionnaire by Reading Ability

	n	*M*	*SD*	*t*
Low reading ability	5	15.00	2.00	
High reading ability	6	16.67	2.73	-1.13

*$p < .05$; **$p < .01$

3.6 Procedure

The experimental flow chart of this study is shown in Figure 1. Before the experiment officially begins, the contents of the informed consent form are first explained to the participants. After the participants understood the entire experimental process, they signed a consent form to express their agreement to participate in the experiment. Subsequently, they completed the DKQ to assess their prior knowledge of diabetes. Following this, the DACC was conducted to evaluate the participants' reading abilities. The duration of the testing phase

was approximately 40 minutes to 1.5 hours, after which participants were permitted a 10-minute break before commencing the eye-tracking experiment.

Before officially starting the eye-tracking experiment, each participant underwent a nine-point calibration and verification process to adjust the camera's position and focus, ensuring that their pupils were aligned with the central cross on the screen. The eye-tracking experiment was then initiated and divided into three stages. After reading each page of text, participants pressed the space bar to proceed to the next page. When the screen displays "Congratulations, you have completed this section", participants are asked to answer questions about the text's topic. After responding, participants were given a 5 to 10-minute break. The entire eye-tracking experiment lasted approximately 20 minutes.

For subsequent analyses, this study utilized heatmaps to evaluate participants' comprehension of the text and their reading behaviors. This involved calculating the fixation duration and frequency in areas related to diabetes proper nouns and non-diabetes proper nouns. The rationale for focusing on these two main categories is that vocabulary significantly impacts readers' understanding of the text. According to Chaffin et al. (2001), readers usually spend more time on cognitive processing when they encounter novel or unfamiliar words. Jian et al. (2013) also explored how readers understand academic vocabulary in physics, finding that readers can infer the meanings of these terms through contextual cues and other familiar vocabulary. Following this, a quantitative analysis of Area of Interest (AOI) was conducted to extract five common eye-tracking indicators, aiming to gain deeper insights into the participants' reading comprehension processes.

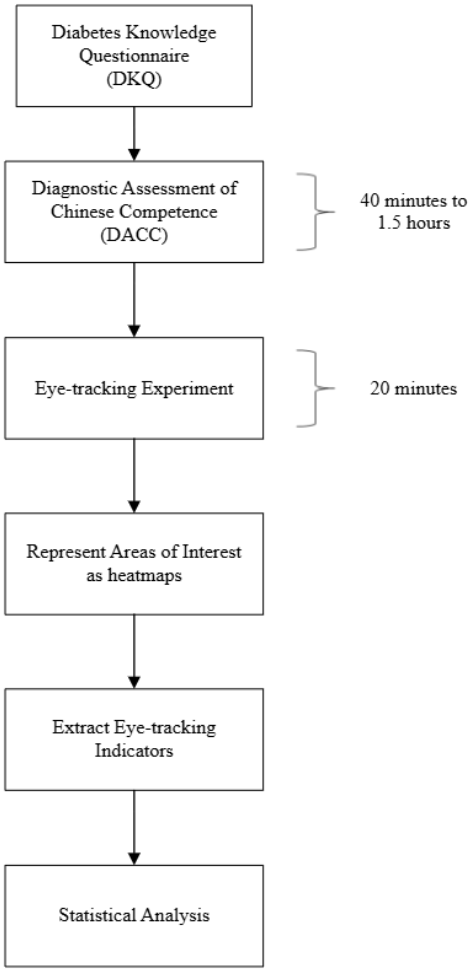

Figure 1: The Experimental Flow Chart

4. Results

This study used heatmaps to visually analyze eye-tracking data, giving an initial look at how participants with different reading skills performed when reading texts of different difficulty levels. Figures 2, 3, and 4 illustrate the findings. The heatmaps show text paragraphs marked with varying color intensities, with darker colors indicating longer reading times and more frequent fixations. Following this initial analysis, diabetes proper nouns and non-diabetes proper nouns were identified as Area of Interest (AOI). The diabetes proper nouns were selected based on definitions provided by the International Diabetes Federation (2024), the American Diabetes Association (2024), and SA Health (2022). Non-diabetes proper nouns were excluded from the specialized terms vocabulary. Subsequent eye-tracking analysis was then conducted on these AOI, as depicted in Figures 5 and 6.

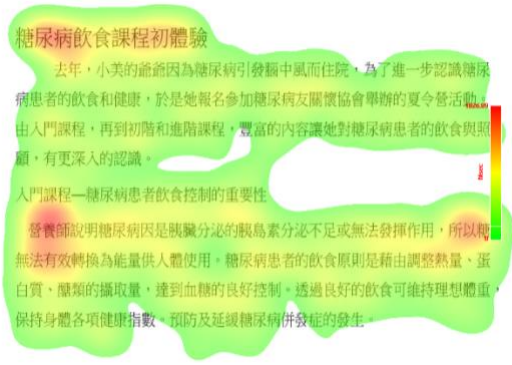

Figure 2: Heatmap of Low Reading Ability Participants Reading a Text of Easy Difficulty

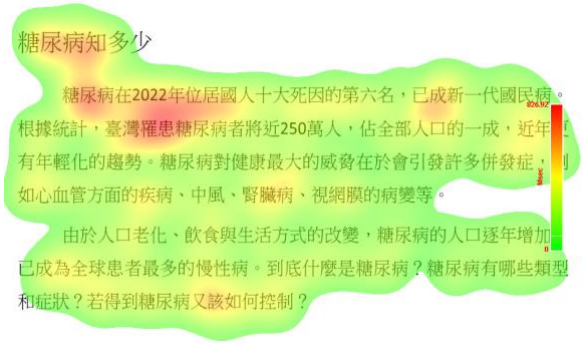

Figure 3: Heatmap of Low Reading Ability Participants Reading a Text of Medium Difficulty

Figure 4: Heatmap of Low Reading Ability Participants Reading a Text of Hard Difficulty

Figure 5: Heatmap With Diabetes Proper Nouns As AOI

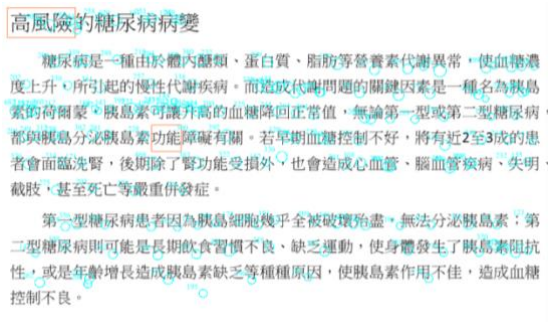

Figure 6: Heatmap With Non-diabetes Proper Nouns As AOI

4.1 Data Selection and Analysis

According to Rayner (2009), participants' gaze duration typically ranges between 100 and 500 milliseconds. If the gaze duration exceeds 1,000 milliseconds, it may be attributed to instrumental error. Therefore, during the eye-tracking data analysis, data with gaze durations shorter than 100 milliseconds or longer than 1,000 milliseconds were excluded (Morrison, 1984; Rayner & Pollatsek, 2016). Ultimately, data from 11 participants were collected, including 5 participants with low reading ability and 6 participants with high reading ability. For the data analysis, diabetes proper nouns and non-diabetes proper nouns were designated as AOI. The eye-tracking indicators employed were based on commonly used eye-tracking indicators from past studies (Jian & Ko, 2017; Jian et al., 2013; Rayner, 1998; Rayner et al., 2006; Schad et al., 2014), such as dwell time, total fixation count, dwell time %, first fixation duration and regression in count. Commonly used eye-tracking indicators are detailed in Table 4.

Table 4: Common Eye-Tracking Indicators

Eye-tracking Indicators	Definition/Measurement	References
Dwell time	The total time spent on all fixation points within the AOI is summed, with longer durations indicating a greater cognitive processing load.	Jian & Ko, (2017); Lai et al., (2013)
Fixation count	The total number of fixations across all AOIs is summed, with a higher number of fixations indicating a higher degree of cognitive processing or that the text information is more engaging.	Eitel, (2016); Schnotz & Wagner, (2018)
Dwell time %	The proportion of dwell time on the AOI relative to the total dwell time on the entire text reflects the reader's selective attention allocation or the time spent on processing the information within the AOI.	Alemdag & Cagiltay, (2018); Mason et al., (2013)
First fixation duration	The first fixation duration reflects the reader's initial semantic processing or the degree of selective attention given to a word; the more attractive or familiar the word is to the reader, the shorter the fixation duration will be.	Alemdag & Cagiltay, (2018); Jian et al., (2013); Scheiter & Eitel, (2015)

Regression in count	The total number of regressions, where the eyes jump backward to earlier positions in the text, reflects the reader's late-stage processing of words. When encountering unfamiliar words or sentences, the number of regressions increases.	Jian et al., (2013); Mason et al., (2016)

4.2 Statistical Analysis Methods

In the statistical analysis, this study followed the experimental design of Jian and Ko (2017), using reading ability (low and high) and text difficulty (medium and hard) as independent variables, with eye-tracking measures as the dependent variables. During the experiment, participants read two articles, and data analysis was based on eye-tracking indicators selected from the AOI. Additionally, following the study by Jou and Mariñas (2023), which assessed the reading behaviors of individuals with dyslexia, the independent variables were set as people without dyslexia and those with dyslexia, as well as three different text designs, with eye-tracking measures again as the dependent variables. Participants read three different text designs in sequence, and subsequent analysis and inference were conducted based on the eye-tracking indicators.

Upon reviewing the two studies mentioned above, a common approach can be observed: the use of a two-factor mixed design, where reading ability is treated as a between-subjects factor and text difficulty as a within-subjects factor, with various eye-tracking indicators as dependent variables. This aligns with the design approach of this study. Therefore, in this study, the independent variables were set as low reading ability (below 7th grade), high reading ability (above 8th grade), and text difficulty (6th, 9th, and 12th-grade levels). The dependent variables were five eye-tracking indicators, aiming to explore the performance differences of participants with different reading abilities when reading texts of varying difficulty, and to infer their eye-tracking behavior further.

4.2.1 Analysis Results Using Diabetes Proper Nouns and Non-diabetes Proper Nouns As Units

In selecting the AOI, the analysis primarily focused on diabetes proper nouns and non-diabetes proper nouns. The descriptive statistics summary is presented in Table 5, and the ANOVA summary table is shown in Table 6. Among the five eye-tracking indicators, only the regression in count for diabetes proper nouns reached significant interaction between reading ability and text difficulty, $F(2, 18) = 3.69$, $p < .05$, $\eta^2 = .29$. This eye-tracking indicator may reflect eye movement behavior when readers have difficulty understanding the text or vocabulary, leading them to integrate or clarify their perspective (Rayner et al., 2003). Additionally, text difficulty also exhibited a significant main effect, $F(2, 18) = 5.75$, $p < .05$, $\eta^2 = .39$.

From the results in Table 7, it can be seen that the simple main effect of reading ability significantly impacted regression in count for easy texts, $F(1, 27) = 5.09$, $p < .01$, $\eta^2 = .16$. Post-hoc comparisons indicated that participants with low reading comprehension ($M = 0.87$, $SD = 0.51$) exhibited significantly higher regression counts when reading easier texts than those with high reading comprehension ($M = 0.42$, $SD = 0.25$). Research suggests that participants with low reading comprehension tend to learn from simpler text and images primarily because easier texts are more comprehensible for them. Consequently, they

concentrate more attention on these simpler texts, leading to a significant increase in the number of fixations and total reading time.

The analysis of regression behaviors also indicated that participants with low reading comprehension had significantly more regressions in easier texts compared to more difficult ones. In other words, individuals with low reading comprehension tend to spend more time and focus on easily understandable texts, aiding their learning and information integration within these materials (Jian & Ko, 2017). However, this study categorized text difficulty into three levels (6th, 9th, and 12th grade) and classified participants' reading comprehension into low (below 7th grade) and high (above 8th grade). As the reading ability of the participants in this study ranged from 5th to 7th grade, providing 6th-grade level texts does not create a significant cognitive gap. In summary, the complexity of the health education texts should be kept at a level that is easily understandable for 6th graders.

On the other hand, the results in Table 7 indicate that the simple main effect of text difficulty significantly influenced participants with high reading comprehension, $F(2, 18) = 10.16$, $p < .01$, $\eta^2 = .06$. Post-hoc comparisons revealed that participants had higher regression in counts when reading texts of medium difficulty ($M = 1.25$, $SD = 0.29$) and high difficulty ($M = 1.14$, $SD = 0.34$) compared to easier texts ($M = 0.42$, $SD = 0.25$). This suggests that even readers with good comprehension skills may need to put in extra effort to understand content when reading texts that match their reading level.

This phenomenon is similar to what is seen in individuals with low reading comprehension, who often take more time to understand texts. As text difficulty increases, readers' fixation durations and regression counts also rise (Jacobson & Dodwell, 1979; Rayner et al., 1989; Rayner et al., 2006). An increase in fixation count reflects the reader's need for higher-level cognitive processing when comprehending the text (Eitel, 2016; Schnotz & Wagner, 2018). Therefore, participants with a high level of reading comprehension tend to have significantly more regressions when they read texts of medium to high difficulty than when they read texts of lower difficulty.

Table 5: Descriptive Statistics Summary of Regression in Count by Reading Ability and Text Difficulty (diabetes proper nouns)

Text Easy		Text Medium		Text Hard	
Low reading ability	High reading ability	Low reading ability	High reading ability	Low reading ability	High reading ability
5	6	5	6	5	6
0.87	0.42	1.00	1.25	0.89	1.14
0.51	0.25	0.30	0.29	0.30	0.34

Table 6: ANOVA Summary Table for Regression in Count by Reading Ability and Text Difficulty (diabetes proper nouns)

SV	SS	df	MS	F	η2
Reading Ability (A)	0.00	1	0.00	0.02	.00
Error(A)	0.89	9	0.10		
Text difficulty (B)	1.40	2	0.70	5.75*	.39
Reading Ability (A) x Text difficulty (B)	0.90	2	0.45	3.69*	.29
Error	2.19	18	0.12		

*$p < .05$

Table 7: Summary Table of Simple Main Effects for Regression in Count by Reading Ability and Text Difficulty (diabetes proper nouns)

SV	*SS*	*df*	*MS*	*F*	η2	Post hoc Comparison
Reading Ability (A)						
Text Easy (b1)	0.56	1	0.56	5.09*	.16	Low>High
Text Medium (b2)	0.18	1	0.18	1.64	.06	
Text Hard (b3)	0.16	1	0.16	1.45	.05	
Error	3.08	27	0.11			
Text difficulty (B)						
Low reading ability (a1)	0.05	2	0.02	0.19	.02	
High reading ability (a2)	2.47	2	1.23	10.16*	.53	Medium, Hard>Easy
Error	2.19	18	0.12			

*p<.01

5. Conclusion

Previous studies primarily focused on elementary and university students to provide appropriate reading materials for them. In contrast, this research focuses on older adults as the participants, whose cognitive comprehension differs from students. To understand the reading abilities of older adults and provide suitable health education texts, this study employed testing and eye movement experiments to observe the reading behaviors and performances of the participants.

In selecting the AOI, the analysis concentrated on diabetes proper nouns and non-diabetes proper nouns, utilizing five eye-tracking indicators. The results revealed a significant effect solely in the regression in count for diabetes proper nouns. Specifically, participants with low reading comprehension showed more regressions when reading simpler texts than those with high reading comprehension; this indicates that individuals with lower reading comprehension may be more willing to spend additional time understanding easier texts. Moreover, participants with high reading comprehension exhibited significantly higher regression in counts when reading medium and hard texts than when reading easy texts. This suggests that even highly proficient readers put in significant effort to understand texts that match their reading level, resulting in longer fixation durations and more regressions as the text difficulty increases. This shows that although cognitive decline does occur in older adults, the results are consistent with previous research and help to fill in the gap. In summary, the 11 participants in this study were from the Taipei metropolitan area. Five of them were identified as having low reading comprehension skills. This group included one fifth grader, one sixth grader, and three seventh graders. In theory, all of these participants have relatively good reading comprehension skills. However, in order to take into account the reading comprehension levels of older adults in non-metropolitan areas, we recommend that the level of difficulty of the text provided should be no higher than the sixth grade level.

6. Limitations of the Study

This study focused on five common eye-tracking indicators for analysis. However, the range of available eye-tracking indicators is extensive. Future research could consider incorporating additional indicators from different dimensions, such as average saccade length and fixation position as spatial metrics. This would provide a more comprehensive observation of participants' eye movement behaviors and enable deeper exploration. In addition, this study

had limitations related to sample size, which may affect the results of statistical analyses. To enhance the inferential strength of future research, it is advisable to increase the sample size and collect more data for a more thorough statistical evaluation.

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Contact email: M11211013@mail.ntust.edu.tw

Transforming Education: Using the Pedagogy, Spaces and Technology (oPSTi) Framework to Teach Project Based Learning Among Southeast Asia Educators

Sanura Jaya, SEAMEO RECSAM, Malaysia
Parvinder Singh Amar Singh, SEAMEO RECSAM, Malaysia
Azman Jusoh, SEAMEO RECSAM, Malaysia

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Abstract
Digital citizenship encompasses interaction via the network, appropriate learning spaces and suitable technology tools in an emerging trend in STEM education. The digital literacies comprise the teaching and learning skills that enable technology to emerge in teaching and learning. This article examines the transformative impact of the Pedagogy, Spaces, and Technology (oPSTi) Framework on teaching and learning among educators in Southeast Asia. The study employed a case study research design using post-test questionnaire. Twenty-four educators from Southeast Asian were involved in the purposive sampling to identify the impact of the oPSTi framework in teaching and learning. The findings reveal a significant enhancement in teaching practices, experiences, and confidence among these educators following their engagement using the oPSTi Framework in the workshop. The findings indicated the key pedagogical strategies and innovative teaching activities, which were highly effective, with a mean value ranging from 4.41 to 4.68. The framework's emphasis on self-determined learning, adult learning principles, and project-based learning with the application of digital learning tools was pivotal in this enhancement. Notably, the use of technology tools, both hardware and software, enabled effective integration of coding and computational thinking skills using Magnetcode. The respondents reported increased motivation and a greater propensity to recommend the oPSTi Framework to their peers, highlighting its potential to drive substantial improvements in educational practices. The study underscores the oPSTi Framework's capacity to foster a dynamic and effective teaching environment, aligning with the current trends in digitalization of STEM education. This transformation is crucial for equipping educators with the skills and confidence needed to integrate coding and programming into their teaching practices, ultimately contributing to the broader advancement of STEM education in the region.

Keywords: oPSTi Framework, Magnetcode Application, Microcontroller, STEM Education, Southeast Asian Educators

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Introduction

In the rapidly evolving educational landscape, digital citizenship and STEM (Science, Technology, Engineering, and Mathematics) education have become crucial components (Economic Planning Unit, 2021). Integrating technology into teaching not only enhances learning experiences but also prepares educators for a technologically advanced future (Qismullah & Yunisrina, 2018). The integration of digital culture in education is a cornerstone of teaching innovation, as highlighted by recent studies on digital education (Cerstin & Andreas, 2019). The pivotal role of digital technology in moving away from traditional models has been especially significant in remote learning environments, bringing attention to training spaces, digital skills, and learning methods(Mason & Rich, 2019; Mattila et al., 2022). This shift has reignited the potential of digital technology, as emphasized in recent STEM educational (Norhaqikah & Kamisah, 2017; Yean & Abdul Rahim, 2021). STEM education has many advantages as it is an innovative and attractive tool for teaching and learning (Suryani et al., 2024). It is an exciting field for children to satisfy their curiosity about the world (Hsieh et al., 2022).

STEM education in Southeast Asia faces several significant challenges in both teaching and learning (Faikhamta et al., 2020). One major issue is the outdated curriculum that many educational institutions still rely on, which fails to reflect the latest advancements in STEM fields (Stamatios et al., 2023). Additionally, the curriculum often lacks contextual relevance, making it difficult for teachers to connect with subject based contents(Blackley & Howell, 2019; García-Peñalvo, 2018). Pedagogically, the reliance on teacher-centered methods, such as lecture-based teaching, limits student engagement and critical thinking. Furthermore, there are limited opportunities for educators to participate in ongoing professional development to update their skills and knowledge in STEM education (Khairani, 2017). This professional stagnation contributes to a lack of student interest in STEM subjects, partly because they are perceived as difficult and uninteresting (Nik Hazimin & Hazrati, 2019).

The adoption of technology tools in STEM education presents its own set of challenges among Southeast Asian teachers (Susilo & Sudrajat, 2020). Teachers face challenge in integration of the learning space physically and virtually which is technological infrastructure, and inconsistent internet connectivity further hampers the effective use of online learning tools (Sastra et al., 2021). Teacher preparedness is another critical issue, as many educators are not adequately trained to integrate technology into their teaching practices effectively (Siti Noor Aneeis et al., 2022; Yeh & Tsai, 2022). This lack of technological literacy (Wu & Anderson, 2015), combined with resistance to change due to unfamiliarity with digital tools, further complicates the adoption process. Additionally, limited financial resources restrict the acquisition of up-to-date technology and software necessary for effective STEM education. The scarcity of high-quality, localized digital educational content and tools also hampers the ability to cater to the specific needs of Southeast Asian students (Daugherty Michael & Carter, 2019; Hidiroğlu & Karakaş, 2022; Lakshminarayanan & McBride, 2015).

Addressing these issues requires a comprehensive approach involving teaching and learning strategies in STEM education embedded with learning space and technology. The researcher aim to assess the impact of the oPSTi framework in term of pedagogy, learning space and technology to enhance the quality of STEM education and better prepare students for the demands of the modern workforce.

Research Objective

To assess the impact of the oPSTi Framework on teaching and learning among Southeast Asian educators.

Research Question

What is the impact of the oPSTi framework on teaching and learning among Southeast Asian educators?

Literature Review

The oPSTi framework is a conceptual map for planning or revising any teaching, learning or lesson. It can be easily adapted and mixed with the elements in the framework. The oPSTi framework was developed through the design and development research (DDR) using the experts consensus for the constructs and elements (Sanura et al., 2022). The Pedagogy-Space-Technology (PST) is the existing framework from Carrick Institute by Professor Radcliffe for the Next Generation Learning Spaces project at the University of Queensland (Radcliffe et al., 2008a, 2008b). The learning environment originated from three interdependent aspects: pedagogy, space and technology (Fisher, 2005; Oblinger, 2005). Earlier scholars, Wilson, Powell and Tibbetts (2008) implied "a nexus between pedagogy, the design of the learning spaces and technology and suggested the PST framework as guidelines in NGLS to enhance 21st-century skill in era 5.0. The transition from PST framework have been improved with development of the oPSTi framework with the strength in emergence the elements of pedagogy in innovative ways, application of the technology and suitable learning space by looking into the objective and implementation of the framework in teaching and learning (Sanura et al., 2022). Figure 1 illustrated the existing framework and oPSTi framework. The outdoor classroom environment and the utilization of space will influence the preferred teaching methods and technology for both teachers and students in next-generation education as illustrated in Figure 1.

(a) (b)

Figure 1: (a) The Transition From Existing Framework
(b) PST Framework to oPSTi Framework
Sources: (Radcliffe, 2008) and (Sanura, 2023)

Figure 1 illustrated the transition from the existing PST (Pedagogy, Space, Technology) (Radcliffe et al., 2008a) framework to the new oPSTi framework represents a significant evolution in educational methodology. While the existing PST framework focuses on integrating traditional teaching methods, learning environments, and basic technological tools, the oPSTi framework enhances these elements with a more dynamic and interactive approach (Sanura, 2023). It incorporates innovative pedagogies such as heutagogy and andragogy, which promote self-directed learning and critical thinking (Blaschake, 2021; Porman Lumban Goal, 2020). Additionally, it extends the concept of learning spaces from outdoor classroom environments to include specialized environments like Makerspaces, STEM Community Hubs, and Virtual Learning Environments, which are designed to foster collaboration and hands-on learning (Bruno Schardong et al., 2020; Hadad, 2020; L. Peterson & Scharber, 2018). The technological component is also significantly advanced, with the inclusion of collaborative technologies, advanced digital tools, and computational thinking, thereby creating a more engaging and interactive learning experience. Overall, the oPSTi framework integrates these enhanced elements to create a holistic, student-centered educational experience that is adaptive to the evolving demands for STEM education among Southeast Asian educators.

Project-Based Learning in STEM Education

The oPSTi framework can be effectively integrated with Project-Based Learning (PBL) to enhance the teaching and learning experience. According to Chistyakov et al (2023), pedagogical strategies through project based learning can influence on student learning, especially in science and STEM education. Project-based learning is a process-oriented learning approach (Mazlini Adnan et al., 2018)that requires flexible learning spaces which is the learning can be everywhere by used of technology tools (Sanura & Rozniza, 2022).

PBL inherently relies on innovative pedagogies (Imms & Kvan, 2021). Therefore, the oPSTi framework emphasizes activities and strategies such as heutagogy and andragogy, which are critical in PBL. According to Mahat and colleagues (2018) these approaches encourage students to take control of their learning process, fostering self-directed learning, which is a core principle of PBL. Project-based learning strategies can upgrade understudies' basic and imaginative reasoning abilities in science acquiring. According to Zulyusri and colleagues (2023), teachers can use the syntax of the project-based learning method to assist students in optimizing their creativity and critical mindsets. By project based learning, students starting learning with essential questions, working together to plan, developing project completion schedules, timelines, and deadlines (Zulyusri et al., 2023).

The framework includes various learning environments like Makerspaces, STEM Community Hubs, Virtual Learning Environments (VLEs), and Outdoor Learning Environments. PBL benefits from these diverse spaces as they provide flexible and dynamic environments where students can collaborate, experiment, and engage in hands-on activities crucial for project-based tasks (Barak, 2020; Nurul Natrah & Ahmad Shidki, 2020; Wang, 2023).

PBL requires the integration of collaborative technologies, digital learning tools, and computational thinking (Malik & Zhu, 2023). The oPSTi framework highlights the use of hardware and software tools, especially the Magnetcode application, screen casting, and other media technologies, which guide teachers to facilitate the implementation of PBL by enabling students to research, collaborate, and present their projects effectively (Khusna et al., 2022; Lin et al., 2021).

The effective implementation of PBL is supported by the oPSTi framework through the creation of conducive learning spaces and the selection of appropriate technological tools. By ensuring that the physical and virtual spaces are suitable for collaborative and interactive learning, the framework enhances the efficacy of PBL. Therefore, both the oPSTi framework and PBL focus on clear learning objectives. For instance, applying technical skills and engaging in collaborative projects help achieve specific learning outcomes. Teachers using the oPSTi framework are guided to set objectives that align with the goals of PBL, ensuring that students develop critical thinking, problem-solving, and teamwork skills.

Methodology

This study used a quantitative approach with a case study design. The researcher employed a one-group post-test design and to evaluate the effectiveness of the oPSTi framework in enhancing project-based learning among Southeast Asia country STEM secondary school educators. The researcher used purposive sampling to select 22 educators who teach STEM subjects, ensuring the participants are directly involved in the areas most likely to benefit from the integration of project based learning using Magnetcode application. The intervention consists of a workshop focused on the practical application of coding and programming through Magnetcode for STEM-based hands-on projects. To assess the impact of integration oPSTi framework using the Magnetcode application, the researcher measured the effectiveness of the oPSTi application among the educators before and after the workshop using standardized survey questions. Five-point Likert scale was used to gather the mean for the impact of the framework.

The oPSTi framework, as outlined by Sanura (2023), provides a structured approach for teachers to achieve their teaching and learning goals through the integration of various strategies and tools (Peterson et al., 2018). Teachers are encouraged to set clear objectives, such as the application of technical skills using diverse media (Lock et al., 2021). They should plan appropriate strategies within their learning environments, like active learning, which facilitates student engagement through discussion or interactive demonstrations. The creation and selection of effective activities, including online learning, is crucial, as is ensuring that the learning spaces, such as collaborative teaching areas, are suited to these activities (Bojer, 2019; Chiasson, 2022). The framework also emphasizes the importance of selecting appropriate technological tools such as smart phone (Schuck et al., 2017), laptop and screen casting for online tutorials, which allow students to engage and build on prior knowledge through peer discussions (Sage et al., 2020). Implementing the oPSTi framework boosts teachers' confidence in using technology, enabling them to evaluate learners with a scaffolding approach that prioritizes student learning and allows for flexible teaching sessions.

Findings and Discussion

This study investigates the impact of the oPSTi Framework on teaching and learning among Southeast Asia educators. Focusing on what is the impact of the oPSTi framework on teaching and learning, the findings ought to answer the research objective and research question in this study. Table 1.0 shows the quantitative findings from the case study design in implementation of the oPSTi framework. The findings reveal significant improvements in teaching practices, experiences, and confidence levels. The mean values for various aspects of the framework's implementation range from 4.41 to 4.68, indicating a high level of effectiveness and satisfaction among the participants as show in Table 1.

Table 1: The Impacts of the oPSTi Framework

No	Impacts of the oPSTi Framework	N	Mean	Standard Deviation
1	The teaching activities introduced in the workshop using oPSTi Framework enhanced my teaching	22	4.41	.503
2	The pedagogies strategies embedded in the oPSTi Framework enhanced my teaching	22	4.59	.503
3	The teaching activities introduced in the workshop using the oPSTi Framework enhanced my teaching experience.	22	4.59	.503
4	The pedagogies strategies embedded in the oPSTi Framework enhanced my teaching experience.	22	4.55	.510
5	The activities during the workshop using the oPSTi Framework provided effective methods for integrating self-determined learning into my teaching]	22	4.55	.510
6	Adult learning was visible during the activities conducted in the workshop using the oPSTi Framework	22	4.45	.596
7	Activities conducted in the makerspace during the workshop using the oPSTi Framework was beneficial for my understanding.	22	4.50	.598
8	The tools utilized in the Makerspace using the oPSTi Framework enhanced my teaching and learning.]	22	4.41	.503
9	The Virtual Learning Environment (VLE) simulation in the workshop using the oPSTi Framework was effective in demonstrating the integration of Magnetcode	22	4.68	.477
10	Project based learning applied in the workshop using the oPSTi Framework contributed to my understanding of integrating Magnetcode	22	4.68	.477
11	The technology tools (hardware) used in the workshop using the oPSTi Framework were effective for integrating Magnetcode in my teaching.	22	4.55	.510
12	The technology tools (software) introduced in the workshop using the oPSTi Framework were helpful in understanding the integration of Magnetcode in the project	22	4.68	.477
13	The digital learning tools used in the workshop using the oPSTi Framework will be beneficial for integrating Magnetcode in my teaching practices.]	22	4.50	.512
14	The workshop using the oPSTi Framework enhanced my skills in computational thinking and coding with Magnetcode	22	4.64	.492
15	I feel more confident to use the oPSTi Framework in my educational practices after attending the workshop.]	22	4.50	.673
16	I will recommend this workshop to other educators to integrate the oPSTi Framework elements into their teaching and learning practices.]	22	4.64	.492
17	The elements in the oPSTi Framework increase my motivation to teach.	22	4.55	.739
18	Overall, the workshop using the oPSTi Framework significantly encouraged me to transform my teaching strategies.	22	4.64	.492

Table 1 illustrated the integration of the oPSTi Framework in teaching activities resulted in enhanced teaching practices and experiences, with mean values of 4.41 and 4.59 respectively. Educators reported that the pedagogical strategies embedded in the framework were particularly effective, with a mean value of 4.55 for enhancing teaching experiences. This demonstrates that the framework successfully incorporates innovative teaching methods that resonate well with educators.

The study also found that the activities conducted during the workshop provided effective methods for integrating self-determined learning into teaching practices, with a mean value of 4.55. Additionally, the visibility of adult learning principles during these activities received a mean score of 4.45, indicating that the framework aligns well with adult learning theories, making it suitable for professional development. The use of the makerspace and technology tools such as Magnetcode application within the oPSTi Framework was highly beneficial.

Educators found the tools used in the makerspace (mean value 4.50) and the integration of Magnetcode in the Virtual Learning Environment (VLE) simulation (mean value 4.68) to be particularly effective. This highlights the importance of practical, hands-on learning environments and advanced technology tools in enhancing teaching practices.

Project-based learning, as applied in the workshop, contributed significantly to the understanding and integration of Magnetcode, with mean values of 4.68 for both software and hardware tools. The framework also enhanced educators' skills in computational thinking and coding, reflected in a mean value of 4.64. This underscores the framework's effectiveness in promoting critical STEM skills. The workshop using the oPSTi Framework significantly boosted educators' confidence in their teaching practices, with a mean value of 4.50, and increased their motivation to teach, with a mean value of 4.55. The willingness to recommend the workshop to peers (mean value 4.64) indicates a strong endorsement of the framework's benefits.

Conclusion

The study underscores the transformative impact of the oPSTi Framework on teaching and learning in Southeast Asia. The framework's emphasis on integrating pedagogy, learning spaces, and technology has proven to be highly effective in enhancing teaching practices, educator experiences, and confidence levels. The findings suggest that the oPSTi Framework's approach to self-determined learning, adult learning principles, and project-based learning is particularly beneficial in fostering a dynamic and effective teaching environment.

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The Role Played by the Student-Centred Approach in the Acquisition and Development of 4Cs of 21st Century Skills Through a Project-Based STEM Curriculum

Vidujith Vithanage, Lincoln University College, Malaysia
Nicola Nakashima, St. George's Teacher Training Institute, Sri Lanka

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Abstract
The study aims to investigate the role played by the student-centred approach to teaching and learning in the transfer and development of the 4Cs (creativity, critical thinking, collaboration and communication) of 21st-century skills via a project-based STEM curriculum. In a rapidly changing world with technological advancements, where most algorithmic functions are on the verge of automation, 4Cs have become pivotal for future career success. Thus, the schools, being institutions that prepare students for the future, should be able to equip them with the required skill set through the curriculum and instructional approaches used. Project-based learning and STEM learning are the two most popular strategies for cultivating 21st-century skills. There is substantial empirical evidence to support the positive impact project based STEM has on the 4Cs. It is equally important to understand the influence of the pedagogical approaches on the positive nurturing relationship between project-based STEM and the 4Cs of 21st century skills. The context for the current study is created at the middle school level in an international school in Colombo, Sri Lanka. The study used a mixed method research prerogative to explore the effects of the student-centred instructional approach on project-based STEM curriculum. The quantitative and qualitative data analysis converged on a student-centred instructional approach to significantly impact the acquisition and development of 4Cs through a project-based STEM curriculum, thus qualifying a student-centred pedagogical approach as a recommended instructional method for project-based STEM.

Keywords: Student-Centred Approach, 21st Century Skills, STEM Learning, Project Based Learning, Collaboration, Communication, Critical Thinking, Creativity

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Introduction

STEM is a learning strategy that incorporates components of Science, Technology, Engineering, and Mathematics into the learning process. STEM education employs problem-solving-based learning by inadvertently including scientific study and the application of mathematics in the construction of technology as a problem-solving strategy (Johnson et al., 2016). Scientific inquiries are uncommon in technology education, while technological design is uncommon in scientific classes. However, in ordinary life, design and scientific research are frequently used in tandem as a technical solution to real-world challenges (Sanders, 2009). These aspects encompass the ability to inquire about scientific concepts and identify problems, devise and execute investigations, utilize mathematical skills, employ information and computer technology, apply computational thinking, and acquire, evaluate, and convey information (Afriana et al., 2016). Project- based learning is highly beneficial and provides strong support for students. One way to facilitate the implementation of habituation activities is by incorporating the STEM (Science, Technology, Engineering, and Mathematics) approach in the classroom. This involves assigning project tasks to learners, which can help them develop skills and knowledge in these areas (Anggraini & Huzaifah, 2017). The ability to think critically is essential for learners to effectively address the diverse challenges they encounter in today's world. By engaging in a systematic thinking process, individuals can develop the necessary skills to analyse and solve problems (Bhakti et al. 2018). Extensive research conducted comprehensively examined the impact of a student-centered learning method on the transfer of the 4Cs of 21st-century abilities (Critical Thinking, Communication, Collaboration, and Creativity) within a project-based STEM curriculum. The concept of student-centered learning places a strong emphasis on learner agency, which empowers students to actively participate in their educational experiences and assume responsibility for their own learning process.

4C’s and Student-Centred Learning

The implementation of a student-centered approach in education promotes the development of critical thinking skills through the encouragement of students to actively engage in questioning, analyzing information, and autonomously exploring potential solutions. The implementation of project-based STEM assignments requires students to engage in the critical evaluation of information sources and the use of analytical reasoning to address intricate challenges. This aligns with the cultivation of critical thinking abilities, as highlighted by Kwon and colleagues (2017). The implementation of student-centered learning methodologies facilitates the development of communication skills by means of interactive activities that necessitate students to express their thoughts, participate in peer dialogues, and provide presentations of their discoveries. In the context of project-based STEM education, it is imperative for students to engage in collaborative teamwork, which requires them to effectively communicate difficult technical concepts to their colleagues and stakeholders (Hmelo-Silver et al., 2007).

Collaboration serves as a fundamental principle in both student-centered learning and project-based STEM education. Collaborative tasks within project-based environments bear resemblance to real-world situations, as students engage in collective efforts to combine multiple viewpoints, navigate discrepancies, and jointly generate knowledge (Krajcik & Shin, 2008). Creativity is fostered within student- centered learning environments, as they provide opportunities for students to engage in critical thinking and explore novel methodologies. The integration of project-based STEM education enables students to develop innovative

solutions to real-world problems by granting them the independence to invent their own techniques while applying STEM principles (Häkkinen et al., 2017). Educators can enhance student engagement and facilitate deeper learning experiences by implementing a project-based STEM curriculum that prioritizes a student-centered approach. This method 34 capitalizes on students' innate motivation and interests, as highlighted by Prince and Felder (2006). This approach is in accordance with the 4Cs framework, since it promotes the development of critical thinking skills, effective communication abilities, meaningful collaboration, and the use of creative potential within a supportive and empowering educational setting.

There is evidence of a statistically significant beneficial relationship between the implementation of student-centered learning approaches and the enhancement of the 4Cs skills, namely Critical Thinking, Communication, Collaboration, and Creativity. Numerous studies have consistently shown that educational methodologies that prioritize student-centered learning, thereby granting learners agency and fostering active participation, are correlated with heightened critical thinking abilities (Prince & Felder, 2006), enhanced communication skills (Hmelo-Silver et al., 2007), more successful collaborative efforts (Johnson et al., 2016), and heightened levels of creativity (Häkkinen et al., 2017) among student populations. The aforementioned results collectively emphasize the beneficial impact of student-centered learning in promoting the development of the 4Cs skills, hence contributing to comprehensive and well-rounded educational achievements. The extant literature also provides evidence of a statistically significant association between student-centered learning and the acquisition of 4Cs skills (Critical Thinking, Communication, Collaboration, and Creativity) through the implementation of a project-based STEM curriculum. Research findings suggest that the implementation of student-centered methodologies in project-based STEM education facilitates the cultivation and utilization of the 4Cs skills, as supported by studies conducted by Hung and colleagues (2008) and Krajcik and Shin (2008). Learners actively participate in project-based activities where they work together to address authentic challenges, fostering the development of critical thinking, proficient communication, productive teamwork, and innovative problem-solving abilities (; (Bell, 2010; Shin & Kim, 2019). The incorporation of student-centered learning into the project-based framework fosters a mutually beneficial connection between both instructional methods, thereby augmenting the acquisition of 4Cs abilities and equipping students to tackle the problems of the 21st century.

Theoretical Framework

Integrating social constructivism, social cognitive theory, and digital connectivism provides a comprehensive theoretical foundation for investigating the role played by student-centred learning approaches in project-based STEM (Science, Technology, Engineering, and Mathematics) education. The theoretical framework of social constructivism, founded on the ideas of Vygotsky, emphasizes the importance of collaborative processes in building knowledge through interactions among peers and the development of common understanding. This perspective aligns well with the collaborative character of project-based STEM assignments and with the ideas such as agency and active engagement of students in the student-centred approaches. (Bell, 2010; Vygotsky, 1978). Bandura's social cognitive theory provides a valuable perspective that aligns with the aforementioned argument. It emphasizes the significance of learners' observation and imitation of their peers' activities within project-based STEM groups. This process enhances many cognitive abilities, including problem-solving, critical thinking, and communication skills (Bandura & Walters,

1963). Self-efficacy in Bandura's theory is closely linked with student-centred practices in learning. Digital connectivism is a concept that explores the influence of technology-mediated networks, with a particular focus on the significance of digital tools and online communities in project-based STEM learning. It highlights promoting cooperation and broadening access to various information sources (Siemens, 2004). In the digital space students get to exercise more autonomy and creates more opportunities for student agency. The synthesized framework presented in this study serves as a guiding framework for research in project-based STEM contexts. It emphasizes the importance of collaboration, observational learning, technological integration, and self-regulation in these contexts. By adopting a holistic perspective, this framework enables researchers to examine effective instructional strategies and outcomes comprehensively.

Present Study

Considering all the literature analyzed in the review above, it can be understood that room exists for a study to investigate the role played by student-centred learning approach in the acquisition and development of the 4Cs of 21st-century skills via a project-based STEM curriculum in the South Asian region at the middle secondary education level to establish statistical significance through the quantitative survey analysis and to further explore in depth any other interrelationships that exist through collection and analysis of qualitative data. Thus, the research gap can be identified as related to geography, which is the South Asian region (Sri Lanka), an academic level which is middle secondary school level (age 12 years to 14 years).

Method

The current study used a case study research model as it has only collected data from a single school in Sri Lanka and conducted a mixed methods study using a convergent parallel design. Researchers used both quantitative and qualitative measurements to analyse the degree and direction of influence student-centred learning has on project-based STEM. Statistical analyses, such as regression analysis, generated helpful information on the degree of link between variables (Hair Jr et al., 2019). Mixed methods allow the author to explore the research questions more comprehensively while drawing from the strengths of both quantitative and qualitative methods and also mitigating their weaknesses (Creswell & Plano, 2011).

When gathering quantitative data authors implemented the Morgan sample size calculator to calculate sample size from a population of 140 middle school students. The sampling strategy used for this study was stratified proportionate random sampling as the middle school student population at the international concerned has unequal gender distribution; thus, this sampling technique ensures that the random sample chosen is reflective of the real population. This method ensures that male and female students are fairly represented in the sample by segmenting the population into different strata based on gender (Fowler Jr., 2013). According to the Table 1, the study used a sample size of 103 students. Researchers can more accurately capture these variances using stratified proportionate random sampling, leading to a better understanding of the total student population (Creswell & Plano, 2012). As it prevents potential biases and guarantees that the research findings are fair and applicable to all gender groups, ensuring proportionate representation of genders in the sample is also crucial from an ethical standpoint (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979).

When selecting the sample for a focus group interviews, purposive sampling was thought to be the best strategy. With this approach, volunteers were specifically chosen based on traits, backgrounds, or areas of knowledge related to the study's subject. The depth and richness of the focus group talks were increased through purposeful sampling, providing deeper insights. Researchers can choose participants through purposive sampling if their characteristics closely match the goals and issues of the 72 study (Klassen et al., 2012). The focus group talks delivered focused and applicable insights by selecting participants with knowledge, experiences, or viewpoints that are relevant to the study. Focus group discussions aim to produce in-depth and complex insights (Patton, 2014). This strategy allowed diverse perspectives in the debate thus contribute to enhance the validity of the qualitative data (Onwuegbuzie & Leech, 2007). By streamlining the participant selection procedure, researchers collected data from resourceful participants who were knowledgeable about the subject matter. Selectively selecting participants who can offer distinctive insights that would not be easily obtained through other methods is made easier using purposive sampling (Dillman et al., 2014; Palinkas et al., 2015).

Survey questionnaire was developed using validated survey items from Project-based learning impact on 21st century skills survey by Hixson and colleagues (2012), items related to STEM learning from Engagement in Science Learning Activities version 3.2 by Masters (1982), and items feeding to 4Cs from 21st century skills survey developed by R. Kelley and colleagues (2019).

Procedure & Ethical Considerations

Participants were asked to complete the survey on paper; the survey consisted of 35 items on a 5-point Likert scale, where each participant was asked to select strongly agree, agree, undecide, disagree, and strongly disagree for each survey item presented. Cronbach's alpha for 4Cs overall was found to be 0.777, and for student-centred learning is 0.853 in the questionnaire, which is acceptable in terms of reliability. To abide by the ethical guidelines, written permission was obtained from the school authorities for data collection. Since participants were legally minors, consent was taken from their parents via a standard informed consent form, which aided in alleviating any concerns about deception or manipulation (Busher & James, 2012). Measures were taken to secure the anonymity and confidentiality of the participant data. Student identities were not collected, so researcher responses could not be linked to specific students (Lapan et al., 2012; Walker, 2017). A participant ID was generated using open-source software, enabling the author to remove the data gathered from a particular participant on request.

Credibility and Trustworthiness

To ensure the effectiveness and the high quality of the data gathered at focus group interviews the following measures were taken. The study objectives and the precise information sought through focus group interviews were explicitly outlined (Krueger & Casey, 2015). This helped to keep the talks focused and relevant. Participants with appropriate expertise or experience with the research issue were carefully chosen. This contributed to the variety and depth of the talks (Morgan, 2014). To successfully lead talks, promote participation, and manage group dynamics, skilled and experienced moderators were used (Barbour & Morgan, 2017). Prior to the session, participants were given detailed information regarding the focus group format and objectives helped to prepare the participants and contributed to a more informed discussion (Morgan, 2014). The focus group discussion was well structured to meet

the objectives, and the group size was at optimum 6 participants to allow more in-depth discussion (Morgan, 2014; Krueger & Casey, 2015).

Various procedures were employed to ensure the credibility and trustworthiness of qualitative data, specifically for data collected via focus group discussions (FGDs) utilizing purposive sampling. The utilization of multiple data sources and methodologies, as proposed by Denzin (1978), contributed to the credibility of the research. the practice of member checking, as advocated by Lincoln and Guba (1985), which entailed sharing research findings with participants to ensure the accuracy and validity of the results. The authors also engaged in reflexive journaling (Charmaz, 2006), which served to uphold transparency and allowed researchers to critically examine any biases. The adherence to qualitative research principles was observed through the establishment of consistency in data collecting (Gibbs, 2007), the incorporation of a theoretical framework to guide the research (Charmaz, 2006), and the deliberate selection of a diverse purposive sample. The implementation of these techniques together served to augment the credibility and reliability of qualitative findings.

The corresponding author was mindful of his background and experiences related to STEM curricula, activities, and views about student-centred learning may have introduced biases into the study. As a teacher by profession, the author strongly supported the idea of activity-based STEM learning to improve skills such as critical thinking, creativity, innovation, and teamwork, so there might been a larger room for subjectivity in collecting qualitative data as it is based on purposive sampling. To overcome, the authors incorporated reflexivity practices where a deliberate attempt was made to list out the authors' own views about the investigation and the variable in concern, then a careful thought process as to how those may have influenced the selection and interpretation of the qualitative data. Authors presented the findings to focus group participants following thematic analysis to verify whether the transcription of the analysis has omitted or distorted their ideas, over a genuine attempt to convey their original ideas. Since the study was a mixed method, the collection and integration of quantitative data aids in adding more objectivity and minimizing researcher bias. For this purpose, triangulation of quantitative and qualitative data was carried out.

Data Analysis

H_{01}	Student-centred learning practices have a significant positive impact on the development of the 4 Cs of 21st century skills in a learning context where project-based STEM activities are conducted

Data was subjected to a linear regression and correlational analysis to test the hypothesis. Regression analysis aided in quantifying the impact of STEM activities and controlling for confounding variables, offering predictive insights. Correlational analysis, on the other hand, explored the strength and direction of these relationships, providing initial insights and a simpler interpretation (Creswell et al., 2012). Together, these methods provide a robust approach to understanding the benefits of STEM activities on student development via the transfer of 4Cs of 21st century skills.

Following the coding and thematic analysis of focus group data, themes emerging from data was compared with survey items used for quantitative data collection, to identify the recurrence of themes, themes converging into variables measured, and points that stand apart (diverge), charts were used by the author to visualize these patterns. The author employed the themes derived from qualitative data to elucidate and provide context for the patterns noticed

in the quantitative results, thus yielding a more comprehensive and nuanced interpretation (Teddlie & Tashakkori, 2010). Furthermore, an additional approach was implemented in which a single dataset was utilized to corroborate or substantiate the conclusions drawn from the other dataset, hence augmenting the total credibility of the research (Creswell et al., 2012).

Findings

Regression Analysis

Table 1: Result of R Square Values

R	R Square	Adjusted R Square	Std. Error of the Estimate
.872[a]	.0.83	.870	9.479

Based on the R Square value of 0.83 is pivotal. It reveals that approximately 83% of the variance in 4C's skills can be explained by variations in student-centered learning activities. With a reasonable standard error estimated at 9.479, and an adjusted R square of 0.870 this analysis emphasizes the crucial role of student-centered learning activities in enhancing 4C's skills.

Table 2: Result of Regression Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10975.83	1	10975.831	25.884	.000[b]
	Residual	41555.31	98	424.034		
	Total	52531.14	99			
a. Dependent Variable: skills (4C's)						
b. Predictors: (Constant), student-centered learning activities						

The ANOVA table clearly demonstrated the strong statistical significance of the regression model incorporating the predictor variable "student-centered learning activities" (F-statistic=25.884, $p<0.0005$). This indicated a substantial influence of "student-centered learning activities" on skills (4C's). The model accounted for a significant portion of the variability in skills (4C's), as indicated by the high R-squared value.

Table 3: Result of Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	68.838	5.667		12.147	.000
	Student-centered learning	.448	.088	.457	5.088	.000
a. Dependent Variable: 21st century skills (4C's)						

As per the results of table 3, the linear regression model assessed the relationship between student-centered learning and 21st Century skills (4C's) in a STEM and project-based learning environment. Results revealed a significant positive impact of student-centered learning on 21st Century skills. The constant (B=68.838) represents the expected 4C's score

when student-centered learning is zero. Student-centered learning (B=0.448) positively affected 4C's skills, with a standardized coefficient (Beta) of 0.457.

The t-statistic (5.088) was highly significant ($p<0.001$), confirming the substantial positive influence. This supports the objective that student-centered learning activities positively impact 21st Century skills in the specified learning environment.

Thematic Analysis

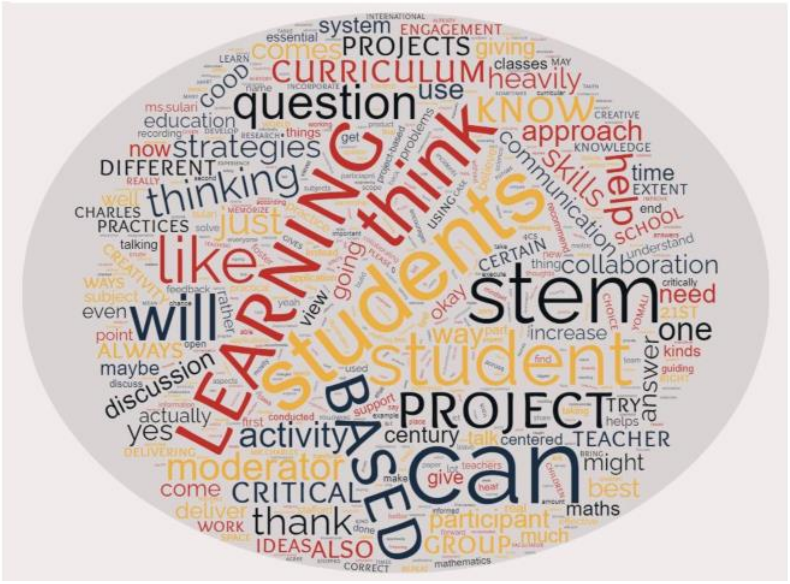

Figure 1: Word Frequency Chart from Teachers' Focus Group

The main themes emerged 4C's, project-based STEM learning and student-centred learning is in apparent agreement with the literature available. Among the sub themes catering to diverse learners relating to student-centred learning and purposeful learning process related to project-based STEM learning were noticeable. Figure 12 depicts the code references and Figure 13 illustrates the word frequencies of these results. Further, appendix 18 provides selected quotes for each theme identified.

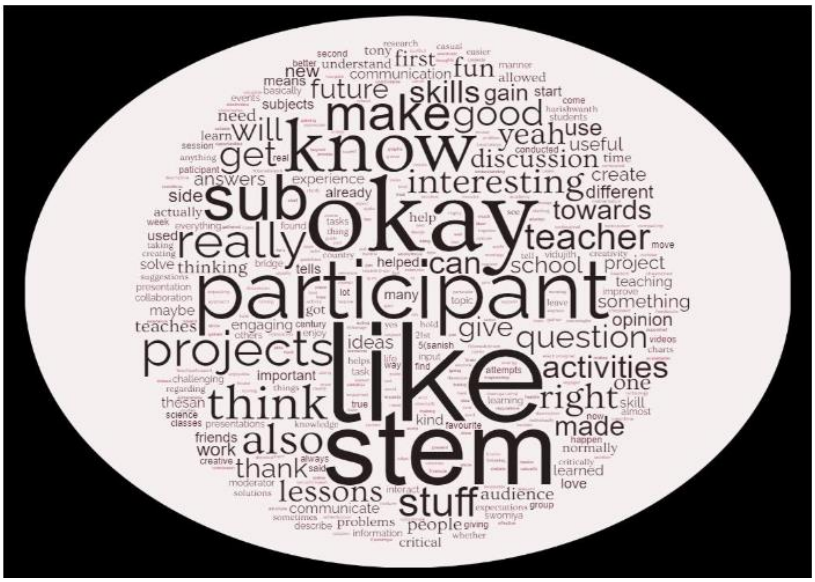

Figure 2: Word Frequency Chart from Students' Focus Group

The main themes emerged from students' focus group were 4C's, project-based STEM learning, and student-centred learning was in apparent agreement with the literature available. Among the sub themes learner satisfaction relating to student-centred learning and design and planning process related project-based STEM learning were noticeable. Figure 2 illustrates the word frequencies of these results.

4C's, project-based STEM learning and student-centred learning was found as sub themes in the survey questionnaire that was administered to gather quantitative data from the students. The word frequency chart is given in Figure 3.

Figure 3: Word Frequency Chart for the Survey Questionnaire

Qualitative findings could be further supported by the following extracts from the focus group interviews.

> Participant T2: "It encourages them to study the subject much more than when we compare it with a situation." "So, you apply those things where it is necessary, and it helps in, you know, Motivating the student and keeping."
>
> "So, we try as much as possible to bring the practical aspects of what we are learning into the subject. Uh, Maybe we can try to do it as a group activity."
>
> "We try to diversify a bit and try to implement different methods of approach to get the knowledge across."
>
> "It helps all kinds of students achieve their learning goals instead of just focusing on one type of student."
>
> Participant T2: "When it gives independent thinking skills for the students to stand on their ground, for their own opinion."
>
> Participant S6: "Come up with like problems and we'll have to, you know, think how to solve it. And sometimes we have events and stuff, which I think is really fun. And

also, I just think that A teaching is really good because it's like a more casual approach in my opinion."

Participant S4: "Give us examples of what we have to do. So he would show us, what he's expecting of us, and then he would point out what we can do to maybe improve and like go beyond his expectations and we would find it fun and we would normally meet his expectations."

Participant S1: "We are allowed to do anything. What we want or like related to STEM

Triangulation and Convergence

The qualitative findings of this study are in congruence with the existing body of research. As The findings propose integration of student-centered learning methodologies and project-based STEM education is mutually beneficial in fostering the development of the 4Cs, namely Critical Thinking, Creativity, Collaboration, and Communication. Student-centered learning, a pedagogical approach that prioritizes active participation, individualized exploration, and self-directed investigation (Means et al., 2014), aligns with project-based STEM education by positioning students as the focal point of their educational journey. The cultivation of autonomy in students fosters the development of critical thinking abilities, as they engage in the examination of problems, assess many potential solutions, and ultimately arrive at well-informed conclusions within the context of project-based learning (Partnership for 21st Century Skills, 2007). Moreover, the iterative and inquiry-based characteristics of student-centered learning are in perfect harmony with the problem-solving element of project-based STEM activities, creating a suitable atmosphere for the cultivation of innovative thinking and creativity.

project-based STEM education offers a tangible and contextualized platform for the utilization of information and skills obtained through student-centered learning. By engaging in practical assignments, students work together to address real-world STEM problems, so strengthening their abilities in collaboration and communication, as outlined by Bell (2010). The interaction between student-centered learning and project-based STEM approaches facilitates the acquisition of theoretical knowledge and its practical application through collaborative projects. This process enhances students' skills in effective communication and teamwork (Thomas, 2000). The integration of student-centered learning and project-based STEM education fosters a mutually beneficial learning environment that is congruent with the comprehensive development of the 4Cs, equipping students with the diverse set of skills necessary for achievement in the modern era.

Conclusion

A deeper exploration of the regression coefficients provides nuanced insights. The positive effect of student-centered learning on 4C's skills is quantified by a standardized coefficient (Beta) of 0.457, with the t-statistic's pronounced significance ($p < 0.001$) attesting to the substantive positive influence of these pedagogical approaches. These quantitative findings reinforce the assertion that student-centered learning activities are indispensable in positively shaping 21st Century skills within the designated project-based STEM learning environment. Qualitatively, participant testimonials further illuminate the positive impact of student-centered learning activities. Participants articulate how these pedagogical approaches foster

independent thinking, enhance motivation, sustain engagement, and facilitate the practical application of knowledge through collaborative group activities. The qualitative narratives resonate with the quantitative outcomes, spotlighting the multifaceted advantages of student-centered learning in championing a diverse array of skills. These findings advocate for a steadfast emphasis on student-centered pedagogies, urging educators to embrace and refine these practices as they constitute a linchpin for nurturing a versatile skill set essential for triumph in the ever-evolving landscape of STEM disciplines and beyond.

Avenues for Future Research

The implementation of longitudinal research would provide significant contributions in understanding the enduring effects of project-based STEM education and student-centered learning on the continuous enhancement of 21st Century skills. By conducting longitudinal studies on students, researchers would have the opportunity to study the progression of skill acquisition and retention over an extended period. This would contribute to a more comprehensive comprehension of the long-term impacts of different educational approaches. The examination of the impact of cultural and socioeconomic factors on the correlation between educational methods and the development of 21st Century abilities is a promising avenue for research. The examination of how various cultural contexts and socioeconomic backgrounds influence the ways in which students engage with project-based STEM activities and student-centered learning has the potential to enhance educational methods that are culturally sensitive and inclusive. Tailoring Instruction for Different Age Groups: Considering the observed disparities in age within the current study, it would be beneficial for future research to explore the customization of instructional methodologies to cater to distinct age groups. Examining the impact of students' developmental stages on their involvement in project-based STEM activities and student-centered learning would yield practical knowledge for educators to modify their methodologies to effectively cater to the varying requirements of students during different phases of adolescence.

Limitations of the Study

In collecting quantitative data, the research utilized a sample size of 104 individuals chosen by a random stratified proportionate sampling method. Even though this strategy improves representativeness, the sample size may still be insufficient to capture the variety of experiences that middle school students have had with project-based STEM learning. Because of this, it is possible that the findings cannot be properly generalized to a larger population of pupils. There is a concern regarding response bias in quantitative data, even though random stratified proportionate sampling was utilized. It is possible that participants will provide socially desirable responses, which will affect the correctness of the quantitative data. The environment of the study may have an effect on the degree to which the responses of the participants provide an accurate reflection of their experiences and attitudes.

When considering the qualitative data utilization of two focus groups, which were chosen through the process of purposive sampling, it might not completely encompass the many points of view that are present within the participant pool. There is a possibility that the qualitative findings will be impacted by the particular qualities of the individuals who participated in the focus group. This could potentially restrict the ability of qualitative insights to be transferred to a more general setting. Dynamics of Focus Groups Due to the nature of focus group talks, there is a possibility that social desirability bias or dominating voices within the group could be introduced, which could have an impact on the qualitative

data. The richness and authenticity of the qualitative findings may be impacted by the fact that some participants may be reluctant to share thoughts contrary to the group norms or may comply with the norms they perceive to be prevalent. The research was carried out in a particular middle school that is part of an international school in Sri Lanka because of the distinctive context of the school. It is possible that the findings cannot be generalized to other educational settings due to the specific characteristics of this particular school, which include its cultural and educational context. This is especially true for educational settings that have different curriculum frameworks or student demographics.

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Contact email: vidujith.vithanage@gmail.com

Envisioning Possible Post-PhD Careers Outside Academia: An Exploratory Study of Two Chinese Doctoral Graduates' Differentiated Experiences

Sangge Qi, University of Turku, Finland

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Abstract
Amid heightened positional competition in the graduate labor market, doctoral graduates' progression into non-academic employment has become an emerging focus of concern. Drawing on the concept of possible selves, this exploratory study examines how doctoral graduates envisage and plan for their post-graduation careers outside academia in the context of China. The study presents the narratives of two PhD holders from the field of Social Sciences and graduated from universities of varying reputational statuses, both of whom had made the decision to enter non-academic employment during their doctoral journeys. The analysis demonstrates marked differences in the scope of graduates' envisioned future careers and their perceived abilities to realize them along the lines of privilege and disadvantage associated with institutional hierarchy, which in turn shaped their strategies of responding to the intensified job competition. In doing so, the paper sheds light on both the material and affective dimensions involved in graduates' construction and negotiation of envisioned future careers, and provide insights into how this is shaped by institutional hierarchy that enables or constrains the ways post-PhD career possibilities can be imagined. With that, this paper seeks to contribute to the broader discourse on doctoral employment and offers implications relating to post-PhD career planning.

Keywords: Doctoral Career, Non-academic Employment, Possible Selves, Institutional Reputation

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Introduction

The increasing emphasis on the notion of knowledge-based economy in global policy discourses has led to a substantial rise in the number of PhDs awarded worldwide in recent decades (OECD, 2016). While the rates of doctoral expansion and labor market conditions vary across countries, in most national contexts, it is evident that a significant proportion of doctoral graduates are leaving academia to pursue non-academic careers upon completing their degrees. This shift aligns with political agenda that frames doctoral recipients as vital contributors to the knowledge economy, especially when employed outside academia. Within this vision, doctoral graduates are positioned as highly qualified human capital whose expertise facilitates knowledge transfer into further societal and economic development (Hancock, 2019).

The Chinese context shares this global outlook. Since the 1980s, the Chinese higher education (HE) system has expanded rapidly following a series of state-led initiatives, producing abundance of doctoral admission opportunities (Huang & Shen, 2019). In 2012, the number of Chinese doctoral graduates (i.e., 53,011) surpassed that of the United States (i.e., 50,977) for the first time, making China the world's largest PhD producer (Li, 2004). Thereafter, the Chinese doctoral population has continued to grow steadily. According to the latest national statistics, a total number of 87,126 doctorates graduated in 2023 from Chinese higher education institutions (HEIs), accounting for an approximate increase of 5.8% from the previous year (National Bureau of Statistics of China, 2024). In light of this doctoral expansion, the global phenomenon of doctoral graduates venturing into non-academic careers is also visible in China. While academia remains the preferred choice for many when first embarking on the doctoral journey, a gradual diversification in post-PhD career destinations has been noted. Increasingly, Chinese doctoral graduates are seeking employment in industry and business sectors, government agencies, and non-governmental organizations, etc. (Shen et al., 2018; Shen & Chen, 2018). As reported in the collective data published by a group of research-oriented Chinese universities, nearly 50% of their doctoral graduates are occupying non-research positions outside academia since 2018 (Chen, 2021).

However, crossing from the familiar academic environment to the dynamic non-academic settings is not always straightforward. Given the increasingly congested graduate job market which fails to keep pace with HE expansion and the excessive supply of highly skilled workers, doctoral graduates are likely to face an intensified job competition where they are placed within a hierarchy based on their relative desirability to employers (Brown et al., 2004). Despite it being a subject of growing relevance, research on doctoral graduates' experiences of navigating the complexities of the non-academic job market remains limited, including how these individuals envisage their possible careers and strategize for post-graduation job competition. Given China's rising prominence in the global doctoral education landscape, the Chinese experience is particularly salient that warrants a deeper exploration.

This paper intends to address the gap by presenting empirical findings derived from interviews with two female doctoral graduates from universities associated with differing reputational statuses in China. Using the concept of possible selves, the paper explores how these graduates envisaged and planned for their post-graduation careers, with a particular focus on examining the role of institutional reputation within this. The findings shed light on both the material and emotional dimensions involved in the construction and negotiation of

their envisioned career possibilities. In doing so, this paper provides insights into the interplay between institutional reputation and doctoral employment in the context of China.

Post-PhD Occupational Landscape Outside Academia

The progression from doctoral education into professional destinations takes place against the backdrop of an increasingly competitive labor market. While the empirical shift of doctoral graduates pursuing non-academic employment is widely recognized and highly encouraged, not all doctoral recipients are able to find opportunities that align with their career aspirations.

We were previously driven to believe that the value of academic credentials would continue to rise as the economy became more knowledge-intensive (Brown et al., 2011). Following this, doctoral graduates were assumed to be moved to the front of the labor market queue with an advantageous access to elite firms and more 'upper-hand' positions (i.e., professional and managerial roles) at the top of the occupational hierarchy. In reality, however, the global expansion of HE has led to more apparent credential inflation, meaning the value of academic credentials as a 'currency of opportunity' is declining (Brown & Souto-Otero, 2020). Similar to undergraduates and master's degree holders, doctoral graduates may also find themselves competing for limited high-status job opportunities that are now allocated based on how well they can demonstrate the exclusivity of their credentials and prove their relative worths.

In the meantime, the labor market competition is complicated by structural divisions, which further undermine the assumption that doctoral graduates are readily welcomed into non-academic sectors. It has been well established that rising participation in HE does not necessarily eliminate inequalities; rather, these disparities are reproduced in new forms (Marginson, 2016). In the Chinese context, the development of a high-participation HE system has been accompanied by an entrenched hierarchical structure that stratifies HEIs into different status groups with distinct reputational influences (Mok, 2016). This institutional hierarchy plays a significant role in differentiating graduate outcomes (e.g., Sheng, 2017).

Essentially, this suggests that doctoral graduates do not compete on a level playing field. The job market competition is therefore framed as a power struggle, where graduates are expected to leverage diverse resources – including their credentials granted by institutions of varying reputational statuses – to create a competitive edge over others. Within this competitive framework, some doctoral graduates may experience prolonged periods of searching and waiting than others (McAlpine & Amundsen, 2016). On top of that, they may also end up in positions offering considerably less than expected (Brown et al., 2004). These outcomes reflect more than just individual differences, but also structural conditions such as institutional hierarchy that perpetuates beyond HE settings to regulate recruitment preferences.

The Concept of Possible Selves

This paper adopts the concept of possible selves to examine how doctoral graduates envisage and plan for their post-graduation careers outside academia. While this concept is grounded in the broader framework of self-concept developed within the field of social psychology (Markus & Nurius, 1986), it has previously been applied in the context of HE to analyze how students' aspirations vary by class differences (e.g., Hardgrove et al., 2015; Harrison, 2018; Henderson et al., 2018; Jones et al., 2021). This thus makes it a useful lens for exploring how

doctoral graduates' perceptions of their possible careers varied along the lines of advantage and disadvantage created by the reputational status of their own universities, and how this shaped their strategies for post-graduation job competition.

According to Markus (1977, 1990), the self-concept is seen as a set of knowledge structures consisting of an individual's generalized assumptions and understanding about himself or herself. Possible selves represent the future form of one's self concept, capturing perceptions about a range of future-oriented visions of the self resulting from the construction of numerous imaginaries (Harrison, 2018; Henderson et al., 2018). As outlined by Markus and Nurius (1986, p. 954), "Possible selves are the ideal selves that we would very much like to become. They are also the selves we could become, and the selves we are afraid of becoming." This underlies the central notions of possible selves, that are, the ideal, probable, and feared selves. These notions define what individuals see as opportunities and constraints, and impact how they initiate and structure their actions to realize or avoid the future selves (Markus & Ruvolo, 1989). It is suggested that when possible selves are activated, it is accompanied by emotions tied to how individuals imagine themselves experiencing the future state (Markus & Nurius, 1986).

A key contribution of this concept lies in its exploration of the relationship between aspirations (or ideal self) and expectations (or probable self). These two dimensions are not necessarily the same, with expectations often tempering aspirations (Harrison & Waller, 2018). The role of elaboration is essential here, referring to how clearly individuals can articulate the imaginaries of their future selves and the steps they must take to realize them (Harrison & Waller, 2018; Jones et al., 2021). The fuller and more coherent these imaginaries are, the more they can be linked to specific strategies to achieve desired outcomes (Oyserman et al., 2002, 2006). The coherence points to the alignment of aspirations and expectations, or in other words, the ideal and probable selves. Such alignment is found to be particularly powerful in motivating individuals to connect present actions with future goals (Leondari, 2007).

Moreover, Markus and Nurius (1986, p. 954) have emphasized that the concept of possible selves also reflect the extent to which the self is socially determined or constrained. This suggests that structural contexts shape normative values and the resultant range of possible selves that can be envisioned. As such, the ability to construct a viable future trajectory is differentially distributed (Harrison, 2018; Papafilippou & Bathmaker, 2018).

Drawing on these insights, the main focus of this paper is to explore how institutional reputation enables or constrains the scope of doctoral graduates' envisioned possible post-graduation careers and the practices undertaken to facilitate the fulfillment of their imaginaries.

Method

The data presented in this paper are part of a larger research project investigating the early career trajectories of Chinese Social Science and Humanities (SSH) doctoral graduates beyond academia. The primary method of data collection involved semi-structured interviews conducted in Chinese Mandarin. The open-ended questions facilitated free-flowing discussions, allowing participants to share openly their experiences of and reflections on how they prepared for the process of seeking post-graduation employment. Questions followed a

pre-determined interview outline, focusing primarily on tracing participants' educational and professional trajectories.

The following section presents the narratives of two female SSH doctoral graduates. Their degree-granting universities are both located in Shanghai, but are associated with differing reputational statuses. The following table provides an overview of their backgrounds.

Table 1: Participant Profile

Pseudonym	Age	Institutional group	Field of study
Song	32	C9 League university	Gender Studies
Cai	31	Non-C9 League university	Cultural Studies

Song earned her doctoral degree from a university known as part of the C9 League in Chinese terms, which refers to an elite group of institutions with long-standing and nationwide reputations bolstered through supportive government policies and funding privileges. On the other hand, Cai graduated from a university outside of the C9 League, with a relatively limited scope of recognizability. Both graduates have made the decision to pursue non-academic careers during their doctoral studies. It is evident from their narratives that institutional reputation had played a significant role as they positioned themselves explicitly as advantaged or disadvantaged graduate job seekers attuned to the reputational status of their respective universities. This in turn influenced their perceptions of what was possible for them to be and achieve in the job market competition, and how to act upon those perceptions.

The use of data from only two interviews was intentionally designed, seeking to provide illustrative and in-depth cases that illuminate the interplay between institutional reputation, possible selves, and individual agency. This aligns with the objective of the paper, which is not to generalize findings, but to offer rich and contextualized insights into how doctoral graduates navigate the complexities of the post-graduation job competition.

Data analysis was guided by the concept of possible selves, focusing on identifying the two graduates' ideal, probable and feared selves. Upon close reading and re-reading of the interview transcripts, the analysis proceeded to uncover the influence of institutional reputation in shaping graduates' imaginaries of post-graduation careers. This involved examining how they revised, confirmed, and translated their envisaged selves into actionable strategies. In this paper, graduates' experiences are presented in reduced forms, accompanied by direct quotes.

Interview Findings

Song's Experience

Song graduated from a C9 League university in 2022, majoring in Gender Studies. She is now working in the area of corporate social responsibility at an IT firm based in Shanghai. She had initially planned to become a university lecturer, but later shifted to non-academic options because of her desire for higher earnings.

Despite her awareness of the supply-demand imbalance within the graduate job market, Song still sensed a wide range of employment opportunities available owing to her institutional affiliation. Coming from a well-regarded university, she believed that she enjoyed an advantageous basis in the job competition and greater chances of securing decent

employment upon graduation. This was articulated as a sense of confidence in the symbolic value of her credential, in which the ideal self was rooted:

> I had a strong faith in the value of my credential and thought it would differentiate me from others. It would help me find something, maybe not the top firms, but for sure it would lead me to a place that wouldn't be too bad.

Throughout her doctoral journey, Song focused wholeheartedly on academic duties and did not engage in additional CV-building activities. According to her, she sought to complete the doctoral degree on time without disruptions. With that, she has not considered alternative strategies for post-graduation job competition other than relying on the reputational value of her credential.

As she started sending out her CV for job applications in the final year of her doctoral studies, unanticipated outcomes were encountered, including constant rejections and unsatisfactory offers which were not aligned with her aspiration. A significant disconnect between what she aspired to achieve (i.e., the ideal self) and what the actual opportunities or realities were (i.e., the probable self) was realized. She reflected, "I thought this would be easy, but now I was told that I was falling short."

At that point, her feared self included more than just prolonged periods of searching and waiting, but also a potential risk of becoming unemployed. As a doctoral graduate from a highly prestigious university, she described this scenario as "getting a slap on the face". This thus reflected her fear of social stigma relating to perceived job market failure. This urged her to develop "some immediate measures in place, to get out of this situation and get back on track". In other words, the need for action emerged as a form of coping strategy to avoid the feared self.

Following the advice of her doctoral supervisors, Song participated in an internship at a start-up company. Although the status of the firm conflicted with her initial aspiration, she explained, "It wasn't the time to be picky … ultimately it was about gaining experience". She was assigned with heavy responsibilities that demanded full commitment and ability to work across several departments. Towards the end of the internship, Song gained clarity about what she could bring to the table and modified her job applications accordingly. In this way, the internship allowed her to recalibrate her aspiration into more attainable goals, aligning her ideal and probable selves to facilitate more targeted job applications.

Cai's Experience

Cai completed her doctoral degree in Cultural Studies earlier this year, and currently works as a social media and community specialist at a leading high-tech company in Shanghai. With the recommendation of her master's degree supervisor, she pursued her doctorate in the same university where she had completed her previous degrees. Although she insisted that her university is a "good one", she also acknowledged that "it's not as prestigious as those top institutions with nationwide reputations". It was explained as such that those outside of Shanghai might not be familiar with her university.

Despite her initial intention to stay within academia upon graduation, the prevailing emphasis on publishing across Chinese HEIs created uncertainty with respect to her academic career prospects. She shared, "the pressure to publish more papers made me anxious about my

future in academia, I wondered if these academic posts were actually stable." After careful consideration, Cai decided to explore the non-academic options.

She was aware that the regionally-confined reputational influence of her university might pose as a constraint in post-graduation job search, making her less competitive in comparison to other graduate job seekers from more prestigious universities:

> My university doesn't have the same nationwide reputation as those top universities, so employers might not see candidates like me as their first choice. I wasn't sure how my credential would be perceived, especially by those based outside of Shanghai. I was worried that it might be less valued, and I might have to focus on finding jobs within Shanghai.

The above comment revealed her feared self, characterized by a sense of insecurity regarding the potential devaluation of her credential when applied beyond the immediate regional boundary, and anxiety linked to perceivably limited chances of success in competing against peers from more prestigious universities. Her sense of what was possible to be and act upon appeared rather restricted, with the expected career options being concentrated within Shanghai where her institutional affiliation might be more appreciated:

> I definitely wanted to join those leading firms, but I must be realistic. I must bring something else to the table, something more than my credential in order to make this happen. Otherwise, I could only expect local employment opportunities because here, employers know my university.

Cai viewed internships as an effective means of acquiring additional forms of distinction. She completed two internships during her doctoral journey. As she was not committed to any specific industry and occupational role, these internships allowed her to develop a more focused career orientation by identifying the business sectors and the kind of roles that she was interested in. By the time she was involved in post-graduation job search, Cai was already able to envisage a more specific and viable career self. With the additional experiences, skills, and industry exposure gained from the internships, Cai felt more prepared to compete in the graduate job market.

Conclusion

This paper provided a preliminary exploration of how doctoral graduates from universities associated with differing reputational statuses envisaged their post-PhD careers and planned for their subsequent movements. Through the conceptual lens of possible selves, the findings reveal how the scope and nature of the two graduates' envisioned career possibilities were shaped by how they perceived and internalized the structural advantage or limitation imposed by the reputational status of their own universities. Song, graduated from a distinctively prestigious C9 League university, perceived the long-standing and nationwide reputation of her university as a significant advantage that created favorable chances of succeeding in the job competition. On the flip side, Cai viewed her affiliation with a non-C9 League institution as a constraint that exposed her to the potential risk of having to narrow down the scope of her job search within the regional confine. Essentially, the internalized hierarchical differences in institutional reputations produced a subjective sense of how they were positioned within the labor market queue and their relative desirability to potential employers. This subjective positioning shaped not only the ways in which their possible careers were

framed, but also informed the kind of practices to be adopted to prepare for post-graduation competition.

In this paper, the role of feared self stemmed as a key motivational force. For Song, the fear of social stigma concerning job market failure prompted her to adjust her aspirations and take pragmatic steps to develop more attainable goals. Similarly, Cai, driven by her fear of a limited range of employment opportunities, subscribed to internships to progressively build her profile and enhance her chances of achieving the pre-determined aspirations. Both cases resonate with Markus and Nurius' (1986) proposition that feared self can drive concrete and targeted strategies to bridge the gap between desired and real-world outcomes, thereby aligning the ideal and probable selves and at the same time avoiding the feared ones.

In fact, the two graduates' interpretations of their relative chances of success in the labor market competition appeared to be underpinned by distinct emotions. Song exhibited a sense of confidence in articulating her ideal self, reflecting the internalized advantage conferred by the distinctively prestigious status of her university. In contrast, Cai's narrative revealed her anxiety associated with her perceived disadvantage in competing against peers from more prestigious institutions. The emotional undertones noted here underscore Reay's (2005) notion of 'psychic landscape of class', wherein structural inequalities are not only lived but also deeply felt.

While this paper contributes to the broader discussion on doctoral employment outside academia, the findings presented here are drawn from a small sample that limits their applicability to the larger doctoral population. Future research can build upon this, incorporating larger and more diverse samples to explore patterns across different disciplines, geographical regions, and cultural contexts, etc. The use of longitudinal methods can also provide a more nuanced understanding of how doctoral graduates' perceptions and strategies evolve over time in response to shifting labor market conditions and policies. Furthermore, the emotional dimensions identified in this paper in shaping how doctoral graduates envision their future selves and possible careers present an important avenue for further exploration. Integrating psycho-social theories with structural analyses can offer a more comprehensive perspective on the interplay between individual agency and structural divisions in individual career trajectories.

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Contact email: sangge.s.qi@utu.fi

Charting Sustainable Pathways: Understanding Private and Public State Universities' Role in Generation Z's Study Abroad Choices Through MCDA and SEM-ANN

Charmine Sheena Saflor, De La Salle University, Philippines
Klint Allen Mariñas, Mapua University, Philippines
Jazel Monterola, Occidental Mindoro State College, Philippines
Reina Krizzia Pranada, Occidental Mindoro State College, Philippines
Macrein Acosta, Occidental Mindoro State College, Philippines
Arnelyn Labao, Rizal National High School, Philippines

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Abstract
This study examines how sustainability influences Generation Z's choices in study abroad programs, including Student Exchange, Work and Study, and Language Immersion Programs. Using Multi-Criteria Decision Analysis (MCDA) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), researchers evaluated factors like program duration, specialization, cost, financial aid, research opportunities, and quality. The Theory of Planned Behavior (TPB) was applied to understand how these sustainability factors affect decisions. Structural Equation Modeling (SEM) revealed relationships among ten variables, including Perceived Benefits (PB), Perceived Cost (PC), Perceived Risk (PR), Perceived Trust (PT), Attitude (A), Subjective Norms (SN), Perceived Behavioral Control (PBC), Awareness of Service (AOS), Intention (IN), and Behavior (B). An artificial neural network (ANN) enhanced the accuracy of identifying key sustainability factors. Data from 320 respondents via 60 surveys indicated that sustainability significantly influences study abroad decisions, with Perceived Behavioral Control (PBC) having the strongest impact, followed by intention and attitude. Perceived Benefits (PB), Perceived Risk (PR), Perceived Trust (PT), and Awareness of Service (AOS) were crucial in shaping intentions. Subjective Norms (SN) indirectly influenced decisions. Student Exchange Programs were the preferred choice due to perceived sustainability benefits. This study provides insights for educational institutions and policymakers better to align programs with Gen Z's sustainability goals.

Keywords: Study Abroad Decision-Making, Generation Z, SEM, MCDA, ANN

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Introduction

The international workforce demands globally proficient individuals (G20, 2011). Abroad programs are one of the various steps that aid students in developing their expertise in the global field (Pruitt, 2021). It has been shown that there has been a significant advancement in the number of students opting to study internationally over the past three decades (Granato et al., 2024). Relevant research has been focusing on elements that influence their decision-making process and shape their engagement in abroad programs to enhance experiences, thus improving the rate of students' participation (Cebolla-Boado et al., 2018). For instance, a study by Wang and Crawford (2020) that focuses on the decision-making process of Chinese students who study abroad illustrated that male students from a lower socioeconomic background were more interested in selecting their destination based on what benefits it would offer in terms of their socioeconomic status. In contrast, younger students rely more likely on subjective recommendations of their circle (Wang & Crawford, 2020). In other studies, factors that impact students' intention to study abroad are immigration opportunities (King & Sondhi, 2017) research opportunities (Delicado, 2010; Ahmad et al., 2010), and their overall experience abroad (Delicado, 2010). Furthermore, status and career upgrades also significantly affect their decisions in international studies (Ahmad et al., 2010). Previous studies, which were cited in a study by Li et al., illustrated that South Korean students opted for master's or doctoral degrees offered by American elite universities for them to have a global competitive edge and cultural capital, Hongkong students going abroad to study to enhance their advances in the labor market, and Chinese students find that gaining learning experience from international universities are perceived as a motivator towards their future careers' success (L. Li et al., 2021). Hence, several institutions have enhanced their program plans abroad and expanded their programs by offering scholarships, focusing on their marketing strategies to increase the higher education students' participation rate (Pruitt, 2021). However, as time evolves, the context of factors that shape their decisions may have significantly changed. This calls for ongoing research to adapt and provide relevant research, ensuring educational institutions and policymakers can accurately design and plan their academic programs (Cheng & Agyeiwaah, 2022).

The Filipino student market for international education is one of the largest and fastest growing in Southeast Asia, driven mainly by students seeking postgraduate degrees. With around 49,000 Filipino students currently studying abroad, this market is expected to grow by 13% annually over the next five years (Tolentino, 2023) China has emerged as a critical partner, actively fostering educational ties with the Philippines over the past two decades. China supports Filipino students to study in the country and facilitates their return to continue their education, reflecting a solid commitment to enhancing cooperation in the educational sector between the two nations. According to Jose Miguel Habana, country director of IDP Philippines, the number of Filipino students studying abroad is expected to grow by 8-10% annually in the coming years due to increasing interest in overseas learning and the perception that it provides opportunities to find work and potentially migrate to more developed countries after completing their education. Many Filipino students are also drawn by the higher quality of education in destination countries and the availability of specific courses that may not be offered in the Philippines (Delaney, 2019). This study aims to determine the factors influencing Filipino students' decisions to study abroad.

The study addresses gaps in the existing literature on Generation Z's decision-making regarding study abroad, specifically in choosing between private and public state universities and colleges (SUCs). While some studies have explored factors such as students' ability,

student development, academic engagement, community/civic engagement (Stebleton et al., 2013). political standpoint and worldview (Siddiqui, K., 2013), personal experiences, social experiences, and educational experiences (Pruitt, 2021). influencing study abroad decisions among a broader participant pool, the researchers recognized the limited focus on Gen Z students. This study thus narrows its scope to investigate the unique decision-making processes of Generation Z in international education. Incorporating the Theory of Planned Behavior (TPB) with additional variables such as perceived cost, perceived risk, perceived benefits, and perceived trust distinguishes this research from previous works. By utilizing multi-criteria decision analysis (MCDA), structural equation modeling (SEM), and artificial neural networks (ANN), the study aspires to provide a more comprehensive understanding of the intricate factors shaping the study abroad decisions of Generation Z students, shedding light on the distinctions between private and public SUCs in this decision-making process.

This study aims to underscore the factors shaping Generation Z's decision-making process in selecting abroad programs among students from private and public state universities and colleges (SUCs). Multi-criteria decision Analysis (MCDA) seeks to determine the criterion that affects the perceived overall quality of programs abroad: The Student Exchange Program, Work and Study Program, and Language Immersion Program. In addition, this study will also explore various variables to understand their role in shaping and influencing the behavior of Gen Z in international studies. Through SEM-ANN, this will shed light on the most critical factors that affect their decision to study. Thus, this study mainly intends to explore and develop insights into how private and public SUCs can entice and improve to make Gen Z students commit to a particular institution. In addition, this also aims to provide relevant research on the decision-making process of Generation Z students that will aid in the planning of abroad programs at various institutions.

The outcomes of this research not only enhance our comprehension of the preferences of Generation Z but also carry practical implications for educational institutions and policymakers. These findings can guide them in customizing study abroad programs to better align with the needs of this generation, fostering more enriching international learning experiences. Furthermore, the study provides a strategic approach for private and public state universities and colleges to boost their competitiveness and attract Generation Z students to participate in overseas education. By assisting educational institutions in refining their programs and services to align with the preferences of Generation Z students, this research aims to contribute valuable insights. The study offers practical recommendations to address the identified research gap and build upon related studies.

Methodology

Participants

Studies incorporating Structural Equation Modeling (SEM) with ten to fifteen variables require a population size of at least 200 (Siddiqui, 2013; Jou et. al. 2022). The 60-component questionnaires were sent to 320 participants from the Net Generation, or Gen Z, via an online platform and face-to-face survey. In addition, the current study applied stratified random sampling, where the researchers divided the sample size of students from public and private state universities and colleges residing in Occidental Mindoro.

Structural Equation Modeling

Structural Equation Modeling (SEM) is a method that uses statistics to analyze the correlation of several variables presented (Hair, 2010; Ouyang et al., 2018; Li et al., 2020; Ong et al., 2023). Thus, SEM is often preferred to implement because it can model observed and latent constructs in a single framework (Kline, 2015; Ang & Lau, 2024). SEM will analyze multiple variables, namely Perceived cost, Perceived risk, Attitude, Perceived benefits, Perceived behavioral control, Subjective norms, Intention, Awareness of service, Perceived trust, and Behavior. In this study, SEM tested ten latent variables, such as Perceived Benefits (PB), Perceived Cost (PC), Perceived Risk (PR), Perceived Trust (PT), Attitude (A), Subjective Norms (SN), Perceived Behavioral Control (PBC), Awareness of Service (AOS), Intention (IN), and Behavior (B). The IBM SPSS AMOS software version 26 was used to analyze the initial to final SEM model data. Moreover, the software was also used to see the model reliability through the Cronbach alpha, estimates, and the Goodness of Fit.

Artificial Neural Network

Artificial neural networks (ANNs) are adept at addressing complex, uncertain, nonlinear, multifaceted, and stochastic problems. The structure of an ANN, as described in the Principles of Artificial Neural Networks (3rd Edition), meticulously specifies the layers, activation functions, and neuron arrangements. Various studies, such as those conducted by (Saritaş & Yaşar, 2019) have explored using ANNs for understanding and predicting global human behavior. Assessing the performance of an ANN model requires a careful selection of evaluation metrics and validation techniques to comprehensively measure its efficacy. In the present study, recognizing the limitations of linear methods like Structural Equation Modeling (SEM), the researchers opted for ANNs implemented through SPSS (Fan et al., 2016). They initiated an optimization process to identify the optimal activation functions, node quantities, optimizer, and training/testing ratios, facilitating a detailed analysis that captures nonlinear relationships within the dataset.

Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)

The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) was introduced in the 1980s as one of the approaches that can be used as a multi-criteria decision analysis approach (Hwang & Yoon, 1981). TOPSIS can identify the most preferred alternative by a specific population based on the distances from given alternatives and the ideal solution (Madanchian & Taherdoost, 2023). In this study, several criteria are incorporated: program duration, specialization, perceived cost, financial support, research opportunities, and program quality. Programs such as the Student Exchange Program, Work and Study Program, and Language Immersion Program are the following alternatives integrated in this study, based on the Gen Z's from public and private SUCs.

Results and Discussion

SEM-ANN Results

Figure 1 presents the ANN model considered in this study. It shows that the variables are interconnected to each other, which is similar to the SEM results with a p-value of >0.05, which shows PC, PR, PT, PB, A, SN, PBC, AOS, and IN were considered the input nodes for the ANN which represents the correlation to behavior. The final result of the ANN model

shows that the most critical factor is PBC, followed by IU, A, SN, PT, PB, PR, AOS, and PC. However, despite yielding comparable outcomes, the study highlights the significant influence of the indirect effect of SEM on its results, underscoring its importance alongside ANN (Blunch, 2013; Onyelowe et al., 2023; Praveen et al., 2020). Hence, the importance of the independent variable is showcased in Figure 4 confirming the consistency of results between both models. This underscores the significance of the finding, as validated by the hybrid SEM-ANN approach.

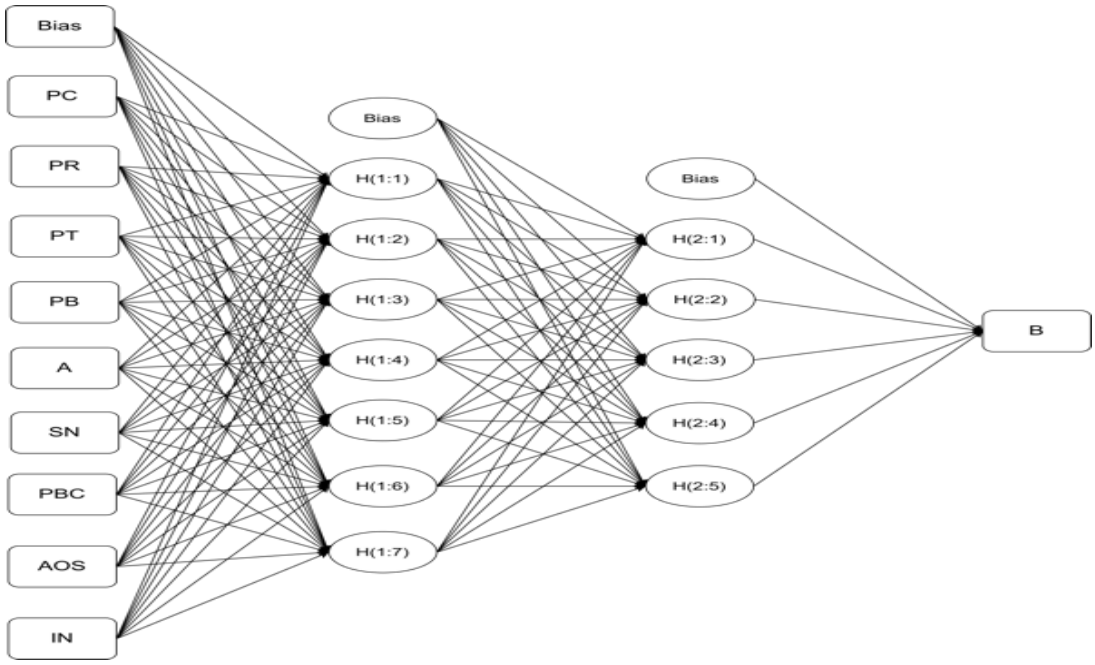

Figure 1: Artificial Neural Network Model

TOPSIS Result

The Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) is a well-known multiple criteria decision analysis method. Its function is to identify the best alternative that is nearest to the positive ideal solution and farthest from the negative ideal solution. TOPSIS is integrated to explore the generation's decision-making regarding studying abroad of the three educational program alternatives based on public and private school preferences. The three alternatives evaluated are the Student Exchange Program, the Work and Study Program, and the Language Immersion Program. Result shows that in Public and Private, the most preferred alternative is Student Exchange Program, while the least is Language Immersion Program.

Conclusion

This comprehensive study investigated the factors shaping Generation Z students' decision-making process regarding study abroad program selection at both private and public state universities and colleges (SUCs) in Occidental Mindoro. By integrating a multi-pronged approach encompassing Structural Equation Modeling (SEM), Artificial Neural Networks (ANN), and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), the research offers valuable insights into the unique priorities and decision-making patterns of this emerging student cohort.

This study revealed that perceived benefits significantly impact intention, followed by perceived risk, trust, and service awareness. Moreover, subjective norms don't significantly impact the intention, which contrasts with other literature studies. The ANN models further validated the SEM results, identifying perceived behavioral control as the most influential predictor, followed by intention to use, and attitude. The TOPSIS analysis provided a ranking of the three study abroad program alternatives - student exchange, work and study, and language immersion - based on factors such as program duration, specialization, perceived cost, financial support, research opportunities, and program quality. The study abroad program's ranking shows that the language immersion pro-gram has the lowest ranking, and the student exchange program is the highest. This holistic assessment offers valuable insights for educational institutions to optimize their international education portfolios.

These multifaceted findings carry significant practical implications. By under-standing the nuanced priorities and decision drivers of Generation Z, universities can tailor their study abroad programs to better align with the needs and expectations of this critical student segment. This, in turn, can help boost participation rates in international education and foster more enriching global learning experiences. Moreover, the strategic framework developed in this research provides a roadmap for both private and public SUCs to enhance their competitiveness in attracting Generation Z students to engage in overseas studies.

Overall, this study contributes to the evolving literature on study abroad decision-making, offering a comprehensive perspective on the factors shaping the international education choices of the next generation of students. The integration of SEM, ANN, and TOPSIS techniques provides a robust and holistic analytical approach that can be replicated in future research to yield valuable insights for educational institutions and policymakers alike.

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Contact email: charmine.saflor@dlsu.edu.ph

Research on the Key Success Factors of Literacy-Oriented Courses Using DANP Method

Chia Wei Wang, National Taiwan Normal University, Taiwan

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Abstract
To align with international trends emphasizing Literacy-Oriented teaching, Taiwan's educational authorities officially implemented a new curriculum in 2019. These guidelines are based on the core principles of "autonomy," "interaction," and "common good." They emphasize three dimensions: "autonomous action," "interactive communication," and "social participation," along with nine specific core competencies that integrate knowledge, skills, and attitudes in learning. To examine the difficulties and challenges schools have encountered in implementing Literacy-Oriented instruction since the new curriculum was introduced over four years ago, this study focuses on seed teachers in the national professional communities of technical high school educators. By reviewing literature, we developed a prototype framework of key success factors. After refining this framework using the Delphi method, eight experts were invited to evaluate the influence weights of different factors. We combined the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method with the Analytic Network Process (ANP) to explore the key success dimensions and criteria for Literacy-Oriented teaching. The study identified four major dimensions: "philosophical alignment," "teacher empowerment," "administrative support," and "evaluation and feedback." According to the DEMATEL causal diagram and ANP network, the "philosophical alignment" dimension is central and has a direct impact on other dimensions. The second most influential dimension, "teacher empowerment," also affects "administrative support." Moreover, the elements within the "philosophical alignment" and "teacher empowerment" dimensions exhibit internal influences. The findings of this study can serve as a reference and provide suggestions for future interdisciplinary curriculum development in Literacy-Oriented education in technical high schools.

Keywords: Core Literacy, Literacy-Oriented Teaching, Decision Making Laboratory Analysis

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Introduction

To align with international trends emphasizing Literacy-Oriented teaching, Taiwan's educational authorities officially implemented a new curriculum in 2019. High schools have since faced significant curriculum reforms, including offering diverse elective courses and flexible learning time to provide students with opportunities for varied and adaptive exploration.

However, the practice of Literacy-Oriented teaching poses significant challenges for most teachers in the field. More than four years since the new curriculum's introduction, the implementation of Literacy-Oriented teaching remains far from meeting policy expectations. Schools face numerous difficulties, particularly technical high schools, which tend to adhere to a skill-based approach. Many vocational subject teachers exhibit resistance to competency-based teaching, often characterized by reluctance to understand or adapt their teaching methods, resulting in limited implementation effectiveness.

Promoting Literacy-Oriented teaching requires the establishment of interdisciplinary teacher communities and the infusion of various resources. These include teachers' in-depth understanding of Literacy-Oriented instruction, curriculum leadership from principals and academic directors, and administrative support and resources. For technical high schools, it is essential to break the barriers of subject-specific skill-based teaching to advance interdisciplinary Literacy-Oriented curricula. Additionally, the distinct groups within technical high schools bring unique cultures and challenges.

To realize the concept of Literacy-Oriented teaching, this study employs multi-criteria decision-making analysis—specifically the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method to identify interdependencies among key success dimensions and the Analytic Network Process (ANP) to determine the weights of evaluation criteria. These serve as considerations for advancing Literacy-Oriented teaching initiatives.

Literacy-Oriented Teaching

The primary research on the development of core literacies by international organizations focuses on the "United Nations Educational, Scientific and Cultural Organization" (UNESCO, 2003), which identified five dimensions and twenty-one specific elements of core literacies; the "Organization for Economic Cooperation and Development" (OECD, 2005) with its DeSeCo framework comprising three dimensions and nine specific elements; and the "European Union" (EC, 2005), which outlined eight dimensions and seven specific elements of core literacies.

The Ministry of Education in Taiwan adopts an integrative perspective from the EU and OECD, defining "literacy" as the indispensable knowledge, skills, and attitudes required by individuals for sound development and to meet the needs of various life contexts (Tsai & Chen, 2013). The concept of core literacies has increasingly gained the attention of scholars, many of whom emphasize the necessity of designing curriculum based on core literacies to address the challenges of an ever-changing social environment.

Literacy-oriented curriculum design and the transformation principles of teaching materials stress the importance of holistic learning, avoiding an exclusive focus on knowledge. It emphasizes a balanced integration of knowledge, skills, and attitudes, fostering meaningful

learning through contextual and situational approaches. Lin Yong-Feng (2017) highlights the need to combine learning content with inquiry processes through curriculum planning and instructional design, enabling students to develop self-directed learning skills. Greater student participation and proactive learning contribute to the cultivation of more effective cognitive and affective dimensions of literacies. Through hands-on learning and reflective practices in real-life contexts, students achieve skill transfer, comprehensive expression, and continuous improvement (Lin, 2017).

Therefore, the implementation of curriculum concepts should not merely stop at policy announcements or the publication of curriculum guidelines. The key lies in how these ideas are practically applied in teaching environments (Lin, 2021).

Decision-Making Trial and Evaluation Laboratory-Based Analytic Network Process (DANP)

DANP combines the DEMATEL (Decision-Making Trial and Evaluation Laboratory) and ANP (Analytic Network Process) methods. It is commonly used to address interdependencies and feedback issues in multi-criteria decision-making by analyzing the mutual influences among dimensions and criteria, ultimately deriving weights and priorities.

DEMATEL (Decision-Making Trial and Evaluation Laboratory)

The Decision Making and Trial Evaluation Laboratory (DEMATEL) is a method developed by the Battelle Memorial Institute of Geneva between 1972 and 1976 as part of the Science and Human Affairs Program. This method is designed to solve complex and intertwined problems. DEMATEL enhances understanding of specific issues, organizes interrelated problems into groups, and provides a hierarchical structure to identify feasible solutions (Tzeng et al., 2007). The key feature of DEMATEL lies in its ability to illustrate the interrelationships among dimensions or clusters and to identify the core criteria that represent these dimensions or elements effectively. (Hori & Shimizu, 1999; Chiu et al., 2006; Liou et al., 2007; Wu & Lee, 2007; Wu et al., 2009).

ANP (Analytic Network Process)

The Analytic Network Process (ANP) theory and application were proposed by Saaty (1996) as an extension of the Analytic Hierarchy Process (AHP). ANP is designed to address decision-making problems where elements exhibit dependence and feedback. Thus, the ANP can be described as a mathematical theory capable of systematically handling problems involving interdependence and feedback. In addition, the hierarchical structure of AHP is linear, whereas ANP adopts a non-linear network structure (Deng, 2005). The ANP analysis method incorporates interdependence and feedback, using a supermatrix to calculate weights. While the AHP framework represents problems with unidirectional hierarchical relationships, ANP allows for more complex interrelationships within and between levels or elements.

Research Framework

This study is based on the research framework proposed by various scholars on the key factors of competency-based teachers, synthesizing literature. A group of eight teachers from national technical high schools, all of whom are current or former first-level administrative leaders and have participated as guiding teachers in competency-based teaching professional

communities, was selected as the expert panel. The study integrates key factors identified by scholars for promoting competency-based teaching in schools. A first-round Delphi expert questionnaire was conducted, and the framework was adjusted based on expert opinions. The following month, a second round of expert interviews was held to further refine the framework. This was done to understand the difficulties and challenges faced by schools in implementing competency-based teaching, while also gathering further insights from experts. After two rounds of expert interviews and revisions, a final research framework was established, which includes four dimensions and twelve criteria. The formal evaluation levels and definitions were then compiled.

DEMATEL Result Analysis

This study evaluates the interrelationships between the four dimensions of competency-based teaching success factors: Conceptual Alignment, Teacher Empowerment, Administrative Support, and Assessment and Feedback. The aim is to establish an ANP evaluation framework. Therefore, the DEMATEL method was used to clarify the causal relationships between these dimensions and measure the degree of influence of each criterion. The results are analyzed as follows:

Establishing the Direct Relationship Matrix

In this study, the geometric mean of the responses from 8 expert questionnaires was calculated to derive the direct relationship geometric mean matrix A (as shown in Table 11). From the direct relationship matrix, it can be seen that the degree of influence between the Conceptual Alignment dimension and the Teacher Empowerment dimension is extremely high (above 4). The degree of influence between the Administrative Support dimension and the Assessment and Feedback dimension is high (above 3.5).

Table 1: Direct Relationship Matrix

	Philosophical	Administrative	Teacher Professional	Assessment
Philosophical	5	4.63	4.13	3.75
Administrative	4	5	3.75	3.75
Teacher Professional	3.63	3.63	5	3.5
Assessment	3.5	3.5	3.75	5

Standardized Direct Relationship Matrix

By calculating the sum of the values in each row and each column of the matrix, we can determine the total sum for each row and column. The maximum total sum is 17.5. By dividing the values in the matrix by the maximum total sum of 17.5, we can obtain the normalized D matrix.

Table 2: Standardized Direct Relationship Matrix

	Philosophical	Administrative	Teacher Professional	Assessment
Philosophical	0.29	0.26	0.24	0.21
Administrative	0.23	0.29	0.21	0.21
Teacher Professional	0.21	0.21	0.29	0.2
Assessment	0.2	0.2	0.21	0.29

Establish the Total Relationship Matrix

To establish the Total Relationship Matrix (T), we use the following formula:

$$T = \frac{D}{I - D}$$

Next, based on the values of the Total Relationship Matrix (T), calculate the sum of each row and column to obtain the row sum (R) and column sum (C). Then, using the row sum (R) and column sum (C), calculate the sum (R + C) and the difference (R - C) for each row and column, as shown in Table 3.

Table 3: The Total Relationship Matrix

	Philosophical	Administrative	Teacher Professional	Assessment	R	C	(R+C)	(R-C)
Philosophical	4.0377	4.1347	4.0671	3.8586	16.09	14.90	31.00	1.19
Administrative	3.7399	3.9231	3.7943	3.6311	15.08	15.41	30.50	-0.32
Teacher Professional	3.5920	3.7066	3.7535	3.4977	14.54	15.23	29.78	-0.68
Assessment	3.5350	3.6478	3.6205	3.5528	14.35	14.54	28.89	-0.18

Set Threshold Values and Draw Causal Diagram

In order to identify the significant influence relationships among the clustered dimensions, the geometric mean calculated was 3.755. Based on Table 14 and expert decision results, the threshold value \(\alpha=3.75 \) was set for the Total Relationship Matrix (T). If the values in matrix T exceed \(\alpha \), it indicates a stronger mutual influence and are retained. If the values are below \(\alpha \), indicating weaker relationships, they are removed and set to 0. Therefore, the Total Relationship Matrix T remains unchanged. Using the (R+C) values and (R-C) values from Table 14, with (R+C) as the X-axis and (R-C) as the Y-axis, a causal relationship diagram of the main dimensions and subdimensions is then drawn (as shown in Figure 1).

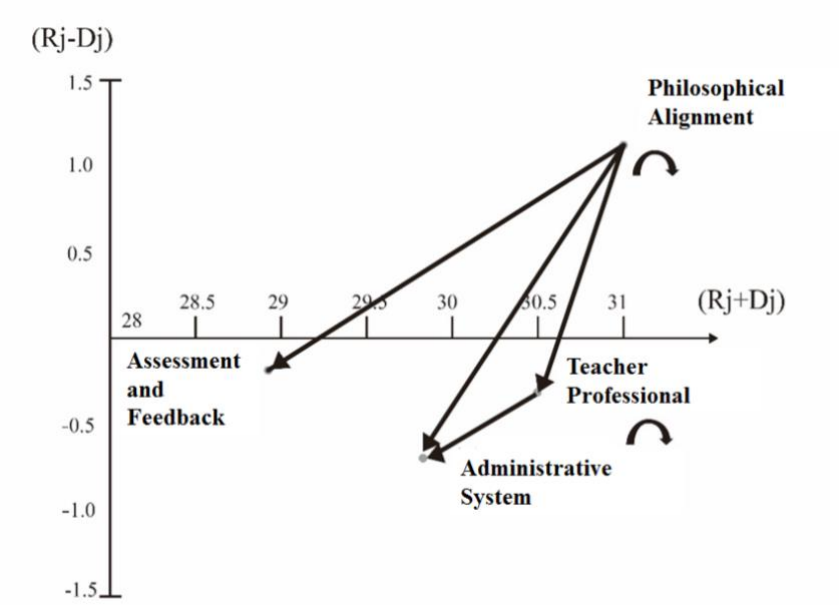

Figure 1: Causal Relationship Diagram (Threshold value α=3.75)

Establishing the ANP Evaluation Framework

The results shown in Table 4 indicate that the ”Conceptual Alignment” dimension is the central influencing factor. At the same time, the “Conceptual Alignment” dimension and the “Teacher Empowerment” dimension are significant driving factors, while the “Administrative Support” and “Assessment and Feedback” dimensions are outcome factors. Based on these relationships, a dynamic causal influence network diagram, required for the ANP method, can be established (as shown in Figure 2).

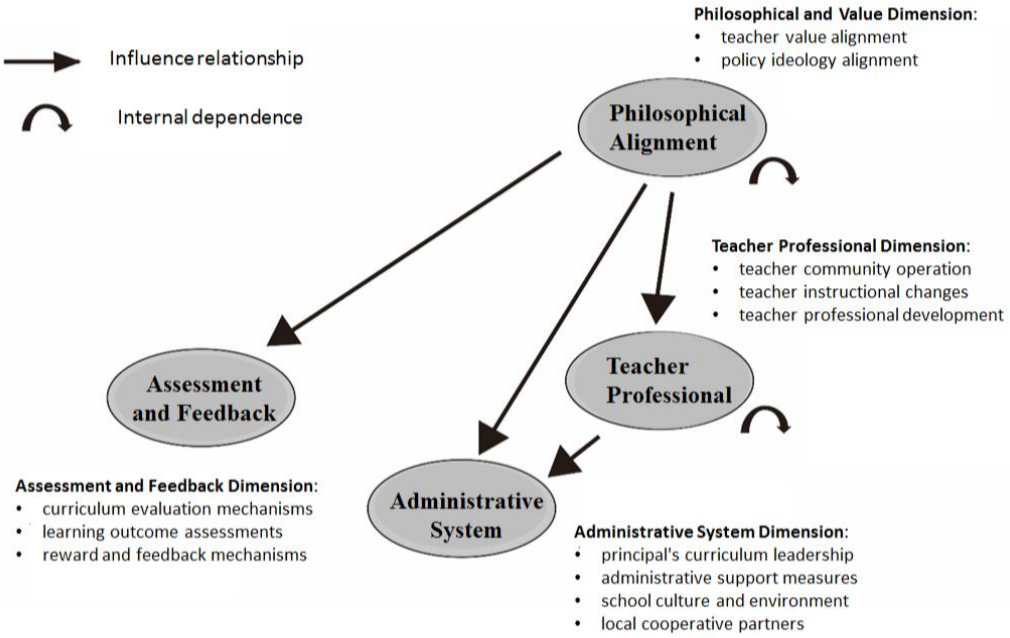

Figure 2: Dynamic Causal Relationship Network Diagram Using the ANP Method

Conclusion

This study synthesizes key success dimensions and elements from relevant literature on competency-based teaching. Based on the opinions of 8 expert scholars, the dimensions identified include "Conceptual Alignment," "Teacher Empowerment," "Administrative Support," and "Assessment and Feedback." Using the DEMATEL questionnaire's pairwise comparison matrix, a total impact relationship matrix was formed. In the causal relationship diagram, the "Conceptual Alignment" dimension directly impacts the "Teacher Empowerment," "Administrative Support," and "Assessment and Feedback" dimensions. The "Teacher Empowerment" dimension also affects the "Administrative Support" dimension, while both "Administrative Support" and "Assessment and Feedback" are influenced, without causing an impact on other dimensions. Additionally, in terms of internal dependencies, both the "Conceptual Alignment" and "Teacher Empowerment" dimensions have internal influences.

Through the ANP method, a dynamic causal relationship network diagram clearly presents that when promoting competency-based teaching policies, the alignment of teachers with the policy's conceptual framework is crucial. This includes whether teachers recognize the value of their roles in education. Secondly, the implementation of teacher empowerment depends on the operation of teacher communities and the enhancement of teachers' expertise, forming a learning organization within the school that promotes teacher growth and willingness to change teaching practices. Teacher empowerment not only relies on conceptual alignment but also influences school administrative support. When teacher motivation is high, curriculum leadership and administrative support are more willing to offer greater assistance, forming a robust support system for teacher empowerment. Furthermore, although "Assessment and Feedback" does not directly impact other dimensions, its internal mechanisms—curriculum assessments, learning outcome evaluations, and reward feedback systems—reflect whether the competency-based teaching philosophy is being implemented and how to adjust the promotion methods and outcomes.

This study finds that when schools promote competency-based teaching, the most important factor is the alignment of teachers with the policy's conceptual framework. Only with conceptual alignment will teachers be motivated to engage in teaching changes. Next, for competency-based teaching to be effectively implemented, teachers play the most critical role. Schools should focus on how to encourage teachers to participate in communities, continuously engage in professional empowerment, and implement teaching changes in the classroom. The school administration can offer reward mechanisms, results presentations, and exchanges to foster mutual growth in teaching between teachers and students, creating a positive school culture.

This study surveyed experts from technical high schools or vocational backgrounds. The findings may differ from those in general high schools or other educational stages, so future research could focus on comparing different educational systems. Secondly, due to the large number of pairwise comparison items and the complexity of the supermatrix in the ANP network analysis method, it is recommended that future studies further investigate to obtain more detailed weight rankings.

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Contact email: k80962002@gmail.com

The Efficacy of Pre-editing as a Means of Improving NMT Output

Kayo Tsuji, Osaka Metropolitan University, Japan
Benjamin Neil Smith, Kwansei Gakuin University, Japan
Kiyo Okamoto, Osaka Metropolitan University, Japan

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Abstract
Neural machine translation (NMT/MT) replicates human brain networks and is often considered a "black box" due to its unexplained structure and function. To use NMT effectively, target-language (TL) learners should pre-edit source-language (SL) documents, similar to how humans paraphrase first-language (L1) texts before translating to their second language (L2) (Tsuji, 2024). Previous studies have shown that pre-editing SL texts improves the quality of MT output. However, the specific differences between NMT output with and without editing have been explored less. This study aims to compare NMT translations with and without pre-editing and examine the impact of pre-editing on the quality of TL texts. The study involved 54 Japanese university students with intermediate English proficiency, each composing a Japanese text which was translated into English using NMT. Three language researchers analysed issues in the unedited NMT output, and systematically categorised them into lexical, grammatical, semantic and formatting errors. Comparing the results with those of Tsuji (2024), exploring issues in pre-edited NMT outputs, showed that NMT output *without* pre-editing displayed more frequent errors than NMT output *with* pre-editing. In particular, the semantic issues in unedited NMT output significantly limited readability. On the contrary, the pre-edited NMT translations described in Tsuji (2024) were generally comprehensible and contained minor errors that did not significantly affect comprehensibility. This study indicates that pre-editing SL texts is essential for improving the quality of NMT translations. The errors illustrated in this study could potentially be used to assist students learning L1 paraphrasing skills required for the human L2 translation process.

Keywords: Pre-editing, Neural Machine Translation, NMT Errors, Japanese-English Translation

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Introduction

Neural machine translation (NMT) has significantly advanced in recent years, achieving higher accuracy compared to statistical machine translation (SMT) (Bahdanau et al., 2015; Sutskever et al., 2014). Designed to mimic human neural networks, NMT continues to evolve, enhancing its capabilities (Ninomiya et al., 2021). Despite its progress, the internal workings of NMT systems remain largely opaque, often referred to as a "black box." Nonetheless, translations produced by modern NMTs are widely perceived to approximate human translation quality.

To further enhance NMT quality, human intervention in the form of pre-editing (modifying the source text) and post-editing (refining the output text) is often required. With the focus of this study being pre-editing, this paper begins with an exploration of four studies that highlight its effectiveness (Farhana et al., 2023; Feifei et al., 2022; Kokanova et al., 2022; Liang & Han, 2022). Following this is an examination of two studies reporting some of its potential limitations (Marzouk & Hansen-Schirra, 2019; Rantan, 2024) with a final discussion of research addressing practical considerations for pre-editing. While prior studies offer mixed insights into the efficacy of pre-editing in improving MT quality, the continuous evolution of NMT raises the question of whether pre-editing will remain necessary as the technology advances.

Previous Studies

Value of Pre-editing

Several studies have demonstrated the advantages of pre-editing for enhancing NMT output. For example, Farhana et al. (2023) investigated English translations of Indonesian texts, focusing on students in translation and interpreting courses as participants. Their findings revealed that over 90% of the pre-edited NMT output was error-free, producing clear and comprehensible English translations. Key pre-editing strategies included reordering sentence elements, refining vocabulary, and eliminating superfluous phrases, leading to improved accuracy and efficiency. The authors emphasized the importance of pre-editing training to maximize its benefits.

Similarly, Liang and Han (2022) compared the different benefits of pre-editing and post-editing when translating academic and medical texts between English and Chinese. They found pre-editing to be essential for enhancing semantic accuracy, while post-editing helped to refine linguistic and cultural aspects of the output text that MT lacks awareness of. These findings underscore the complementary roles of pre- and post-editing in producing high-quality translations.

Feifei et al. (2022) examined the impact of pre-editing on translating an English academic book into Chinese. Their study revealed significant improvements in BLEU scores due to precise adjustments such as adding, omitting, or replacing words and ensuring technical terms were accurately rendered, resulting in contextually appropriate translations.

In another study, Kokanova et al. (2022) evaluated the translation of English news articles from *bbc.com* into Russian. They observed that pre-editing reduced lexical inaccuracies, particularly in handling polysemous words, which were often mistranslated without pre-

editing. This intervention enhanced both clarity and precision, highlighting the value of pre-editing in mitigating common translation errors.

Collectively, these studies demonstrate the substantial role of pre-editing in improving MT quality, particularly in addressing lexical challenges and refining text clarity across various genres.

The Potential Limitations of Pre-editing

That being said, not all research supports the efficacy of pre-editing. Rantan (2024) analysed English-to-Finnish translations, specifically focusing on the challenges posed by Finnish prepositions. The findings indicated that pre-editing strategies were insufficient to fully address errors associated with complex sentence structures and, consequently, the study suggested that post-editing might be more effective for such cases.

Marzouk and Hansen-Schirra (2019) evaluated the application of controlled language (CL) rules in German-to-English translations of technical manuals. Their results showed minimal differences in error rates before and after applying CL rules, suggesting that modern NMT systems can often produce accurate texts without extensive pre-editing. They concluded that the relevance of pre-editing might diminish as NMT technology advances, and this would likewise diminish the need to investigate and implement effective strategies thereof.

Despite the benefits of pre-editing, these studies raise questions about its necessity in an era of increasingly sophisticated NMT systems.

Purpose of the Study

This study aims to identify differences in translation quality between pre-edited and unedited source texts (STs), focusing on Japanese-to-English translations of academic reports written by Japanese learners of English. Specifically, it seeks to verify the efficacy of pre-editing as a means to improve NMT output. The central research question is: What are the specific differences between NMT output produced with and without pre-editing? By addressing this question, the study could illuminate the areas where pre-editing enhances translation accuracy and readability in this context, as well as its potential limitations.

Methodology

This study compares the NMT output without pre-editing to the output with pre-editing. To achieve this, data from Tsuji (2024) was used as pre-edited NMT output. In said study, 73 students with intermediate English proficiency wrote reports in Japanese during the spring semester of 2022. The participants input their texts without pre-editing into a NMT system to generate NMT output. They then compared the resulting target-language texts (TTs) to the source-language texts (STs), identifying parts of the translations that did not accurately reflect the ST. The problematic parts in STs were subsequently rewritten (pre-edited), and then re-entered into NMT. The students repeated this until they were satisfied that the ST meaning was accurately reflected in their TTs. The final TTs, consisting of about 15-20 sentences, and the revised STs were collected as raw data. Each student selected several TSs that they were unable to verify the accuracy of, making for a total of 183 TL sentences.

Reflecting the above, the current study involved 54 students who wrote academic reports in Japanese during the spring semester of 2023. They followed the same procedure and identified parts of the translations that did not accurately reflect the STs. However, this set did not pre-edit their sentences and submitted them as is. Each TT consisted of approximately 400 words, organized into 15-20 sentences, with 144 TL sentences being submitted for analysis in total. In identifying the common errors that students couldn't self-diagnose, typical MT errors present in students' writing can be illustrated. In both cases, the STs and TTs were collected as raw data.

Participants were all students enrolled in English courses taught by the researchers, and provided consent for their writing to be used for research purposes. The participants were deemed appropriate as they had an intermediate level of English proficiency, representative of a typical university student in Japan. As in Tsuji (2024), the 54 participants were instructed to create their academic texts on their own specialised subject under the condition that their degree of familiarity with the topic should be relatively high.

Three language researchers, comprising one native English speaker and two native Japanese speakers, analysed both sets of the data. The analysis was conducted manually by the analysts initially working independently and later collaborating to compile and classify results based on mutual agreement. The analysts identified syntactic and semantic errors, as well as mistranslations, in the unedited MT output, and categorized these problematic elements accordingly.

Among the freely available online NMT tools, this study focused on DeepL, which has demonstrated strong performance based on BLEU (Bilingual Evaluation Understudy) scores, a widely recognized metric for assessing MT quality (Fujii et al., 2021). Higher BLEU scores indicate translations that are closer in quality to human-generated translations.

Results

As in Tsuji (2024), three language researchers systematically categorised errors in unedited NMT output into *Lexical, Grammatical, Semantic* and *Formatting Issues*. *Lexical Issues* included inappropriate use of TL vocabulary and redundant or repeated TL expressions, while the *Grammatical Issues* discovered were mainly those such as misuse or lack of determiners, misuse or lack of prepositions, and inappropriate singular and plural forms. *Semantic Issues* related to incomprehensible sentences and missing information. Finally, *Formatting Issues* indicated misuse of punctuation, misuse of upper- and lower-case characters, and missing quotation marks.

The findings of this investigation reveal that many errors were present in the unedited translations, while pre-edited NMT translations displayed fewer and relatively minor errors, shown in Tsuji (2024).

Two prominent error categories, in particular, relating to *Lexical* and *Semantic Issues*, showed significant difference between the NMT output with and without pre-editing.

With regard to *Lexical Issues*, there was little difference between the pre-edited and unedited NMT output. Moreover, these errors largely did not impede the comprehensibility of the sentences in both the NMT output with and without pre-editing. This issue may therefore

require greater TL (English) knowledge to repair, as pre-editing had little effect on its occurrence.

Regarding *Semantic Issues*, without pre-editing, errors emerged more frequently, negatively impacting the accuracy and readability of the translations. In contrast, pre-editing let authors simplify sentence structures, thereby reducing semantic ambiguities.

The errors in the unedited NMT output were frequently linked to long or overly complex SL sentences. TL sentences observed in the unedited output mixed multiple pieces of information in a single sentence, and the subject and predicate did not always align, making it difficult to understand the relationship between each piece of information or what was and was not a necessary sentence element. Further analysis highlighted the nature of these semantic issues, which were especially prevalent in the unedited NMT translations.

The results emphasize the critical role of pre-editing in enhancing the clarity and precision of NMT output.

Examples of Lexical Issues

Detailed examples of *Lexical Issues* are discussed in this section.

NMT Output Without Pre-editing

Example 1
MT output[1]: There is a problem that children with *disabilities float* in class due to their *disability* characteristics.

The word “float” does not make sense in this context, wherein the author meant that children with disabilities may be left behind or ignored in the class. Moreover, “disability” is incorrectly used as an adjective, where the correct phrasing ought to be “disability’s characteristics” or, potentially, “disabled characteristics”. Since “disabilities” is mentioned earlier in the sentence, the word could also be deleted and the sentence would make more sense. That said, despite these problems the overall meaning of the sentence comes through in the NMT output.

Example 2
MT output[2]: Although I was still not very good at *making* hairpins and smashes, when I was able to actually *make* them in the matches, I *could feel* the results of my technical practice, and I *felt* a sense of accomplishment.

Although there is nothing mistaken in this sentence, it displays repetition of the verbs “make” and “feel” in different forms and its length makes its meaning somewhat difficult to parse. By using synonyms or equivalent phrases or by separating the ideas into different sentences, its readability would be improved.

[1] The SL equivalent of the MT output is as follows: 障害特性により、障害を持った子供たちがクラスで浮いてしまうという問題がある。
[2] ヘアピンやスマッシュの精度はまだまだでしたが、実際に試合で決めることができたときは、技術練習の成果を感じることができ、達成感を感じました。

NMT Output With Pre-editing

Example 3
MT output[3]: A semiconductor made from a single crystal with no impurities is called a *true* semiconductor, in which the outermost electrons of the atoms that make up the semiconductor, *such as silicon,* are used for covalent bonding without excess or deficiency.

Here, the term "true semiconductor" is incorrectly used in place of the term "intrinsic semiconductor", and the placement of the example "such as silicon" would work better following the initial term it is an example of. Despite this, the overall meaning does come through, albeit somewhat awkwardly.

Example 4
MT output[4]: In addition, companies are set up to conduct development *locally*. However, their arrangement for R&D activities is still less than that of companies that do manufacturing *locally* or sales *locally*.

These sentences use the word "locally" repetitively and although the meaning is clear its readability would be improved by either cutting one instance of the word (for example, "manufacturing or sales locally") or using a synonym in its place.

From these examples, it can be seen that both the NMT output with and without pre-editing exhibited lexical issues, but this did not tend to affect their comprehensibility in both cases. Within this data, this type of issue can be edited during the phase of post-editing, but given its minor nature it is less of a priority for NMT users to focus on.

Examples of Semantic Issues

Detailed examples of *Semantic Issues* are discussed in this section.

NMT Output Without Pre-editing

Example 5
MT output[5]: It can be inferred that the element sought in American *anime* is the ability to *experience* through images what one cannot *experience* oneself by looking down from a third person's point of view, to feel *a sense of* elation and to *experience a sense of* the extraordinary.

The organization of the text in a relatively long sentence make the author's meaning unclear, as it is difficult to understand exactly how one point connects to another. Moreover, repetitive phrasing ("experience", "a sense of") and the wrong term make it more unintelligible. The use of "anime" is incorrect in this context, as this term is used mainly for animations made in

[3] 不純物を持たない単結晶で作られた半導体を真性半導体といい、シリコンなどの半導体を構成する原子の最外殻電子が過不足なく共有結合に使用された状態である。
[4] また、開発を現地で行う会社が設置される。しかし、研究開発活動を行うためのそれらの配置は、製造を現地でする会社や販売を現地でする会社に比べるとまだ少ない。
[5] 第三者の視点から俯瞰して見ることで、自分では体験できないことを、映像を通して体験することで高揚感を抱いたり、非日常感を味わったりすることができるのがアメリカのアニメに求められる要素なのではないかと推測できる。

Japan with a particular and iconic style. A more appropriate term would be “animations” or “cartoons”.

Example 6
MT output[6]: I believe that *women, among all the stressful household chores*, lack understanding and appreciation from those around them.

This example illustrates incorrect word order and semantic ambiguity. The phrase “women, among all the stressful household chores” suggests that women are somehow included as a household chore, which is nonsensical. This error stems from ambiguity in the ST, which could have been resolved by reconstructing the sentence during the pre-editing phase.

NMT Output With Pre-editing

Example 7
MT output[7]: The background of the incident may be that people in a socially distressed position, of low status and low income, were not in a situation where they could fully use their *reason* due to the hardships of life and dissatisfaction with the *disparity*.

In this sentence, there is missing information, since the form of “disparity” is unmentioned (for example, it may refer to “wealth disparity”). Moreover, the NMT has incorrectly used the word “reason” rather than “reasoning”. However, given the proximity of “reason” to “reasoning” and the context within the sentence, the true meaning can be easily gleaned without much effort from the reader.

Example 8
MT output[8]: Bischofia javanica is a popular guide item *as a “bleeding tree”*; when the bark is injured, red sap flows from the wound.

This sentence is also missing information, as the subject is “known as a bleeding tree” (rather than literally being a “bleeding tree”) due to its characteristics. As with example 7, however, this too, can be understood by the reader due to the context provided in the sentence.

From these examples, it is clear that pre-editing can help reduce the impact of semantic problems and improve the overall comprehensibility of sentences. The output of unedited STs was often long with ideas mixed together in ways that made the overall meaning difficult to parse, whilst the output from pre-edited STs – although still displaying errors – could be understood without difficulty.

Examples of Other Frequent Errors in Unedited NMT Output

Here are sample sentences of frequent errors: inappropriate use of subjects, inappropriate use of conjunctions, and illogical causal relationships.

[6] 私は女性が、家事をストレスに感じる中でも特に周りからの理解や感謝が足りないのではないかと思う。
[7] 事件の背景にあるのは、社会的に苦しい立場にいる、低い地位、低収入の人々が、生活苦や格差に対する不満などで、理性を十分に働かせるような状況になかったということでないかと思われる。
[8] アカギとは「血を流す木」として人気のあるガイド項目で、樹皮を傷つけると傷口から赤い樹液が流れる。

Inappropriate Use of Subjects

Other frequently observed errors fell under the category of inappropriate use of subjects. Japanese learners of English often omit the subject in their writing, as it is typically implied in Japanese and contextually understood (Tsuji, 2024). This characteristic led to frequent subject-related errors.

Example 9
MT output[9]: Therefore, *we* decided to prevent influenza infection by increasing the rate of hand disinfection using bottles of disinfectant ethanol, which *we* are tempted to push.

In this example, the double use of "we" is inappropriate as it creates ambiguity – either the people who decided to use disinfectant ethanol are the same as those who are tempted to use it, or these are two distinctly defined groups of people. Given the context of preventing the spread of infection, it is likely that the second "we" is referring to a larger group (which may or may not include those of the former "we"). Therefore, substituting this for a generic term such as "people" would improve intelligibility and make it clear that the latter "we" is separate and greater, and that the former "we" were making a decision for the benefit of a larger group. This more closely aligns it with the ST.

Based on the findings of Tsuji (2024), pre-editing had a significant effect on this kind of issue. As mentioned, Japanese is a language that often omits explicit subjects in favor of implied ones, which can lead to ambiguous or inappropriate translations when entered into NMT systems. Pre-editing addressed this by allowing the author to explicitly supplement implied subjects, improving clarity and syntactic correctness.

Inappropriate Use of Conjunctions

Other frequent errors, pertaining to inappropriate use of conjunctions, were also prominent, as illustrated by the following sentence.

Example 10
MT output[10]: I have not had much opportunity to work with people who lack self-care at this point, *and* I do not think I have been able to develop such skills.

Although grammatically and structurally correct, the conjunction "and" does not effectively convey the causal relationship implied in this sentence. Replacing it with "so" would better reflect the intended connection between the two statements. Notably, the ST itself lacked punctuation, which may have contributed to the suboptimal translation. This could easily be remedied through pre-editing, giving the author an opportunity to add the necessary punctuation to help clarify meaning.

Illogical Causal Relationships

Another notable issue was illogical causal relationships.

[9] そこで、つい押したくなる消毒用エタノールのボトルを使用し、手指消毒の実施率をあげることでインフルエンザ感染を予防することとした。
[10] 私自身もあまり現時点でセルフケアが欠如している人と関わる機会がなくそういった力をつけることができていないと思うので。

Example 11
MT output[11]: This has increased the income of farmers, and the population has also risen due to the *increase in society*.

This output demonstrates a logical inconsistency. The statement “the population has also risen due to the increase in society” is vague and illogical, as the rising population would likely cause societal changes rather than result from them. While the translation is grammatically accurate, the logical disconnect likely originates from the ST. Such issues must be addressed during pre-editing to ensure coherent causal relationships in the NMT output.

Conclusion

This study sought to identify specific differences in NMT output with and without pre-editing. Analysis revealed that errors relating to lexical and semantic problems were particularly prevalent in translations without pre-editing. Semantic errors, such as incomprehensible sentences and missing information, were observed frequently and had significant implications for the comprehensibility of a sentence. NMT output without pre-editing often exhibited poorly expressed sentence elements, illogical idea connections, and subject inference errors, resulting in unintelligible texts. However, the degree and frequency of these errors in pre-edited NMT outputs are reduced to the point that they did not significantly hamper readability, demonstrating its effectiveness in enhancing clarity and accuracy of NMT output. Whatever developments improve NMT capabilities, the results suggest that, at present, pre-editing remains essential to improve the quality of NMT output.

Limitations

Despite its valuable insights, the study had several limitations. The sample consisted of a limited number of students with intermediate TL proficiency. This was due to the small-scale of the study, as the participants were all students enrolled in English courses taught by the researchers. Moreover, the pre-edited NMT output data was not collected since the time allocated to complete the task was limited by the curriculum prescribed by the university administration. Furthermore, the study focused exclusively on the NMT output of academic reports translated from Japanese as a source language to English as a target language. These limitations mean that the findings may not generalize to other language pairs, genres of writing, different levels of TL proficiency in the authors, or alternative contexts. Future research should involve larger participant groups, adopt a longitudinal design, and include multiple genres to provide more comprehensive insights.

[11] それにより農家の収入も上がり、社会増加による人口の上昇も実現した。

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Factors Influencing University Selection and Future Educational Trends: A Survey of Thai High School Students Applying to Study at KMUTT

Somsri Binraman, King Mongkut's University of Technology Thonburi, Thailand
Suchapa Netpradit, King Mongkut's University of Technology Thonburi, Thailand
Chanin Tungpantong, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
This study investigates the factors influencing Thai high school students' university selection decisions and their perceptions of future educational trends. A survey was conducted among 139 applicants of KMUTT to technology-related programs in the 2023 academic year. The main respondents were female students (57%) recent high school graduates (around 18 years old) from public schools (86%) from all over Thailand. Regarding academic background, 45.32% graduated from the Science-Math stream, followed by Arts-Mathematics (25.18%) and Language Arts (14.39%). The dominant student interest resided in science and technology fields integrated with art and design (43.17%). A significant portion (33.09%) expressed interest in Education or Industrial Education, Engineering (9.35%) and Business Management (5.04%). Architecture, Fine Arts, Communication Arts, Mass Communication, and Law drew interest from a smaller percentage of students. Perceptions of future educational trends were largely consistent. Most students anticipated a shift towards blended learning, a focus on analytical thinking skills, and the integration of AI and robotics in teaching. University selection factors were evaluated using a 5-point scale. "Better career opportunities" received the highest score (mean=4.61), followed by "support from family" (mean=4.56) and "meeting personal needs" (mean=4.42). Issues that still need to be addressed include providing sufficient information for University program admission and promoting student preparation for further study. This survey provided valuable insights for universities to design learning programs that cater to current high school students' evolving needs and aspirations. Additionally, analyzing applicants' information could help schools enhance their guidance for students.

Keywords: Future Educational Trends, University Selection, High School Students

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Introduction

Choosing a university for higher education is currently a major decision for high school students, as it affects their educational path and future job market opportunities. Therefore, studying the factors that influence the decision to choose a university, as well as important trends that may affect the future education of high school students, is something that colleges recognize as important. The university will analyze the importance of the decision and understand the factors that affect the decision-making process, as well as predict trends that play an important role in educational development. We will conduct an analysis of the important factors influencing students' university selection. Studying these important factors is important for universities that want to select students with diverse abilities that meet university needs, as well as respond to policies that are being changed in education in line with future labor market needs.

In addition to analyzing the factors that influence university selection, this research also explores important trends for future education, such as the importance of digital learning, interdisciplinary education, and more skill-based learning. In analyzing such educational trends, it is possible to know about the changing trends of universities in the future to adapt to the changing world. This research aims to study the decision-making process of current students and strategic planning for educational institutions to enhance their competitiveness in the future job market.

This research will comprehensively analyze both the factors affecting university selection and the future educational trends of students. This study presents an overview of the impacts of changes in higher education. This research aims to study the factors affecting university selection and the perspectives of future educational trends among high school students, focusing on those who applied to study in related technology fields in the Faculty of Industrial Education and Technology at King Mongkut's University of Technology Thonburi (KMUTT). The results of this study will serve as guidelines for improving and developing the curriculum to be in line with the needs and expectations of future students.

Methodology

This research utilized a survey method through questionnaires to collect data from high school students applying to the Faculty of Industrial Education and Technology at King Mongkut's University of Technology Thonburi. The questionnaire consisted of questions regarding factors influencing university selection and future educational trends. The sample group included 240 high school students who applied for the 2024 academic year to study in the fields of Printing and Packaging Technology, Educational and Communication Technology, and Applied Computer-Multimedia.

Data was collected using an online questionnaire via Google Forms, which included both closed-ended and open-ended questions. The survey employed a 5-point Likert scale for opinion assessment, ranging from 1 (least) to 5 (most) for collected data analysis, as shown in Table 1. The collected data was then analyzed using descriptive and inferential statistical methods. The questions in questionnaire included of 3 sections:

- Section 1: General Information of Respondents.
- Section 2: Questionnaire on Higher Education Preferences, Interests, and Educational Goals, 6 questions with multiple choice for selection and 1 open-ended questions.

- Section 3: Questionnaire for Opinions, consisting of 5 closed-ended questions with a 5-level rating scale and 2 open-ended questions.

The topics of multiple choice for selection in Section 2 included of 7 questions:

1) Academic program studying in high school
2) Subjects interested during studying in high school
3) Interest of fields in higher education
4) Reasons for interested fields
5) Factors influence decision for higher education
6) Change in the future of educational trends
7) Important role in the future of interested fields (open-ended question)

The topics of questions in Section 3 included of 5 questions for rating:

1) Higher education at university gives better career opportunities.
2) Preparation of students for university application.
3) Support from family for university study.
4) Sufficient information about the field of study in university.
5) Higher education meets your personal needs.

There are 2 additional open-ended questions: 1) plans or goals for study in university and 2) additional opinion on future education.

Table 1: The Descriptive and Inferential Statistical Methods With 5-point Likert Scale

Scale	Scale Interval	Opinion for Quality
5	4.50-5.00	Most
4	3.50-4.49	High
3	2.50-3.49	Moderate
2	1.50-2.49	Low
1	1.00-1.49	Least

Results and Discussion

General Information of Respondents

From a total of 240 participants, it was found that 139 students responded to the questionnaire. The main students were female, totaling 80 students (58%), followed by males 59 students (42%), and 1 student did not specify their gender. The respondents were aged around 18, accounting for 109 students (78%) and aged around 19, accounting for 18 students (13%). Most of the students came from public schools (government-run schools) across the country, totaling 116 students (83%), while 23 students (17%) were from private schools, as shown om Figure 1.

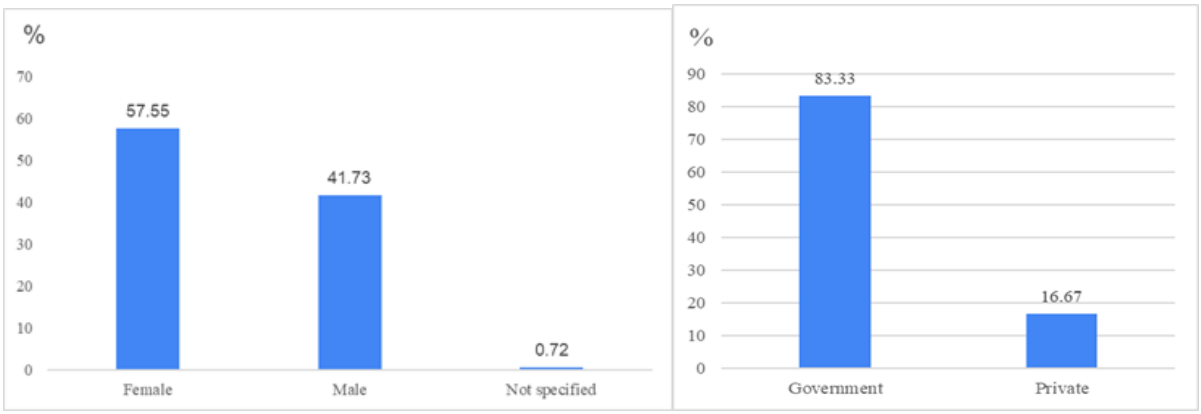

Figure 1: The General Information of the High School Students as Respondents

Questionnaire on Higher Education Preferences, Interests, and Educational

The survey showed that among the high school students as the respondents, most of them (63 students) graduated from the Science-Mathematics field, accounting for 45.32%. The second largest group with 35 students graduated from the Arts-Calculations field at around 25.18%. The third group with 20 students graduated from the Arts-Languages field or 14.39%. The remaining students graduated from other fields with smaller numbers, as shown in Figure 2. For studying the higher education level at KMUTT, there are many programs relating to Sciences, Engineering, and Technology accepting the applicants graduated the school from the field of Science-Mathematics.

The information showed that most students who applied to study at the university were interested in studying Education, with 82 students, making up 58.99%. This was followed by Science and Technology with 62 students, or 44.60%, and Business Administration with 52 students, or 37.41%, respectively, as shown in Figure 3.

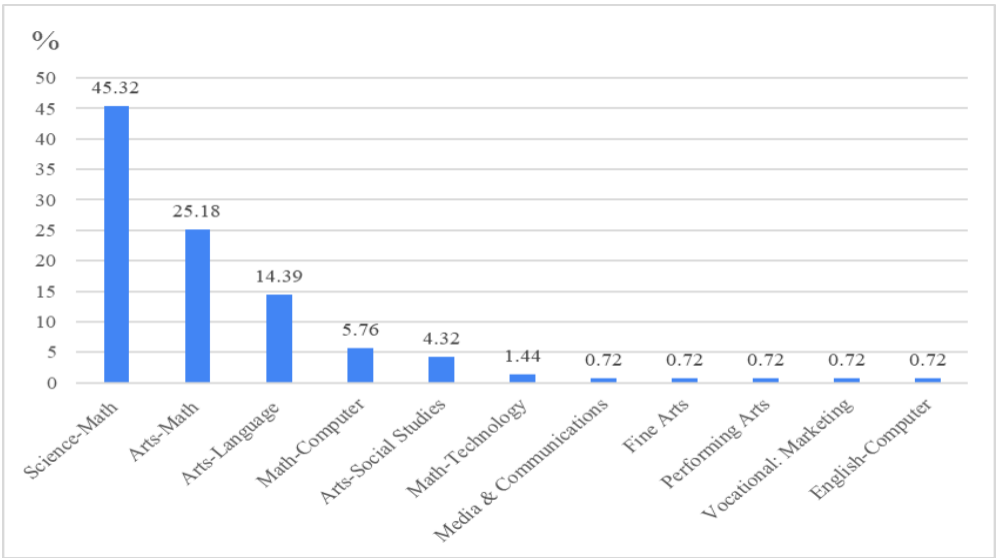

Figure 2: The Graduated Field of High School Students

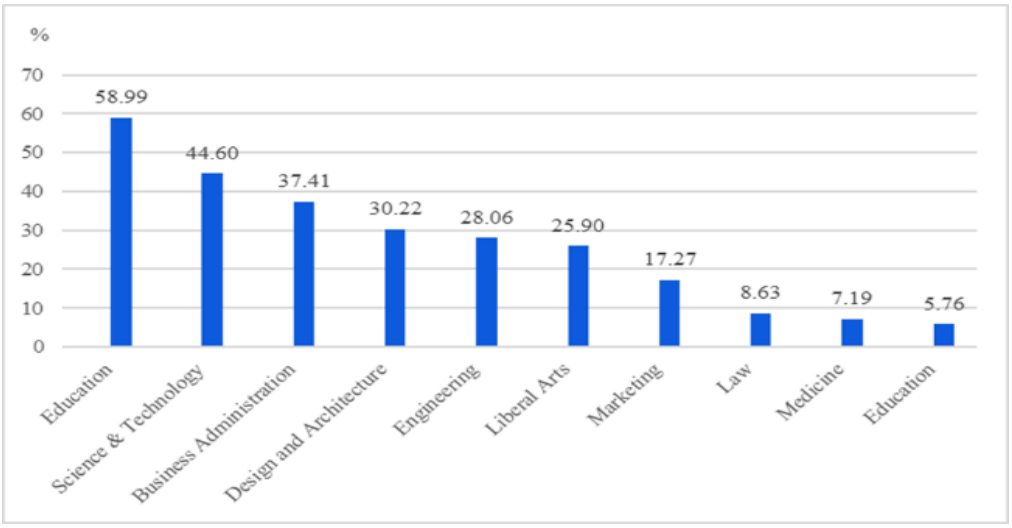

Figure 3: The Interesting Program of High School Students for Study at the University

The respondents also gave the reasons for interested fields, as shown in Figure 4. The results showed that 62.59% of the respondents were concerned about the high opportunity to work. The second reason was the good income at 50%. The last reason was desire to help society at 15.11%.

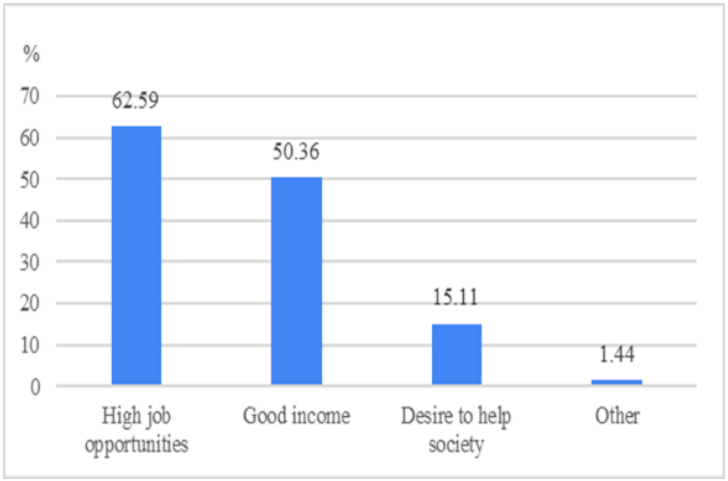

Figure 4: The Reasons for Interested Fields

From the survey responses of 139 participants, the factor that most influenced their decision in program selection for study at higher education was personal interest responded by 126 students, 90.65%. The next factors were labor market trends and economic conditions, responded by 50 students, 35.97%, and family advice, responded by 47 students, 33.81%, respectively, as shown in Figure 5.

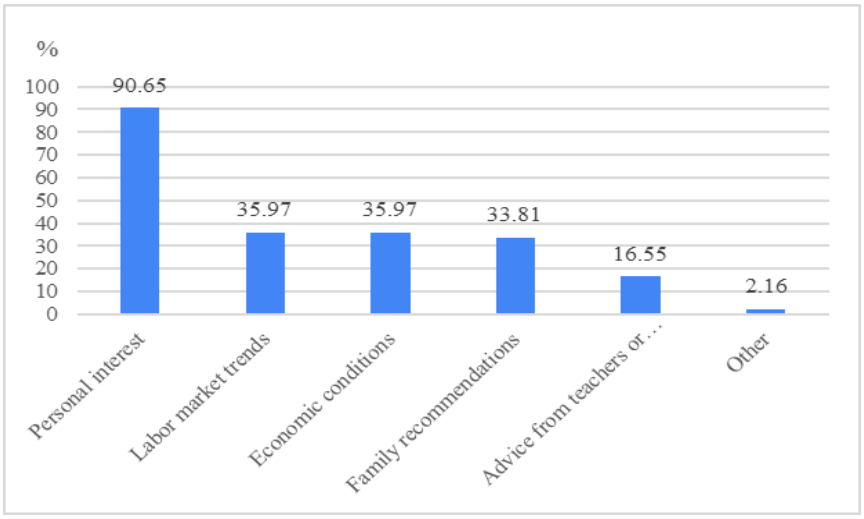

Figure 5: The Factor Influences the High School Students' Decision in Program Selection for Higher Education

Additionally, the researcher inquired about how future education trends might be changed. According to the responses from 139 respondents as in Figure 6, the following opinions were expressed regarding future education trends: Blended Learning was the most popular, agreed with 53 students, 38.13%. With 40 students, or 28.78% of respondents agreed with the use of AI and robotics in teaching and learning. The next trends emphasis on critical thinking skills and artificial intelligence skills, agreed with 33 students, or 23.74%. The least popular trend was online learning and teaching, responded by 12 students, or 8.63%.

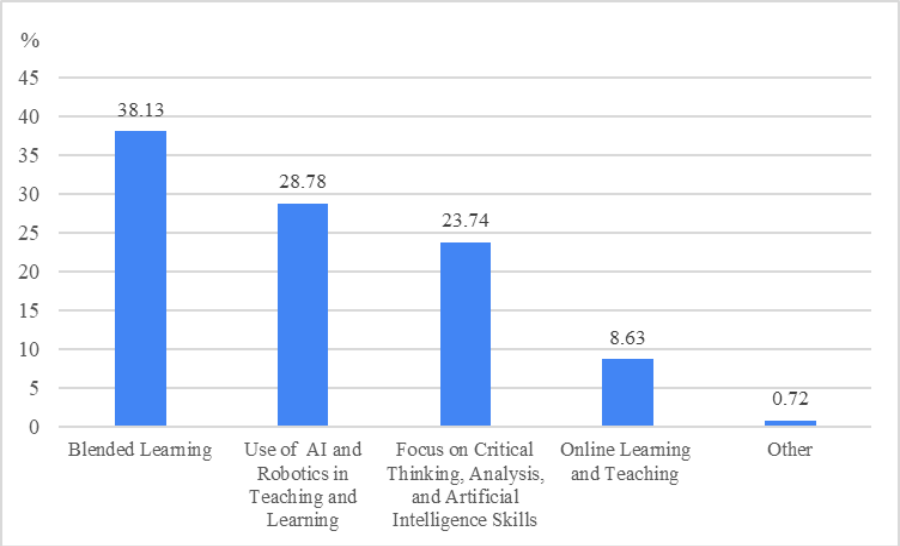

Figure 6: The High School Students' Opinion About the Future Education Trends

The Closed-Ended Questions With a 5-Level Rating Scale

The high school students who applied to study at KMUTT responded to the questionnaire in the Google Form. They expressed their opinion on the study in higher education level with a 5-level rating scale in the closed-ended questions, as shown in Table 2**.**

Table 2: The Students' Opinion on Higher Education

Item	Evaluation Topic	Mean	S.D.	Definition
1	Higher education at university gives better career opportunities.	4.61	0.56	Most
2	Preparation of students for university application.	4.16	0.76	High
3	Support from family for university study.	4.56	0.77	Most
4	Sufficient information about the field of study in university.	4.12	0.75	High
5	Higher education meets your personal needs.	4.42	0.71	High
	Total mean score	4.37	0.71	High

Among the 139 respondents, the topic "Pursuing higher education will provide better career opportunities" had the highest mean score ($\bar{X}$=4.61 and S.D.=0.56). The second topic was "Receiving support from family to pursue higher education" ($\bar{X}$=4.56 and S.D.=0.77). The third topic was "Feeling that higher education will meet personal needs" with $\bar{X}$=4.42 and S.D.=0.71.

For additional open-ended questions, they responded about plans or goals for study in university as follows:

Academic and Career Goals

- Intend to pursue a master's degree to expand knowledge and career opportunities in the future.
- Focus on learning fully in every subject to apply the knowledge in developing a stable and efficient career.
- Aim to explore myself through learning in various fields to find my strengths and interests in a suitable career.
- If possible, I want to secure a scholarship to study abroad, especially in Austria, as a long-term goal.

Self-Development

- Plan to use every opportunity to improve myself through society, studies, and activities to prepare for real-world work.
- Commit to learning and gaining experience through both education and participation in university activities.
- Plan to study foreign languages and seek opportunities to participate in exchange programs to enhance international experience.

Contribution and Knowledge Sharing

- If they gain useful knowledge, they would like to share it and use it to help others.

Overall Perspective on Education

- They want to apply the knowledge and experience gained to fulfill my dream career and create a stable income in the future.

- Overall, university education is a significant opportunity for me to develop myself, preparing for a stable career and life, both in terms of knowledge, skills, and experience.

They responded about the additional opinion on future education as follows:

- Education should be developed into a more systematic approach to ensure that all children have equal access to learning opportunities. It should emphasize a blend of theoretical knowledge and practical application.
- Learning methods should be diverse, with activities that encourage knowledge and idea exchange, aligned with labor market demands, and prepared for international standards.
- Classroom hours should be reduced, allowing more time for activities that build skills and experiences, while technology should be integrated into the learning process.
- Education must adapt to global changes, promoting learning that focuses on critical thinking, problem-solving, and resilience in overcoming unexpected challenges.
- The use of electronic devices for learning should be encouraged, alongside opportunities for hands-on practice in real-world scenarios.

Conclusion

Most of the survey respondents were female, aged 18, and primarily studying in government educational institutions. Most of the participants had a background in science-mathematics, followed by arts-mathematics and arts-language fields. Most respondents expressed interest in pursuing higher education in fields related to science and technology, followed by education/teaching. The primary reasons for choosing their fields of interest were personal preference and high employment opportunities. Regarding future education trends, most respondents believed that learning would shift towards a blended learning model, emphasizing critical thinking skills and incorporating AI and robotics in teaching. The respondents overwhelmingly agreed that pursuing higher education would provide better career opportunities, followed by strong family support for continuing their studies. In conclusion, most students aspire to pursue university education, preferring a blended learning approach that leverages AI technology to enhance learning experiences.

Suggestions

Based on the findings of this research, the following suggestions are proposed:

1. Universities should enhance the quality of academic programs to meet higher standards and address labor market demands.
2. Efforts should be made to promote the university's reputation through public relations and collaborations with other institutions.
3. Foster a learning environment that supports the development of students' skills and abilities.
4. Increase opportunities for internships and job placements to better prepare students for entering the workforce.

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Contact email: Somsri.bin@kmutt.ac.th

Examining Vocational Education in Indo-Pacific Countries and Implications for Taiwan's Vocational Education

Jen-Chia Chang, National Taipei University of Technology, Taiwan
Po-Ching Lu, National Taipei University of Technology, Taiwan

The Asian Conference on Education 2024
Official Conference Proceedings

Abstract
Vocational education is pivotal in shaping a country's workforce by providing essential skills and training to meet modern economic demands. However, Taiwan's current vocational education system faces multiple challenges, including insufficient government support for vocational training needs, inadequate industry collaboration, and a lack of innovation. These issues need to be addressed to enhance Taiwan's vocational education level and prepare its workforce for future economic challenges. Countries in the Indo-Pacific region, such as Japan, India, Australia, and the United States, have developed robust vocational education systems that have substantially contributed to their economic achievements. This comparative study analyzes the vocational education frameworks of these countries, offering insights for improving Taiwan's vocational education system. By employing a comparative analysis methodology, this study systematically evaluates the vocational education systems of these nations alongside Taiwan's. Historical and policy analyses further assess the development and effectiveness of these systems. Key findings indicate that successful vocational education systems rely on strong government support, effective industry collaboration, continuous innovation, and rigorous quality assurance. Implementing these strategies in Taiwan could significantly improve its vocational education framework, better preparing its workforce for future economic challenges. The study emphasizes the importance of comprehensive legislation, fostering industry partnerships, integrating digital skills, and establishing quality assurance mechanisms. By adopting these measures, Taiwan can enhance its vocational education system to better meet the evolving demands of the global economy and maintain its competitive edge.

Keywords: Vocational Education, Government Support, Industry Collaboration, Innovation, Quality Assurance

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Introduction

Vocational education is a crucial factor in developing a nation's workforce by providing practical skills and specialized training to meet the demands of modern economies. Particularly in rapidly industrializing regions, vocational education plays a vital role in helping the workforce adapt to the evolving needs of industries. For Taiwan, whose economy heavily relies on technology and innovation, vocational education holds significant potential to drive long-term economic success and sustainable development. However, Taiwan faces challenges in promoting vocational education, fostering industry-academia collaboration, and adopting innovative practices, which hinder its ability to fully realize its potential and respond effectively to the rapidly changing global economy.

The aim of this study is to identify best practices from the vocational education systems of Japan, India, Australia, and the United States that can be applied to Taiwan's vocational education framework. By analyzing the successful strategies of these countries and the shortcomings of Taiwan's current approach, this study provides specific policy recommendations to enhance government support, foster effective industry collaboration, and promote continuous innovation. Ultimately, the goal is to better prepare Taiwan's workforce to meet future economic challenges and maintain competitiveness in the global market.

This study examines key countries in the Indo-Pacific region, including Japan, India, Australia, and the United States, which have successfully leveraged vocational education to cultivate a highly skilled workforce, contributing significantly to their economic growth and global competitiveness. Through comparative analysis, this research explores the policies, historical developments, and innovations within these countries' vocational education systems, extracting key insights and best practices that Taiwan can adopt to overcome its challenges and improve its vocational education framework to better respond to the rapidly changing global economy.

The analysis focuses on three critical areas: government promotion, industry-academia collaboration, and continuous innovation. These elements have been proven effective in other countries and can serve as a blueprint for vocational education reform in Taiwan. By advancing legislative reforms, fostering industry partnerships, integrating digital skills training, and establishing quality standards, Taiwan can strengthen its vocational education system and enhance its competitiveness.

The findings of this study have significant implications for Taiwan's vocational education sector. These strategies can help Taiwan better address future economic challenges while creating more career development opportunities and economic prosperity for its citizens. By adopting the best practices of regional leaders, Taiwan can build a stronger competitive edge in the global economy and ensure sustainable development.

Literature Review

Vocational Education and Economic Growth

Vocational education plays a pivotal role in economic development by equipping individuals with the technical skills required by industries. Numerous studies emphasize how well-established vocational education systems contribute to enhanced workforce productivity and economic resilience (Hanushek et al., 2017). In countries like Japan and Germany, strong

vocational systems are credited with maintaining competitive advantages in the global market. According to Oketch (2007), vocational education bridges the gap between education and employment, directly impacting economic growth by reducing youth unemployment rates and fostering economic inclusivity.

Government Support in Vocational Education

Government support is critical in ensuring that vocational education systems are well-structured and adequately funded. According to Raffe (2011), government investment in vocational education can drive both innovation and inclusion by creating policies that promote access and industry alignment. In Japan, the government has been instrumental in aligning vocational education policies with national development strategies, ensuring that skills development matches labor market needs (Hori, 2018). In Taiwan, research suggests that challenges in promoting vocational education and fragmented policies have hindered the growth of its vocational education system (Cheng, 2020). Strengthening government involvement in Taiwan could significantly elevate the quality and relevance of vocational training programs.

Industry Collaboration and Its Impact

Collaboration between industries and vocational education institutions is fundamental to ensuring that the skills taught in schools are relevant to market needs. Many countries have adopted the dual training model, which integrates classroom learning with practical on-the-job training. Countries like Germany and Australia excel in this area, where partnerships between industries and educational institutions ensure that students gain hands-on experience (Busemeyer & Trampusch, 2012). Taiwan's vocational education system, however, faces challenges in this regard. Studies indicate that the lack of close industry collaboration leads to a mismatch between skills learned in vocational schools and those required in the labor market (Wang, 2019). Greater involvement from industry in curriculum development and practical training could address this gap.

Innovation in Vocational Education

The integration of digital skills and new technologies into vocational education is crucial in today's knowledge-based economy. According to OECD (2020), countries that embed digital literacy into vocational training programs produce graduates who are better equipped to work in emerging industries such as IT, renewable energy, and artificial intelligence. Australia's focus on integrating technology into vocational programs has enabled it to produce a workforce capable of competing in the global digital economy (Knight, 2021). In Taiwan, while traditional industries like manufacturing are well-supported through vocational training, the system has been slow to incorporate digital skills into its curriculum. Studies recommend that Taiwan prioritize digital innovation to remain competitive in the rapidly changing global economy (Lin & Chen, 2021).

Quality Assurance in Vocational Education

Quality assurance mechanisms are essential for ensuring the effectiveness and relevance of vocational education programs. According to UNESCO (2016), effective quality assurance involves the establishment of national qualification frameworks, accreditation systems, and regular program evaluations. These mechanisms help maintain consistent educational

standards and ensure that vocational training aligns with the needs of the labor market. For example, Australia's quality assurance framework, managed by the Australian Skills Quality Authority (ASQA), has been instrumental in maintaining high standards in vocational education and training (ASQA, 2020). Similarly, Germany's dual vocational training system relies heavily on quality assurance measures to align educational outcomes with industry requirements (Busemeyer, 2015). Taiwan currently lacks a comprehensive quality assurance system for vocational education, which undermines the consistency and effectiveness of its training programs. Implementing a robust quality assurance framework could help Taiwan improve the quality and credibility of its vocational education, ultimately making it more attractive to both students and employers.

Lifelong Learning and Vocational Education

Lifelong learning is increasingly recognized as a critical component of vocational education, particularly as industries undergo rapid technological changes. According to Aspin and Chapman (2007), lifelong learning ensures that workers can continually update their skills to remain relevant in an evolving job market. Finland, for instance, has successfully integrated lifelong learning into its vocational education system, offering adults multiple opportunities to reskill or upskill in response to changes in the labor market (Stenström & Virolainen, 2014). Taiwan's vocational education system has yet to fully embrace lifelong learning as a central tenet, which limits opportunities for adult learners to participate in vocational training. Promoting lifelong learning through vocational education programs could enhance workforce adaptability and resilience, enabling Taiwan to maintain its competitive edge in a rapidly changing global economy.

Methodology

Research Design

This study adopts a comparative analysis approach by examining the vocational education frameworks of Japan, India, Australia, and the United States, to identify best practices that can be applied to enhance Taiwan's vocational education system. The research combines historical analysis and policy analysis, systematically evaluating these countries' vocational education systems in comparison with Taiwan.

Data Collection

Data sources include:

- Government Reports and Public Data: Policy documents and annual reports from relevant government bodies, such as Japan's Ministry of Education, India's Ministry of Skill Development and Entrepreneurship, Australia's Department of Employment and Skills, and the United States Department of Labor.
- International Organization Reports: Reports from organizations like the Organization for Economic Cooperation and Development (OECD), World Bank, and Asian Development Bank (ADB) that provide assessments of vocational education systems.
- Academic Journals and Papers: Analysis of studies on the impact of vocational education on economic growth and specific strategies used in each country. Key journals include the Journal of Vocational Education and Training.
- Official Educational Statistics: Statistical data from official websites of Taiwan's Ministry of Education and Australia's National Skills Commission.

These data sources provide in-depth insights into the vocational education systems of these countries, including policy background, government investment, industry collaboration, and innovation integration.

Comparative Framework

To conduct effective comparisons, this study developed three core areas of analysis: government promotion, industry collaboration, and continuous innovation. These elements have proven to be essential in successful vocational education systems elsewhere and can serve as a blueprint for vocational education reform in Taiwan.

Table 1: Comparative Framework

Country	Government Promotion	Industry Collaboration	Innovation Integration
Japan	Strong government support aligned with industry needs	Strong emphasis on industry-academia collaboration	Integration of digital skills in curricula
India	National skill policies to expand vocational education	Key role of private companies in vocational training	Introduction of innovative learning technologies
Australia	Government incentives and support policies	Deep industry collaboration with dual training implementation	Digitalization and technology-driven curriculum
United States	Vocational policies aligned with economic needs	Local industry participation in curriculum and training	High digital integration and future skills emphasis
Taiwan	Insufficient support and fragmented policies	Lack of close collaboration with industries	Slow adoption of digital skills and innovation

The comparative framework helps in analyzing Taiwan's gaps in government support, industry collaboration, and innovation integration, providing directions for reforms.

Data Analysis

The primary analyses used in this study are descriptive statistics and comparative analysis. Descriptive statistics are used to present the baseline situation of key variables in the vocational education systems of different countries, such as government investment in vocational education, levels of industry collaboration, and the extent of innovation integration. Comparative analysis was used to assess the differences between these variables and to derive implications for Taiwan.

Key Variables

Government Promotion: Policies and investments made by governments in vocational education. Industry Collaboration: The cooperation model between vocational schools and industries, including internships and curriculum development. Innovation Integration: The extent of technological innovations in vocational curricula. The analysis results reveal that Taiwan falls short in all three areas, highlighting the need for further policy intervention.

Additional Information on Regulations

Table 2: Information on Regulations

Indicator	Japan	India	Australia	United States	Taiwan
Regulation Name	Vocational Training Law	National Skill Development Law	Vocational Education and Training Law	Carl D. Perkins Vocational and Technical Education Act	Technical and Vocational Education Act
Regulation Years	1958 - 2021	2009 - 2020	1992 - 2020	1984 - 2018	1995 - 2022
Key Content and Features	Government support for training, industry collaboration, skill certification	Skill development agency, public-private cooperation	National quality assurance framework, industry participation	Federal funding, curriculum innovation	Diversification, alignment with industry needs
Historical Context	Introduced skill certification in 1980s, emphasized digital skills in 2021	Reinforced under "Skill India" in 2015, introduced digital training in 2020	Strengthened digital skills in 2020	Introduced accountability mechanisms in 1998, emphasized digital skills in 2018	Promoted lifelong learning in 2000s, introduced digital skills in 2015
Challenges Faced	Aging society, lack of youth interest	Workforce lacking training, resource inequality	Status disparity with higher education	Insufficient funding, low recognition	Lack of attractiveness, policy discontinuity
Implications for Taiwan	Enhance attractiveness, strategies for different age groups	Comprehensive skill system, equitable resources	Elevate status, flexible responses	Increase funding, social recognition	Increase industry participation, strengthen continuity

Data Sources Summary

This study uses data from various countries to analyze vocational education systems, including government reports from Japan, India, Australia, and the U.S., as well as international sources like the OECD and World Bank. It also references the Journal of Vocational Education and Training and official statistics from Taiwan and Australia to provide recommendations for improving Taiwan's vocational education.

Results and Discussion

Results

The results of this comparative study indicate that Taiwan's vocational education system lags behind those of Japan, India, Australia, and the United States in several key areas: government support, industry collaboration, and innovation integration. The descriptive statistics highlight Taiwan's shortcomings in government investment, industry collaboration participation, and innovation integration. Specifically, Taiwan's government investment in vocational education is significantly lower compared to other countries, limiting its capacity to expand and innovate vocational training programs.

The results also show that Taiwan's industry collaboration rate is suboptimal, which hinders the effective alignment of vocational education with industry needs. This lack of collaboration leads to a skills mismatch, where graduates of vocational education programs may not possess the competencies needed by employers. Moreover, the innovation integration level in Taiwan remains low, indicating that digital and emerging technologies are not sufficiently incorporated into vocational curricula, which reduces the competitiveness of graduates in the modern workforce.

Discussion

The findings underscore the importance of comprehensive government support, effective industry collaboration, and continuous innovation as essential components of a successful vocational education system. Countries like Japan and Australia have demonstrated the positive impact of strong government policies that align vocational training with industry needs, highlighting the need for Taiwan to develop similar frameworks.

Government Support: Strong government involvement, as seen in Japan and Australia, ensures that vocational education is well-funded and aligned with national economic needs. According to research by Smith and Brown (2020), government policies that align funding with economic needs have been instrumental in improving vocational training outcomes in these countries. Taiwan needs to increase its financial commitment to vocational education and develop cohesive policies to overcome fragmented support. This increased investment would facilitate the development of specialized training programs tailored to evolving industry needs.

Industry Collaboration: The successful models of industry collaboration in Australia and Germany emphasize the importance of creating partnerships between vocational institutions and industries. According to Johnson (2019), industry partnerships in Germany have significantly reduced the skills mismatch and improved graduate employability. Taiwan should establish stronger incentives for industries to participate in curriculum development and offer on-the-job training opportunities. These partnerships are crucial for closing the skills gap and ensuring that vocational education meets labor market demands.

Innovation Integration: Innovation, particularly in the form of digital skills integration, is critical for modern vocational education. Australia's focus on integrating technology into vocational curricula has enabled the development of a highly competitive workforce (Davis, 2021). Taiwan must prioritize digital literacy and integrate emerging technologies into

vocational training to prepare students for the rapidly evolving job market. This includes incorporating courses on artificial intelligence, renewable energy, and other growth sectors.

The analysis also points out the need to address the challenges Taiwan faces, such as policy discontinuity and the lack of attractiveness of vocational education. Research by Lee (2022) suggests that continuous policy frameworks are essential for maintaining stable support for vocational education. By establishing continuous policy frameworks, Taiwan can ensure sustained support for vocational education and increase its appeal to prospective students. Additionally, the need to elevate the social status of vocational education in Taiwan is evident, as this would help improve enrollment and enhance the overall quality of vocational training.

Conclusion and Policy Recommendations

Taiwan's vocational education system requires substantial reforms to enhance its effectiveness and align with international best practices. To achieve this, the government should increase investment in vocational education, strengthen partnerships with industries, and integrate digital skills into the curriculum. Specific recommendations are as follows:

Firstly, the government should significantly increase funding for vocational education to ensure that schools and training institutions have sufficient resources to improve teaching facilities, acquire advanced equipment, and hire instructors with practical experience. At the same time, the government should provide incentives to attract more outstanding teachers to the vocational education field, thereby improving the quality of instruction.

Secondly, a closer collaboration mechanism between academia and industry should be established to strengthen the connection between schools and industries. Specifically, the government can encourage companies to jointly design curricula with schools and provide internship opportunities to ensure that students gain real work experience during their studies. Companies should also participate in teaching evaluations to ensure that the curriculum content aligns with market needs, thereby enhancing students' employability.

In addition, the government should promote the comprehensive integration of digital skills, enabling students to acquire the abilities needed to adapt to the future digital economy. This includes adding programming, data analysis, and artificial intelligence to the curriculum and providing relevant teacher training to ensure that educators can effectively teach these skills. The government should also collaborate with technology companies to offer students opportunities to access the latest technologies, bridging the gap between learning and practical application.

Finally, Taiwan can learn from the successful experiences of countries such as Japan, India, Australia, and the United States to formulate policies that meet local needs. For example, Taiwan could introduce Australia's vocational qualification framework to provide students with diverse learning and certification pathways, allowing them to flexibly choose suitable learning directions at different stages. Through these measures, Taiwan can establish a more resilient vocational education system that meets market demands, improves satisfaction for both students and employers, and ultimately drives sustainable economic development.

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Contact email: jjjean168@gmail.com

Professional Identity Development of Multi-role Teachers in Technical High Schools

Chia-Hao Liu, National Taipei University of Technology, Taiwan
Hsiao-Fen Liu, National Taipei University of Technology, Taiwan

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Abstract
The professional identity is the core of professional practice, and the formation, maintenance and change of professional identity are a lifelong learning process. For teachers with multiple identities in a technical high school, the construction of professional identity in multiple roles is an important issue that needs to be clarified in the professional development selection process, whether it is to prioritize the general teaching role, optimize administrative capabilities, or develop coaching skills. This article finds that for teachers with multiple mixed roles, the concept of professional identity is sometimes vague and overlapped. Based on phenomenology, this article uses the body as a research tool to clarify the perception of professional identity in seven perceptual propositions under the state of vagueness and adjustment of professional identity. After repeated reviews of texts, self-extraction and reflection, this article preliminarily classifies the concept of professional identity and development for teachers with multiple identities in four dimensions: 1. Professional identity should start from within, 2. The lack of identity makes it difficult for teachers to develop professionally, 3. Teachers with multiple professions need guidance in the process of identity recognition, and 4. Emphasizing the career development and professional growth of teachers with multiple role identities. Through the clarification of these four dimensions, this article provides a reference for teachers with multiple identities to adapt and adjust themselves internally and externally in the process of changes and entanglements.

Keywords: Professional Identity, Social Identity, Phenomenology

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Introduction

The new era and modern educational landscape have given rise to a new ecology of educational personnel. In alignment with the context of social changes and career expectations of education professionals, teachers' professional identity has evolved under new policies promoting interdisciplinary competency development.

In technical high schools, there are two primary sources of professional teachers. The first comprises those who obtain qualified teacher certificates through national examinations and are subsequently selected through teacher recruitment processes to serve as formal teachers. The second consists of teachers who receive national-level professional skill certifications through national skill assessments (or competitions). Objectively, the latter group serves both as teachers and professional technicians, creating a subjective identity formation where professional technical personnel engage in student guidance and classroom management within schools. While this may not necessarily lead to conflicts in duty execution, teachers with dual professional backgrounds may develop "multiple" (or hybrid) complex identities. For teachers with such dual professional backgrounds, the process of developing and exploring self-identity and professional identity, without adequate guidance or equivalent understanding, often results in contradictory and ambiguous feelings toward their professional or technical professional identity. When a teacher's professional identity exists in such an ambiguous state, struggling to confirm their sense of identity, it inevitably affects their attitude and willingness toward professional advancement and development in their teaching career.

Furthermore, many professional subject teachers must not only fulfill their duty of transmitting professional knowledge but also implement student guidance and classroom management as educational work, while engaging in school administrative affairs. Additionally, due to their professional technical certification and background, they often bear the mission of coaching students for relevant competitions according to the school's development blueprint, thereby assuming another role with a professional image.

Under such multi-tasking conditions, for teachers in technical high schools, determining their professional development path—whether to prioritize general teaching identity, optimize administrative capabilities, or develop as a professional technical "coach"—becomes a significant issue in constructing professional identity amid multiple roles. However, as teachers committed to lifelong learning, their professional identity development process must face the dynamics and entanglements within external social identity structures while simultaneously enduring the impact, conflicts, and adaptation processes from internal professional recognition. Therefore, how teachers find their professional identity amid multiple overlapping roles remains a topic worthy of investigation.

Literature Review

The implications of teacher professionalism have been explored for years in both regulatory and academic research domains. The topic of teacher professional identity has also been extensively studied. In Wei, Song, and Zhang’s (2013) research, they posit that the subject of "teacher occupational identity" is the individual teacher, while the objects of "teacher occupational identity" include both the "teaching profession" and the "professional role" internalized by individual teachers. They identify four dimensions of teacher professional identity: occupational values, role values, occupational belonging, and occupational behavior.

Their research indicates that both the individual teacher's understanding of their role's meaning and their personal awareness of the collective consciousness of the teaching profession as external constraints of occupational responsibility demonstrate that teacher professional identity encompasses not only teachers' self-identity consciousness of their occupation but also the scope of professional identity as constrained, defined, and regulated by external factors.

Xing and colleagues (2019) studied teacher professional identity through multiple perspectives, including professional identity stage theory, external expectation factors, and internal expectation factors. Their research suggests that teacher professional identity involves complex interactions between many internal and external factors and is a dynamic process that changes over time.

1. External Professional Identity of Teachers

Wang Yuwen (2017) points out that postmodern teacher professional identity involves creating a personal style, where teachers must be sensitive to external self-regulatory discourse while seeking their self-defined professional teacher image. This indicates that teachers' professional identity forms through continuous interaction, negotiation, and communication with external social contexts, pursuing and shaping a self-identified professional pattern. Xing Zhibin and colleagues (2021), in their study of guidance teachers with professional psychological counseling certificates, found that school guidance teachers receive more workplace recognition than counseling psychologists primarily due to practical factors, including salary structure, working conditions, and social evaluation. This context influences dual-professional individuals' choice of school guidance teaching as a career. Yan Guoliang (2003) suggests that teacher professionalism in school duties is recognized through completing action research, teaching portfolios, self-compiled materials, certification workshops, IT integration in teaching, teaching demonstrations, and professional development evaluations set by educational administrative agencies. In summary, during teacher professional identity formation, many key factors affecting teachers' professional self-identity come from external social expectations, views, norms, and evaluations.

2. Teachers' Self Professional Identity

Teachers' professional self-identity closely connects with their personal perceptions and expressions. According to B. Bernstein, teacher professional identity reflects external circumstances (translated by Wang Ruixian, 2005), maintaining this identity shows the function of externally-driven projective discursive organization/practice, meaning professional identity links teachers' feelings with the external environment, expressed through discourse. Guo Yingjie (2008), studying junior high school guidance teachers' professional role identity, found their challenges mainly stem from struggles between "self-awareness" and "others' expectations," doubts about "professional definition," and tension between "ideals" and "performance." Thus, teachers' internal and external adjustments or compromises during professional development are necessary perceptual integration processes in self-identity stages.

Past emphasis on teacher professional description and normative meaning has shifted to professional self-identity in teachers' professional life development. Teachers are no longer viewed as a collective but as unique individuals with life experiences, educational concepts, and value systems. Scholars now emphasize teachers' "voices" and lives, highlighting how

personal values, life experiences, and knowledge systems influence both the journey toward professional identity and its continuous shaping. Teachers' varying educational backgrounds and personal experiences lead to different levels of professional identity awareness in their teaching careers (Zhou, 2004).

Identity is a transformation process. When teachers consider their identity, self-awareness of experiences, occupation, and life values influences their perspectives, strategies, and actions. Teachers' self-identity forms the basis for giving meaning and making decisions in their profession (Korthagen, 2001). Teachers must identify with themselves to move toward professionalism, and identifying with their profession enables opportunities for deep cultivation and development.

3. Professional Identity in Multiple Roles

Teachers' mission includes teaching their subject, transmitting knowledge, and guiding students. Recent educational policy changes have increased the number of teachers with dual or multiple professional identities. For dual-professional teachers, single-profession teaching regulations can create identity conflicts and impacts. External factors further influence teachers' professional identity choices, conflicts, adjustments, or avoidance issues, emerging during professional development promotion.

Domestic research on multiple professional identities in schools is limited. Only Guo Yingjie's (2008) study on "Junior High School Guidance Teachers' Professional Role Identity Challenges and Responses" and Zheng Chunqi's (2016) research on "Professional Identity Experiences of High School Guidance Teachers with Counseling Psychologist Certificates" address professional identity states and challenges for guidance teachers with professional psychological counseling qualifications at different school levels. The researcher believes different school types and professional work experiences create different perceptions through personal experiences and social expectations. When teachers possess multiple professional identities in educational settings, their professional identity impacts become more complex.

Teachers with multiple identities in educational settings live in external and internal conflicting circumstances as cross-domain hybrid roles. While appearing simply as school teachers, they carry multiple identity backgrounds, constantly choosing, struggling, and compromising in daily work life. In pursuing teacher professional identity, their persistent perceptions and insights merit further exploration.

Research Methods

This research topic emerged from the researcher's personal experiences of confusion, challenges, and insights regarding professional identity. According to Zhou Shuqing's (2003) research, the shaping of teacher professional identity can be facilitated through narrative processes, helping individuals understand the relationship between self and society, providing a means for critical reflection and reconstruction. Phenomenologist Husserl believed that intentional activities have a constitutive effect on objects, as objects do not exist independently but are constructed through self-consciousness via intentional activities. Therefore, the existence of objects is intentionality itself, representing the conscious relationship between subject and object (Li, 2007).

Consequently, this study will utilize the researcher's perceptual narrative process within a phenomenological framework to examine the bodily perceptual intentions of teacher professional identity amid multiple roles. It will explore the state, needs, and challenges of professional identity for teachers with multiple roles. Additionally, two technical high school teachers who also possess professional skills and administrative duties (detailed information about the researcher and interviewees is presented in Table 1) were invited to participate. Semi-structured interviews were conducted to collect textual data and perform perceptual comparisons. This approach aims to clarify the author's intersecting and mixed consciousness states under multiple identities, as well as the internal professional identity recognition, external development challenges, contexts, and opportunities faced by teachers with multiple roles.

Table 1: Basic Information of Research Participants

CATEGORY	RESEARCHER	INTERVIEWEE 1	INTERVIEWEE 2
CURRENT POSITION	Taipei Municipal Public Technical High School	Taipei Municipal Public Technical High School	Taipei Municipal Public Technical High School
PROFESSIONAL CERTIFICATIONS	1. Construction Supervisory Teacher Certificate 2. National Table Tennis Teacher Certificate	1. Information, Electronics, Control, Life Skills & Resources Technology Teacher Certificate 2. Computer Assembly and Maintenance Level C Technician	1. Refrigeration and Air Conditioning Teacher Certificate 2. Refrigeration and Air Conditioning Maintenance Level C Technician
TEACHING EXPERIENCE (YEARS)	17	15	4
PROFESSIONAL EXPERIENCE (YEARS)	3	1	5
COACHING SPECIALTY	Competition Table Tennis	Information Network Technology, Competition Operation	Refrigeration and Air Conditioning Equipment
COACHING EXPERIENCE (YEARS)	5	12	1
ADMINISTRATIVE EXPERIENCE	Director, Secretary, Section Chief	System Administrator, Director, Secretary, Section Chief	Director
ADMINISTRATIVE EXPERIENCE (YEARS)	15	6	3
CURRENT SCHOOL ROLE	Teacher, Athletic Training Teacher (Coach), Administrative Position	Teacher, Athletic Training Teacher (Coach), Administrative Position	Teacher, Athletic Training Teacher (Coach), Administrative Position

Research Findings and Discussion

Teaching is a profession characterized by close human connections. A teacher's professional identity state continuously manifests dynamically—whether positively, neutrally, or negatively—through the interweaving of external factors and personal experiences. This internal-external adjustment process progresses from external to internal and back to external, encompassing cognition, behavior, and expression.

Based on the researcher's awareness of professional identity ambiguity, which emerges from the conscious relationship between self and situation, this consciousness is not simply caused by a sense of self-loss or unclear professional identity perception. Therefore, through reflection, detachment, and textual review, using a phenomenological perspective on the essence of ambiguous identity brought by multiple roles, the researcher proposes seven perceptual propositions to clarify the perceptual consciousness under ambiguous and adjustment states.

1. Sense of Life

Life occurs only once, with no chance for repetition. While we are powerless against time's passage and cannot change the present in our teaching career, we can anticipate the professional future. Sometimes, knowing too much about the future isn't beneficial, as the waiting mindset can consume one's passion for present matters.

> Compared to the enjoyment of practical courses, the repetitive teaching mode of theoretical courses can feel monotonous. Such formalized life creates a sense of emptiness, while relatively challenging administrative roles provide a feeling of fulfillment and growth. (Interviewee 1)

In a limited lifetime, regular teachers performing the same tasks for 30 years, without competition or self-growth, might be interpreted as specialized dedication. However, this unchanging pattern creates dissatisfaction with life, feeling that limited youth will be consumed in "waiting" like a candle in the wind.

2. Physical Sense

A healthy body is essential for a good life, particularly for professional teachers who lead by example. Previous professional technical work modes made acute bodily awareness a natural ability, considering many subtle physical perceptions as "natural." In the workplace, appropriate environmental transitions sometimes provide distance, allowing space to perceive our primary professional state. However, unexpectedly, prolonged separation can gradually diminish the body's original energy and superior functions.

> As a professional technician, prolonged equipment contact and practical operation led to more acute physical responses. As a general teacher in school, while professional technical judgment skills may gradually decline over time, teaching experience increases and can become living teaching material, showing students that skills require practice for improvement. Though not meeting industry professional standards might slightly shake professional identity, basic teaching doesn't affect teaching confidence. (Interviewee 2)

3. Sense of Space

Pressure fosters growth and propels forward movement. While excessive pressure requires release to find personal living space, insufficient pressure makes personal space feel too empty and life hollow, lacking the driving force for professional development.

> Despite facing multifaceted pressure and challenges in multiple roles, this state, though stressful with stronger life tension, can stimulate more motivation under pressure. Compared to regular teachers' more uniform lifestyle, multiple roles enable more personal growth. (Interviewee 1)

4. Sense of Existence

Teaching's vocation is to achieve success for every student. Regardless of how illustrious one's pre-teaching experiences were, with the role transition, the feeling of being noticed and expected gradually diminishes. When external applause disappears and self-achievement becomes insufficient to support self-identity, one begins to question their existential purpose.

> The source of personal existence stems from whether one's confidence in professional abilities is sufficient. The stronger my professional capabilities, the more I'll be needed by students or the school, and the stronger my sense of existence becomes. Having dual professional identities as both technician and teacher enables me to excel in both theoretical and practical courses, making me less replaceable and more distinctly present. (Interviewee 2)

5. Sense of Time

Time in the objective material environment is measured by clocks, seconds, and physical changes. However, when time exists within subjective consciousness, it becomes emotion, awareness, perception—a sum of multiple sensations. During the busy state of multiple roles, a day's objective time isn't merely displayed in numbers, but in the accumulation of various tasks and events. Teachers exist in a blurred temporal experience, while full-time teachers' lives, with fewer uncertain administrative duties, have clear time markers and planning for each class. Time passes gradually between classes, increasing the sense of subjective time passing, yet leaving little trace in life. Time's passage isn't frightening; what's frightening is losing oneself in passing time.

6. Sense of Interaction

> Administrative work involves frequent but superficial interactions with stronger defensive mechanisms. As a training teacher or full-time teacher, being the core duty of teaching, interactions with students and parents are closer. Through these interactions, one can better understand students' backgrounds and conditions, becoming more helpful in guiding and assisting students. However, interactions among colleagues lack external environmental factors to promote closer relationships. (Interviewee 2)

7. Sense of Center

Single-role teaching duties are clear with simple responsibilities, making it easy to distribute work and life focus. However, under intersecting multiple roles, more detailed planning is needed for time management, task prioritization, and energy investment control. Overly complex duties create an "heavy" sense of life center, while simple duties of full-time teachers may create a "weightless" feeling of having no burdens. Finding balance between "light" and "heavy" in life's center becomes crucial for healthy and passionate professional development.

Regarding these seven propositions of professional identity's ambiguous perception, through detachment from events themselves and external perspective examination, reflection, self-detachment, and interviewee text comparison confirm that the sense of professional identity ambiguity indeed influences multiple-role teachers' professional identity state through these seven propositions' different aspects within external environmental frameworks and internal self-perception intersections. These seven propositions interact without absolute or single directionality (such as center sense affecting existence sense, or time sense affecting space sense), but rather interconnect and influence each other reciprocally. For instance, sense of center links with sense of existence, which in turn intersects with sense of center, thus creating the researcher's initial perception of ambiguous, confused, and disordered professional identity.

Conclusion

After self-detachment, reflection, and review of interviewees' texts, this research preliminarily categorizes the concepts of professional identity and development for teachers with multiple roles as follows:

1. **Professional Identity Should Develop From Inside Out**
   Throughout the process of identity formation, teachers continuously respond to a single question through countless events in their teaching life: "Am I a professional teacher?" While self-questioning, one's consciousness becomes involved in pursuing the teacher identity. For teachers with dual roles as both teacher and coach, besides asking "Am I a professional teacher?", they must also ask "Am I a professional coach?" Through this self-seeking process of constant stimulation and tension, they gradually clarify that while having a single identity (teacher), they possess dual professional characteristics (teaching/training). Through pursuing professional self-identity, they realize that professional development must first involve continuous introspection, analyzing role tasks, understanding self-capabilities, and familiarizing with environmental expectations to identify with their profession. Only then can their perceived sense of life, physical sense, and sense of space have clearer directionality.
2. **Professional Development is Difficult Without Identity Recognition**
   Li Xinrong (2022) believes that teacher identity formation should enable self-agency and aim for self-realization, though the implementation process isn't always smoothly progressive. Based on both interviewees' experiences, the inadequate development of professional skills in their early career affected their self-realization process, creating ambiguity in professional identity. This hindered development in both general teaching and athlete training capabilities, demonstrating that professional development is unlikely without sufficient self-professional identity. In such ambiguous states, external support through policies or peer support might have helped

clarify confused perceptions of existence, time, and center through interaction and exchange.

3. **Teachers With Dual Professions Need Guidance in Identity Formation Process**
   Teacher professional identity is a dynamic, continuous reflective process. In teachers' career cycles, their development level results from the combined effects of personal characteristics, school environment, support systems, and solid training processes (Steffy, 2001). Therefore, for teachers with technician (coach) and teacher dual professional identities, like our interviewees, besides clarifying professional identity through reflection, school development, peer support, external professional training, or guidance from experienced individuals can serve as lifelines for teachers caught in professional identity ambiguity, reducing perceptual emptiness and uncertainty from lack of interaction, helping them find their uniqueness and subsequently develop deep roots.
4. **Emphasizing Career Development and Professional Growth for Teachers With Multiple Roles**
   Single-identity teacher roles experience perceptual voids and imbalances in life sense, time sense, and center sense, leading to ambiguous and disordered professional identity states. However, teachers with multiple role careers can develop broader and more diverse thinking dimensions in understanding educational professionalism, professional skill inheritance mission, and policy implementation. This enriches their growth energy in life sense, center sense, or existence sense along professional development paths. From a school management perspective, considering teachers' perceptions of time and space in experiencing professional identity, when planning and arranging duties, maintaining balance in teachers' "multiple roles" clarifies satisfaction with different role self-identities and achieves teachers' agency in developing multiple roles. This creates opportunities for teachers to experience diverse roles, contributing to the deepening and development of their professional careers.

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Contact email: t110499003@ntut.org.tw

Exploring the Effects of Gender, Technology, and Economic Status Towards Indonesian Students' Science Performance in PISA 2022

Wawan Kurniawan, The University of Adelaide, Australia

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Abstract
Science is one of the vital subjects that assists students to develop their high order thinking skills. Correlatively, Programme for International Student Assessment (PISA) is one of impactful international studies that is also assess and evaluate students' science performance through tests and surveys that may affect their performance in science. However, studies that explore how gender, technology, and economic status is rarely found in Indonesian and global contexts. Therefore, this study aims to examine the effects of gender, information and communication technologies (ICT) resources, and index of economic, social and cultural status (ESCS) towards Indonesian students' science performance based on PISA 2022 data. This quantitative study used the whole sample (N=13,439) of 15-year-old Indonesian students who participated in the tests and surveys. Through the conduction of structural equation modelling (SEM) using AMOS software 29 version, this study found that student gender insignificantly influences science performance (β=-0.05) and also has minor correlation towards ICT resources and ESCS (β=0.02). Meanwhile, ICT resources had direct moderate effect (β=0.29) on science performance which is supported by ESCS as it is highly correlated to the availability of ICT resources (β=0.99). Although this research provides a substantial impact on the body literatures, this research is limited only based on PISA data which there could be other relationships among variables included in the study. Further investigation is recommended to include other variables to clarify whether there are different effects on science performance, particularly with diverse background of students in Indonesia.

Keywords: Science, Gender, ICT, ESCS, Indonesia, PISA

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Introduction

The international standard of quality education can be measured from many aspects, and one of the largest programs named Programme for International Student Assessment (PISA) test, which is held by Organization for Economic Co-operation and Development (OECD) has measured education quality in many countries in the last two decades. The PISA test measured three main subjects, namely science, mathematics, and reading performance. In this case, science achievement becomes one of the intriguing topics among academic researchers, and there are many factors that can be examined. According to PISA 2018 results (OECD, 2019), Indonesian students' performance in science in 2018 were at low level. After pandemic corona virus disease (COVID-19) occurred, Indonesian students' science performance in PISA 2022 is lower compared to previous test in 2018 (OECD, 2023b). The situation that happened in 2020 to 2022 changed the way in which schools were conducted lesson from face-to-face to online. This situation forced students to use digital devices, such as computer, laptop, and smartphone during learning processes which can be considered as Information and Communication Technologies (ICT). The availability of ICT resources enables students to access learning material without depending on school activities, allowing them to enhance their knowledge independently.

Numerous studies have been conducted that examine factors influencing science achievement such as teaching approaches, learning media, and socioeconomic status. For example, a study by Gómez and Suárez (2020) mentioned that socioeconomic is one of the strong predictors that influence science achievement in PISA 2015. There are many potential factors that may influence student's science performance in Indonesia based on PISA 2022. In this case, it is possible that ICT resources, students' gender, and socioeconomic status are associated to one another and might become the significant factors among other variables that collected in PISA test. Besides, remote learning or online learning that conducted during the pandemic might also influence on PISA test 2022. Therefore, this study aims to explore the influence of student gender, the availability of ICT resources, and economic status regarding science performance based on PISA 2022 dataset in Indonesia. This report will contribute to the literature as the evidence from Indonesia to support the development of knowledge as there are only few studies that examine factors influence science performance in Indonesia. The findings may also contribute to the development of quality education in Indonesia and other developing countires regarding the implementation of technology in learning activities. Moreover, this report may also influence other educational researchers to explore further that related to science.

Research Question

The grand question of this study is "How is the influence of gender, ICT resources, and Index of economic, social, and cultural status towards Indonesian students' science performance in PISA 2022?"

Review of Related Literatures

There is literature that related to the scope of this study which is limited to gender, ICT, and economic status towards science performance. However, there are limited literature that focuses on Indonesia based on reputable resources. Therefore, the supporting evidence in this study is combined from various countries. Student gender can sometimes become the factor that differentiate students' academic performance at school. A study by Reilly and colleagues

(2019) which compared academic performance in science based on Trends in Mathematics and Science Study (TIMSS) found that female students achieved better than male in mathematics and science. Also, a study by Stoet and Geary (2018) on science literacy which is based on PISA data 2015 found that female students achieve higher score than male students. The previous studies are contrast with study by Jia and colleagues (2020) in China found that although female students have more interest in science, male students somehow achieve better in some section such as multiple-choice section. Likewise, Smith and colleagues (2014) claimed that male students have more confidence in science than female, meaning that male students may have more interest in science which leads to better performance. From the literature found, student gender is not always influence academic performance in science because both male and female have equal opportunity in learning.

Moving to ICT resources, this factor has massive effect in our daily activities as well as for education purposes (Al-Rahmi et al., 2020). Both female and male students may have different interest in the use of technology in their learning processes. An investigation by Dúo-Terrón and colleagues (2022) in Spain, which involved primary school students reported that male students presented higher score in using ICT than girls. It is also happened in Bangladesh, as Rashid (2016) found that female has more hurdles to use ICT although compared to male students. The use of ICT in learning may directly affect students' academic performance in various subjects. For instance, a research by Bai and colleagues (2021) revealed that ICT improves English performance which is align with Rohatgi and colleagues (2016) who claimed that ICT positively correlated to computer science performance. Similarly, some studies by Xiao and Sun (2022), and Palomares-Ruiz and colleagues (2020) also found that ICT resources are positively affects students' academic performance, meaning that the availability of ICT at school and home assists students to obtain better visualization on science resources and supports their interactive learning activities. In detail, Palomares-Ruiz and colleagues (2020) claimed that the implementation of ICT in science class increases student's motivation to learn science, and they mentioned that female student scored higher that male students. Ultimately, it is true that ICT supports students to achieve better in their academic environment and both male and female students have the equal opportunities to enhance their knowledge through ICT. Besides, there are various ICT resources either hardware or software that can be used by teachers and students in teaching and learning activities. For example, study by Zainuddin (2018) in Indonesia reported that online interactive quiz increase students' motivation in learning. However, the literature found are mostly from other countries as there is limited resources from Indonesia. Besides, pandemic that happened across the world in the last few years indirectly forced students to have ICT resources to support their learning and they were required to be able to learn independently.

OECD also has categorized the ICT resources items that are commonly used by school communities for their learning activities both at school and home. Those devices include portable computers such as notebook and laptop, tablets, smartphones with all operating system, e-book readers. In addition, supporting facilities also required to accommodate ICT resources such as a room of your own, internet access, and television (OECD, 2023c). In this case, decent ICT resources at home is provided by their parents. Moreover, there must be integration among devices in order to work properly. For example, integrated computer consists computer, software, and internet connection in order to be used by students. The availability of ICT resources is highly correlated to family support. In this context, PISA also measured index of economic, social, and cultural status (ESCS) which is the combination of parents' occupation, parents' education, and home possession.

According to PISA 2022 dataset, there is no data of parents' professions. In this case, parents' educational background and home possession can be the indicator of financial support for students which is associated to ICT resources support at home and students' academic performance. A study by Roksa and Kinsley (2019) stated that financial support from students' family has indirect impacts on their academic attainment, which is supported by Claro and colleagues (2015) based on Chile PISA dataset, who claimed that parents' education is highly correlated to better academic performance. It is because socioeconomic status may support students with electronic devices and digital skills, allowing students to explore more information related to school activities independently. Likewise, a study conducted by Lagravinese and colleagues (2020) that explored data in PISA 2009 and 2012, also mentioned that socioeconomic is correlated to students' academic performance. Similarly, Gómez and Suárez (2020) who explored factors influence science achievement in PISA 2015, claimed that socioeconomic characteristic is strong factor that affect science performance. In addition, socioeconomic may also correlated to ICT resources at home as parents should provide budget to have technology devices at home. Hence, the different of socioeconomic status may lead to different results in science performance.

Based on the studies that found related to gender, ICT resources, and ESCS towards science performance, hypothesized path model has been formulated which is shown in Figure 1 below.

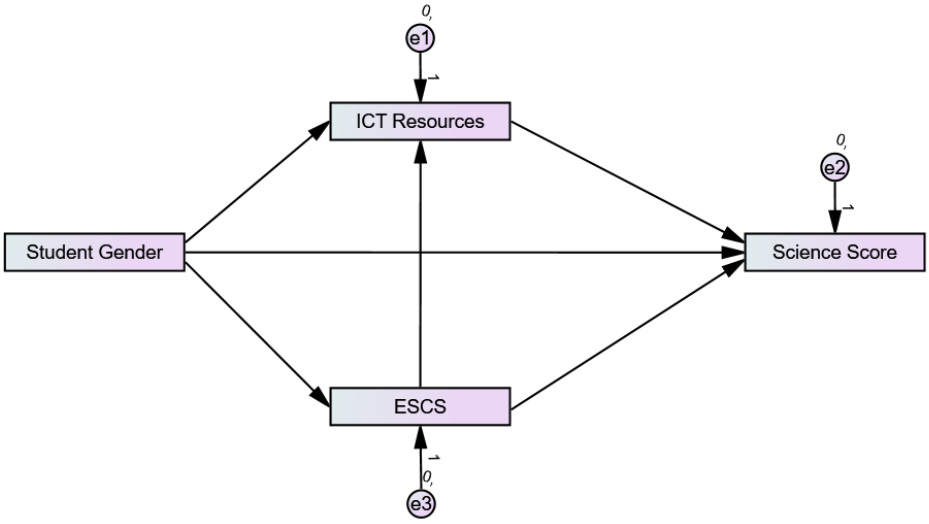

Figure 1: Hypothesized Path Model

Methodology

This quantitative research report is based on Program for International Student Assessment (PISA) data reported in 2022 which was held by OECD. Therefore, the selected data of ICT questionnaires in PISA data 2022 is based on OECD framework (OECD, 2023a). According to OECD, surveys and tests were conducted by employing questionnaires and using two methods namely paper-based and computer-based (OECD, 2023c). There are many developing countries that participated in the study and Indonesia data were chosen in this study. Indonesia participated in PISA test 2022 which 13,439 students from 410 schools were completed the test and surveys. The number of participants in this period is higher compared to PISA 2018 which is at 12,098.

Data for this report focuses on student gender, ICT resources, index of economic, social, and cultural status (ESCS) or Economic Status and science score in Indonesia PISA 2022 dataset. According to OECD (2024), there are some changes in the survey. ICT resources in 2018 has 21 items while in PISA 2022 only 12 items. Therefore, ICT resources items were trimmed from 12 items to nine items because only nine items that similar to previous period in 2018. Besides, data for ICT resources in Indonesia were focused on the availability at home which can be seen from the survey. Moreover, items from ICT resources that are not included were moved to ESCS items because the items of ICT resources also from ESCS in PISA survey. It can be seen from PISA technical report where ESCS consist of three main components namely parent profession, parent education, and home possession. In this case, ICT resources items were included in home possession. Furthermore, ESCS component only include parent education and home possession because parent profession items were not found in the Indonesia PISA 2022 dataset. In addition, value for each item have been checked and there are some items that its value required to be recoded. For instance, the value for ICT resources in ST250Q01JA has value number 1= Yes and 2= No, which recoded to 1=1 and 2=0 so that all factor loadings that generated by the software will become positive, in other words, all items will have the same direction of scale. Detail for the variables name, code, and recoded values that used in this report can be seen in Appendix A.

Data from PISA 2022 were analyzed by using SPSS (Statistical Package for the Social Sciences) version 29 to describe the data and explore the component of questionnaire. Moreover, AMOS (Analysis of Moment Structure) software version 29 was employed to conduct confirmatory factor analysis (CFA) which aims to assess the validity and reliability of questionnaire items in four alternative models. CFA allows researchers to identify factors, variance, and correlation between latent constructs (Hill & Hughes, 2007) cited in Yosita Ratri (2023). In addition, it is important to look at the factor loadings produced by CFA analysis before creating structural equation modelling (SEM) model. According to Hair and colleagues (2021), data analysis through SEM methods allows researchers to examine multivariate analysis where there are complex associations among various dependent and independent variables.

Results

The objective of this study is to scrutinize and estimate the influence of gender, ICT resources, and index of economic, social, and cultural status towards science performance in Indonesia. Initially, confirmatory factor analysis (CFA) on ICT resources and ESCS items reveals the best model for SEM analysis. All models and summary of goodness fit model indices is shown in Appendix B. From all models, hierarchical model is decided to be the best model of ICT resources and ESCS. Therefore, the model for SEM combines both hierarchical models. The SEM model in this study is depicted in Figure 2 below.

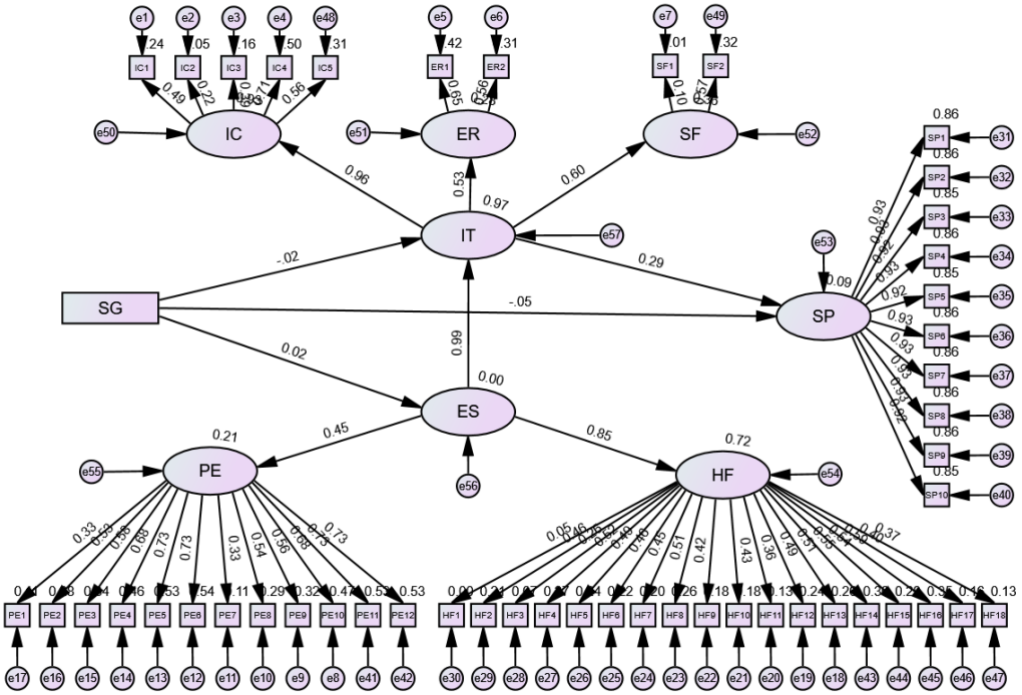

Figure 2: Final Model of SEM

Lists of abbreviation in the model:

SG= Student Gender
IT = Information Technology (ICT Resources)
ES= Economic Status (ESCS)
SP= Science Performance
IC= Integated Computer
ER= Electronic Reader
SF= Supporting Facilities
PE= Parent Education
HF= Home Facilities (Home Ownership)

The final model of SEM includes all items for each variable in order to maintain the model. It is because there is different value of RMSEA when some items that have factor loadings less than 0.30 were trimmed. When some insignificant items not included, the value of RMSEA is increasing from 0.064 to 0.068. Moreover, the path from ESCS to science performance was removed because it leads to negative value of ICT recources to science performance. The value of TLI and CFI are 0.801 and 0.818 respectively, meaning that the values still below standard level of good model fit. Detail of regression weights and significant levels is depicted in Table 1.

Table 1: Standardized Significant Levels and Regression Weights of the Final Model

	Standardized Regression Weights	S.E	P level
SG -> ES	0.016 (0.02)	0.002	0.144
SG -> IT	-0.023 (-0.02)	0.004	0.014
ES -> IT	0.986 (0.99)	0.069	***
SG -> SP	-0.045 (-0.05)	1.104	***
IT -> SP	0.291 (0.29)	3.068	***

Based on the table above, it can be seen that science performance in Indonesia PISA 2022 dataset can be influenced by gender, ICT resources, and ESCS. Student gender in PISA 2022 seems has insignificant impact on science performance as the effects value is very small which indicate that male perform better than female students. Compared to gender, ICT resources directly affect students' performance (β=0.29) and ESCS directly affect ICT resources with path loading extremely high at β= 0.99. Furthermore, ESCS has positive affects towards ICT resources, meaning that a high-income family will be able to provide more ICT resources for learning. On the other hand, low income family will provide limited resources for the students.

Looking more details, each item has different value on how it influences students' performance in science. For example, in ICT resources, the availability of laptop computer and notebooks becomes the most influence among other items while private room becomes the less influential aspects with factor loadings at 0.71 and 0.10, respectively. Moreover, parents educational background has the biggest influence in index of economic, social, and cultural status with factor loadings at 0.73. However, it seems that most parents in Indonesia has low educational level because the International Standard Classification of Education (ISCED) indicate that they are at level 4 and 5. Also, those levels have highest factor loading for both mother and father education. Detail factor loadings for each item is shown in Appendix C.

Discussion

The results of this study indicate that Indonesian students' academic performance in science can be influenced by gender, ICT resources and economic status. However, student gender has poor impact science performance in PISA 2022 which is align with the literature found where both female and male students have equal opportunity in their learning activities which are indicated by their academic performance. Besides, the correlation between student gender and science performance in this study is not is not significant which can be seen from the value less than 0.30.

In terms of ICT resources, the result of analysis is positively aligned with the literature found where it supports learning activities, in this case, science subject (β= 0.29). In detail, electronic device that popular among Indonesian students is laptop computer or notebooks which has significant factor loadings at 0.71. On the other hand, it seems that most students in Indonesia has no private study room in their house as the factor loadings is extremely small at 0.10 and they also do not depend on educational software to support their study because the factor loadings only 0.22. The results are positively correlated with the situation at school where computer or laptop is the most reliable device that can be used in learning activities. For example, working on assignments and quiz, online group meeting, and access online material from the teachers. In addition, Indonesia is a developing country where many students are from low-income family, meaning that their family may have limited budget to provide ICT resources facilities. Furthermore, learning activities in Indonesia may not depend on educational software as the learning management system (LMS) such as Canvas (Mpungose & Khoza, 2022), as teachers may use software that both students and teachers are already familiar with. For instance, they can use free platform such as Google classroom or social media such as WhatsApp to manage classroom activities. Hence, ICT resources is directly influence Indonesian students' performance in science based on PISA 2022 dataset.

Probing further, the results of this study indicate that economic status (ESCS) results is not aligned with the hypothesized as ESCS has indirect impact on students' science performance in Indonesia through ICT resources (β= 0.99). In detail, the data from Indonesia PISA 2022 depicts that not all parents have higher degree education (ISCED level 7-8) which can be seen from the factor loadings that lower compared to education level 4-6. In this case, low performance in science may because of lack of parent educational level. Parent educational level is important especially when pandemic COVID-19 occurred, and students were studying with their family at home. Parent education background enables students to received support when they face difficulties in learning. Moreover, socioeconomic status also consists of home possession or facilities that students can be used to study. The result shows that books play an important role to support academic achievement, either physical book or electronic book which can be accessed through computer, tablet, and e-book readers. The factor loadings for the availability of technical book and science book are higher at 0.59 and 0.55 respectively compared to other items on home facilities. However, other aspects also important and correlated each other. Ultimately, parents with higher education level may have higher income, meaning that they will be able to provides all facilities at home, including ICT resources to be used by students. In other words, the higher ESCS level may lead to better academic outcome, particularly in science score. The results of this study are aligned with previous investigation such as the report from Lagravinese and colleagues (2020).

Conclusion

To sum up, the present study aims to explore the impact of gender, ICT resources, and index of economic, social, and cultural status towards students' science performance in Indonesia based on PISA 2022 dataset. The study employed CFA and followed by multivariate analysis through SEM in AMOS software. The results indicate that student gender almost has no influence towards science performance, while ICT resources directly affect science performance in PISA 2022, which is highly supported by socioeconomic status. The availability of computer laptop becomes the most significant items that influence of students' performance in science which is supported by parents' educational background and home facilities such as science books. The findings may contribute to educational policies, particularly on how government assists school activities by providing decent educational resources in ICT devices for students. In addition, Lagravinese and colleagues (2020) mentioned that there should be public policies in education sector that are able to reduce inequalities among students that are from various socioeconomic level. For example, provide activities to improve students' literacy skills which also supported with adequate facilities such as books and free access learning materials to students. However, this study is based on Indonesia PISA 2022 dataset, which is limited to quantitative data by OECD surveys. According to OECD, test and surveys in PISA 2022 were collected through surveys which is only using quantitative approaches (OECD, 2023c). Further investigation is required, particularly with factors that are related to science performance such as science enjoyment and support from family for students' learning activities. Also, employing qualitative approach will allow to obtain more details factors that affect Indonesian students' performance in science.

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Contact email: wawan.kurniawan@student.adelaide.edu.au

Appendices

Appendix A. Study Items From Indonesia PISA 2022 Dataset

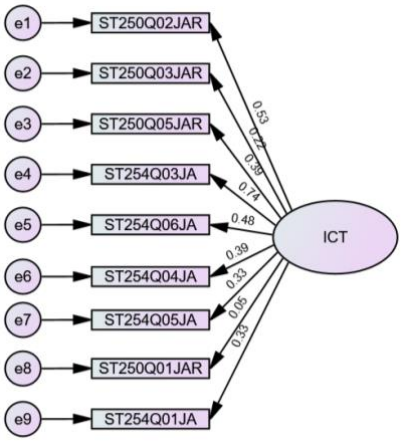
No.	Variables	Item name	Label	Code in the study	Values	Recoded Values
1.	Student gender (SG)	ST004D01T	Student (standardized) Gender	SG	1 = Female 2 = Male 5 = Valid Skip 7 = Not Applicable 8 = Invalid 9 = No Response	
2	ICT Resources **(IT)** **(9 Items)**	ST250Q01JA**R**	Which of the following are in your [home]: A room of your own	IT1	1= Yes 2= No 5= Valid Skip 7= Not Applicable 8= Invalid 9= No Response	**1=1** **2=0** 5=5 7=7 8= 8 9= 9
		ST250Q02JA**R**	Which of the following are in your [home]: A computer (laptop, desktop, or tablet) that you can use for school work	IT2		
		ST250Q03JA**R**	Which of the following are in your [home]: Educational Software or Apps	IT3		
		ST250Q05JA**R**	Which of the following are in your [home]: Internet access (e.g. Wi-fi) (excluding through smartphones)	IT4		
		ST254Q01JA	How many of the following [digital devices] are in your [home]: Televisions	IT5	1= None 2= 1 or 2 3= 3-5 4= More than 5 5= I don't know 95= Valid Skip 97= Not Applicable 98= Invalid 99- No Response	
		ST254Q03JA	How many of the following [digital devices] are in your [home]: Laptop computers or notebooks	IT6		
		ST254Q04JA	How many of the following [digital devices] are in your [home]: Tablets (e.g. [iPad®], [BlackBerry® Playbook™])	IT7		
		ST254Q05JA	How many of the following [digital devices] are in your [home]: E-book readers (e.g. [Kindle™], [Kobo], [Bookeen])	IT8		
		ST254Q06JA	How many of the following [digital devices] are in your [home]: [Cell phones] with Internet access (i.e. smartphones)	IT9		
3	Index of economic, social, and cultural status (ES) **(30 item)**	ST250Q04JA**R**	Which of the following are in your [home]: Your own [cell phone] with Internet access (e.g. smartphone)	ES1	1= Yes 2= No 5= Valid Skip 7= Not Applicable 8= Invalid 9= No Response	**1=1** **2=0** 5=5 7=7 8= 8 9= 9
		ST251Q01JA	How many of these items are there at your [home]: Cars, vans, or trucks	ES2	1= None 2= One 3= Two 4= Three or more 95= Valid Skip 97= Not Applicable 98= Invalid 99= No Response	
		ST251Q02JA	How many of these items are there at your [home]: Mopeds or motorcycles	ES3		
		ST251Q03JA	How many of these items are there at your [home]: Rooms with a bath or shower	ES4		
		ST251Q04JA	How many of these items are there at your [home]: Rooms with a [flush toilet]	ES5		
		ST251Q06JA	How many of these items are there at your [home]: Musical instruments (e.g. guitar, piano, [country-specific example])	ES6		
		ST251Q07JA	How many of these items are there at your [home]: Works of art (e.g. paintings, sculptures, [country-specific example])	ES7		
		ST253Q01JA	How many [digital devices] with screens are there in your [home]?	ES8	1= There are no (digital devices) with screens 2= One 3= Two 4= Three 5= Four 6= Five 7= 6 to 10 8= More than 10 95= Valid Skip 97= Not Applicable 98= Invalid 99= No Response	
		ST254Q02JA	How many of the following [digital devices] are in your [home]: Desktop computers	ES9	1= None 2= 1 or 2 3= 3-5	
					4= More than 5 5= I don't know 95= Valid Skip 97= Not Applicable 98= Invalid 99- No Response	
		ST255Q01JA	How many books are there in your [home]?	ES10	1= There are no books 2= 1-10 3= 11-25 4= 26-100 5=101-200 6= 201-500 7= more than 500 books 95= valid skip 97= not applicable 98= invalid 99= no response	
		ST256Q01JA	How many of these books at [home]: Religious books (e.g. [Bible], [Example 2])	ES11	1= None 2= 1-5 3= 6-10 4= More than 10 5= I don't know 95= Valid Skip 97= Not Applicable 98= Invalid 99= No Response	
		ST256Q02JA	How many of these books at [home]: Classical literature (e.g.[Shakespeare],[Example 2])	ES12		
		ST256Q03JA	How many of these books at [home]: Contemporary literature	ES13		
		ST256Q06JA	How many of these books at [home]: Books on science	ES14		
		ST256Q07JA	How many of these books at [home]: Books on art, music, or design	ES15		
		ST256Q08JA	How many of these books at [home]: [Technical reference books]	ES16		
		ST256Q09JA	How many of these books at [home]: Dictionaries	ES17		
		ST256Q10JA	How many of these books at [home]: Books to help with your school work	ES18		
		ST005Q01JA**R**	What is the [highest level of schooling] completed by your mother?	ES19	1= ISCED level 3.4> 2= ISCED level 3B, 3.3> 3= ISCED level 2> 4= ISCED level 1> 5= She did not complete ISCED level 1> 95= Valid Skip 97= Not Applicable 98= Invalid 99= No Response	**1=5** **2=4** **3=3** **4=2** **5=1** 95=95 97=97 98=98 99=99
		ST006Q01JA**R**	Does your mother have any of the following qualifications: [ISCED level 8]	ES20	1= Yes 2= No 95= Valid Skip 97= Not Applicable 98= Invalid 99= No Response	**1=1** **2=0** 95=95 97=97 98= 98 99= 99
		ST006Q02JA**R**	Does your mother have any of the following qualifications: [ISCED level 7]	ES21		
		ST006Q03JA**R**	Does your mother have any of the following qualifications: [ISCED level 6]	ES22		
		ST006Q04JA**R**	Does your mother have any of the following qualifications: [ISCED level 5]	ES23		
		ST006Q05JA**R**	Does your mother have any of the following qualifications: [ISCED level 4]	ES24		
		ST007Q01JA**R**	What is the [highest level of schooling] completed by your father?	ES25	1= ISCED level 3.4> 2= ISCED level 3B, 3.3> 3= ISCED level 2> 4= ISCED level 1> 5= He did not complete	**1=5** **2=4** **3=3** **4=2** **5=1** 95=95 97=97 98=98 99=99

					ISCED level 1> 95= Valid Skip 97= Not Applicable 98= Invalid 99= No Response	
		ST008Q01JA**R**	Does your father have any of the following qualifications: [ISCED level 8]	ES26	1= Yes 2= No 95= Valid Skip 97= Not Applicable 98= Invalid 99= No Response	**1=1** **2=0** 95=95 97=97 98= 98 99= 99
		ST008Q02JA**R**	Does your father have any of the following qualifications: [ISCED level 7]	ES27		
		ST008Q03JA**R**	Does your father have any of the following qualifications: [ISCED level 6]	ES28		
		ST008Q04JA**R**	Does your father have any of the following qualifications: [ISCED level 5]	ES29		
		ST008Q05JA**R**	Does your father have any of the following qualifications: [ISCED level 4]	ES30		
4	Science Performance (SP)	PV1Science	Plausible value 1 in science	SP1		
		PV2Science	Plausible value 2 in science	SP2		
		PV3Science	Plausible value 3 in science	SP3		
		PV4Science	Plausible value 4 in science	SP4		
		PV5Science	Plausible value 5 in science	SP5		
		PV6Science	Plausible value 6 in science	SP6		
		PV7Science	Plausible value 7 in science	SP7		
		PV8Science	Plausible value 8 in science	SP8		
		PV9Science	Plausible value 9 in science	SP9		
		PV10Science	Plausible value 10 in science	SP10		

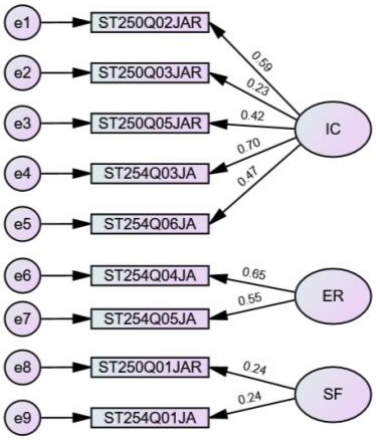
Appendix B. Confirmatory Factor Analysis of ICT Resources and ESCS

1. CFA results of ICT Resources

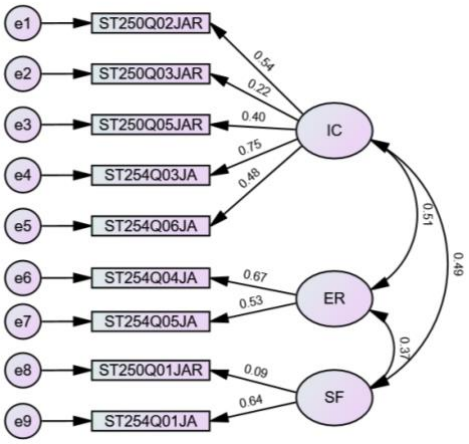
2. One Factor Model



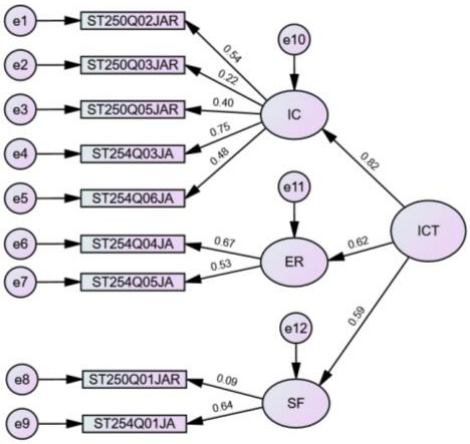
3. 3-Factor Orthogonal Model



4. 3-Factor Correlated Model



5. Hierarchical Model

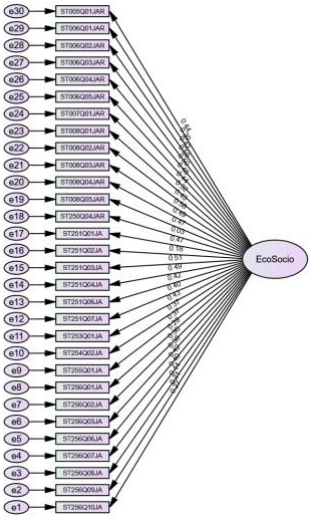


2. Table Summary of goodness fit indices for ICT resources 2022

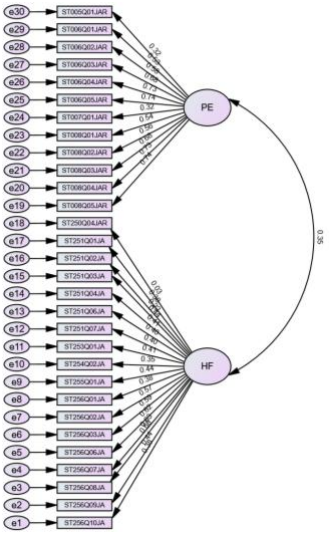
Model	Chi-square	df	Chi-square/df	RMSEA	CFI	TLI
One factor model	2017.998	27	74.741	.074	.816	.693
3-factor model uncorrelated	3234.037	30	107.801	.089	.704	.555
3-factor model correlated	958.523	24	39.938	.054	.914	.838
Hierarchical model	958.523	24	39.938	.054	.914	.838

3. CFA ESCS

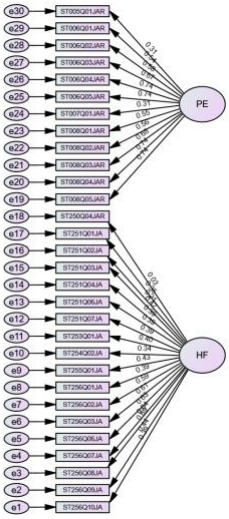
1. One Factor Model



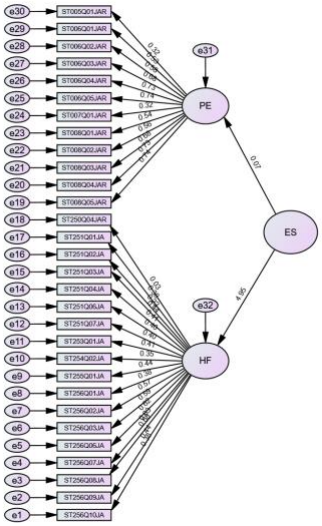
3. 2-Factor Correlated Model



2. 2-Factor Orthogonal Model



4. Hierarchical Model



4. Table Summary of goodness fit indices for ESCS 2022

Model	Chi-square	df	Chi-square/df	RMSEA	CFI	TLI
One factor model	66987.017	405	165.400	.111	.398	.309
2-factor model uncorrelated	49858.126	405	123.106	.095	.553	.487
2-factor model correlated	48690.873	404	120.522	.094	.564	.498
Hierarchical model	48690.873	404	120.522	.094	.564	.498

Appendix C. Detail Factor Loadings of Observed Variable

No	Variables		
	Latent	Observed	Loadings
1	ICT Resources	Which of the following are in your [home]: A room of your own	0.10
2		Which of the following are in your [home]: A computer (laptop, desktop, or tablet) that you can use for school work	0.49
3		Which of the following are in your [home]: Educational Software or Apps	0.22
4		Which of the following are in your [home]: Internet access (e.g. Wi-fi) (excluding through smartphones)	0.39
5		How many of the following [digital devices] are in your [home]: Televisions	0.57
6		How many of the following [digital devices] are in your [home]: Laptop computers or notebooks	0.71
7		How many of the following [digital devices] are in your [home]: Tablets (e.g. [iPad®], [BlackBerry® Playbook™])	0.65
8		How many of the following [digital devices] are in your [home]: E-book readers (e.g. [Kindle™], [Kobo], [Bookeen])	0.56
9		How many of the following [digital devices] are in your [home]: [Cell phones] with Internet access (i.e. smartphones)	0.56
10	ESCS	Which of the following are in your [home]: Your own [cell phone] with Internet access (e.g. smartphone)	0.05
11		How many of these items are there at your [home]: Cars, vans, or trucks	0.46
12		How many of these items are there at your [home]: Mopeds or motorcycles	0.26
13		How many of these items are there at your [home]: Rooms with a bath or shower	0.52
14		How many of these items are there at your [home]: Rooms with a [flush toilet]	0.49
15		How many of these items are there at your [home]: Musical instruments (e.g. guitar, piano, [country-specific example])	0.46
16		How many of these items are there at your [home]: Works of art (e.g. paintings, sculptures, [country-specific example])	0.45
17		How many [digital devices] with screens are there in your [home]?	0.51
18		How many of the following [digital devices] are in your [home]: Desktop computers	0.42
19		How many books are there in your [home]?	0.43
20		How many of these books at [home]: Religious books (e.g. [Bible], [Example 2])	0.36
21		How many of these books at [home]: Classical literature (e.g. [Shakespeare], [Example 2])	0.49
22		How many of these books at [home]: Contemporary literature	0.51
23		How many of these books at [home]: Books on science	0.55
24		How many of these books at [home]: Books on art, music, or design	0.54
25		How many of these books at [home]: [Technical reference books]	0.59
26		How many of these books at [home]: Dictionaries	0.40
27		How many of these books at [home]: Books to help with your school work	0.37
28		What is the [highest level of schooling] completed by your mother?	0.33
29		Does your mother have any of the following qualifications: [ISCED level 8]	0.53
30		Does your mother have any of the following qualifications: [ISCED level 7]	0.58
31		Does your mother have any of the following qualifications: [ISCED level 6]	0.68
32		Does your mother have any of the following qualifications: [ISCED level 5]	0.73
33		Does your mother have any of the following qualifications: [ISCED level 4]	0.73
34		What is the [highest level of schooling] completed by your father?	0.33
35		Does your father have any of the following qualifications: [ISCED level 8]	0.54
36		Does your father have any of the following qualifications: [ISCED level 7]	0.56
37		Does your father have any of the following qualifications: [ISCED level 6]	0.68
38		Does your father have any of the following qualifications: [ISCED level 5]	0.73
39		Does your father have any of the following qualifications: [ISCED level 4]	0.73
40	Science Performance	Plausible value 1 in science	0.93
41		Plausible value 2 in science	0.93
42		Plausible value 3 in science	0.92
43		Plausible value 4 in science	0.93
44		Plausible value 5 in science	0.92
45		Plausible value 6 in science	0.93
46		Plausible value 7 in science	0.93
47		Plausible value 8 in science	0.93
48		Plausible value 9 in science	0.93
49		Plausible value 10 in science	0.92

Cultural Affective Factors and Group Dynamics in COIL Projects: How Much Autonomy Is Too Much Autonomy?

Brian Bachman, Kyoto University of Foreign Studies, Japan
Michael David Barr, Kyoto University of Foreign Studies, Japan
Yi-hung Cathy Liao, National Pingtung University, Taiwan

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Abstract
This study examined the collaboration and group dynamics within international cohorts researching the United Nations' Sustainable Development Goals in a COIL (collaborative online international learning) environment. It culminated in a final recorded video project in the format of a multi-participant screencast-style presentation. Cultural concepts of politeness, leadership, turn-taking, and perceived notions of correct behavior naturally affect interactions in group communicative situations. This study aimed to develop a greater understanding of the interplay between stereotypically shy Japanese behavior and traditionally assertive Taiwanese communicative norms. What can we do as language educators to promote effective group work and intercultural communication, and what is the best balance between scaffolded content and student-centered autonomy? This project was the fifth iteration of an ongoing COIL project between Taiwan and Japan. Building on past successes, shared materials on the Google platform were used as an effective method of working between international groups in asynchronous interactions. Additionally, participants used LINE OpenChat groups for direct communication, allowing for a safe and moderated space which maximized privacy and transparency. Students utilized their choice of online platforms for live meetings, giving each cohort autonomy within their learning environment. Our methodology for evaluating the efficacy of group interactions used student surveys and the analysis of recordings and transcripts of group meetings. Consent and anonymization of data protected student privacy and confidentiality. This study should be of interest to educators undertaking COIL projects and/or enabling their students to improve communication skills in international contexts.

Keywords: COIL, Cross-Cultural Communication, Group Dynamics, International Collaboration

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Introduction

Collaborative Online International Learning (COIL) has become a trendy and crucial approach in bridging cultural divides and fostering global citizenship. By integrating academic tasks with intercultural collaboration, COIL projects offer students opportunities to engage in meaningful interactions while addressing global issues, such as the United Nations Sustainable Development Goals (SDGs). However, the success of such initiatives hinges on navigating the complexities of intercultural communication and group dynamics.

This study focuses on the fourth iteration of a COIL project between Kyoto University of Foreign Studies (KUFS) in Japan and National Pingtung University (NPTU) in Taiwan. Over a four-week period, students worked in 20 international groups to research and present on SDG-related topics through collaborative video projects. These interactions revealed key challenges, including differing cultural norms in leadership, turn-taking, and communicative politeness. Groups involved in the project examined the SDGs within the context of both synchronous and asynchronous virtual interaction. The project's structure, culminating in a multi-participant, screencast-style video presentation, presented unique challenges and learning opportunities, particularly as participants navigated diverse cultural communicative norms. In group settings, cultural concepts of politeness, leadership, turn-taking, and behavioral norms were hypothesized to influence the ways in which students would interpret and respond to each other.

Our research seeks to address two critical questions:

1. How do cultural affective factors, such as politeness, leadership, and turn-taking, influence group dynamics in COIL projects?
2. How can educators balance scaffolded guidance with student autonomy to optimize intercultural collaboration and communication?

By examining these questions, we aim to provide actionable insights for educators and policymakers seeking to enhance the effectiveness of COIL projects and equip students with essential skills for global engagement.

Literature Review

Intercultural collaboration in educational settings, especially within COIL projects, has garnered significant attention due to its ability to bridge cultural divides and develop students' global awareness. This section explores key themes in existing literature related to cross-cultural communication styles, leadership dynamics in international collaboration, high-context versus low-context communication, and the pedagogical balance between scaffolding and autonomy.

High-Context vs. Low-Context Communication Styles

One of the foundational frameworks for understanding intercultural communication is the distinction between high-context and low-context communication, as introduced by Edward Hall (1976). High-context cultures, such as Japan, rely heavily on implicit communication, shared cultural knowledge, and non-verbal cues. Silence and subtlety are essential in maintaining group harmony, as direct disagreement is often avoided (Gudykunst & Ting-Toomey, 1988). In group settings, this can lead to misinterpretations by individuals from low-context cultures, who may perceive silence as disengagement rather than respect. For

instance, Japanese students may avoid direct disagreement by softening their language or relying on pauses, which can be interpreted as a sign of thoughtfulness or respect.

In contrast, Taiwanese communication, while historically influenced by high-context norms, incorporates notable elements of low-context communication, particularly among younger generations. Taiwanese students are often more direct in expressing opinions or offering feedback, especially in academic or professional contexts influenced by Western norms and educational style (Curtis & Sussex, 2018; Wu & Kawamura, 2011). This dual influence creates a unique blend of communicative influences whereby Taiwanese students balance politeness and assertiveness depending on the context or task.

Taiwanese communicators are often more direct and willing to express dissent than their Japanese counterparts, particularly in academic or professional contexts. Ting-Toomey and Chung's (2005) intercultural communication competence framework underscores the need for individuals in multicultural settings to recognize and adapt to these differing styles to minimize conflict and enhance collaboration.

These distinctions are particularly relevant in COIL projects, where implicit assumptions about communication can affect group dynamics, lead to misunderstandings, or create friction. Educators must equip students with the tools to interpret and respond to both verbal and non-verbal cues effectively. Understanding and adapting to these communication styles is critical for fostering effective collaboration in both academic and professional settings.

Intercultural Leadership Dynamics

Leadership in intercultural contexts involves navigating differing cultural expectations regarding authority, collaboration, and decision-making. According to Hofstede's (1980) cultural dimensions theory, hierarchical or power-distance orientations influence how leadership roles are assumed and perceived. In high-power-distance cultures, leadership is often authoritative and positional, while low-power-distance cultures favor egalitarian and rotational leadership styles.

In East Asia, collectivism adds another dimension to leadership practices. Japanese group dynamics often emphasize shared decision-making and role rotation, aligning with Hofstede's concept of high collectivism. Leadership is viewed as a collaborative responsibility rather than an individual role (Matsumoto, 1994). Taiwanese leadership, while also collectivist, tends to integrate assertiveness and proactive task delegation, reflective of lower power-distance influences in younger generations (Wu & Kawamura, 2011).

Studies on intercultural leadership suggest that misaligned expectations can hinder group cohesion and productivity. Thomas and Peterson (2015) emphasize the need for cultural intelligence (CQ) in navigating such differences, recommending structured interventions like role definitions and reflective discussions to harmonize team dynamics. In COIL settings, fostering intercultural leadership can cultivate essential global competencies among students, such as adaptability and empathy.

Pedagogical Balance: Scaffolding vs. Autonomy

The interplay between teacher-led scaffolding and student autonomy has been widely studied in collaborative learning contexts. Vygotsky's (1978) concept of the Zone of Proximal

Development (ZPD) highlights the importance of guided support to help learners achieve tasks beyond their independent capabilities. In intercultural settings, scaffolding provides students with structured strategies for communication, such as frameworks for active listening, turn-taking, and conflict resolution (Chen & Starosta, 1997).

However, excessive scaffolding can inhibit the development of autonomy, which is critical for fostering adaptability and confidence in global contexts. Deci and Ryan's (1985) Self-Determination Theory emphasizes the importance of autonomy in motivating learners to engage deeply and take ownership of their learning. In COIL projects, this balance is particularly crucial as students navigate linguistic and cultural barriers.

Wu and Kawamura (2011) suggest a phased approach, where initial scaffolding transitions to greater autonomy as students gain confidence and competence. This allows students to internalize structured skills while developing the independence needed for authentic intercultural collaboration.

Cultural Stereotypes and Their Impact

Cultural stereotypes, though often reductive, play a significant role in shaping perceptions and behaviors in intercultural settings. Stereotypes of Japanese communication frequently highlight indirectness, formality, and a preference for silence, whereas Taiwanese communication is characterized by warmth, expressiveness, and a willingness to engage in open dialogue.

Gao and Ting-Toomey (1998) note that affective factors like politeness, turn-taking, and emotional expressiveness significantly impact group dynamics. For example, silence may signify respect in Japanese culture but could be misinterpreted as disengagement by participants from low-context cultures. Similarly, the use of humor or emotional expressiveness in Taiwanese communication may be perceived as inappropriate or unprofessional by more reserved cultures (Matsumoto, 1994).

While these stereotypes provide a starting point for understanding cultural differences (see table below), their application in real-world settings can lead to oversimplifications. For instance, younger generations in both Japan and Taiwan are increasingly influenced by global norms, resulting in communication styles that blend traditional and modern elements. Educators must approach these stereotypes with caution, emphasizing flexibility and individual variation over rigid assumptions. Familiarity and awareness with cultural stereotypes is a valuable tool for the educator, however it must also be emphasized that communicative stereotypes are obviously not true in all circumstances for all students. This is particularly true in the context of higher education, with students having varying degrees of multicultural or international experience.

The impact of stereotypes was observed in the KUFS-NPTU project, where initial interactions often reflected preconceived notions of politeness and assertiveness. Specific examples will be discussed later in the findings section. By fostering open discussions about cultural norms and encouraging reflective practices, the project helped students move beyond stereotypes, cultivating a deeper understanding of each other's perspectives.

Key Cultural Communication Traits of Japanese and Taiwanese Students: A Collaborative Foundation for COIL Project

To provide a strong foundation for the COIL project, this table—developed collaboratively by the three instructors and authors—summarizes key differences in Japanese and Taiwanese communication styles. Japanese communication is characterized by indirectness, reserved emotional expressiveness, and the strategic use of silence to foster harmony. These traits often prioritize group consensus over individual expression, promoting cohesion but occasionally creating misunderstandings with participants from low-context cultures.

Table 1: Stereotypical Cultural Communicative Factors in Group Dynamics

Aspect	Japanese (JP)	Taiwanese (TW)
Directness	Indirect, often avoids saying "no" directly to prevent offending, using hints or softened refusals.	More direct, may openly express disagreement while maintaining respect, especially in group settings.
Expressiveness	More reserved in physical expression, with a focus on subtle gestures and limited overt emotion.	Tends to be expressive, using body language and tone to convey emotions.
Use of Silence	Silence is meaningful, used to convey thoughtfulness or respect, and is an integral part of dialogue.	Less reliance on silence; pauses are generally brief or conversational.
Harmony and Conflict	Prioritizes group harmony (Wa), often suppressing personal opinions to align with group consensus.	Open to expressing individual views in group contexts.

Taiwanese students, influenced by a blend of traditional and Western educational norms, are more direct and expressive. They openly share opinions while maintaining respect, using tone and body language to enhance clarity in discussions. Pauses in Taiwanese communication are typically brief and conversational, encouraging an inclusive and active exchange of ideas. This openness fosters dynamic group interactions, balancing personal viewpoints with collective goals.

By integrating these insights into project design, COIL instructors ensured participants were equipped to navigate cultural differences effectively. Understanding these distinctions empowers students to embrace diverse perspectives, mitigate potential misunderstandings, and leverage the strengths of both cultural approaches for meaningful collaboration.

Methodology

This study explores the intercultural communication and group dynamics of a Collaborative Online International Learning (COIL) project between students from Kyoto University of Foreign Studies (KUFS) in Japan and National Pingtung University (NPTU) in Taiwan. Conducted over a four-week period, the project aimed to foster linguistic proficiency, leadership development, and cross-cultural understanding through research and presentations on topics related to the United Nations Sustainable Development Goals (SDGs).

Project Design and Timeline

The COIL project followed a structured, phased timeline to guide student collaboration and learning:

Table 2: KUFS-NPTU COIL Project Design & Timeline

Phase	Tasks	Activities	Objectives
1	Contact & Connect	- Use LINE OpenChat for introductions and team building. - Orientation on communicative appropriateness (e.g., politeness, turn-taking).	- Establish rapport in a low-pressure environment. - Foster initial team cohesion and comfort with communication tools.
2	Communicate & Compare	- Engage in discussions to identify SDG-related issues. - Reflect on global and local challenges using descriptive writing exercises (5W1H framework)	- Develop understanding of global and local perspectives. - Enhance descriptive writing and analytical discussion skills.
3	Correlate & Collaborate	- Synthesize data gathered from prior discussions. - Conduct brainstorming sessions on shared challenges & opportunities. - Analyze regional dynamics collaboratively.	- Foster solution-oriented thinking. - Promote dynamic group discussions and mutual learning.
4	Construct & Change	- Produce a final multimedia video presentation. - Combine persuasive speaking, collaborative design, and advocacy.	- Clarify issues and propose actionable solutions. - Encourage advocacy and engagement through creative multimedia outputs.

These phases provided a balance between guided activities and opportunities for independent decision-making, allowing students to develop linguistic, critical thinking, and intercultural competencies.

Tools and Platforms

Two primary tools were used to facilitate the COIL project: LINE OpenChat and Google Workspace.

LINE OpenChat.

LINE was chosen for its familiarity and ease of use among students, providing a moderated and invite-only platform to ensure privacy and transparency. It allowed students to communicate asynchronously, fostering friendly, informal exchanges before transitioning to more formal tasks.

A clear rationale for starting with an SNS (social networking) platform is that an international project which could seem daunting to university students, started with the method of informal, concise, and immediate communication that students already use regularly.

The LINE application, widely used by Asian students, was chosen specifically for several reasons. First, it's a platform that most students are comfortable with. Secondly, it ensures privacy. Invite-only, moderated LINE groups are protected and moderated by the professors, which largely eliminates issues like cyberbullying or discomfort with students sharing personal information. Finally, the use of such an SNS platform lends itself to specific instruction, scaffolding, and orientation regarding appropriate communication manners. Students are then more effectively prepared to engage in collaborative research on global or local issues. Because students have an innate curiosity about their international peers' community, living situations, and academic environment, our goal as educators should be to nurture that curiosity. A foundation of informal, friendly, 'chat-based' communication results in participants who are more invested and motivated in the COIL project.

Workshops, practice sessions, and in-class instruction proved to be an effective tool for Japanese participants, allowing them to bridge the gap between a traditionally reserved or indirect communicative style, and the more assertive and direct approach of their Taiwanese counterparts. These workshops covered techniques for effective greetings, offering choices, asking questions, encouraging others, turn-taking, and promoting group sharing. Practicing these skills in a controlled environment before team meetings helped immensely.

Google Workplace (Google Sheet, Google Slides, Google Docs).

Google Sheets, Slides and Docs served as the main platform for collaborative work, enabling students to co-create presentations. Its features, such as color-coded sections and integrated links, ensured accessibility, flexibility, and clarity. Students used this suite of tools to organize their ideas, share resources, and prepare their final video projects. For students with a limited experience using the Google Suite of applications for education, familiarity and practice with these ubiquitous platforms in an international shared context yielded a tremendous collateral benefit for students, many of whom will have opportunities to work collaboratively in their future careers.

Additionally, the combination of these platforms facilitated synchronous and asynchronous interactions, ensuring that all participants could engage effectively despite differing schedules and technological proficiencies. The reality of COIL projects is that a great deal of logistical negotiations become necessary when a group of participants attempt to align schedules and project-based activity.

Data Collection and Ethical Considerations

Data were collected from multiple sources to analyze group dynamics and communication strategies, including:

- Transcripts of group discussions and meeting recordings.
- Reflective surveys documenting students' perceptions of leadership, communication styles, and collaborative experiences.
- Observational notes on participation and interaction patterns during workshops.

All participants provided informed consent, and data were anonymized to protect privacy and confidentiality. These ethical protocols ensured that the study adhered to international research standards, maintaining the integrity of the research process.

Integrating ChatGPT for Communication Data Analysis

To analyze the communication data from the COIL project, ChatGPT was leveraged as a scalable AI tool to process and interpret the extensive chat logs generated by participants. ChatGPT enabled for the systematic analysis of key communication patterns, including leadership traits, participant engagement, and group dynamics, across groups A to T. Prompts were designed to identify leadership roles, quantify message contributions, and highlight collaborative behaviors such as turn-taking and problem-solving. This AI-driven analysis provided nuanced insights, such as identifying students who demonstrated strong leadership through initiative, task management, and organizational skills. Additionally, ChatGPT helped uncover patterns in group interactions, revealing how cultural communication styles influenced collaboration and adaptability. The integration of AI not only streamlined the data analysis process but also allowed for real-time exploration of group dynamics, supporting the study's aim to better understand intercultural collaboration. This approach demonstrates the potential of AI tools in educational research for efficiently extracting meaningful trends from large datasets.

Communication data analysis using ChatGPT included:

- **Analyze Group A to T Chat Logs:**
  Summarize notable leadership traits exhibited by students in Groups A to T.
- **Quantify Data:**
  Determine participant count, roles, number of messages, and word count for each participant in each file.
- **Provide Overall Leadership Analysis:**
  Summarize observations on students who exhibited leadership qualities within their groups.
- **Identify Strong Leaders:**
  Specify which students demonstrated good leadership skills based on engagement, initiative, and organizational skills.
- **Determine Patterns in Group Dynamics:**
  Explain observed patterns in group dynamics across all groups, including leadership, collaboration, and adaptability.

Figure 1: Data Analysis Findings Using ChatGPT

Conclusion

The integration of structured phases, user-friendly tools, and a well-grounded pedagogical framework provided students with a supportive yet challenging environment to develop intercultural communication skills. This methodology enabled researchers to observe the interplay between cultural norms, leadership dynamics, and the balance of scaffolding and autonomy, offering valuable insights for future COIL projects.

Results & Discussion

Quantitative Results and Analysis

The quantitative analysis of group dynamics and leadership roles was conducted using AI tools such as ChatGPT to process communication data from LINE OpenChat logs. The results provided insights into participant engagement, leadership distribution, and messaging trends across 20 COIL groups.

Leadership dynamics in Multicultural Teams

This table provides an overview of the leadership roles and contributions observed across the 20 COIL project groups. The data highlights how leadership was distributed, with a majority of leaders being Taiwanese participants who demonstrated strong organizational and task-oriented behaviors, such as setting meeting agendas, coordinating schedules, and guiding group discussions. Notably, Japanese leaders, though fewer in number, contributed significantly by fostering inclusivity and maintaining group harmony. For instance, in Group F, leadership responsibilities were shared between Casper (TW) and Kurumi (JP), illustrating a collaborative approach that bridged cultural communication styles. This data underscores the interplay of proactive task management and collaborative harmony, emphasizing the complementary strengths that diverse cultural approaches bring to group dynamics.

Leadership Distribution

The analysis revealed that 85% (17 out of 20) of group leaders in the dataset were Taiwanese participants, while only 15% (3 out of 20) were Japanese students. This indicates a significant disparity in leadership roles, with Taiwanese participants frequently assuming proactive leadership positions.

Leadership Contributions

Key leadership activities included, organizing meetings and managing schedules, assigning roles and maintaining focus on group objectives, and facilitating topic discussions and ensuring progress on SDG-related tasks. For instance, in Group A, the Taiwanese leader was responsible for setting the SDG focus and coordinating meeting agendas, while the Japanese leader in Group F supported the group by scheduling meetings and assisting with coordination.

Patterns in Communication and Engagement

The analysis also quantified engagement by examining the frequency of messages and the distribution of responsibilities. Taiwanese participants, on average, sent more directive and action-oriented messages, while Japanese participants contributed by providing reflective inputs and ensuring inclusivity. The data confirmed that these complementary styles fostered group cohesion and productivity.

Table 3: Leadership Roles and Contributions in COIL Project Groups

Group	Leader(s)	Leadership Contributions
A	WeiZi (TW) Sammy Tu (TW)	Organized meetings, set SDG focus
B	Tiffany (TW)	Set group norms, coordinated tasks
C	Rita (TW)	Managed meeting schedules, inclusive approach
D	Jessie (TW) Agnes (TW)	Organized schedules, led topic focus on SDGs
E	Amanda (TW)	Guided meetings, maintained group focus
F	Casper (TW), Kurumi (JP)	Scheduled meetings, helped with coordination
G	Yuki (JP)	Facilitated introductions, kept the group on task
H	Sun (TW)	Coordinated meetings, managed scheduling
I	Sheren (TW)	Organized topic voting, clear communication
J	Jin Ni (TW)	Set group structure, coordinated tasks
K	Adam (TW)	Setup chat, guided discussions
L	Daisy (TW)	Led group introductions, managed schedules
M	Grace (TW)	Organized meetings, maintained focus
N	Cindy Wu (TW)	Facilitated topic discussions, organized meetings
O	Wendy (TW)	Setup chat, encouraged participation
P	Hana (JP)	Coordinated schedules, guided SDG topic focus
Q	N/A	No data available
R	Abner (TW)	Set meetings, facilitated collaboration
S	Shi Yiyi (TW)	Led setup and maintained group cohesion
T	Sherry (TW)	Established group structure, supported collaboration

Qualitative Results and Analysis

Students demonstrated critical thinking skills such as (1) leadership, (2) negotiation, and (3) problem-solving, which are crucial for managing group dynamics and ensuring productive outcomes. In addition, participants had to (4) balance scaffolded and autonomous interactions. By leveraging LINE OpenChat as the preferred communication platform, students could coordinate their efforts seamlessly, share ideas in real-time, and maintain a record of their progress. ChatGPT allowed for the rapid data analysis of text exchanges to identify real-time text exchanges for examples of these key skills. Insights are supported by chat transcript excerpts and data visualization from ChatGPT analysis.

Leadership Skills

Students exhibited leadership within their groups by using communication in LINE OpenChat. On Wednesday, May 8, 2024 at 12:19 PM, the Japanese student (Kana) from Group L texted her group. Her text message was as follows:

> "What our group will do first:
> 1. Decide on one SDG as a group.
> 2. Discuss solutions.
> 3. Divide roles for the presentation (examples: introduction, SDG explanation, solutions, examples, and closing).
> 4. Determine roles for video submission (e.g., video editing, PowerPoint slides, YouTube upload).
>
> The video is due June 9. Let's give it our best!"

This detailed message highlights Kana's clear organization and encouragement of group participation. It also exhibits her ability to maintain focus on deadlines and tasks. Furthermore, it shows initiative because her action was from self-motivation to benefit the group.

Negotiation Skills

An additional exchange using LINE OpenChat showed a clear example of negotiation. On Tuesday, May 14, 2024 starting at 7 PM, Group R discussed the following:

> Abner: "I'm free on weekends."
> Haruto: "Yes."
> Abner: "Which SDGs are you interested in?"
> Haruto: "SDG 2 is interesting."
> Yuri: "I'm also interested in SDG 13. What about everyone else?"
> Yuri: "We have to decide one SDG as a group?"
> Haruto: "I can accept SDG 2."
> Abner: "I am interested in both SDG 2 and SDG 4."
> Yuri: "So will our group choose SDG 2?"
> Abner: "Yes."

This exchange from Group R demonstrates negotiation as students collaboratively discussed their preferences for SDG topics. Members openly shared their interests, considered alternative suggestions, and worked toward a consensus by agreeing on their selection. The dialogue reflects respectful communication and a willingness to accommodate differing opinions to reach a group decision effectively. As a result, the team was able to successfully compromise on SDG 2.

Problem-Solving Skills

Students communicated in Line OpenChat to problem-solve specific issues in their groups. On Tuesday, May 11, 2024, beginning at 9:45 AM, Group F exchanged the following messages:

> Kurumi: "Can anyone create a Google Meet room and record it?"

Casper: "I can create the room, but I don't have storage space on my phone to record."
Hana: "Thank you, Casper! I'll use the screen recording function on my phone to record it."

Group F's problem-solving exchange demonstrates effective teamwork and resourcefulness. Kurumi identified the need for both a meeting platform and a recording solution, initiating the problem-solving process. Casper contributed by creating the Google Meet room but acknowledged a limitation in recording capabilities. Hana offered a practical solution by using her phone's screen recording feature. This demonstrated adaptability and willingness to take responsibility. This exchange highlights how open communication and shared efforts can resolve logistical challenges efficiently within a group.

The Balance Between Scaffolding and Autonomous Activities

Achieving an optimal balance between scaffolding and autonomy requires ongoing assessment and flexibility from educators. As the dynamics of roles within cohorts coalesced, structured support was gradually reduced, and instructors transitioned from explicit guidance to a more observational role, with feedback offered only when necessary. Such an approach respected the individual learning trajectories of students, allowing them to develop confidence in both controlled and autonomous group interactions. By fostering both structured skill-building and opportunities for independent application, a nurturing learning environment encouraged not only linguistic proficiency but also essential skills for global citizenship.

Furthermore, student-centered autonomy is important in cultivating authentic group dynamics. Giving students control over group tasks, such as choosing topics, assigning roles, or deciding on the methods they will use to accomplish goals, encourages ownership of their learning and fosters a sense of accountability. When students are encouraged to negotiate roles and contribute their unique perspectives, they not only learn language skills but also develop the ability to navigate and appreciate diverse viewpoints. This aspect of autonomy can deepen intercultural competence by promoting an open-minded attitude and adaptability in group settings.

Discussion

The study's findings provide a nuanced understanding of how cultural communication styles influence group dynamics in COIL projects, addressing both research questions effectively. Leadership, negotiation, and problem-solving emerged as essential skills, with Taiwanese and Japanese students contributing distinct strengths that balanced directness and harmony. These insights demonstrate the potential of diverse cultural approaches to enhance group collaboration and innovation.

The phased structure of the project, combining scaffolding with autonomous activities, enabled students to navigate intercultural challenges while developing confidence and competence. By gradually transitioning to autonomy, students were able to take ownership of their tasks and decisions, fostering critical thinking and intercultural adaptability. These practices also deepened students' appreciation for diverse perspectives and communication styles.

Qualitative analysis revealed meaningful patterns in leadership and collaboration, with students successfully negotiating tasks, resolving logistical challenges, and building inclusive group dynamics. The integration of AI tools like ChatGPT to analyze the communication data from LINE OpenChat logs facilitated a detailed examination of these interactions, offering valuable recommendations for refining future educational strategies. In sum, this study highlights the transformative potential of COIL projects in preparing students for meaningful engagement in a multicultural and interconnected world.

Conclusion

This study provides valuable insights into how COIL projects can bridge cultural divides and prepare students for the demands of global citizenship. By examining leadership, negotiation, and problem-solving within the context of intercultural collaboration, the research questions were addressed with a focus on cultural communication norms and the pedagogical balance of scaffolding and autonomy.

The findings reveal the complementary strengths of Taiwanese and Japanese students in managing group dynamics, with the former often taking proactive leadership roles and the latter ensuring inclusivity and harmony. These dynamics illustrate the potential for diverse cultural approaches to enrich collaboration and foster mutual understanding. The project also highlighted how carefully calibrated scaffolding transitions to autonomy can empower students to take ownership of their learning, fostering critical skills and confidence.

The integration of AI tools like ChatGPT for analyzing communication provided actionable insights into group interactions, enhancing the ability of educators to tailor support to students' needs. This approach offers a scalable and innovative model for improving the effectiveness of COIL projects.

Looking ahead, future COIL initiatives should explore larger and more diverse participant groups, incorporate longer-term collaborations, and examine the role of emerging technologies in supporting intercultural learning. By continuing to innovate and refine these practices, COIL projects can play a vital role in equipping students with the skills and perspectives needed to thrive in an interconnected, multicultural world.

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Beyond Content: Exploring the Impact of Team Characteristics in Effective Project-Based Learning

Low Bee Lee, Singapore Polytechnic, Singapore
Desmond Ng, Singapore Polytechnic, Singapore
Heng Jun Jie, Singapore Polytechnic, Singapore
Low Kang Min, Singapore Polytechnic, Singapore

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Abstract
Project-based learning (PBL) is a pedagogy that is widely adopted for its authentic, complex and collaborative learning experience. Many studies have shown that team effectiveness (TE) plays a pivotal role in determining the success of project outcomes. Effective teams are generally characterised by shared goals, clear communication, mutual respect and a commitment to collective success. This paper aims to study the specific mechanisms and conditions that optimally enhance team performance in PBL. It highlights the importance of effective team processes and team dynamics, including appropriate deployment of decision-making and conflict resolution strategies, task assignments, team feedback and reflections, in conjunction with the cohesive integration of each member's contribution with a growth mindset towards the development and evaluation of team competencies. Furthermore, it also explores the role of project supervisors in fostering team effectiveness through providing structured guidance, constructive feedback and appropriate resources to students. The framework of fostering a positive team culture is evaluated by four dimensions, namely Team Motivation (TM), Team Structure (TS), Team Dynamics (TD) and Team Excellence (TE). Empirical evidence inferred from their strong positive Spearman correlation ($\rho > 0.82$) confirm the proposition that team characteristics are interrelated and mutually reinforcing for the facilitation of successful PBL learning outcomes.

Keywords: Project-Based Learning, Team Effectiveness, Team Motivation, Team Structure, Team Dynamics and Team Excellence

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Introduction

Teamwork is the catalyst for success in project-based learning (PBL). By leveraging diverse perspectives and skills, teams can tackle complex challenges, foster innovation, and achieve exceptional outcomes. Effective collaboration is crucial for optimising learning and project quality. Given the significant impact of team effectiveness on student learning and performance, there is imperative to explore the key components of effective teams and identify strategies to cultivate positive team dynamics within the PBL framework. This research aims to answer the following questions:

1. What are the core characteristics of a high-performing team in a PBL context?
2. Which strategies can educators implement to foster a positive and collaborative team environment within PBL projects?

To fully understand and enhance team effectiveness in PBL setting, this study will adopt a multidimensional framework comprising Team Motivation (TM), Team Structure (TS), Team Dynamics (TD) and Team Excellence (TE).

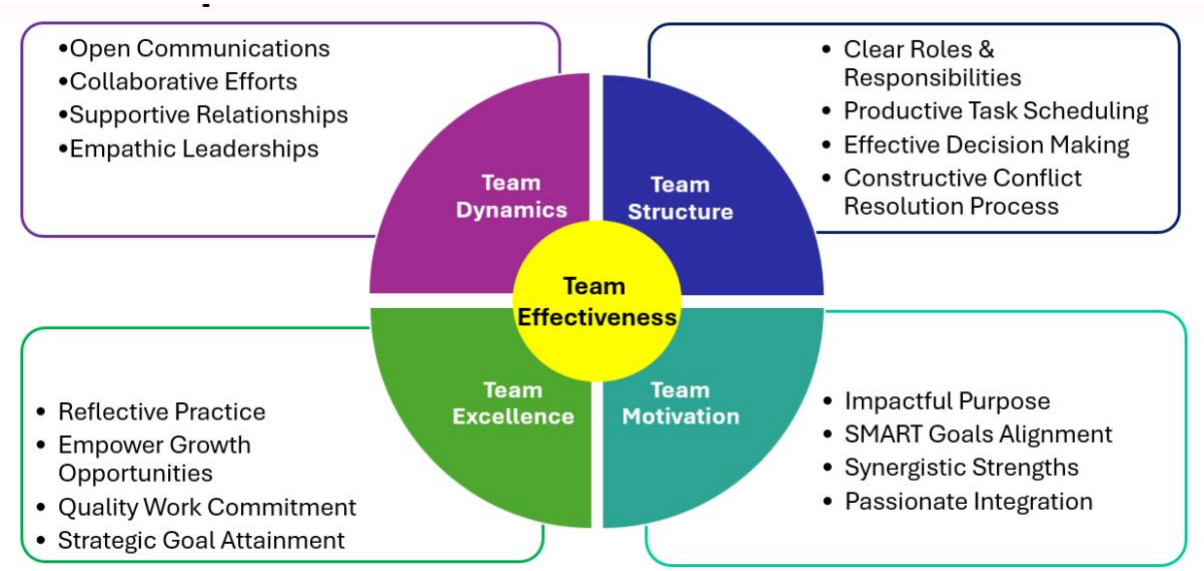

Figure 1: The Conceptual Framework of an Effective Team in PBL Settings

Figure 1 illustrates these dimensions and their subcomponents. The first dimension, TD, delves into the interpersonal interactions and relationships within the group that foster a positive and collaborative team culture. Effective collaboration depends on open communication and mutual support among team members. Team members who can share relevant information, expressing their opinions and feelings, offering active listening and constructive feedback would also respect and appreciate each other's diverse perspectives, needs, and emotions to create a supportive and trusting environment. The second dimension, TS, explores the organisational aspects of the team that facilitate optimal performance. These aspects involve defining clear roles and responsibilities, facilitating productive task scheduling, establishing effective communication channels, making decisions, and resolving conflicts constructively. A well-structured team assigns tasks based on members' strengths and preferences, coordinates efficiently to meet deadlines, makes decisions that reflect the team's consensus and goal directives, and manages disagreements and conflicts in a respectful and positive way, focusing on issues rather than personality differences and seeking win-win solutions. It conveniently leverages on e-platforms (e.g. WhatsApp, Telegram, and Google Doc) and regular meetings for facilitating group discussions. The third dimension, TM,

examines the factors that would inspire team members to engage in the project. These factors include having a clear and meaningful purpose that aligns with the team's values and interests, identifying and synergise the diverse strengths and skills of the team members in the facilitation of shared SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals. The passionate integration of the team members is manifested in their enthusiasm, passion, and dedication for the project. The final dimension, TE, is envisioned to be adopting a growth mindset that leads to high-quality innovation and improved student learning outcomes through reflective practice, opportunities for growth and commitment to quality work. While achieving the strategic goals, teams are capable of self-monitoring, recognising strengths and weaknesses and using feedback or mistakes as learning opportunities. Teams are also dedicated to continually improving their skills and producing high work standards.

Literature Research

PBL is a pedagogical approach that engages students in active and collaborative inquiry to solve authentic problems and acquire domain knowledge and transferable skills (Guo et al., 2020; Helle et al., 2006; Marinho et al., 2022; Sadji et al., 2023; Žerovnik et al., 2021). PBL aims to develop the 21st century competencies in students with emphasis on problem-solving, critical thinking, teamwork and communication (Billah et al., 2019; Martínez, 2022; Yong & Saad, 2023). By working in small groups, students can tackle real-world issues that are relevant and meaningful to them and their communities. Several studies have shown the positive effects of PBL on student learning outcomes, motivation, and teamwork and collaboration (Andriyani & Anam, 2022; Hasan et al, 2023; Hussein, 2021; Johnsen et al., 2024; Le, 2018; Lee et al, 2015; Lou et al, 2004; Papanikolaou & Boubouka, 2010). Qualitative and quantitative research methods have been used to explore the effects and outcomes of collaborative learning in PBL settings. Qualitative studies have revealed how PBL fosters an inclusive and equitable culture that leverage on the diverse backgrounds of the group members to enhance their social and academic skills. In particularly, deep conceptual understanding and knowledge retention are important for Science and Technology education (Alharbi et al., 2018; Almulla et al., 2020; Dogara et al., 2020; Kim & Iwuchukwu, 2022; Konrad et al., 2021; Ma, 2022; Setyowidodo et al., 2020; Zhang et al., 2023). In contrast, quantitative studies complement the investigations by providing empirical evidence on the positive impact of PBL on student outcomes. Various measurement instruments of questionnaires, peer assessments, interviews, observations and self-reflection journals have been used to assess quality of the teamwork, efficacy and motivation in students (Andriyani & Anam, 2022; Guo et al., 2020; Zhang & Hwang, 2022). For instance, Andriyani and Anam (2022) showed that PBL can improve collaborative skills among Indonesian university students. Similarly, Guo and colleagues (2020) emphasised the importance of using multiple measurement methods to elicit students' experiences and perceptions. Moreover, Zhang and Hwang (2022) examined how peer assessment and problem-solving tendencies interacted to affect students' learning achievements and collaboration in a technology-enhanced PBL environment. However, challenges and barriers had been identified to hinder effective collaboration. Conflicts often emerge in teams due to poor communication, unfair task allocation, clashing values, lack of responsibility and communication skills among team members which can jeopardise the group’s synergy. Other barriers may include the uncertainty about the project scope, process, and outcomes as well as inadequate competency or skills needed for the project. These challenges prompt the need for careful instructional design and intervention strategies to facilitate and sustain successful collaboration in PBL (Alharbi et al., 2018; Berta et al., 2020; Dogara et al., 2020; Hussein, 2021; Marinho et al., 2022).

Methodology

Forty-five year two DPCS students (n=45) had been recruited for this study. They were divided into thirteen project teams, with six groups consisting of four students and seven groups consisting of three students. Each group was assigned a real-world project, sponsored by industry partners who provided the general project direction and requirements. The cohort was divided into six groups of four and seven groups of three. Each team with composition of diverse skills, interests, personalities and working styles, was responsible for working out the specifics and managing project to achieve innovative solutions using PBL. This approach encourages collaboration and helps students develop transferable skills of problem-solving, decision making and investigative abilities, in addition to acquiring relevant technical knowledge and skills.

Figure 2 illustrates the five stages of PBL. They involve planning, organisation and monitoring, forming the key aspects in developing communication and collaborative teamwork skills. During the initial stage of ‘Questioning’, teams employed an inquiry-based approach to ignite curiosity and generate innovative ideas for their projects. By conducting SWOT analyses, teams leveraged on their strengths and opportunities while mitigating weaknesses and threats. Simultaneously, team members brainstormed and developed interview questions to gather consumer insights. These insights guided the team's strategic ideation process, leading to the 'Define' stage, where the team established the project's persona, needs statement, scope, roles and responsibilities designation and SMART goal setting. Establishing shared goals and ground rules within a team not only increased accountability and clarified expectations for each member, but also enabled the team to effectively plan and track project milestones with the use of Gantt charts. Prior to beginning experimentation, the 'Research' stage allows teams to gather relevant information from reliable sources, including books, journals, lecture notes, articles, and online materials. The teams then organised, analysed, synthesised, and made sense of the information to answer the driving questions. This led to knowledge sharing, collaborative learning, and peer feedback. During the 'Create and Improve' stage, teams engaged in prototyping activities such as setting interim goals, experimenting with formulations, testing, data collection, and other laboratory work whereby collaboration and communication skills are emphasised. Teams were given the autonomy to collectively manage resources as well as recommend improvements and solving problem-solving methods. Additional support from their project supervisors and industry partners were also rendered. A robust monitoring and feedback system is essential to track each member’s progress, ensure resource availability, evaluate findings and facilitate efficient and effective decision-making. In the final ‘Present and Evaluate’ stage, team collaborated to achieve their goals, reflect on their findings and present their recommendations to an audience of lecturers, industry partners and professionals.

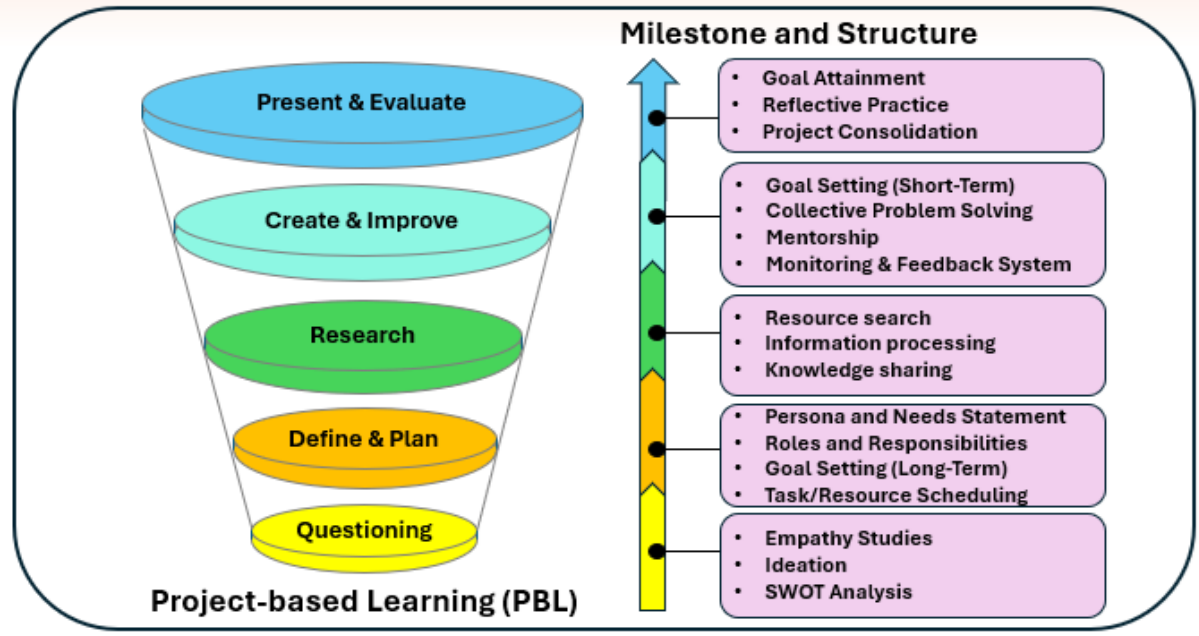

Figure 2: The Facilitation of Effective Teamwork in PBL Settings

To monitor the team effectiveness throughout the project, dialogue sessions were conducted in the first and third quarter of the semester. These sessions aimed to help the students reflect on their collaboration and communication skills beyond the project tangible outcomes. As a final evaluation, a questionnaire adapted from the Team Effectiveness Diagnostic by London Leadership Academy, National Health Service, was administered. The assessment tool used a five-point Likert scale - (1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Strongly Agree) - to measure the students' perception of their team effectiveness based on four dimensions: TM, TS, TD and TE respectively. These dimensions capture the key aspects of team functioning that are considered crucial for successful PBL.

Results and Discussions

The reliability of the questionnaire was first assessed by calculating the Cronbach alpha (α) for each dimension of team effectiveness. This parameter is a measure of internal consistency that indicates how well the questionnaire items in a scale are related to each other. With reference to Table 1, the data reflected that all the dimensions had high reliability, with α values ranging from 0.972 to 0.980. This indicates that the questionnaire items were consistent and coherent in measuring the different aspects of team effectiveness in PBL. A Spearman correlation analysis was subsequently conducted to examine the relationships between the four dimensions of team effectiveness in PBL settings. The results in Table 1 showed that all the dimensions were positively and significantly correlated at 95% confidence level, signifying that they were mutually reinforcing and collectively contribute to the overall team performance. A matrix plot was used to graphically represent the data in Figure 3. The upward trends observed in all the plots validate the analysis with strong correlations with ρ values of 0.934, 0.922, and 0.909 between TS and TD, TS and TM, and TD and TM respectively. These findings suggest that the quality of team interactions and relationships has a direct impact on the formation of team structure and motivation. A well-defined team structure emerges from effective communication, trust, and collaboration among team members, who can clarify their roles and responsibilities, allocate tasks, and make decisions efficiently. Similarly, team motivation is enhanced by clear team goals that minimise

ambiguity and uncertainty, which are potential sources of stress and demotivation. When team members have a shared understanding of what is expected from them and how their individual contributions align with the team's outcomes, they are more likely to perform their tasks competently with a sense of accomplishment. This positive feedback loop is strengthened by fostering a culture of sharing and learning among team members, which further improves the quality of interactions and facilitates the development of a structure that supports coordinated, communicative, and collaborative work. The learning environment becomes a motivating one where team members feel respected, challenged, confident in their ability to contribute and excel, leading to enhanced performance and ultimate team success.

Table 1: Spearman's Coefficients (ρ) and Cronbach's Alpha (α) Values.

Spearman Coefficient (ρ)	Team Motivation	Team Structure	Team Dynamics	Cronbach's Alpha (α)
Team Motivation				0.9799
Team Structure	0.922			0.9724
Team Dynamics	0.909	0.934		0.9776
Team Excellence	0.839	0.884	0.832	0.9794
			Overall	0.9829

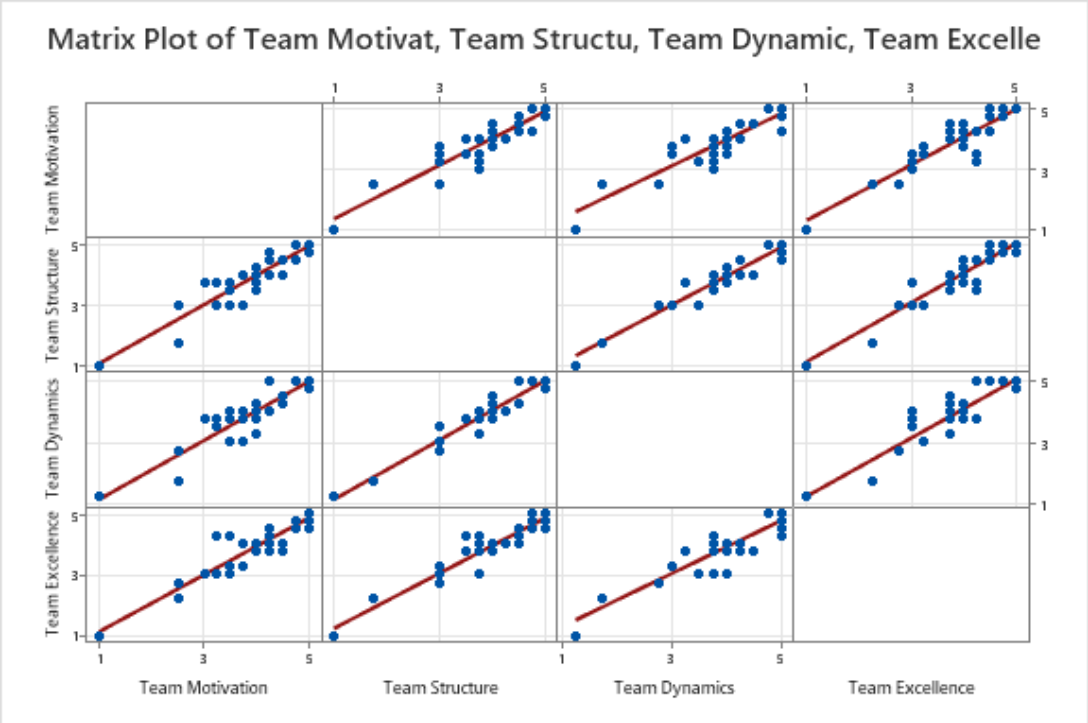

Figure 3: The Matrix Plot Comparison of the Measured Variables

In this section, we posit a team effectiveness model in PBL settings that integrates the four dimensions. The proposed model, depicted in Figure 4, represents the sequential relationship between these four factors that influence and support one another. The innermost layer (TD) is the foundational condition that affects the quality of team interactions and sets the stage for team activities in relation to group dynamics. It involves the development of positive interpersonal relationships, trust, cohesion, communication and conflict resolution among team members. The second layer (TS) is the mechanism that guides and regulates team interactions towards productive outcomes. It involves the implementation of a structural system that the team establishes and adapts to changing conditions and encompasses the

process of defining and assigning roles, responsibilities, tasks, setting milestones, monitoring progress and performance, and providing feedback and support. The third layer (TM) is the driving force that energises and directs team interactions towards shared goals. It involves the alignment of team vision, values and purpose as well as encompasses the intrinsic and extrinsic factors that motivate team members to participate, contribute and collaborate in the team. The outermost layer of the model (TE) is the mindset that shapes the team's attitude and approach in addition to a collective belief in the team's capabilities and potentials. It involves fostering a culture of growth, improvement and resilience in the pursuit of excellence. For example, positive team dynamics can facilitate the adoption of an effective team structure, which in turn can enhance team motivation and team excellence. Conversely, negative TD can hinder the establishment of a clear TS, which in turn can affect TM and TE subsequently.

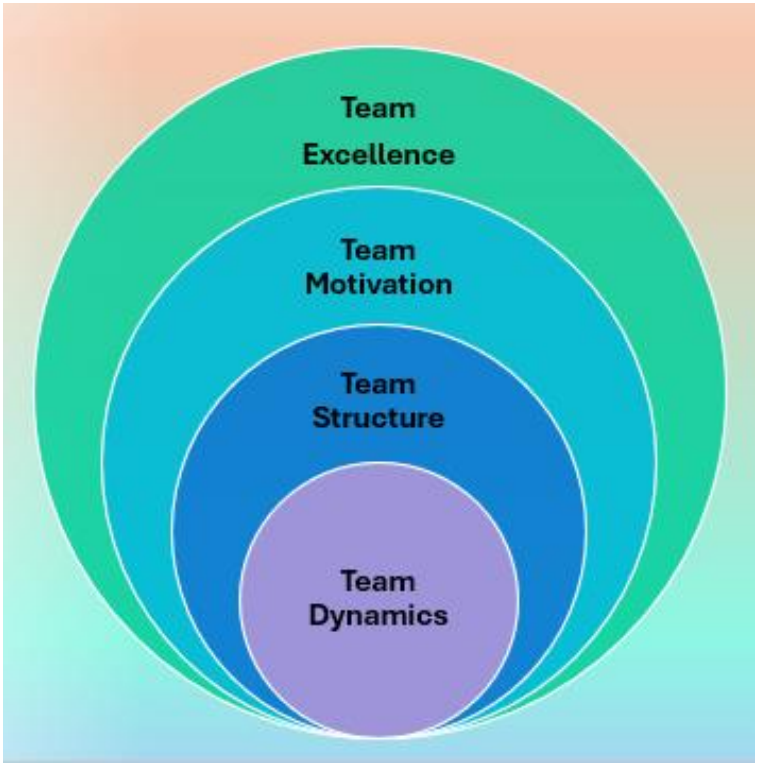

Figure 4: The Conditions and Mechanisms That Optimally Enhance Team Effectiveness in PBL Settings

On the other hand, the model should also consider the diversity and complexity of PBL settings and allows for flexibility and adaptability in its application. Therefore, it does not prescribe a fixed or universal set of conditions and mechanisms for optimal team performance but rather provides a flexible and adaptable framework that can be applied and adjusted according to different situations and needs. Consequentially, the team performance model is not a static outcome but a dynamic process that evolves over time and responds to multiple contextual factors such as the nature of the problem, the characteristics of the learners, the role of the facilitator, and the institutional environment.

In PBL settings, one of the key factors is the role of the project supervisors from academia and professional. They are instrumental (Alharbi et.al., 2018; Kokotsaki et.al., 2016) in enhancing the team's performance, learning and satisfaction by facilitating teams to establish and maintain a clear and coherent team structure that is consistent with the team objectives

and project demands. They also monitor and evaluate team's progress and performance, steer teams towards the desired direction, provide constructive feedback and timely support to address challenging issues such as constructive feedback and support to address challenging issues that exceed students' control, such as technical difficulties, ethical dilemmas or interpersonal conflicts. Furthermore, project supervisors can alleviate students' anxiety by ensuring that the team has adequate and reliable resources, such as information, tools, materials and facilities, that enable them to accomplish the project successfully. While they can stimulate team members to reflect on their learning processes and outcomes periodically, they can also promote team motivation by recognising their accomplishments and progress.

Table 2 summarises the qualitative data collected from self and peer reflections on teamwork performance. The qualitative data revealed the team dynamics in terms of communication, collaboration, coordination and conflict resolution skills that affected the team outputs' quality, efficiency, and creativity, as well as the team members' satisfaction and motivation. The analysis identified various factors that influenced the level of team effectiveness, which are categorised into three levels of high, moderate, and low efficacy. The teams with high efficacy established a positive and supportive team culture that fostered mutual trust, respect and morale. Each member communicated clearly and consistently to ensure alignment with their team goals. The members showed high levels of motivation and accountability to provide constructive feedback and innovative solutions. The teams with moderate efficacy displayed some strengths and weaknesses in different aspects of team effectiveness, but they could improve by addressing their gaps and challenges. On the opposite end of the spectrum, the teams with low efficacy encountered significant difficulties in their fundamental issues such as ineffective leadership, personality clashes and lack of trust that hindered the teams to have clarity about their team goals and roles and responsibilities, leading to the escalation of internal conflicts. Due to an absence of a proper execution of the team mechanism, the ‘free riders’ persisted to lack initiative. The unequal work distribution and contributions from the team members resulted in low team morale and manifested in their poor feedback and creativity skills.

Table 2: The Qualitative Evidence of the Key Team Characteristics Associated to Various Level of Team Effectiveness.

Level of Team Effectiveness	**Team Assessments**
High	- Contribute proactively and significantly to goal attainment by conducting extensive research, sharing of knowledge, seeking feedback regularly and striving for continuous improvement - Exhibit strong role/goal alignment, set detailed plans and follow timelines - Actively engage in problem-solving and provide valuable recommendations and constructive ideas - Develop comprehensive action plans and apply effective strategies collaboratively - Demonstrate high cooperation and strong mutual support in a blame-free environment by actively, acknowledge feelings, maintain optimism and spread positivity, show appreciation, and maintain mutual respect that foster high team morale - Demonstrate effective communication and leadership qualities - Demonstrate strong responsibility. remarkable dedication and adaptability

Moderate	- Inconsistent leadership style and role alignment - Occasional lapses in shared goal setting (prioritise personal goal), task delegation. communication, commitment and contributions, resulting in struggles to meet some of the deadlines - Selective listening and acceptance of criticisms - Moderate efforts in providing innovative ideas
Low	- Ineffective leadership style and role alignment - Inability to overcome personality differences that hinders team dynamics - Failure to understand team goals - Lack of initiative/proactiveness/urgency and commitment, requiring for close supervision - Unequal/minimal contributions - Low team morale resulted from inconsistent support and communication issues

Limitations and Recommendations

There are several limitations in this preliminary study that suggest possibilities for future research. One of them was the short span of a 15-week semester, which might not capture the full development and outcomes. A longitudinal design will offer a more holistic and dynamic evaluation of the team characteristics and their impact on the PBL process. Another limitation lies in the customisation of the intervention strategies that can address the specific needs and challenges of each team, rather than applying a uniform strategy. Extensive studies on various factors such as team leadership, conflict management, and peer evaluation, as well as faculty support in terms of coaching, mentoring, or scaffolding techniques, can reveal how they affect team performance and satisfaction in relation to different levels of team efficacy. They can also help to tackle fundamental issues such as social loafing and blocking in self-selected teams and enhance the team characteristics such as goal clarity, feedback mechanisms, interpersonal relationships, trust, commitment, communication, and respect etc. Furthermore, regular reflections by the team members will lead to more realistic assessment of the strengths and weaknesses of their team composition, process, dynamics and behaviours, and how they influence their overall performance and satisfaction with the projects. This would enable teams to make the necessary adjustments along the way and guide the design, implementation and recommendations of future PBL activities for improving team skills and competencies among students. A third limitation was the focus on one course and subject area, which might limit the relevance and generalisability of the findings to other courses and subject areas. A comparative study of different courses and subject areas, as well as different modes of delivery, such as online or blended learning, could examine the similarities and differences of the team characteristics and outcomes across different contexts and settings.

Conclusion

This study proposes a model of team characteristics that can optimise the benefits of PBL through effective teamwork. PBL is a pedagogical approach that engages the DPCS students in authentic and meaningful projects that require collaboration, communication, creativity, and critical thinking skills. It can effectively enhance the students' learning outcomes and experiences, especially when the team characteristics are well-developed and aligned. The empirical findings indicate that the four dimensions of team effectiveness (TD, TS, TM and

TE) are strongly correlated and mutually reinforcing (ρ>0.82), creating a trajectory of positive PBL experiences. The team characteristics serve as indicators to evaluate team performance. The key to a highly effective team is a cohesive TD that lays the foundational condition for an effective implementation of TS to meet the project requirements and expectations. A clear and strategic structure should guide students' actions and facilitate their project coordination. This clarity of the mechanism drives TM. The high level of enthusiasm and commitment in teams leads to TE, which involves the development of a growth mindset of continuous improvement on the learnings and challenges encountered throughout the PBL process. The strive for excellence continues to promote a collaborative team culture, strengthen team structure, and boost motivation. This cycle of reinforcement is further supported by project supervisors who play a vital role of a facilitator in creating a positive and productive learning environment and providing timely guidance and support in the development of students' technical and soft skills. They also offered opportunities for reflective practice so that teams could evaluate their progress and performance at strategic intervals. In conclusion, this study provides an alternative perspective on how to optimise the benefits of PBL through effective teamwork.

Acknowledgement

The authors would like to express their gratitude to Singapore Polytechnic for its invaluable support in this research.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work the author(s) used ChatGPT, Gemini, Copilot and Perplexity AIs for drafting, language polishing, and content enhancement. These tools were utilised to streamline the writing process, enhance clarity, and ensure coherence. After using these tools/services, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Contact email: LOW_Bee_Lee@sp.edu.sg

A Hybrid SEM-Artificial Neural Network Study on Students' Usage and Perceptions of ChatGPT: Exploring Academic Work Engagement

Klint Allen Mariñas, Mapua University, Philippines
Charmine Sheena Saflor, De La Salle University, Philippines
Jasper Von Chico, Occidental Mindoro State College, Philippines
Hannah Maureen Manzano, Occidental Mindoro State College, Philippines
Monica Shane Tanglao, Occidental Mindoro State College, Philippines

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Abstract
The emergence of artificial intelligence (AI), particularly ChatGPT, has become widely used to aid students in educational tasks. This study investigated students' usage and perceptions of ChatGPT in academic work engagement using a revised Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB). An online questionnaire with 55 items was distributed, collecting 315 responses. Eleven latent variables were examined: technology readiness, user engagement, perceived ease of use, perceived usefulness, social influence, academic work engagement, attitude towards using ChatGPT, self-efficacy, response quality, intention to use, and actual use of ChatGPT. Structural Equation Modeling (SEM) revealed that technology readiness positively correlated with user engagement. User engagement significantly influenced social influence, affecting academic work engagement. Intention to use was significantly influenced by attitude towards using, response quality, and was related to the actual use of ChatGPT. Integrating Artificial Neural Networks (ANN) indicated the intention to use it as the most influential factor. The findings provide insights into the factors influencing ChatGPT adoption in academic environments and enhance the platform's performance.

Keywords: ChatGPT, SEM, ANN, Academic Work Engagement

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Introduction

ChatGPT is an artificial intelligence-based chatbot developed by OpenAI that uses natural language processing (NLP) to generate human-like responses to text-based inputs. Its emergence became a topic of interest, especially in the academic field, emphasizing its benefits and challenges. It has gained 100 million monthly active users in the two months since its release, marking it the fastest-growing consumer application in history (Dempere et al., 2023). Previous studies highlight the diverse benefits of ChatGPT in education, including research support and automated grading; however, issues such as online testing security, plagiarism, and broader societal and economic impact also arise (Robledo et al., 2023).

In the Philippines, ChatGPT has shown transformative effects on the education system. It became a tool that helps educators create educational content, as it offers suggestions and aids them in answering learners' questions, promoting collaborative work (Malik, 2024). Students in the Philippines utilize ChatGPT to generate and explore new concepts and ideas for their academic work (Antivola, 2023).

However, there are issues regarding its usage, such as the possibility of providing wrong and misleading information and plagiarism (Yu, 2024). However, despite these issues, integrating ChatGPT in academic environments positively impacts teaching-learning (Abderahman, 2024). Integrating ChatGPT in education has advantages and disadvantages; thus, educating teachers and students about its capabilities and restrictions is crucial (Agariadne, 2024).

An artificial neural network (ANN) is a computational model based on the structure and functions of biologically derived neural networks like humans' brains. It comprises interconnected nodes or neurons divided into layers: input, hidden, and output. Each neuron processes input data using weights, biases, and activation functions, allowing the network to learn from complex, non-linear relationships in the data through training. In SEM, indicator variables can be integrated with indirectly visible indicators (Shaghayegh, 2023). A new generation that merges SEM with artificial neural networks (ANNs) has emerged and aims to address the issues that cannot be solved solely by SEM analysis.

Contrary to SEM, an ANN is not suitable for hypothesis testing, but further to linear relationships can also deal with non-linear relationships. In addition, the ANN is capable of assessing the non-compensatory procedures. Moreover, the ANN is more reliable and can provide more accurate predictions than linear models (Sol & Baras, 2022). Furthermore, the integration of the SEM and ANNs allows for further validation of the findings of the SEM and the capture of the non-linear interactions between the antecedents and the outcome variables (Ghavifekr & Rosdy, 2015).

The research examines how college students utilize ChatGPT for their academic studies, aiming to fill a significant gap in the existing literature on this subject. The research examines how college students utilize ChatGPT for their academic studies, aiming to fill a substantial gap in the existing literature on this subject. These findings have implications for educators and students and provide valuable insights into teaching methods and strategies that promote deeper learning and responsible technology used in the classroom. By understanding how students engage with ChatGPT, educators can adapt their instructional approaches to integrate better AI-powered tools into the learning environment, ultimately enhancing the overall educational experience for students (Khan & Siddiqui, 2023). By understanding how students engage with ChatGPT, educators can adapt their instructional approaches to

integrate AI-powered tools into the learning environment better, ultimately enhancing the overall educational experience for students.

The study offers insights into the potential challenges and opportunities associated with AI-powered writing assistants, particularly in developing regions such as the Philippines. By shedding light on adopting the technology acceptance model (TAM) at the academic level, this research contributes to an expanding body of knowledge on the utilization of AI tools in educational settings (Kamalov et al., 2023). Understanding the unique challenges and opportunities presented by AI-powered writing assistants in developing regions can inform the development of tailored strategies to maximize their benefits and address potential barriers to adoption, thereby contributing to advancing educational practices and technologies in these contexts.

The research aims to comprehensively investigate the factors consistently motivating college students to utilize ChatGPT within educational settings. By exploring elements such as perceived usefulness in academic tasks, convenience in accessing information, efficacy in resolving queries, and broader impacts on academic advancement, the study seeks to uncover the fundamental motivations underlying students' recurrent engagement with the platform. Through this thorough examination, the research endeavors to attain a holistic understanding of what encourages students to persistently employ ChatGPT as a valuable resource in their educational pursuits.

The research investigates accessibility and ongoing user engagement, particularly among college students, to facilitate effective utilization of AI tools for deeper learning and responsible technology use. This endeavor highlights the importance of adopting a holistic strategy, including implementing innovative pedagogical practices integrating AI tools into educational approaches. By offering dynamic learning experiences tailored to diverse learning styles, educators can address potential disinterest or boredom that may lead to persistent usage of AI tools (Nguyen, 2023).

Moreover, ethical considerations are pivotal, necessitating open discussions on responsible technology use to empower students to make informed decisions and navigate ethical dilemmas associated with AI tools. Adopting student-centered approaches allows educators to understand better and address motivations driving persistent usage, fostering a sense of ownership and accountability among students (Iversen et al., 2015). Additionally, promoting critical thinking skills through activities that stimulate analysis, evaluation, and synthesis of information enables students to approach AI tools thoughtfully, minimizing the potential for over- dependence. Maintaining a balance between technology use and traditional pedagogical approaches ensures a comprehensive education encompassing varied learning experiences, diminishing the risk of excessive reliance on AI tools (Yu, 2024).

Methodology

Participants

The researchers implemented a hybrid methodology for disseminating survey questionnaires, integrating digital and conventional approaches. Google Forms served as the principal platform for distributing survey inquiries across diverse social media channels, complemented by face-to- face surveys wherein participants were provided with physical copies of the questionnaires. Before participation, each respondent provided informed

consent. The study was conducted at Occidental Mindoro State College (OMSC), encompassing eight distinct college departments with a population exceeding 5,000 individuals as of 2024. A simple random sampling technique was employed, and a sample size of 315 respondents was determined, exceeding the typical requirement of 200 respondents, especially in studies involving Structural Equation Modeling (SEM) (Khan & Siddiqui, 2023). These selected participants actively engaged in online and physical surveys, responding to a comprehensive questionnaire comprising 55 items.

The data gathered indicates that among the 315 participants surveyed, 54.3% identified as female, while 45.7% identified as male. Most respondents fell within the age range of 20-22 years (44.1%). Additionally, 33.7% were between 18-20 years old, 16.2% were aged 22-25, and only 6.0% were 25 years old and above. Regarding academic affiliation, the College of Business and Administration accounted for the most significant proportion of respondents, comprising 23.8% of the total. The School of Architecture had the lowest representation at 5.1%. Regarding educational attainment, 52.4% of respondents held a bachelor's degree, 34.9% had not completed high school, 8.3% had undergone college or vocational training, and 4.4% held a master's or doctorate. When examining monthly income, most respondents reported earning less than Php 10,000, constituting 60.6% of the sample. Additionally, 22.5% earned Php 20,000 or more monthly, 10.5% earned between Php 15,000 and Php 20,000, and only 6.3% earned between Php 10,000 and Php 15,000 monthly.

Structural Equation Modeling

The variables were drawn from a variety of research sources in literature. Observable factors were assessed using a Likert scale ranging from 1 to 5, where 1 signified "strongly disagree" and 5 signified "strongly agree", as shown in Figure 2. Data analysis was performed using AMOS software. The theoretical model data were confirmed through Structural Equation Modeling (SEM). SEM is especially effective for constructing a theoretical causal model that includes anticipated covariances among variables (Cruz-Cárdenas et al., 2021). This facilitates the exploration of covariances and provides valuable insights.

Results and Discussion

Results

This study investigates underlying factors influencing students' behavior and attitude in utilizing ChatGPT in their academic work. Eleven latent variables were examined using the structural equation model (SEM) to assess the relationship between technology readiness (TR), user engagement (US), perceived ease of use (PEU), perceived usefulness (PU), social influence (SI), academic work engagement (AWE), attitude towards using ChatGPT (ATU), self-efficacy (S), response quality (RQ), intention to use (IU), and actual use of ChatGPT (AUC). The SEM results show that out of 14 hypotheses, three were found to be insignificant, namely technology readiness towards perceived ease of use, academic work engagement towards perceived usefulness, and perceived ease of use towards attitude towards using ChatGPT having the p-value above 0.05, which does not meet criteria of the SEM standards on cut off procedures. Thus, a revised SEM was obtained by removing these hypotheses following the previous studies (Khoza et al., 2024).

Significant relationships, evidenced by p-values below 0.05, exist between technology readiness and user engagement (H1), user engagement and social influence (H3), user

engagement and perceived ease of use (H4), social influence and academic work engagement (H5), perceived usefulness and social influence (H6), perceived usefulness and perceived ease of use (H8), perceived usefulness and attitude towards using ChatGPT (H9), self-efficacy and attitude towards using (H11), attitude towards using and intention to use (H12), response quality and intention to use (H13), and intention to use and actual ChatGPT use (H14). Conversely, non-significant relationships, with p-values of 0.05 or higher, were found between technology readiness and perceived ease of use (H2), academic work engagement and perceived usefulness (H7), and perceived ease of use and attitude towards using ChatGPT (H10).

A detailed examination of literature-derived guidelines concerning students' engagement with ChatGPT alongside a compilation of standard model fit statistics obtained from a structural equation model. A thorough evaluation of these model fit indices is essential to ascertain how the proposed model accurately reproduces the observed co-variance matrix among all indicators. The Chi-Square (CMIN) statistic, when normalized by the degree of freedom (DF), yields an estimate of 2.196, indicative of an excellent fit. Moreover, the Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Tucker Lewis Index (TLI) surpass the minimal values recommended for satisfactory fit, boasting respective values of 0.803, 0.805, and 0.792. Researchers have diligently addressed all modification indices within the same variable to enhance model fit, implying room for further refinement. Finally, the Root Mean Square Error of Approximation (RMSEA) meets the established criteria at 0.062, with lower values denoting superior fit (Ekşioğlu & Ural, 2022). The evaluation shows that a well-fitted model, based on positive values for all the fit indices, indicates potential improvements by addressing these modification indices within individual variables.

Artificial Neural Network

An Artificial Neural Network (ANN) operates similarly to the brain's neural structure, processing data through interconnected nodes to recognize patterns and make predictions (Raj, 2023). Similarly, Structural Equation Modeling (SEM) analyzes relationships between variables, making it an applicable tool for assessing how ANNs learn and predict outcomes. The SEM findings indicate that all latent variables positively correlate with each connection, as indicated by p-values > 0.05. In the context of ANN, input nodes such as RT, US, PEU, PU, SI, AWE, ATU, S, RQ, and IU demonstrate a significant correlation with the dependent variable, representing the actual use and the study's endpoint. The findings from the ANN revealed that the variable Intention to Use (IU) emerged as the most influential factor, followed by the respective parameters as outlined. The consistent findings observed in both SEM and ANN are crucial to consider the indirect effect of SEM, emphasizing its substantial impact on the reported outcomes. This underscores the discovery's significance, validated through the hybrid SEM-ANN methodology (Figure 1).

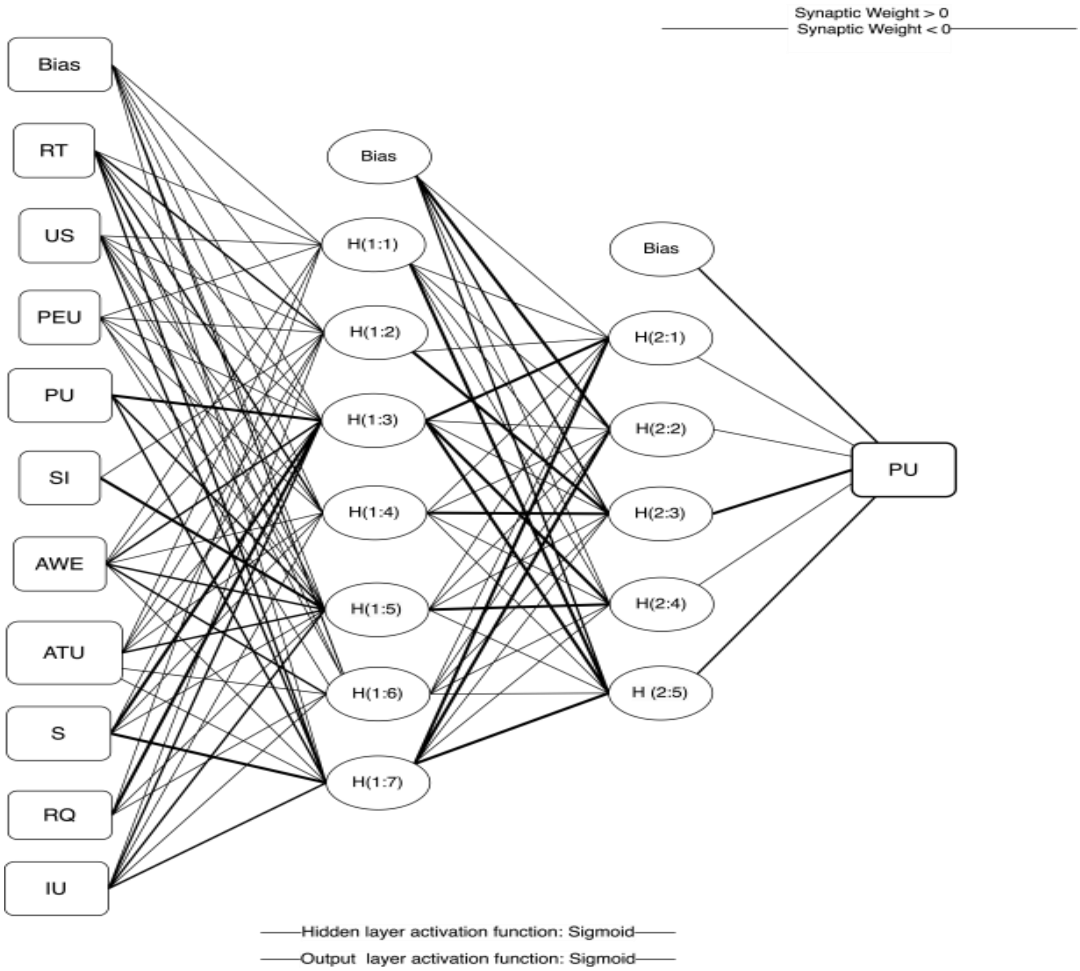

Figure 1: Artificial Neural Network Model

Conclusion

Flash Chat GPT is an artificial intelligence-based chatbot developed by OpenAI that uses natural language processing (NLP) to generate human-like responses to text-based in-puts. Its emergence has become a topic of interest, especially in the academic community, emphasizing its advantages and challenges. Hence, the study delved into the intricate relationships among various factors influencing college students' engagement with ChatGPT, including technology readiness, user engagement, perceived ease of use, perceived usefulness, social influence, academic work engagement, attitude towards using ChatGPT, self-efficacy, response quality, intention to use, and actual use of the platform. Utilizing Structural Equation Modeling (SEM), the analysis unveiled significant positive correlations, most notably between technology readiness and user engagement. This finding implies that students with a better grasp of effectively utilizing ChatGPT tend to participate more actively on the platform.

The researchers used digital and traditional methods in distributing survey questionnaires to 300 participants to understand students' attitudes, identify key engagement factors, and evaluate ChatGPT's impact on academic outcomes. The questionnaire, created by the researchers, was divided into 14 sections and covered 11 factors, with 55 questions. They used AMOS software to analyze the data and confirmed their theoretical model with SEM.

To further explore and validate these relationships, an Artificial Neural Network (ANN) model was employed to analyze training and testing datasets related to students' perceptions and usage of ChatGPT. The ANN model, trained on a 70% data sample and tested on a 30% data sample, provided performance metrics such as the Sum of Squared Errors (SSE) and Root Mean Square Error (RMSE), which indicated the accuracy and predictive capability of the models in assessing students' engagement with ChatGPT. Recognizing the limitations of SEM in capturing nonlinear relationships and non- compensatory procedures, the study integrated SEM with ANN. This hybrid approach allowed for a more comprehensive validation of SEM findings and enabled the capture of nonlinear interactions between the antecedent and outcome variables. The combined insights from SEM and ANN offer valuable implications for educators and students, informing the development of tailored strategies to promote deeper learning and responsible technology use in higher education settings.

In conclusion, the study provides researchers, teachers, and educational technology developers with a deeper understanding of factors that affect students' involvement in using AIWriters Writing Assistants, which offers valuable insight on developing effective teaching practices, as well as information on designing and implementing artificial intelligence tools in education settings.

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Contact email: kaamarinas@mapua.edu.ph

The Impact of Skill Test on Technical High Schools in Taiwan

Jen-Chia Chang, National Taipei University of Technology, Taiwan
Shao-Chen Chou, National Taipei University of Technology, Taiwan

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Abstract
This study primarily investigated the impact of skill test on vocational education in Taiwan. The skill test certificate, issued by the government, assessed the proficiency of technical skills, providing vocational school students with a clear understanding of their learning outcomes. Through a questionnaire survey, this research gathered insights from vocational school principals regarding the use of the skill test as a measure of student skill acquisition and its appropriateness within the educational context. A survey was conducted using a combination of open-ended and closed-ended questions as research instruments. The survey targeted principals of technical high schools and a total of 60 questionnaires were collected. The results indicated that the primary benefits of implementing a skill test were the improvement of the students' technical proficiency (98.3%) and the enhancement of the teachers' professional instructional skills (71.7%). The primary issues requiring improvement were the impact of skill test on traditional school instruction (45%) and the obsolete nature of examination questions (33.3%). The policy recommendations included: 1. increasing industry participation and assigning private organizations to manage relevant skill test certificates under the Workforce Development Agency, MOL. supervision; 2. reviewing and updating skill test to improve their content; and 3. urging the Ministry of Education to align the curriculum with skill test requirements. In conclusion, optimizing the content and processes of skill test, promoting Occupational Competency Standard and enhancing the social image of vocational education could effectively change societal perceptions of skills and improve the overall quality of vocational education.

Keywords: Skill Test, Skill Test Certificate, Vocational Education, Technical High Schools, Talent Cultivation, Special Achievement and Screening-Based Admission, Ability Identification

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Introduction

The skill test as an evaluative tool for assessing technical proficiency has had a significant impact on the development of vocational education in Taiwan. Vocational education aims to equip students with specialized skills in specific fields to meet the rapidly changing demands of industries. The skill test system plays a critical role in this process, not only by providing students with a standard to self-assess their learning outcomes but also in helping institutions set educational goals and directions.

Research by Hsi-Shan Lai (2020) highlights a positive relationship between awareness of the skill test, learning effectiveness, and employment awareness. Furthermore, learning effectiveness positively influences employment awareness. In relation to skill test-related topics, experts and scholars in Taiwan have conducted extensive research on areas such as the appropriateness of question bank design, the impact on teaching, learning motivation, attitudes and learning effectiveness. These studies, primarily focused on students and teachers, include works by Wei-Ming Hsieh (2016), Ching-Chin Su (2019), Hsi-Shan Lai (2020), Tsu-Ming Yeh, Fan-Yun Pai, Yi-Long Shu (2020), and Chia-Yu Wang and Chung-Yung Tu (2021). These studies provide valuable insights for improving the content of the skill test and fostering student skill development, while also laying the groundwork for better alignment between vocational education and industry needs.

Although many scholars have offered valuable suggestions regarding the skill test and student skill development, there remains a lack of empirical research on the role and influence of vocational school principals in this area. As key leaders of vocational schools, the principals' perspectives are crucial to understanding the role of the skill test in vocational education. Therefore, this study aims to explore the views of technical high school principals on the use of the skill test to measure the students' skill acquisition and its appropriateness within the educational context. The main research objectives are as follows:

1. Understand the application of the skill test in vocational education.
2. Investigate the impact of implementing skill tests for full-time students in technical high schools on teaching.
3. Analyze technical high school principals' perspectives on the skill test system.
4. Provide suggestions for the application of the skill test system in Taiwan’s technical high schools.

Literature Review

Current Status of the Skill Test

The skill test is a system designed to assess the professional skills of technicians, with certificates awarded to those who meet the required standards. The primary objective of the skill test is to enhance labor skills and support social and economic development. The exam consists of both a written and a practical test, and individuals who pass are designated as "technicians," receiving a skill test certificate issued by the central competent authority. Since its inception in 1963, more than 9.7 million certificates have been issued.

Of the 139 available occupational categories, 82 carry legal significance, including fields such as crane operations, childcare, Chinese cuisine, occupational safety and health management and employment services. The skill test categories are divided into three levels:

Level A, B and C. If a category is not suited for this tiered classification, it is assigned a single level.

Application of the Skill Test in Vocational Education

The relationship between the skill test, talent cultivation and industry demand is dynamic and interdependent. The skill test not only boosts corporate productivity but also has a significant impact on vocational education. As industries rapidly evolve, educational institutions have increasingly integrated skill development into their curricula to ensure that students acquire the practical skills demanded by the marketplace. The Ministry of Education has adjusted educational policies accordingly, aiming to better align the skill test with formal education.

Special Achievement and Screening-Based Admission Policy.

To improve admissions pathways, the Ministry of Education introduced the "Special Achievement and Screening-Based Admission" policy in 2001 (Ministry of Education, 2001). This policy encourages vocational students to engage in skill learning by offering extra points on entrance exams for those holding relevant skill test certificates. However, some students began acquiring certificates unrelated to their field of study solely to gain bonus points, straying from the policy's original intent of promoting professional skill development.

As a response, the Ministry revised the qualifications for this program. Bonus points are now awarded to students who win prizes in international or national skill competitions. For students holding Level B or higher skill test certificates, bonus points for admission to 2-year and 4-year technological colleges are tiered based on the certificate's relevance to the student's field of study, with 15%, 8% and 4% bonuses for high, medium and low relevance, respectively.

Licensing in Vocational Education Policy.

To enhance the employability of vocational graduates, the Ministry of Education introduced the "Licensing in Vocational Education" policy in the 2009 academic year. This policy emphasizes aligning teaching content with employment demands, making Level B and C skill tests a graduation requirement to ensure that students are job-ready. This initiative has significantly boosted the competitiveness of vocational graduates in the job market (Meng et al., 2010). Institutions such as the Taipei University of Marine Technology and National Chin-Yi University of Technology have already incorporated certification as a graduation criterion. Additionally, the Ministry of Labor offers three certification channels: the national technician skill test, full-time student testing programs and instant testing, immediate evaluation and certification programs, encouraging students to obtain multiple skill test certificates.

Pilot Program for Encouraging Youth to Obtain Skill Test Certificates in Key Industries and Achieve Stable Employment.

To encourage the youth aged 15 to 29 to acquire professional skills and obtain skill test certificates, the Workforce Development Agency, MOL launched the "Pilot Program for Encouraging Youth to Obtain Skill Test Certificates in Key Industries and Achieve Stable Employment" on July 1, 2023 (Workforce Development Agency, MOL, 2024). Key industries include semiconductors, communications and smart machinery. The program

offers two tiers of incentives: first, a "Certificate Incentive Bonus" for youth obtaining skill test certificates in 22 key industries, with rewards based on the certificate level: NTD20,000 for Level A, NTD10,000 for Level B and NTD5,000 for Level C. Additionally, those who secure a certificate and work in a corresponding key industry for at least 90 days will receive an "Employment Incentive Bonus."

Impact of Full-Time Student Skill Testing on Teaching in Technical High Schools

The skill test assesses workplace-specific skills in-depth. While it helps students master individual skills, the preparation often involves repetitive practice, limiting the teaching of broader competencies (Fang, 2021). Huang-Chia Huang (2002) noted that skill testing significantly influences internship teaching in vocational high school electrical engineering departments, especially in private institutions. Many teachers believe regular classroom instruction is insufficient to prepare students for the skill test, necessitating additional practice outside of class.

I-Hsuan Chiang (2012) highlighted several challenges faced by vocational high schools' special education sections in preparing students for the Level C skill test, including limited practice time, high exam difficulty, a lack of administrative resources and insufficient specialized equipment. Despite these challenges, teachers still viewed the use of skill testing as an effective student development tool. Hui-Chun Chuang (2007) found that practical instructions based on skill test questions significantly improved the students' cognitive and technical performance. Tzu-Ming Yeh and colleagues (2020) showed that students' learning behavior, teaching methods and the learning environment significantly affect the outcomes of the skill test, demonstrating that vocational education certification aligns education with industry needs, enhancing student competitiveness and creating a win-win-win scenario.

Methodology

Participants and Procedure

A total of 141 questionnaires were distributed to principals of technical high schools, with 60 valid responses collected, yielding a response rate of 42.55%. The survey employed purposive sampling and was conducted via an online questionnaire from December 12 to December 15, 2023.

Measurement

The research tool used in this study was a questionnaire titled "Principals' Survey on Skill Tests for Full-Time Technical High School Students." It included sections on school attributes and location, featuring both multiple-choice and open-ended questions.

Results and Discussion

The SPSS statistical software was used to analyze data from the 60 valid questionnaires. The research findings are as follows:

Basic Data Analysis

The analysis focused on school attributes and whether or not the school was located in one of the six major municipalities. Among the respondents, 85% of schools were public, while 15% were private. In terms of location, 48.33% of schools were in the six major municipalities and 51.67% were not. The distribution of schools by both attribute and location is as follows: 35% were public schools in the six major municipalities, 13.33% were private schools in the six major municipalities, 50% were public schools outside the six major municipalities and 1.67% were private schools outside the six major municipalities, as shown in Table 1.

Table 1: Basic Data of Principals' Schools

(N=60)

Attribute	Category	Quantity	Percentage (%)
Public or Private	Public	51	85.00
	Private	9	15.00
School Location	Six Major Municipalities	29	48.33
	Not in the Six Major Municipalities	31	51.67
In the Six Major Municipalities	Public	21	35.00
	Private	8	13.33
Outside the Six Major Municipalities	Public	30	50.00
	Private	1	1.67

Data Analysis

Advantages of Conducting Skill Tests.

The principals were asked to select the advantages of skill tests. The top three were: "Enhancing students' technical abilities" (27.83%), "Improving teachers' professional abilities" (20.28%), and "Increasing graduates' employment rate" (14.15%). These results suggest that skill tests not only directly improve students' technical abilities but also enhance teachers' professionalism, ultimately increasing the graduates' competitiveness in the job market. The results are shown in Table 2.

Table 2: Advantages of Conducting Skill Tests (Multiple Selections)

Attribute (Advantages)	Frequency	Percentage (%)
Enhancing students' technical abilities	59	27.83
Improving teachers' professional abilities	43	20.28
Increasing graduates' employment rate	30	14.15
Improving school equipment	25	11.79
Increasing the graduates' further education rate	22	10.38
Enhancing the school's reputation	15	7.08
Increasing the chances of obtaining government funding	13	6.13
Expanding the students' international outlook	5	2.36

Disadvantages of Conducting Skill Tests.

The principals were also asked to identify the disadvantages of skill tests. The top three were: "Disrupting regular teaching" (22.88%), "Inappropriate exam content" (16.95%), and "Low student participation" (16.10%). This indicates that while skill tests have advantages in enhancing technical skills, they may also disrupt regular teaching and suffer from issues such as outdated exam content and low student participation. The results are shown in Table 3.

Table 3: Disadvantages of Conducting Skill Tests (Multiple Selections)

Attribute (Disadvantages)	Frequency	Percentage (%)
Disrupting regular teaching	27	22.88
Inappropriate exam content	20	16.95
Low student participation	19	16.10
Complex regulations for the test	17	14.41
Complicated administrative procedures	12	10.17
Low pass rate of the test	6	5.08
Exam content too simple	5	4.24
Poor communication between schools	5	4.24
Exam content too difficult	3	2.54
High difficulty in executing the test content	2	1.69
Low cooperation from host schools	2	1.69
Inefficient execution by host schools	0	0.00
Unclear test regulations	0	0.00

Impact of School Attributes and Location on the Advantages and Disadvantages of Conducting Skill Tests.

Chi-square tests were conducted to analyze the impact of school location and attributes on the advantages and disadvantages of skill tests. For advantages, several items showed significant effects:

1. School location and improvement of school equipment: Schools located in the six major municipalities were more likely to believe that conducting skill tests could enhance the improvement of school equipment compared to private schools.
2. School location and increased chances of obtaining government funding: Schools in the six major municipalities were more likely to believe that conducting skill tests could increase their chances of obtaining government funding compared to private schools.
3. School attributes and improvement of school equipment: Private schools were more likely than public schools to believe that conducting skill tests could enhance the improvement of school equipment.

However, in terms of disadvantages, neither "school location in the six major municipalities" nor "school attributes" showed any significant relationship with any of the disadvantage items. This indicates that while there are significant differences in the evaluation of the advantages of skill tests based on school location and attributes, their influence on the disadvantages is not significant.

Table 4: Chi-Square Test of School Location

Statistics	Is your school located in one of the six major municipalities?		χ^2
	Yes	No	
Improvement of school equipment			9.613*
Yes	18 (62.07%)	7 (22.58%)	
No	11 (37.93%)	24 (77.42%)	
Increased chances of obtaining government funding			5.432*
Yes	10 (34.48%)	3 (9.68%)	
No	19 (65.52%)	28 (90.32%)	

*p<.05

Table 5: Chi-Square Test of School Attributes

Statistics	School attributes		χ^2
	Public	Private	
Improving school equipment			9.714*
Yes	17 (33.33%)	8 (88.89%)	
No	34 (66.67%)	1 (11.11%)	

*p<.05

Conclusion and Recommendations

Conclusion

The results of the chi-square tests in this study indicate that most advantages and disadvantages are not significantly correlated with a school's geographical location or type, but they are significantly related to equipment updates and government funding. The study found that schools in the six major municipalities generally believe that holding skill tests helps increase the rate of equipment updates and makes it easier to receive government funding. In comparison, the private schools demonstrated a significantly higher recognition of the benefits of skill tests in promoting equipment updates than the public schools.

The differences between schools in the six major municipalities and those outside may stem from multiple factors. First, the economic development of the six municipalities is relatively stronger and resources are more abundant, enabling schools to more effectively promote skill tests and equipment updates. Additionally, schools in these municipalities are geographically closer to government agencies, making it easier to receive policy support and funding. Furthermore, the diverse vocational demands in these municipalities encourage schools to actively update their facilities to meet market needs.

Private schools, due to intense competition, prioritize equipment updates to attract students and enhance their image. Although public schools receive relatively more government subsidies, their use of resources is more constrained, which may lead to insufficient awareness or demand for equipment updates. These factors collectively influence how schools view skill tests and their implementation, which in turn affects the overall quality of vocational education and the development of students' skills.

In open-ended responses from principals, many pointed out that skill tests are often treated as the primary focus of vocational education, which may narrow its original goals. According to the 2018 examination regulations, industry experts make up only 39.2% of the exam

committee, while academic experts account for 42.8%. Despite efforts by the Ministry of Labor (MOL) to promote greater participation by industry experts, this proportion still needs improvement. Additionally, of the 138 skill test certificates issued by the MOL, only 82 have legal utility, with most concentrated in industrial categories. This suggests that over 40% of the certificates offer limited practical assistance to job seekers, thereby limiting the real value of vocational education to some extent.

Recommendations

Based on the survey results, it is evident that schools' views on skill tests vary according to geographical location, school type and access to resources. These differences influence the promotion of equipment updates and government funding support. To further improve the overall quality of vocational education and ensure that the certification system effectively fosters students' skill development, this study offers the following recommendations:

1. Enhance resource investment in equipment updates: To reduce the resource gap between schools in the six municipalities and those outside, it is recommended to provide more financial support to schools outside the six municipalities to minimize urban-rural disparities. Additionally, establishing an equipment-sharing platform between schools in and outside the six municipalities can reduce update costs, promote resource sharing and ensure that schools in all regions can effectively enhance the quality of vocational education.
2. Strengthen alignment between skill tests and industry needs: Increase the proportion of industry experts involved and delegate skill tests that lack legal utility to be managed by private organizations, with the MOL overseeing management. Industry stakeholders should be required to formulate certification standards and sign confidentiality agreements.
3. Support equipment updates in private schools: The government should provide targeted subsidies and financing support (such as loans) to private schools, allowing them to maintain teaching quality amid intense market competition. Furthermore, cooperation between public and private schools should be strengthened, encouraging both sides to form partnerships, share successful experiences in resource updates and promote cross-school collaboration.
4. Reduce over-reliance on skill tests: Vocational education should rebalance the relationship between teaching and certification, focusing on cultivating students' practical and innovative abilities rather than solely treating skill tests as the primary teaching objective. Therefore, it is recommended that the Ministry of Education strengthen guidance on school teaching policies, ensuring that the skills taught align with the content of skill tests and improve students' overall vocational competencies. A comprehensive assessment mechanism should also be established to provide students with diverse learning evaluations and promote holistic development.
5. Promote policy and industry dialogue: Regular industry-academia collaboration meetings are recommended to establish a long-term dialogue mechanism between the government, schools, and industries. This will facilitate ongoing assessment of the need for skill tests and equipment updates, ensuring that vocational education keeps pace with market changes and technological innovations.

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Contact email: mateda2015@gmail.com

Use Eye Movement Features to Explore the Impact of Language Features on Text Difficulty

Yi Ju Chan, National Taiwan University of Science and Technology, Taiwan
Hou-Chiang Tseng, National Taiwan University of Science and Technology, Taiwan
Yao-Ting Sung, National Taiwan Normal University, Taiwan

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Abstract
Lifelong learning emphasizes continuous learning throughout one's life, with reading enriching elders' lives and aiding their adaptation to aging. However, aging is often associated with a decline in cognitive functions and an increased risk of impairment, making providing appropriate reading materials for elders a crucial matter. Scholars have explored the correlation between eye movement indicators and text difficulty. However, previous research has rarely explicitly linked eye movement indicators to linguistic features, which may limit authors' ability to comprehensively assess their texts' readability. Therefore, this study utilizes an eye tracker to observe elders' reading behavior when engaging with texts of varying difficulties, extracts eye movement indicators to examine challenges faced by elders with different reading abilities, and employs CRIE (Chinese Readability Index Explorer) to analyze the computational linguistic features. The aim is to understand why certain linguistic features pose reading challenges for elders. The findings revealed that when elders read difficult texts, their dwell time and regression count increased, particularly with longer sentences and unfamiliar vocabulary. Linguistic indicators exhibited moderate correlations with several eye movement indicators, suggesting that language structure significantly influences reading behavior. This study, beginning with the reader's reading process, identifies specific correlations between eye movement indicators and text difficulty, offering a novel perspective for research in eye movement and computational linguistics. Furthermore, it has implications for the cognitive health management of elders in medical and psychological fields, ultimately enhancing their quality of life and promoting lifelong learning.

Keywords: Eye Tracker, Linguistic Feature, Text Difficulty, Text Readability, Elders

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1. Introduction

Since Taiwan entered an aging society in 1993, the proportion of people over 65 years old has been increasing year by year. According to statistics from the Ministry of Interior (2024), the population over 65 years old in Taiwan has reached 4.158 million, accounting for 17.8% of the total population. Given this data, aging has gradually become an important issue in Taiwan. For example, lifelong learning has been the focus of aging in recent years. In contemporary education and psychological research, lifelong learning is widely considered to profoundly impact individual cognitive, psychological, and social well-being. For the elderly, reading is not only a means of acquiring knowledge, but also a key activity for maintaining cognitive functions, promoting mental health, and social cipation (Rigg & Kazemek, 1983; Zhang et al., 2022). In light of the growing elderly population, it is imperative to provide materials that are appropriate for the reading abilities of elders.

Reading is a cognitively demanding activity that requires the coordination of both linguistic and non-linguistic cognitive functions, such as attention, abstract reasoning, working memory, long-term memory, and lexical and conceptual retrieval (Kweldju, 2015; Afifah et al., 2008). As people age, there are natural declines in memory, language, and other cognitive functions, which is a normal aspect of the aging process. Aging leads to cognitive decline and memory deterioration, among other cognitive impairments (Pearman & Storandt, 2005). Therefore, reading materials for elders should consider cognitive load to ensure that they can engage with reading while also receiving an appropriate cognitive challenge.

Many studies have started to focus on text difficulty, with research commonly falling into two categories. First, some studies use multiple-choice questions and cloze tests to assess text difficulty. For example, Bormuth (1969) utilized readers' performance on cloze tests as an objective measure of text readability. Fanguy and colleagues (2004) used cloze tests to determine whether readers understood a company's privacy policy. Similarly, the McCall-Crabbs Standard Test Lessons in Reading designed multiple-choice questions based on the writing and content of the texts, requiring readers to read the passages and respond to questions (McCall & Crabbs, 1961). Second, traditional readability models assess difficulty based on vocabulary quantity and complexity. For instance, Lively and Pressley (1923) argued that textbooks filled with technical terminology made it difficult for students to learn, while the Flesch Reading Ease formula measures readability by considering the average number of syllables per word and sentence length (Flesch, 1948). Although research on text difficulty is abundant, these readability assessment standards often predict readability using surface-level linguistic features, which fail to reflect the deeper cognitive mechanisms involved in reading (Benjamin, 2012; Bormuth, 1966; Davison & Kantor, 1982).

In comparison to the limitations of the traditional readability models previously discussed, eye-tracking technology provides a relatively objective method for investigating how readers engage with texts (Rayner, 1998). Eye movements are frequent and highly variable (Shan & Zhou, 2020), making eye-tracking an effective tool for providing real-time information about a user's psychological state (Djamasbi et al., 2010) and reflecting cognitive processing through eye-tracking indicators (Just & Carpenter, 1976; Martin et al., 2011). This method has been widely used to explore topics related to reading processes, such as eye movement characteristics, perceptual span, and information integration. Furthermore, eye-tracking data is frequently utilized to investigate cognitive processes across diverse cognitive tasks (Rayner, 1998), and eye-tracking devices provide sufficient indicators to capture real-time cognitive processing during reading (Jian, 2022). As this technology has matured, it has continued to be

applied in various fields of learning research, particularly in process-oriented studies. For instance, Wang and Jian (2022) reviewed nearly 30 years (1990-2020) of research on the reading processes of scientific text and images, revealing that research in this field has primarily focused on university students, with a few studies involving elementary school students (Guo & Jian, 2022). However, there is a notable lack of studies examining the cognitive processes of elders. Therefore, this study utilizes eye-tracking to observe the eye movement indicators of elders as they read texts of varying difficulty, aiming to explore the relationship between these eye movement indicators and text difficulty. The results can be applied to cognitive health management for elders, contributing to improving their quality of life and promoting lifelong learning.

2. Literature Review

Many studies have explored the relationship between eye-tracking indicators and text difficulty, although the methods used by each researcher vary. For example, Ko and colleagues (2005) examined the effects of term frequency and word class on eye movement patterns during the Chinese reading processes of university students. The research found that when analyzing words with available word frequency data, higher-frequency words tended to have shorter fixation times in both the first fixation duration and rereading gaze metrics when reading expository texts. This indicates that word frequency significantly influences word recognition during reading (Ko et al., 2005; Carpenter & Just, 1983; Rayner & Duffy, 1986). Ko and colleagues (2005) also examined the relationship between word class and fixation time, discovering that postpositions, a type of function word (e.g., "after" or "between"), had the highest fixation rates and the longest first fixation duration. They suggested that this could be related to temporal and referential coherence in narratives, which are crucial indicators of whether readers can understand the story content. This phenomenon also appears in English. Graesser and colleagues (1994) and Zwaan and colleagues (1995) found that postpositions in English bear a significant cognitive load for conceptual understanding. Liu and Zhou (2019) explored translation difficulty using fixation and saccade durations. Just and Carpenter (1993) investigated sentence comprehension among university students by examining pupil dilation, finding that more complex sentences required longer processing times and resulted in more significant pupil dilation.

In studies using eye-tracking to assess reading task difficulty, the results show that readers tend to have longer fixation times when processing the following types of words: long words (Just & Carpenter, 1980; Rayner et al., 1996), low-frequency words (Just & Carpenter, 1980; Inhoff, 1984; Rayner & Fischer, 1996; Rayner & Raney, 1996), novel or unfamiliar words (Chaffin et al., 2001; Williams & Morris, 2004), ambiguous words (Rayner & Duffy, 1986; Sereno et al., 2006), and words that are contextually unrestricted or difficult to predict based on the surrounding context (Ehrlich & Rayner, 1981; Zola, 1984; Rayner & Well, 1996; Ashby et al., 2005). Table 1 summarizes the above-mentioned studies, showing that scholars have explored text difficulty through eye-tracking indicators, but most of the participants in these studies were university students. In addition, researchers also conducted statistical analyses on the range of values for eye movement indicators. For example, Rayner (1998) reviewed 20 years of eye-tracking research (1978-1998) on reading and other information processing tasks and found that fixation duration typically ranges from 100ms to 500ms, and saccadic latency falls between 150ms and 250ms. Bentivoglio and colleagues (1997) observed that adults blink at a frequency of 10-20 times per minute. In summary, the variables considered in these studies were relatively limited, primarily focusing on basic linguistic features such as word frequency and word class. Important factors such as syntactic

complexity, contextual relevance, and the reader's prior knowledge were not fully addressed, limiting the studies' ability to accurately reflect the true difficulty of the texts (Collins, 2014).

Table 1: Research on Text Difficulty Using Eye-Tracking Indicators

Eye tracking indicators	Linguistic features	Text difficulty	Participants	References
Fixation Duration Saccade		Word Translation Difficulty	College Students	Liu & Zhou, (2019)
Fixation Duration Character per minutes		Classical Chinese Difficulty	College Students High School Students	Chen (2014)
First Fixation Duration Rereading Gaze	Word frequency Word class		College Students	Ko et al. (2005)
Fixation Duration	Word class		College Students	Ko et al., (2005)
Pupil Dilation		Sentence Complexity	College Students	Just & Carpenter, (1993)

The analysis of eye-tracking indicators is highly complex. Researchers not only examine eye-tracking data from a macro perspective but also conduct detailed analyses of Areas of Interest (AOIs), which may include individual words, sentences, or broader regions (Wang & Chien, 2022). This study references and integrates the eye-tracking indicators used in previous literature (Wang & Chien, 2022; Chen et al., 2010; Chien & Wu, 2012; Alemdag & Cagiltay, 2018; Hyönä et al., 2003; Mason et al., 2018). Although there is a wide variety of eye-tracking indicators, due to space limitations, Table 2 lists only five commonly used indicators. These indicators help us more precisely observe participants' reading behavior and identify their cognitive characteristics and challenges when processing texts.

Table 2: Common Eye-Tracking Indicators

Eye tracking indicators	Definition/Meaning	References
Total fixation count, TFC	The total number of fixation points within the AOI. Generally, a higher fixation count indicates a higher level of cognitive processing and is highly correlated with total fixation duration.	Eitel (2016); Schnotz & Wagner (2018)
First-pass fixation duration	The total duration of all fixations from the first entry into an AOI until leaving it, typically reflecting initial processing, such as semantic processing after word recognition.	Hyönä et al. (2003); Mason et al. (2013)
Regression count	The total number of times a fixation leaves an AOI and then re-enters it, typically reflecting late-stage processing, particularly when the reader encounters content they do not understand.	Chen et al. (2010); Mason et al. (2016); Schüler (2017)

Percentage of fixation duration	Other fixation duration metrics (e.g., total fixation duration on an AOI, first fixation duration, or re-fixation duration) divided by the total fixation duration during the learning period, usually reflect the reader's selective attention allocation.	Jian & Wu, (2012); Alemdag & Cagiltay, (2018); Mason et al., (2013)
Total fixation duration	The total duration of fixations within the AOI generally reflects the level of cognitive processing during reading. Longer fixation durations indicate that the reader needs to expend more cognitive resources to process the information in that area.	Chen et al., (2010); Jian & Wu, (2012)

Since different eye-tracking indicators capture various layers of cognitive activity during the reading process, this study aims to explore how elders with different reading abilities perform when reading texts of varying difficulty. To achieve this goal, this study utilizes the Diagnostic Assessment of Chinese Competence (DACC) developed by Li and colleagues (2021) to evaluate the reading ability of participants. Eye-tracking technology is used to record participants' eye movements, and eye-tracking indicators are extracted to analyze the corresponding sentences or words. Additionally, the CRIE (Chinese Readability Index Explorer) system (Sung et al., 2016) is employed to analyze the computational linguistic indicators of text. This study aims to explore the relationship between eye-tracking indicators and computational linguistic indicators. This study not only establishes a concrete connection between eye-tracking indicators and text difficulty in the fields of linguistics and eye-tracking but also provides new perspectives and methodological support for future eye-tracking research. In the fields of medicine and psychology, it can be applied to cognitive health management for elders, contributing to improving their quality of life and promoting lifelong learning.

3. Methodology

This study observes the reading behavior of elders using an eye tracker while they read texts of varying difficulty. Eye-tracking indicators are extracted to examine the challenges faced by elders with different reading abilities during the reading process. Furthermore, computational linguistic features of non-proper nouns, proper nouns, sentences, and passages are analyzed to explore how these features impact reading challenges for elders. The proper nouns are diabetes-related terms defined by the International Diabetes Federation (2024), the American Diabetes Association (2024), and SA Health (2024), while non-proper nouns are words excluding these diabetes-related terms. This study conducts eye-tracking experiments from the reader's perspective, using heat maps for visual analysis and defining Areas of Interest (AOI) based on non-proper nouns, proper nouns, and sentences. Various eye-tracking indicators are captured and analyzed, and the extracted words and sentences are input into the Chinese Readability Index Explorer (CRIE) (Sung et al., 2016) to observe the relationship between computational linguistic indicators and eye-tracking indicators. By aligning these two types of indicators, the study aims to achieve its research objectives.

3.1 *Participants*

The participants in this study were 15 elders aged 65 and above from the "Dinning Together for the Elderly" program in Taipei City. All participants were native Chinese speakers with

normal or corrected-to-normal vision. One participant did not meet the age requirement, two participants had partial data loss due to failure in eye-tracking during the experiment, and one participant skipped pages while reading. Therefore, a total of 4 datasets were excluded, leaving 11 usable datasets.

3.2 *Apparatus*

This study used the SR EyeLink 1000 eye-tracking system, with a sampling rate of 1000 Hz (i.e., 1,000 samples per second). The reading texts were displayed on a 24-inch LCD monitor with a resolution of 1920 x 1200, and the text size was set to 28. The distance between the participants and the monitor was 65 cm.

3.3 *The Experimental Text*

According to the report《Taiwan Diabetes Report 2000-2045》by the International Diabetes Federation (IDF) Diabetes Atlas, Taiwan has the highest prevalence of diabetes in Asia, with more than one in ten people potentially facing diabetes-related issues. Therefore, this study selected diabetes as the topic for the experimental texts. The texts provided to the participants were divided into three difficulty levels: easy (6th grade), medium (9th grade), and difficult (12th grade). The diabetes-related content was written by six professional reading teachers. The readability of the texts was confirmed using the CRIE (Chinese Readability Index Explorer) readability model (Sung et al., 2016), and the final difficulty levels were approved by the six reading experts. The accuracy of the medical content was also reviewed and verified by professional doctors.

3.4 *Diabetes Knowledge Questionnaire*

Before conducting the eye-tracking experiment, participants in this study were asked to complete the Diabetes Knowledge Questionnaire (DKQ) (Gracia et al., 2001) to assess their prior knowledge of diabetes. This step aimed to determine whether the participants' eye-tracking performance was driven by their reading ability or influenced by their familiarity with diabetes-related background knowledge. By administering this questionnaire, the study sought to investigate whether participants' eye-tracking data during the diabetes-related texts were associated with their prior knowledge, thereby further examining how differences in prior knowledge might impact reading behavior.

The Diabetes Knowledge Questionnaire (DKQ) is a standardized tool used to assess participants' understanding of diabetes knowledge and has demonstrated good internal consistency, with a Cronbach α coefficient of 0.78. The Traditional Chinese version of the questionnaire was translated by a native Mandarin speaker with a Bachelor's degree in English and back-translated by a Taiwanese professional translator with a Master's degree in English. The translation process was reviewed by two experts: a psychometrician and a doctor certified in diabetes education. The Simplified Chinese version of the DKQ, developed by Hu and colleagues (2013), was also referenced to ensure linguistic accuracy and cultural appropriateness. Through this questionnaire, the study can compare whether there are differences in prior diabetes knowledge among the participants.

3.5 *Diagnostic Assessment of Chinese Competence (DACC)*

During the experiment, participants will complete the Diagnostic Assessment of Chinese Competence (DACC) (Lee et al., 2021) to evaluate their reading abilities. This assessment is conducted in the form of a computer-adaptive test that comprehensively evaluates participants' reading proficiency. The DACC system assesses reading comprehension skills, including understanding (e.g., vocabulary, literal and inferential comprehension), contextual integration, analysis, and evaluation. The assessment is designed for students from second to twelfth grade. The DACC test items were drafted by school teachers, PhD students in psychology, and professionals in Chinese language research. All drafters must undergo and pass training before they are allowed to contribute test items to the DACC system. The DACC consists of multiple-choice questions, with each question corresponding to one of five dimensions: vocabulary, literal understanding, contextual integration, inferential comprehension, analysis, and evaluation. This design allows for a comprehensive measurement of student performance across these dimensions, providing an in-depth analysis of their reading ability upon completion of the DACC.

3.6 *Procedure*

The experimental procedure of this study is illustrated in Figure 1. Before the eye-tracking experiment begins, participants are first asked to sign an informed consent form, indicating that they understand the study details and agree to participate. After completing the informed consent form, participants are given the Diabetes Knowledge Questionnaire (DKQ) to assess their prior knowledge of diabetes. Next, participants take the Diagnostic Assessment of Chinese Competence (DACC) to evaluate their reading ability. After completing this assessment, participants are given a 10-minute rest before proceeding to the eye-tracking experiment. Before the formal experiment, the researcher asked participants to position themselves comfortably on the eye-tracker mount and adjusted their positions accordingly. Calibration and validation tests, necessary for data collection using the eye-tracker, were then conducted. The researcher used a nine-point calibration procedure, during which participants were instructed to steadily gaze at each calibration point until all nine were completed. If the calibration results showed no significant errors, the eye-tracker computed the correspondence function between the screen and eye movements, converting eye movement distances directly into screen coordinate displacements. The text was divided into three levels of difficulty—easy, medium, and hard. After reading each section, participants answered simple questions to ensure comprehension. To reduce cognitive load and eye fatigue, participants rested for five minutes after completing each section before proceeding to the next.

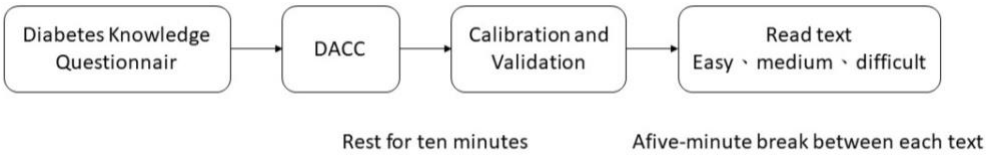

Figure 1: Experimental Procedure

4. Results

4.1 *Analysis Based on Areas of Interest: A Comparison of Sentences, Non-proper Nouns, and Proper Nouns*

4.1.1 *Diabetes Prior Knowledge Assessment*

In this study, participants were divided into two groups based on their reading ability: the low reading ability group (below 7th grade) and the high reading ability group (8th grade and above). The Diabetes Knowledge Scale (DKS) was used to assess participants' prior knowledge of diabetes. The average number of correct answers on the scale for the low reading ability group was 15.00, while the average for the high reading ability group was also 15.00. The results showed no significant difference between the two groups in their diabetes-related background knowledge, indicating that both groups had a similar level of understanding of the subject. Therefore, if significant differences are observed in eye-tracking indicators in subsequent analyses, these differences are likely attributable to variations in reading ability rather than differences in background knowledge about diabetes.

4.1.2 *Choose AOI*

In this study, participants were first divided into two groups based on their reading ability: low (below 7th grade) and high (8th grade and above). Heat maps for participants with different reading abilities were generated (as shown in Figures 2-4). Based on the heat maps of these two reading ability groups, non-proper nouns, proper nouns, and sentences that showed differences between the groups were selected as Areas of Interest (AOI). This selection aimed to identify which text components were processed differently by participants with varying reading abilities.

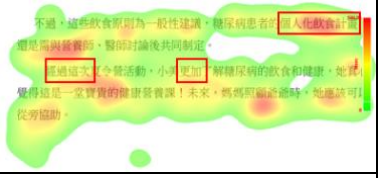

Figure 2: Heat Map for Low Reading Ability With Low Text Difficulty

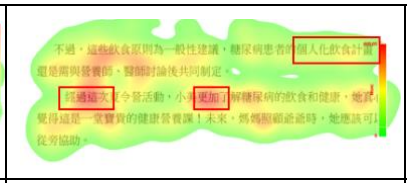

Figure 3: Heat Map for Medium Reading Ability With Low Text Difficulty

Figure 4: Heat Map for High Reading Ability With Low Text Difficulty

4.1.3 *Data Analyze*

Previous reading studies have often focused on analyzing individual word-level features (such as word frequency and word length) or used sentences as the sole unit of analysis. While this approach has provided valuable insights, it has not fully explored how readers simultaneously process both lexical and sentence-level information during reading, particularly the differences between proper nouns and non-proper nouns, which have been less examined in past research. To address this gap, this study divides the Areas of Interest (AOI) into three categories for data analysis: "non-proper nouns," "proper nouns," and "sentences."

This study consists of three parts, each focusing on a different unit of analysis: non-proper nouns, proper nouns, and sentences. After the experiment is completed, the collected eye-

tracking data and assessment results from each participant will be analyzed. The data analysis includes:

- Summarizing the reading results of the participants.
- Converting each participant's eye-tracking data while reading the three texts of varying difficulty into mp4 or avi files for post-experiment review.
- Using the Data Viewer software to define AOI regions and extract the AI report data for further analysis.

In eye-tracking studies focused on reading plain text, AOI (Areas of Interest) can be analyzed at the word, sentence, or paragraph level. The eye-tracking indicators selected for this study include Dwell Time, Fixation Count, Dwell Time Percentage (Dwell Time%), First Fixation Duration, and Regression Count, as detailed in Table 2, which provides a comprehensive explanation of each indicator's meaning.

4.1.4 *Analysis Results Based on Non-proper Nouns*

Following the experimental design of Jian and Ko (2017), this study employed a two-way mixed design ANOVA to examine the effect of vocabulary across different text difficulty levels and its interaction with reading ability on eye-tracking indicators. The results, as shown in Table 3, revealed that text difficulty had a significant main effect on total fixation count, $F(2, 9) = 4.26$, $p < .05$, $\eta^2 = .32$, indicating that text difficulty significantly influenced the total number of fixations. Post-hoc comparisons revealed that participants had significantly more fixations when reading simple texts compared to medium-difficulty texts. Although the interaction between reading ability and text difficulty did not reach statistical significance, an interesting pattern emerged from the raw data: in the low reading ability group, two participants had a higher fixation count for simple texts than for medium-difficulty texts. Similarly, three participants in the high reading ability group exhibited the same pattern. Even though the simple texts appear to be easier on the surface, participants may have needed more time to verify and comprehend the content, leading to a higher number of fixations. This outcome suggests that participants, when faced with simpler texts, might spend more time confirming information.

Table 3: Post-hoc Comparison Table of Fixation Count for Non-proper Nouns Across Different Text Difficulties

SV	*SS*	*df*	*MS*	*F*	η^2	Post-hoc Comparison
Reading Ability	0.01	1	0.01	0.01	0.00	
Error	9.99	9	1.11			
Text Difficulty	2.62	2	1.31	4.26*	0.32	Easy > Medium
Text Difficulty * Reading Ability	0.33	2	0.17	0.54	0.06	
Error	5.53	18	0.31			

*p<.05

4.1.5 *Analysis Results Based on Proper Nouns*

This study examined the effects of proper nouns on eye-tracking indicators about different text difficulty levels and their interaction with reading ability. The results, as shown in Table 4, revealed that text difficulty had a significant main effect on total dwell time, $F(2, 18) = 5.12$, $p < .05$, $\eta^2 = .36$, indicating that text difficulty significantly influenced total dwell time.

Post-hoc comparisons showed a significant difference between difficult and easy texts, with participants spending significantly more time on higher-difficulty texts. This finding aligns with Rayner and colleagues (2006), who suggested that processing time increases with text difficulty. The results indicate that when participants faced more challenging texts, they needed more time to comprehend the content, resulting in extended total dwell time. This outcome further supports the view that increased cognitive load during complex text processing significantly affects reading behavior.

Table 4: Post-hoc Comparison Table of Dwell Time for Proper Nouns Across Different Text Difficulties

SV	*SS*	*df*	*MS*	*F*	η^2	Post-hoc Comparison
Reading Ability	85509.63	1	85509.63	0.20	0.02	
Error	3845811.66	9	427312.41			
Text Difficulty	983292.20	2	491646.10	5.12*	0.36	Hard > Easy
Text Difficulty * Reading Ability	145779.50	2	72889.75	.76	0.08	
Error	1728420.79	18	96023.38			

*p<.05

As shown in Table 5, the results for first fixation duration indicate that text difficulty had a significant main effect, $F(2, 18) = 5.52$, $p = .01$, $\eta^2 = .38$, demonstrating that text difficulty significantly influenced the first fixation duration. Post-hoc comparisons revealed a significant difference between high and low-difficulty texts, indicating that participants spent significantly longer on their first fixation when reading high-difficulty texts compared to low-difficulty texts. First fixation duration reflects the initial understanding and response to words, and reading more difficult vocabulary tends to take longer, as participants require more time for initial cognitive processing (Jian et al., 2013). In this study, proper nouns are considered low-frequency words, which aligns with the "word frequency effect" in computational linguistics. The word frequency effect suggests that readers process high-frequency words more quickly, while low-frequency words demand more processing time (Inhoff & Rayner, 1986). Consequently, when encountering low-frequency words, participants showed significantly increased total fixation time and first fixation duration, reflecting the increased difficulty of processing these words (Inhoff & Rayner, 1986).

Table 5: Post-hoc Comparison Table of First Fixation Count for Proper Nouns Across Different Text Difficulties

SV	*SS*	*df*	*MS*	*F*	η^2	Post-hoc Comparison
Reading Ability	769.30	1	769.30	0.98	0.10	
Error	7101.06	9	789.01			
Text Difficulty	8776.67	2	4388.34	5.52*	0.38	Hard > Easy
Text Difficulty * Reading Ability	537.491	2	268.75	0.34	0.04	
Error	14298.40	18	794.36			

*p<.05

Previous studies have mostly focused on the reading behavior of children or university students and have consistently observed a common phenomenon: when confronted with high-difficulty texts or low-frequency vocabulary, both total fixation time and fixation count increase. However, this study, which focuses on elders, found a similar pattern—elders also

exhibited increased total fixation time and fixation count when reading high-difficulty texts. This result suggests that text difficulty significantly impacts readers across different age groups, especially when processing low-frequency proper nouns. This finding extends the current understanding of reading behavior in elders, showing that despite cognitive changes associated with aging, elders still exhibit reading patterns similar to those of younger participants. It highlights that text complexity, particularly the challenge posed by low-frequency vocabulary, affects readers regardless of age, indicating a universal aspect of cognitive processing during reading.

4.1.6 *Analysis Results Based on Sentences*

This study examined the effects of sentence-level text difficulty and its interaction with reading ability on eye-tracking indicators. The results showed that for regression count, first fixation duration, dwell time percentage, total dwell time, and total fixation count, neither reading ability, text difficulty, nor their interaction reached statistical significance. This suggests that in the current sample, these variables may have a weaker impact on eye-tracking behavior, or the sample size may have been insufficient to detect significant differences. Although some indicators approached significance, the overall results did not achieve statistical significance, particularly about text difficulty. Therefore, future research should consider increasing the sample size to further examine whether these variables significantly affect eye-tracking behavior. This would also allow for a more accurate assessment of the potential impact of text difficulty on reading behavior.

4.2 *Analysis Based on Passages*

At the vocabulary and sentence levels, AOI are primarily analyzed using heat maps, which provide localized insights from a micro-level perspective, allowing for a detailed examination of specific regions. In contrast, passages are analyzed from a macro-level perspective, helping researchers gain a comprehensive understanding of how readers process and comprehend the overall structure of the text. This broader approach allows for a more holistic exploration of readers' understanding of the entire language structure and their cognitive processing throughout the reading experience.

To correlate eye-tracking indicators with linguistic features, this study follows the approach of Ozeri-Rotstain and colleagues (2020) by utilizing Pearson correlation analysis. Based on Cohen's (1988) guidelines, the Pearson correlation coefficient r is used to measure the strength of the relationship between two variables. Specifically, an r-value of 0.1 indicates a small correlation, suggesting a weak relationship; an r-value of 0.3 represents a medium correlation, indicating a moderate relationship; and an r-value of 0.5 reflects a large correlation, suggesting a strong relationship with significant practical implications. This approach enables a clear interpretation of how linguistic complexity and cognitive load interact during reading, providing deeper insights into the connections between language features and eye-tracking data.

The passage analysis inputs the text into CRIE to analyze the computational linguistic indicators and extract the participants' eye-tracking metrics for Pearson correlation analysis, to examine the relationship between the computational linguistic indicators and the eye-tracking metrics. According to the statistical analysis results, there is a significant correlation between eye-tracking indicators and linguistic features. Table 6 defines these moderately correlated linguistic features. In terms of negative correlations, the log-transformed average

word frequency of the corpus showed significant negative correlations with total fixation time, total fixation count, and total saccade count ($r = -.30$, $r = -.33$, $r = -.33$, respectively). The ratio of noun phrase modifiers also showed a significant negative correlation with total fixation time ($r = -.31$), while the average number of prepositional phrases was negatively correlated with total fixation time, total fixation count, and total saccade count ($r = -.30$, $r = -.32$, $r = -.32$, respectively). On the positive correlation side, the number of intentional words had significant positive correlations with total fixation time, total fixation count, and total saccade count ($r = .31$, $r = .33$, $r = .33$). Additionally, the number of causal conjunctions was positively correlated with total fixation count and total saccade count ($r = .32$, $r = .32$), and the ratio of conjunctions in complex sentences also showed positive correlations with total fixation count and total saccade count ($r = .33$, $r = .33$). These results suggest that there are moderate positive and negative correlations between linguistic features and eye-tracking behavior, reflecting the potential influence of linguistic structure on reading behavior (Ozeri-Rotstain et al., 2020).

Table 6: Correlation Values Between Linguistic Features and Eye-Tracking Indicators

Linguistic Features	Definition/Meaning	Corresponding Eye-Tracking Indicators	Correlation Value
SD of average of word freq. in logcorresponding to external database	The average word frequency in the Academia Sinica Balanced Corpus is calculated logarithmically for all the words in the text, to align with the cognitive processes of word recognition	Dwell Time	-.30
		Fixation Count	-.33
		Saccade Count	-.33
Modifiers per NP	The average occurrence of modifiers in noun phrases. Studies indicate that the longer the modifiers, the more likely they are to cause comprehension difficulties	Dwell Time	-.31
		Fixation Count	-.33
		Saccade Count	-.33
Average propositional phrase	The average number of prepositional phrases per sentence in the entire text.	Fixation Count	-.32
		Saccade Count	-.32
Intentional words	The number of words in the text with an 'intent' meaning, such as 'attempt' or 'force'.	Dwell Time	.31
		Fixation Count	.33
		Saccade Count	.33
Causal conjunctions	The total number of causal conjunctions in the text used to indicate a causal relationship between two sentences, such as 'because,' 'therefore,' and 'so that'.	Fixation Count	.32
		Saccade Count	.32
Conjunction ratio in complex sentences	The proportion of compound sentences in the text that contain conjunctions.	Dwell Time	.31
		Fixation Count	.33
		Saccade Count	.33

This study explores the relationship between linguistic features and reading difficulty by analyzing readers' actual eye-tracking data. By examining the correlation between eye movement patterns and specific linguistic features, such as sentence structure or vocabulary, writers can more accurately assess the difficulty level of their text. These data can help authors gain clearer insights into which linguistic features significantly affect readers' perception of text difficulty, enabling them to make appropriate adjustments to improve the overall readability and comprehension of their articles.

5. Conclusions

The results of the study show that text difficulty has a significant impact on the processing of both non-proper nouns and proper nouns during reading. Specifically, while simple texts are easier to comprehend, participants exhibited a significantly higher number of fixations on these texts compared to medium-difficulty texts. This may be because elders are more willing to carefully scan and verify information when dealing with simpler content. In contrast, for difficult texts, participants spent more total fixation time processing proper nouns, which aligns with the "word frequency effect," indicating that low-frequency vocabulary requires more cognitive resources for processing.

This study also explored the correlation between eye-tracking indicators and linguistic features, particularly the relationship between different linguistic characteristics (such as word frequency and grammatical structure) and reading behavior. The results indicate that the linguistic features listed in Table 6 significantly influence readers' eye movement patterns, suggesting a strong connection between language structure and cognitive processing during reading.

The results indicate of log-transformed frequency of corresponding parent words, noun phrase modifier ratio, and average number of prepositional phrases are negatively correlated with total fixation duration and saccade count. This suggests that higher values for these linguistic indicators are associated with shorter fixation durations and fewer saccades, implying that these linguistic structures may reduce cognitive load. The indicators of intentional vocabulary count, causal connective count, and compound sentence connective ratio are positively correlated with eye-tracking metrics. This indicates that readers allocate more cognitive resources to process these complex grammatical structures and logical connections, resulting in increased fixation and saccade counts. These findings underscore the significant impact of syntactic structures on reading behavior, particularly as cognitive load markedly increases when readers engage with more complex linguistic units.

Overall, these results underscore the profound impact of linguistic features on reading behavior. Simpler language units, such as high-frequency vocabulary and more straightforward grammatical structures, reduce cognitive load for readers, while more complex language units increase processing difficulty. These findings not only support previous research but also provide valuable empirical evidence for future studies on language processing and eye-tracking behavior.

Future research could extend these findings to readers from different age groups or language backgrounds to validate the results of this study. Additionally, further analysis of the impact of passage-level linguistic structures on overall eye movement patterns could provide a more comprehensive understanding of the cognitive processes involved when readers engage with various types of discourse. This has particular significance for the field of education, as it can

inform the design of reading materials tailored to the needs of different readers, ultimately enhancing learning outcomes.

6. Limitations

This study provides initial insights into the relationship between eye-tracking indicators and linguistic features, but several limitations should be noted. First, the small sample size, which included only a limited group of elders, may reduce the representativeness of the statistical analysis and impact the reliability and generalizability of the results. This is particularly relevant when considering differences across various age groups, cognitive abilities, educational backgrounds, and reading habits within the elderly population. The small sample size may not fully capture these variations. Therefore, future studies should increase the sample size to enhance the external validity of the findings, ensuring that the observed relationships between eye-tracking indicators and linguistic features are more broadly applicable.

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"Students Have Been Cheating With or Without AI!": Doing What Matters Most – Designing Authentic, Critical and Meaningful Learning With AIEd

HG Retno Harsanti, National Taiwan Normal University, Taiwan

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Abstract
A global survey conducted by UNESCO in 2023 across 450 schools and universities worldwide has disclosed a notable increase in the adoption of AI across various nations, yet only 10% among them have established regulatory frameworks governing its implementation. Concerns have been raised about the potential negative consequences of AI in education (AIEd), including fears that it may trigger unethical behavior in academics, blunt critical and creative thinking processes, lead to human loss in decision-making, and promote laziness. Through a systematic literature review of the Scopus database spanning 2018-2020 and 2022-2024, this study juxtaposes empirical instances of breaches in academic integrity by students. These insights serve as the foundation for advocating the development of a learning design tailored for K-12 educational settings in the AIEd era. This design involves (1) authentic learning through real-world problems and data-driven learning, (2) critical learning through open-ended critical questions, reasoning, and metacognitive processes, and (3) meaningful assessment such as performance-based, output-based, and action-driven assessment. The implementation integrates technology, including AIEd, and employs collaborative and communicative approaches. By adhering to this design, educators aim to enhance student engagement, mitigate academic misconduct, and maximize the benefits of AIEd in enriching the learning experience.

Keywords: AIEd, Authentic, Cheating, Critical, Meaningful, Learning

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Introduction

The rapid development of technology has encouraged high discussions about the impact of technology utilization in various fields, including education. Artificial intelligence (AI) is one of the topics that is very intensely discussed, especially related to concerns about educational output and outcomes. UNESCO (2023) reported the results of a global survey of 450 schools and universities regarding the use of AI, where the results of the survey indicated that the use of AI is increasing in various countries, yet only 10% of countries have regulations related to AI utilization. This condition encourages UNESCO to encourage countries to develop policies and regulations regarding the utilization of AI in education (O'Hagan, 2023).

Discussions related to the utilization of AI in the field of Education have sparked many debates around ethical issues (Akgun & Greenhow, 2022; Foltynek et al., 2023; Karan & Angadi, 2023). Debates have arisen regarding the dynamics of benefits obtained through Aid as discussed by some scholars argue with the belief that AIEd brings benefits such as enhancing personalized learning, improving student-teacher interaction in online learning (Seo et al., 2021), supporting students with special needs (Vincent-Lancrin & Vlies, 2020) nd reducing teachers' administrative workload (Grassini, 2023). On the other hand, some scholars have raised concerns about the decline in students' thinking abilities that can be caused by the use of AIEd in the learning process, such as blunting critical and creative thinking processes, impacting to human loss in decision-making and laziness (Ahmad et al., 2023). In addition, other concerns about the increasing unethical behavior in academics were also raised by Kamalov et al. (2023).

Based on the importance of the ongoing scientific discussions regarding the impact of AIEd utilization, the author proposes that both the pros and cons presented by scholars hold merit. While AI has benefits that can be leveraged in learning, it also has the potential to compromise academic integrity and stifle students' thinking processes if not managed properly. Notably, the issue of academic integrity and blunting of thought processes is not a new phenomenon, as students have been cheating all the time, with or without AI. Therefore, as educators, our primary concern should be designing authentic, critical, and meaningful learning experiences with the help of AI.

Systematic Review on Empirical Research on Academic Integrity of *AIEd*

The widespread use of AIEd has raised significant concerns regarding academic integrity, including in the research field. A systematic literature review was conducted in the Scopus database, focusing on the topic of academic integrity and AIEd, categorized by social sciences field categories, and including articles published between 2021 and 2025. The search query consisted of the following keywords: student AND cheating AND ai OR gpt AND PUBYEAR > 2021 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (EXACTKEYWORD , "Academic Integrity")) AND (LIMIT-TO (LANGUAGE , "English")). The search results yielded 64 articles relevant to the tertiary level. After screening using exclusion criteria, including non-English articles, non-relevant articles to academic integrity, and non-empirical research in the abstract section, 15 articles remained. To further refine the search, we added a focus on: high AND school AND K-12. The search results yielded 76 articles but only 3 are relevant to this paper. Therefore, in total there are 18 articles used in this paper.

The results of the literature review analysis conducted found that empirical studies related to academic integrity, triggered by AIEd, have been widely discussed in the academic community. Specifically, the results of the literature review found that in the realm of academic writing, there are complexities and challenges caused by the use of AI-generated content (Mah et al., 2024). In addition, there are different views between teachers and students regarding the use of technology, one of which is AI-generated content in completing learning assignments. For students, AI-generated content is seen as a tool that can help in exploring ideas and improving the quality of language in completing assignments. On the other hand, teachers view the use of AI-generated content as a shortcut that undermines the learning process. This tension increasingly shows the importance and need for regulations that regulate the Limits of AIEd use that can be understood by both students and teachers to provide clear guidelines and policies on ethical use.

The next emergence theme that was intensively discussed in the literature analysis was related to the impact of AI-generated content on academic integrity. Concern related to the importance of teaching ethics in academic writing related to the importance of the value of original work and the consequences of academic dishonesty, is considered very important for the purpose of plagiarism prevention (Premat, 2023). This objective can be achieved by teaching students how to present source criticism, and acknowledge the work of others through citation, doing appropriate paraphrasing and writing appropriate references. This theme is considered important because the discussion of plagiarism cases in writing assignments was found to be massive. The literature review also found that there is an emerging need for educators to be more aware and critical in assessing students' written work in order to be able to distinguish from human-written work as it becomes more challenging.

The next theme that is also an important discussion in the literature is the need for integration of higher order thinking in the preparation of student learning assessments. The massive AI-generated content that provides opportunities for students to get answers needs to be addressed by implementing the complexity of giving assignments to encourage students to think critically and creatively (Kirwan, 2023). In addition, AI is also seen as being able to help facilitate grading efficiently and objectively, although with the following weaknesses where it may not be able to capture the complexity of human thought that may be needed in assessing student learning performance (Kumar, 2023). This integration is important to consider considering that education does not only focus on results, but also on the process. Overall, the literature highlights the importance of striking a balance between embracing the benefits of AI-generated content and maintaining the integrity of education.

Students Have Been Cheating All the Time, With or Without AI

The systematic literature review in this article is continued in the second stage. It is essential to acknowledge that academic cheating is not a novel phenomenon and is not solely attributable to the presence of AI. According to a systematic literature review conducted using search keywords: student AND cheating AND academic AND integrity AND PUBYEAR > 2017 AND PUBYEAR < 2021 AND (LIMIT-TO (SUBJAREA ,“SOCI”)) AND (LIMIT-TO (DOCTYPE , “ar”)) AND (LIMIT-TO (LANGUAGE , “English”)) AND (LIMIT-TO (EXACTKEYWORD , “Academic Integrity”)). The results of the search yielded 94 documents, which were subsequently filtered to exclude non-relevant items, resulting in a final selection of 18 articles.

The findings of the systematic literature review revealed several significant themes. Firstly, the problem of academic integrity is a pervasive issue that affects students and institutions globally, with contract cheating being a particularly notable manifestation of this problem. The literature found that many students have a subjective threshold for outsourcing their academic work, and once they reach a certain level of energy expenditure, they are willing to engage in cheating. This can include paying someone else to do their work, which is a common practice known as contract cheating. One of the study found that 8% of respondents admitted to engaging in contract cheating, and that certain groups of students, such as those with a language background, are more likely to engage in this behavior (Foltynek et al., 2023). The student are willing to pay some money around US$33.32 per 1,000 works to get the work done (Amigud, 2020). Another study also found that essay mills, which provide custom-made essays, are readily available to students at a low cost, and that revenue calculations indicate a price point of US$31.73 per 1,000 words (Lancaster, 2019).

Secondly, the perceived reasons for indulging in plagiarism include busy schedule, easy accessibility of electronic resources, unawareness of plagiarism instructions, poor knowledge of research writing, and lack of penalty (Kampa et al., 2020). The literature also found that staff estimated high costs for assignments from online essay mills, believed that low numbers of students are using these services, and reported that outcomes were lenient. However, the literature identified three significant variables associated with contract cheating, including dissatisfaction with the teaching and learning environment, perceptions of cheating opportunities, and language background (Awdry & Newton, 2019; Bretag et al., 2019).

A systematic literature review reveals that academic integrity violations can occur independently of AI, in various forms. Notably, the presence or absence of AI does not guarantee the absence of cheating. Moreover, research conducted by Stanford University in 2023 found that the popularity of AIEd tools, including ChatGPT, did not significantly increase the prevalence of cheating among high school students, as 60-70% of respondents reported having engaged in cheating prior to the introduction of AI (Singer, 2023). A separate survey of 1,200 undergraduate students conducted by UCAS in the UK found that 53% of respondents used ChatGPT to assist with assignment preparation, while 36% employed AI as a private tutor to aid in concept explanation, and only 5% used AI-generated text in assessments without editing and violating institutional rules (Freeman, 2024). These findings suggest that academic dishonesty can occur with or without AI, but this does not preclude its prevention. As educators, it is essential for us to address this issue seriously and effectively to maximize the benefits of AI while preserving the core principles of education.

Doing What Matter Most: Designing Authentic, Critical and Meaningful Learning With AI

A critical examination of studies on academic challenges underscores the crucial role of educators in designing learning experiences that successfully achieve learning objectives. The increasing ubiquity of digital devices in educational institutions is undeniable, with 9 out of 10 students in OECD countries having access to computers within school infrastructure (OECD, 2024). However, despite this widespread adoption, digital efficacy remains a concern in various countries, including Jordan, the Philippines, Palestine, Morocco, and Thailand, where the digital divide persists. In these countries, only half or fewer students report feeling confident or very confident in using video-based communication programs (OECD, 2023a).

Furthermore, the time spent by students on digital devices at school is also increasing. According to the PISA 2022 database report, students in OECD countries spend a substantial amount of their daily time using digital devices for learning purposes (OECD, 2023c). On average, students allocate around 2 hours per day to digital learning activities, which is a significant proportion of their overall time. Moreover, students also spend a notable amount of time on digital devices for leisure activities at school, with an average of 1.1 hours daily. Notwithstanding the benefits of digital devices, concerns have been raised about their impact on student learning. Referring to OECD (2023b) data, it was found that students who studied with the help of digital devices for up to 1 hour per day had 14 points higher math scores than those who did not use digital devices. However, the use of digital devices also has negative impacts, where 65% of students report being distracted by digital devices in math classes, including decreased life satisfaction and emotional resilience caused by anxiety about being far away and not having access to using digital devices (OECD, 2024). Overall, the relationship between digital devices and student learning is complex, and it's important to strike a balance that maximizes the benefits while minimizing the drawbacks.

Proposed Learning Design

Based on the literature review and understanding of the psychological conditions of students in the current era, it is important to understand that technology provides benefits and also challenges in the teaching and learning process. In addition, technology cannot be avoided, but it needs to be managed carefully and appropriately so that it is useful and not disruptive. Therefore, a supportive learning design is imperative. Given the ubiquity of digital devices in learning, teachers must design learning experiences that enable students to utilize digital devices for learning purposes. However, teachers need to design engaging learning, so that even though there are digital devices, students fully use them for learning purposes, and avoid unnecessary distractions. Teachers play a pivotal role as facilitators, creating a conducive learning environment that encourages self-directed learning, fosters healthy communication and collaboration, provides guidance and support, offers feedback, models skills and behaviors, builds relationships, and provides choices and autonomy. Learning schemes that allow the use of media require a construct of trust between teachers and students, as well as the habituation of awareness of independent and responsible learning responsibilities.

To achieve a learning scheme that answers the challenges of the AIEd era, three essential elements must be considered when designing learning experiences: presenting authentic, critical, and meaningful learning. Authentic learning is facilitated by providing relevant real-world problems accompanied by the utilization of real data whenever possible. "Relevance" is the paramount keyword in presenting authentic learning. Relevant learning can be achieved by providing real-world problems to students, ensuring that the topics are contextual to their environment, so that they can be comprehended and engaging. The utilization of real data is also beneficial for students, particularly at the high school level, as it enables them to understand that the learning material is truly real and important to learn. This data can be used to design assignments that promote critical thinking and problem-solving skills. Teachers also do not have to be data providers all the time, on the contrary, teachers need to encourage students to search for and obtain data independently so that they can use the digital devices they have to explore data and additional information.

The second element of the learning design scheme is critical learning, where teachers must design critical questions that provoke critical thinking and curiosity. Following the provision

of real-world problems and supporting data, teachers must ask open-ended questions that are personal, and encourage exploration of open answers. Teachers need to be able to present critical questions that challenge students' reasoning abilities. This critical learning scheme will be more authentic if it is carried out dialogically than written assessment, although it does not rule out the possibility of being carried out in writing. However, dialogical discussions can present broader critical interactions between teachers and students more broadly. The teacher can pose questions such as, "What do you think about...?" "Why do you think that...?" "How do you feel about...?" "Why do you feel that way?" "What are you going to do about...?" "How will your plan work to solve the problem?" "how will you get the resources to do such a plan?" "What do you think about your friend's plans or arguments?"

In the discussion process, teachers play an important role in leading the discussion and being a moderator. In this framework, there are no right or wrong answers, as the priority is on developing students' thinking and argumentation skills. Teachers can also use a mix model scheme, where learning begins with giving authentic real-world problems and encouraging students to work on certain learning tasks, which are then presented and discussed in class. In this learning process, students are allowed to utilize digital devices to explore and obtain information. In some cases, students may be able to answer questions by asking AI, but it is essential to encourage students to be honest in presenting their thoughts and explain the sources they use to obtain information.

The third element of the learning design scheme is meaningful learning, where teachers must design high-quality assessments. Meaningful learning aims to encourage students to contribute to producing valuable or beneficial outputs or outcomes, so that students understand that their thinking and learning efforts have meaning and value. There are three assessment models that can be used to achieve meaningful learning. First, performance-based assessments where students are presented with a scenario, task, or problem that requires them to apply their knowledge and skills to solve a real-world problem or complete a task. The assessment is designed to mimic real-world situations, allowing students to demonstrate their ability to apply what they have learned in a practical and meaningful way. This assessment can take the form of project-based learning, case study, portfolio-based assessment, or simulation-based assessment.

Second, output-based assessments, where students are encouraged to develop tangible products or results of a learning process. This assessment model can be a continuation of the performance base, where after carrying out the thinking-based assignment model and worksheets, students can continue with the creation of performance output. This output can take the form of artwork, programs, designs, etc.

Finally, action-driven assessments can also be given to students. This assessment encourages students to take real action related to the real-world problems being studied. Actions that can be taken include creating a digital campaign, creating a letter of concern and sending it to relevant parties, holding hearings with relevant parties. This entire assessment process does not stop at the level of knowledge in the classroom but encourages students to produce something, whether it is an outcome, output, or action. In the process of carrying out assessments, students can also conduct various explorations using technology. Teachers must encourage students to be honest and give credit to the sources of ideas they use to carry out their assessments.

The Learning Support System

In implementing the design planning scheme, which incorporates the three key elements previously discussed, several support components are necessary to ensure effective implementation. First, schools must have adequate digital infrastructure in place to facilitate students' independent construction of knowledge using digital devices. This infrastructure includes reliable internet connections, learning management systems, IT support departments, and digital resources that are easily accessible to students, typically managed by the library. IT support can generate learning analytics reports, particularly from the Learning Management System (LMS) used by schools on a regular basis, such as mid-semester. Although teachers can access and analyze learning analytics data independently, reports from the IT department provide a broader and more comprehensive picture, enabling both teachers and administrators to inform their decisions regarding learning implementation.

The second support component is related to ICT literacy, digital competence, and citizenship, both for teachers and students. For teachers, training and workshops are necessary to equip them with the knowledge and skills to effectively manage learning with digital integration. Concurrently, students require ICT subjects (or equivalent) that provide an understanding of how to access and utilize technology and various digital learning resources independently and responsibly. In particular, with regards to the development of AIEd, teachers and students need to be equipped with engineering prompts and coding skills to maximize the use of AI. Enrichment programs can be one effective way to achieve this goal. The learning design scheme is presented in Figure 1.

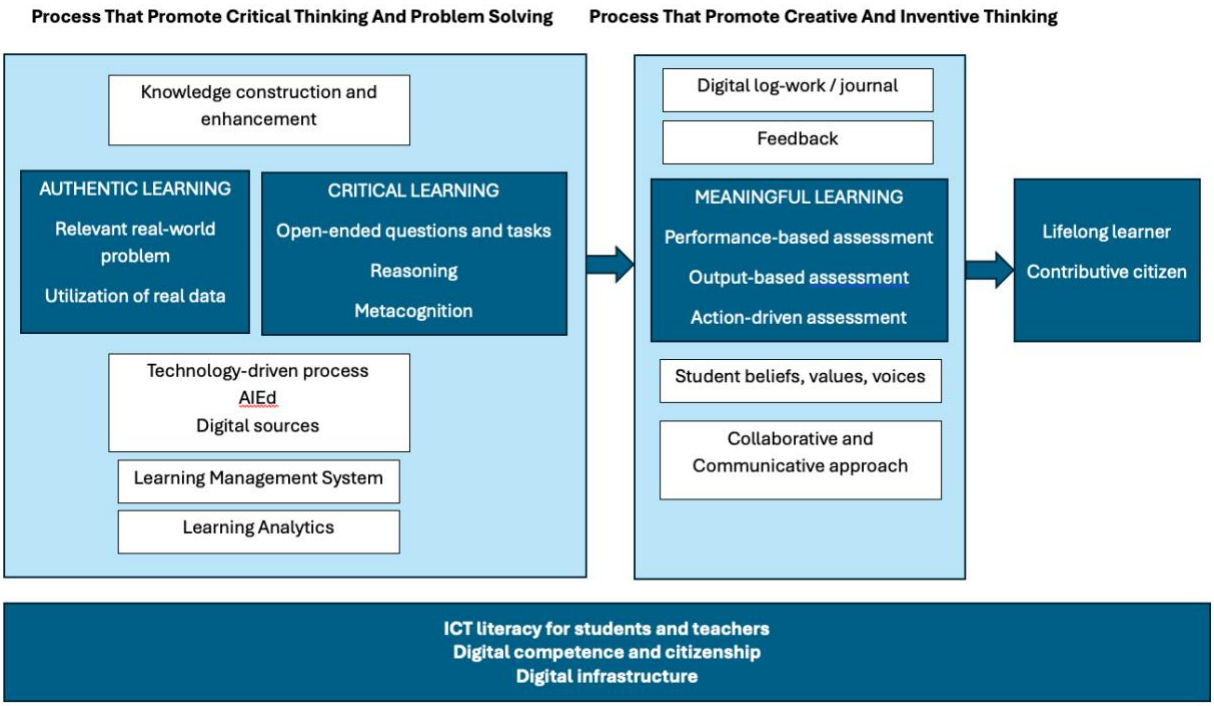

Figure 1: Learning Design Mapping (Source: Author)

Conclusion

The literature suggests that students have consistently committed academic integrity violations over a long period of time. Consequently, the concern that the emergence of AI will encourage students to commit academic violations can be understood but is not entirely legit. As technology continues to evolve and develop, educational institutions must foster adaptability among both teachers and students. Moreover, technology that is unavoidable in the classroom must be utilized lawfully to maximize the learning process.

To achieve authentic, critical, and meaningful learning, education should focus on engaging students with real-world problems, encouraging them to critique these issues, and producing a meaningful learning process. To accomplish this, substantial support is required, including: digital infrastructure that ensures seamless access to digital resources, enrichment programs on ICT literacy, digital competence, and citizenship to equip students with the necessary skills for responsible technology use, IT support/departments that are prepared to provide assistance to teachers and students throughout the teaching and learning process. By providing these support components, educational institutions can effectively leverage technology to promote meaningful learning outcomes.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

This article uses ChatGPT solely for grammar checking purposes and not for any other use. The ideas, concepts, and arguments presented in this article are entirely the author's own.

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Contact email: hildegardis.harsanti@gmail.com

Learning to Labor? Reconsider Schooling and Capitalism in the 21st Century From a Post-marxist Perspective

Autthapon Prapasanobol, National Taiwan Normal University, Taiwan

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Abstract
This article develops a theoretical framework to understand the relationship between schooling and capitalism in the present from a Post-Marxist perspective, critically reconsidering how students engage with schooling and labor in the context of 21st-century capitalism. Drawing on Paul Willis's classical Marxist ethnographic study, Learning to Labor: *How Working Class Kids Get Working Class Jobs*, this article uses key theoretical elements proposed by Willis as a foundation for debate and further development from a Post-Marxist perspective. Willis's work demonstrates how working-class students ultimately reconcile their roles as workers, despite initial resistance to schooling and awareness of capitalist ideology. His study highlights students' experiences as active subjects engaged in cultural processes that shape their relationship with education and labor. However, changes in the contemporary capitalist landscape require fresh analysis. In response, this article integrates key concepts from the theories of Hardt, Negri, and Žižek to extend Willis's ideas. The first section proposes new ways to understand how schooling functions within emerging modes of production and temporal structures, drawing on the concept of the "social factory." This is followed by a discussion of penetration, half-rejection, and counter-school culture. Using the notion of "fantasies," the article rethinks these concepts to explore the relationship between subjects and consciousness.

Keywords: Learning to Labor, Schooling, Capitalism

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Learning to Labor in 1970s

During this period, the influential wave of liberalism dominated educational narratives, promoting the idea that every child could achieve upward mobility through education. Education was portrayed as a golden ticket to fulfilling dreams and attaining a better life. This perspective aligned with functionalist theories, which viewed education as a mechanism for allocating individuals to roles suitable for society. Those deemed proficient and fitting were positioned for higher societal roles. However, reality diverged from these promises. Leftist scholars argued that schools perpetuate and reinforce class structures within capitalism. Bowles and Gintis (1976) asserted that schools operate as microcosms of the broader societal structure, training students to become compliant and obedient workers. Consequently, school curricula and pedagogies were seen as tools for transmitting ideologies aligned with capitalism.

Yet, the leftist critique often reduces person as subject, particularly students, to passive objects shaped entirely by the system, portraying schools as being wholly dominated by capitalist ideologies. This perspective overlooks the creativity and agency of a person in their daily lives, ignoring how they construct meaning and make choices. Paul Willis's Learning to Labor addresses this gap, raising critical questions about the cultural processes occurring in everyday interactions between individuals and structures. How do these interactions unfold in daily life, and what do they reveal about the relationship between human agency and systemic forces?

In his study, Willis sought to understand why and how working-class students often end up in working-class jobs. Conducted in 1970s, his ethnographic fieldwork focused on 12 working-class boys, or “lads,” in a secondary school located in an industrial district in England. Over six months, Willis employed interviews, informal diaries, and observations to uncover the cultural forms and resistance strategies of these students. He identified a “counter-school culture” among the lads, characterized by opposition to school authority and the formal educational system. This culture manifested in behaviors such as mocking conformist students, neglecting schoolwork, playing cards during class, and openly drinking in public. Such actions defied the structured and regulated environment of the school, which the lads viewed as a restrictive and oppressive space. Willis observed parallels between this resistance and the “shop-floor culture” of working-class workers responding to exploitative capitalist conditions. Importantly, the lads were aware of the limits of social mobility through individual qualifications, recognizing its unattainability within their social reality. In response, they rejected the meritocratic promises of the education system and sought alternative paths. This demonstrated their ability to penetrate the illusions of their social position within capitalism, analyzing risks and opportunities within their constrained circumstances.

However, counter-school cultures are transient and rarely develop into broader collective movements. Willis argued that their understanding was only partial, preventing them from articulating a comprehensive critique of the system. Moreover, these cultural interactions often reinforced gendered and racialized divisions rooted in dominant forms of masculinity, leading the lads to perceive themselves as superior to other groups. This phenomenon exemplifies what Willis termed “half-rejection”.

From *Learning to Labor* to *Learning to Self-Entrepreneur*

While Willis's seminal work elucidates the cultural processes shaping students' transitions into the workforce under Fordist systems—characterized by regimented production lines and fixed schedules—it is vital to address the transformation of production methods in the post-Fordist era. Contemporary capitalism has fundamentally altered the dynamics of work, introducing flexible schedules, decentralized production, and new modes of labor control. This shift prompts a crucial question: how can *Learning to Labor* be reimagined within the context of 21st-century capitalism?

At the core of Willis's analytical framework lies a traditional Marxist perspective, which examines the modes of production, exchange, and exploitation inherent to capitalist systems. Central to this framework is the concept of capital accumulation, achieved by extracting *surplus value* from the labor power of workers during production. Marxist theory argues a foundational exchange relationship between capital and labor: while the capitalist class controls the means of production, the working class is compelled to sell its labor power in a supposedly free market. While the labor force inherently possesses the potential for unbounded creativity and agency, the capitalist system imposes structures to quantify and regulate labor. This commodification aims to maximize profit by controlling labor and extracting surplus value. Within this framework, the value of a commodity is not merely the sum of its costs and profits; it also embodies the surplus value created by labor. A portion of this value is retained by the capitalist class as capital, while wages represent the fraction returned to the laboring class. The utilization of wages, therefore, become mechanisms through which societal relationships are defined. These wages shape individuals' roles and positions within the broader capitalist structure, perpetuating the hierarchies and inequalities central to the system.

Wages serve as an innovation in transforming labor power as abstract value into concrete value, quantified by the time spent working each day. Willis explicates this transformation through the concepts of "abstract labor" and "concrete labor," illustrating how the capitalist system endeavors to convert labor from an abstract form into concrete labor—standardized and nominally represented. In this process, the "standard minute" emerges as a pivotal tool for measuring labor value, operationalized through timetables and segmented work schedules.

In this notion, factory workers' lives are regimented by a "rhythm" established through rigid work schedules. Such time patterns, however, are not exclusive to factories; they are mirrored in schools. Children are embedded within timetables that structure learning into blocks, with teachers acting as quasi-factory supervisors mediating the exchange relationship between students and knowledge. Willis characterizes counter-school culture as a form of resistance, challenging the fairness of these relationships and rejecting the mechanisms of standardization and control that limit alternative expressions of labor power.

Willis further delineates the capitalist system's constructed divisions between "mental work" and "manual work." These distinctions, far from natural, are ideologically shaped to perpetuate capitalist hegemony by determining who is deemed deserving of rewards or compensation, ostensibly based on merit. Mental work is positioned as superior to manual work, legitimizing claims to higher wages and status. This process, shrouded in the guise of meritocracy, is normalized as the natural order of reality. Working-class boys, as Willis observes, possess an acute awareness of these relationships. They recognize that while their jobs may involve manual labor, they derive satisfaction from earning higher wages than

women and marginalized racial groups, interpreting this as a symbol of male superiority. Wages thus become more than economic compensation; they serve as markers of hierarchical positioning within class structures.

In summation, *Learning to Labor* involves pedagogy to exist within the exchange relationships of a market under the paradigm of "standard minute", which dictates the conditions of the value of production. Labor is controlled and its value transformed based on measurable work hours. This learning extends to vertical relationships within society through "wages" and "job characteristics," indicating class symbols in the social hierarchy. It constructs an understanding of societal positions, revealing who occupies which class. Despite the possibility of resistance or rejection in the learning process, it is not inherently dangerous or alarming within the capitalist system. It ultimately culminates in the option of "half-rejection".

Willis's analytical perspective looks at the learning experiences of children both during and after their school years in same page with the industrial factory production, where the relationships are tied to standardized time, wage, and job characteristics. As evident, the school schedule is sometimes resisted by working-class children as it does not lead to meaningful returns for them. Additionally, recognizing themselves as different from the general student in terms of engaging in manual labor helps them perceive the reward as satisfactory and gratifying. Children's lives are shaped by the conditions and contexts associated with the three elements that guide their actions and decisions as students. However, in contemporary production, time is no longer strictly defined within an 8-hour standard schedule. Work hours have become more flexible and less rigid, while wage or reward and job characteristics have also undergone changes. In this context, what then is Learning to Labor?

Post-Marxist scholars have turned their attention to understanding production within the contemporary capitalist system. In their 2001 book *Empire*, Michael Hardt and Antonio Negri propose a new understanding of this changing landscape, particularly the concept of the *deterritorialization of production* (p. 296). This refers to the shift away from traditional factory settings, where labor is no longer confined to specific workplaces but has permeated every aspect of our daily life and relationships. The boundaries between work and life have become increasingly blurred, as evidenced by the rise of freelancing and various online social platforms.

This is what Hardt and Negri describe as the "social factory," where labor, production, and consumption continuously occur in everyday life. In this paradigm, labor is no longer confined to a workplace or factory; it can take place anywhere. Hardt and Negri introduce the concept of "biopolitical production" to explain these transformations in the capitalist system during the post-industrial era. A clear example of this new mode of production can be found in online food delivery platforms, where delivery riders are turning the "streets" into a "factory". In an interview from Tularak and Bunyasiriyanon's research on platform-delivery workers in Thailand, published in Prachatai News in 2022, one rider, a university student, described the flexibility of the work system. He had to plan his schedule independently to maximize earnings, often choosing to deliver long distances (sometimes up to 50 kilometers). He spent over 10 hours on the road during weekends and an additional 4-5 hours after classes, all while managing the risks of accidents on his own. Another rider, "Note," explained that working for over 10 hours a day left little time for rest, as breaks depended on where he happened to be along his route.

This example highlights a shift in the nature of labor: workers are no longer tied to standard schedules or factory machinery. Instead, they can set their own work hours within the framework of a flexible, often precarious system. This new model of production is characteristic of the post-Fordist era, which emphasizes temporary employment, flexible hiring practices, and increasingly unstable contracts. Alongside these structural shifts, a new consciousness has emerged—the "entrepreneurial self." In this context, individuals are encouraged to see themselves as the masters of their own labor. The ownership of production means has shifted from traditional capitalists to individuals who must create and control their own productive factors. However, this shift also means that individuals now bear the risks and costs of their work. Meanwhile, capitalists are no longer responsible for directly managing production but instead facilitate flexible work arrangements and determine the value of labor based on factors such as distance and number of deliveries. This new framework characterizes contemporary capitalism, where flexibility, uncertainty, temporariness, and self-regulation are paramount. Workers, now more than ever, must navigate a system that values flexibility and autonomy but places the responsibility for managing risk and maintaining productivity squarely on their own shoulders.

Although traditional factory production still exists, the transformation of the capitalist system has given rise to the concept of "social factories," blurring the boundary between work and life. Even in conventional jobs with clear schedules, individuals are increasingly connected as both producers and consumers of labor, extending beyond formal working hours. Willis's perspective suggests that the temporal structure of schooling plays a critical role in shaping students' perception. However, in today's capitalist landscape, schools may no longer hold the central place they once did. During the school day, students can escape the rigidity of formal time and evade classes, particularly through online spaces, as long as they are not under strict surveillance. In this context, the distinction between standardized time and flexible time becomes increasingly blurred. Students can learn to navigate between these time structures, gaining autonomy and agency over their decisions and actions. They become "active users" in digital spaces while also remaining "passive learners" within traditional educational systems. But does this represent a form of counter-school culture, or is it simply a response to the capitalist system that seeks to limit or control labor power, as Willis suggests?

In this sense, this behavior may not necessarily challenge the capitalist system directly. Instead, it reflects a response to traditional work structures where individuals have little control over their own labor power. The movement between standardized and virtual time is, in fact, a learning process that aligns with the development of flexible labor. In traditional Marxism, media and entertainment industries were seen as platforms where audiences passively consumed content. Today, however, individuals are active participants in the production of their own identity, becoming commodities in the broader market. Through posting, sharing, and uploading, people cultivate a sense of self-ownership, crafting and projecting their identities. This shift is emblematic of cognitive capitalism, where we are continually engaged in the production and exchange of symbols and meanings. In this new economy, students, like workers, learn to manage their labor power flexibly, blending emotional self-management with entrepreneurial practices.

The flexibility of time in this new era has led to the emergence of continuous and ubiquitous production. During study sessions, time after work, and other intervals are now opportunities for biopolitical production—an ongoing process of labor and value creation that spans all aspects of life. This transformation also signifies the dissolution of traditional metrics of value, no longer bound by standard time. From Willis's perspective, work and wages are

symbols that define our place within the capitalist hierarchy. The rigid distinction between "manual work" and "mental work" is increasingly irrelevant in this context. Instead, the primary divide may be between the "entrepreneur" and the "laborer." This divide represents the degree of autonomy one has in their work, which correlates with greater life independence. Social class today seems to be measured by the extent to which individuals can exercise this independence. The contemporary capitalist system seeks to erase overt class consciousness, instead fostering the illusion that everyone has the potential to be an entrepreneur.

Penetration and Entrepreneur's Fantasies

Willis's analysis offers an explanation for why working-class children often end up in working-class jobs, despite their resistance to the school system. Willis argues that these students do not merely resist; they learn to understand the system and recognize its illusions. For example, they come to see that the meritocratic ideal promoted in schools—where anyone can rise to the top of society—is a false narrative. They realize that school attendance does not translate into real-world rewards for them. As a result, they often view any job as an opportunity to earn money and achieve tangible results. This paradox reveals that, despite their resistance to school as a symbol of the capitalist system, they eventually accept and enter the labor market.

"Penetration" becomes thus a main concept that Willis uses to explain the phenomenon. For this concept, it is the ability of a person to understand their "positions" and "patterns of relationships" with others in society. It is what they learn to penetrate and articulate, infiltrating the fog of the capitalist system and understanding how it operates in their positioning with others.

This is what Willis is conveying, that while the capitalist system is at work, persons are also learning how the system operates in relation to themselves. They are not passive objective within the capitalist system. The ability of human to make sense of the world they inhabit through penetration is not accidental; it is because humans have the creativity to generate and produce culture based on their positions, with culture serving as a guiding principle.

However, the problem is that person cannot fully understand the system they are in. The existence of limitations serves as an obstacle and diverts learning from reaching its full potential. This results in our inability to achieve "political articulation by deep" (Willis,1981, p. 145). One example is the distinction between "mental work" and "manual work," where even though working-class students may penetrate the school's illusion of providing opportunities, the prevailing male-dominated culture imposes limitations on working-class children. They are unable to see the division; instead, they perceive themselves as superior to women and other ethnicities. Therefore, Willis refers to this situation as "half-rejection," meaning that, ultimately, even though they may break through, they still cannot fully comprehend the entire system. This ultimately results in temporary resistance, concluding with acceptance of the existing relationship. In this sense, the survival of the capitalist system is also because we are all "social agents are not passive" (Willis, 1981, p. 175).

Penetration and the development of consciousness in understanding the capitalist system present challenges for people. Willis argues that the capitalist system intentionally creates limitations, making it difficult for people to fully comprehend its structures and dynamics. These limitations are not just external, but also internalized by subjects themselves. This

aligns with traditional Marxist theory, which distinguishes between “consciousness” and “unconsciousness”. According to this view, workers are initially unaware of their exploitation, but once they gain a full understanding, they are positioned for liberation.

However, through the lens of Žižek (Myers, 2003; Žižek, 2009; Jayanama, 2022), we might argue that the notion of self-entrepreneurship has emerged as a crucial fantasy that conceals the Real—the actual social conditions that lie beneath the surface. Unlike Willis's view, which suggests that capitalism attempts to hide its flaws, Žižek posits that capitalism does not hide its contradictions or ideological failures. Instead, it openly exposes these flaws but presents them as an inherent part of reality. In this sense, self-entrepreneurship functions as a compelling fantasy, convincing individuals that success is possible within the capitalist system, provided they exert enough effort. This illusion sustains their desire and encourages them to accept their current circumstances, ultimately transforming them into active participants in the capitalist ideology.

Capitalism, then, does not operate by concealing its truths. On the contrary, it allows people to see the system in all its rawness. People are aware of how the system functions and its inherent flaws, but even so, they accept it as the way things are. As Fisher (2009) observes, “they know things are bad, but more than that, they know they can’t do anything about it” (p. 21). This recognition of the system’s failings, paired with a sense of powerlessness, exemplifies how the ideological structure of capitalism operates not by hiding the truth, but by making it appear unavoidable and inescapable.

When people can see the capitalist system clearly, there must still be an enjoyment element that encourages them to remain engaged. This enjoyment stems from fantasies, which shape desires and tell us who we are and what others expect from us. These fantasies construct desires that make us believe we must want certain things, even though these desires are not truly our own. They lead us to believe we are heading toward achievable goals, with success framed as a matter of self-discipline and personal choice. The ideology suggests that with proper planning and efficient work, success is attainable. For example, in an interview from the research project mentioned earlier, delivery riders expressed the belief that they had the freedom to work on their own schedules. Their ultimate goal was to earn more money. When asked for feedback on the platform company they worked for, one rider, after mentioning an accident, replied, “Nothing, they are already good,” before adding, “Increasing the pay a bit would be nice.” This response exemplifies how fantasies embedded in capitalist ideology allow us to find enjoyment, even when the system’s flaws are evident.

Fantasies also allow people to chase the reward of success or fulfillment. A poignant example of this is found in the documentary *School Town King*, which follows two boys, “Nont” and “Book”, from a slum in Thailand who dream of becoming rappers. Both clearly see that the education system under capitalism fails to meet their needs and attempts to mold individuals into uniform products, much like in a factory. The boys resist this by spending their after-school hours rehearsing songs instead of doing homework or attending additional tutoring, as many of their peers do. However, their paths diverge. “Nont” eventually decides to return to his studies, reflecting that “Dreams can be pursued anytime, but education must come first.” Meanwhile, “Book” drops out of school despite opposition from both his teachers and family, determined to carve out his own path as an entrepreneur. He believes that with hard work, success will eventually come. This belief is grounded in a fantasy that, despite the harsh realities they both understand, paints a picture of success within their reach. Unfortunately, Book’s fantasy is eventually shattered. He realizes that without engaging in political struggle,

his dream of a better life is unattainable. In 2021, Book joined the youth-led protests demanding democracy and a future free from the military regime (see The Standard, 2021, October 6, *Din Daeng protest: Why does it have to be violent? | UNCOVER #1*). Despite being labeled a violent troublemaker by some, his actions were a direct response to an oppressive system. After the protests lost momentum, Book was arrested and imprisoned in 2023. His story illustrates how the fantasy of self-entrepreneurship and individual success can only sustain individuals for so long. Eventually, the harsh reality of systemic oppression forces them to confront the broader socio-political structure, challenging the belief that personal effort can overcome deep-rooted societal inequalities.

Following Žižek's analysis, we might argue that working-class children (and even middle-class individuals) are not inherently limited in their understanding of the capitalist system. Rather, it is fantasy that shapes their engagement with the system, providing enjoyment and pleasure in their experiences. While they are aware that the existing system is flawed, it is fantasy that enables them to engage with it. This fantasy does not mask their awareness of the system's shortcomings; instead, it constructs desires that make their participation in the system pleasurable. In this sense, the issue is not their ability to comprehend the capitalist system, but the desires that society instills in them. They know the system is problematic, yet fantasy makes it enjoyable and tolerable.

Fantasy plays a crucial role here: it does not restrict what people know but rather influences what they desire. The capitalist system allows them to see its workings openly, including its flaws, yet they are encouraged to participate within it. The act of resisting, then, does not signal an effort to break free from the system but rather occurs within the parameters set by fantasy. Resistance, in this context, is not an act of dangerous rebellion but an action carried out within the limits of the fantasy that capitalism has constructed for them. Thus, capitalist schooling does not obscure ideology through a false consciousness, as traditional Marxist theory might suggest. Instead, it invites critique and dissent, allowing people to openly voice their complaints. This paradoxically makes capitalism even more powerful, as it markets products—such as ready-made courses, online programs, skill-building workshops, and alternative schools—that encourage individuals to invest in self-improvement. These products sell the idea that by enhancing one's skills, individuals can fully realize their potential as self-entrepreneurs, thus reinforcing capitalist ideology while making the system seem more accessible and rewarding.

Conclusion

Reconsidering *Learning to Labor* through a post-Marxist lens aims to critically reevaluate and offer alternative understandings of the relationship between schools and capitalism in the 21st century. First, the evolving nature of working culture within the capitalist system has blurred the boundaries between work and life, making it difficult to solely view the reproduction of cultural norms through standardized time. Instead, it becomes essential to examine both official and flexible time to understand how student as subject construct their consciousness around life within the work world. In the second aspect, what they learn and desire to become amidst the divide of increasingly characteristics of new jobs is flexible and immaterial. This marks a departure from an era characterized by a division of labor based on mental and manual work. Third, as capitalism increasingly centers on the production of symbols and meaning in all aspects of life, it leads to new social relationships that reconfigure class positioning. A critical question arises: what symbols are subjects producing and exchanging among themselves? This question helps illuminate how people self-

entrepreneur and position themselves within the capitalist structure. To what extent do schools contribute to this process? Finally, we must consider how fantasies and forms of enjoyment are constructed and mediated within the society. How have students engaged with, contributed to, and been shaped by capitalism? Understanding how subjects participate in and are influenced by these structures offers important insights into the dynamics of power, resistance, and acceptance within the modern capitalist framework.

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Contact email: autthaponpon@gmail.com

Exploring the Effects of Integrating SVVR Into High School History on Students' Self-Efficacy, Learning Behavior, and Learning Performance

Chia-Ling Wu, National Taiwan University of Science and Technology, Taiwan
Hui-Xin Chen, National Taiwan University of Science and Technology, Taiwan
Shuo-Jung Hsu, National Taiwan University of Science and Technology, Taiwan

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Abstract
Previous studies show that VR immersion effectively enhances students' curriculum integration, content understanding, self-efficacy, learning behaviors, and performance. In this study, the impact of creating a VR course related to historical homes tours through Uptale is expected to enhance students' self-efficacy, learning behaviors, and learning performance. The initial test was conducted by recruiting 22 graduate students. Comparison of 2D video and SVVR to test the effectiveness of the software. This experiment explored the SVVR group's self-efficacy, learning behaviors, and learning performance through the results of the Achievement Test in History, and analyzed the effects of SVVR on the learning of historical through descriptive statistics and t-tests. The statistical results show that although there is no significant difference between the two groups, it can be seen that the value of the SVVR group is still higher than that of the 2D film group. It is expected that SVVR teaching will be extended to senior high schools and used in curriculum teaching, and experiments and interviews will be conducted in the hope that effects such as enhanced learning concentration can be facilitated for use in other subjects or professional training programs.

Keywords: Virtual Reality (VR), Self-Efficacy, Learning Behaviors, Learning Performance

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Introduction

Research Motivation and Background

Virtual reality (VR) is increasingly being utilized in the domains of education and learning (Zawacki-Richter & Latchem, 2018). Spherical video-based virtual reality (SVVR) serves as a notable example, as it immerses users in realistic scenarios, thereby offering an engaging experience (Elmezeny et al., 2018; Jong et al., 2018). This technology can be implemented using cost-effective or more accessible VR solutions. The application of SVVR spans a wide range of areas, including science education (Yang et al., 2024), library guide (Lin et al., 2019), English language acquisition (Huang et al., 2023), engineering education (Lingli, 2023), teacher training (Pitura et al., 2024), and nursing education training, among others (Chang et al., 2022). Research suggests that SVVR promotes a learning style that enhances student interest, motivation, and academic performance (Geng et al., 2018). Additionally, it has the potential to complement traditional pedagogical approaches, introduce novel concepts, and deepen students' comprehension of content while simultaneously increasing their motivation to learn (Huang, et al., 2020; Lin et al., 2019). However, practical opportunities for students to engage in field trips are often constrained by factors such as time, distance, cost, safety, and the complexities of real-world environments (Geng et al., 2021; Çaliskan, 2011), which may adversely affect their learning interests and opportunities for experiential practice. Furthermore, there is a paucity of research focusing on tours of historical homes within the context of social studies. Consequently, we propose a further investigation to explore the integration of SVVR into senior secondary history education, specifically examining its effects on students' self-efficacy, learning behaviors, and academic performance.

Research Purposes

The main purpose of this study is to allow users to experience a learning experience that is different from traditional learning during the game, and to experience historical situations without being limited by time and space, thereby enhancing students' interest in learning. This study aims to enhance students' interest in learning. Since most senior high school history lessons are typically delivered in a conventional textbook format, students often struggle to develop a profound understanding of the temporal and spatial contexts of historical periods. The purpose of this study is to explore the impact of SVVR learning on students' self-efficacy, learning behavior and academic performance. By enhancing students' sense of self-efficacy, we hope that they will be more confident in handling learning challenges, thereby cultivating positive learning behaviors. In addition, we expect that immersive learning will promote a deeper understanding of history and culture while enhancing interactive learning experiences, resulting in improved academic performance. Researchers believe that this teaching method can present the best interactive and immersive learning, make students better understand history and culture, and provide them with a more interesting and effective learning experience.

Research Questions:

1. What is the effect of self-efficacy on students using SVVR versus 2D Video learning?
2. What is the effect of learning behaviors on students using SVVR versus 2D Video learning?
3. What is the effect of learning performance on students using SVVR 2D Video learning?

Literature Review

Virtual Reality (VR)

Virtual reality (VR) is a new media technology that brings a sense of real presence through computer simulation of a 3D virtual world. It is regarded as an innovative teaching method in learning (Gadelha, 2018). With its 360-degree panoramic immersion, VR allows users to feel as though they are in a genuine environment (Elmezeny et al., 2018; Jong et al., 2018). Chen (2016) pointed out that through appropriate learning design, VR can help students develop more complex and higher-level thinking skills, while improving students' learning motivation, problem-solving ability, opinion expression skills, and strengthening critical thinking Sexual thinking and self-efficacy (Meyer et al., 2019).

The Influence Between Self-Efficacy and Learning Behaviors of SVVR

With the rapid development of technology, VR has been widely used in online courses. This study chose to use spherical video-based virtual reality (SVVR) in course learning. SVVR is VR that uses 360-degree panoramic photos or videos. SVVR has been used in teaching a variety of subjects and has been proven to be effective in influencing students' learning behavior. Research indicates that this kind of course can stimulate students' interest in learning, improve students' learning motivation and learning performance (Geng et al., 2018), and improve academic performance. Research has proven that compared with the learning satisfaction of students who use traditional teaching and students who use SVVR to learn, students who use SVVR to learn achieve better learning satisfaction.

The Impact Between Learning Behaviors and Learning Performance of SVVR

SVVR provides multi-sensory stimulation and allows learners to experience a high degree of interactivity (Chang et al., 2019). Its convenience, interactivity, and contextualized experiences hold great potential for the educational field (Ye et al., 2019). Traditional classroom instruction often struggles to effectively capture learners' attention, which frequently leads to deficiencies in problem-solving and critical thinking skills (Durham, 2015). SVVR can arouse students' interest and motivation to learn through the interaction in the scene. Gilliam et al (2017) pointed out that learning in an authentic learning environment is of certain importance and helps improve students' academic performance in the subject. Chang et al. (2017) introduced SVVR teaching into the natural science geology course in primary schools and used a two-tier testing strategy to improve students' learning performance. Research results show that this teaching method not only improves students' learning performance and motivation but also enables them to learn how to solve problems more proactively.

Self-Efficacy

Self-efficacy refers to an individual's subjective beliefs and feelings regarding their ability to organize and achieve specific competencies (Bandura, 1997). In this study, self-efficacy is operationally defined by the scores of participants on the General Self-Efficacy Scale (GSES), developed by Zhang and Schwarzer (1995). The GSES consists of 10 questions designed to measure an individual's confidence in facing setbacks and solving problems. A higher score on the scale indicates greater self-efficacy, while a lower score reflects diminished self-efficacy.

Post-experiential Immersion Experience Scale

In the study of Jennett et al. (2008), they explored the personal emotional aspect and observed the changes of users during the immersion process through three different experimental situations and proposed the "Immersion Experience Scale after Experience Activities" to make the immersion experience visible. Quantitative testing, this scale contains six aspects and is divided into: 1. Attention: refers to the degree to which the subject is devoted to the interactive navigation system; 2. Temporal dissociation: refers to the subject's degree of concentration Ignore the surrounding things or forget about the passage of time, and only focus on the interactive navigation system; 3. Transportation: refers to the degree to which the subject feels after experiencing the interactive navigation system; 4. Challenge): refers to the subject's level of challenge to the interactive navigation system; 5. Emotional involvement: refers to the degree to which the subject invests his/her emotions in the interactive navigation system; 6. Enjoyment (enjoyment): refers to the subject's level of challenge Experience the level of enjoyment that comes with an interactive tour system.

Methodology

Research Structure

This study employs a quasi-experimental design utilizing the Uptale system to examine the effects of integrating Spherical Video-based Virtual Reality (SVVR) into history instruction for senior secondary school students. The experimental group will engage with SVVR for their learning, while the control group will receive traditional teaching methods. The study's content will feature a guided tour of a historical home relevant to high school curriculum. By interacting with the system in a virtual reality environment, students can develop a deeper understanding of historical figures and their contexts. An overview of the entire study is presented in Figure 1 below.

While the course design of this study was intended for senior secondary school students, postgraduate students were selected as the subjects for this experiment. The goal was to help the courseware designers understand the optimization needs of the SVVR courseware design, allowing them to better grasp the key considerations and precautions necessary for the design of such courseware when it is implemented in other training programs in the future.

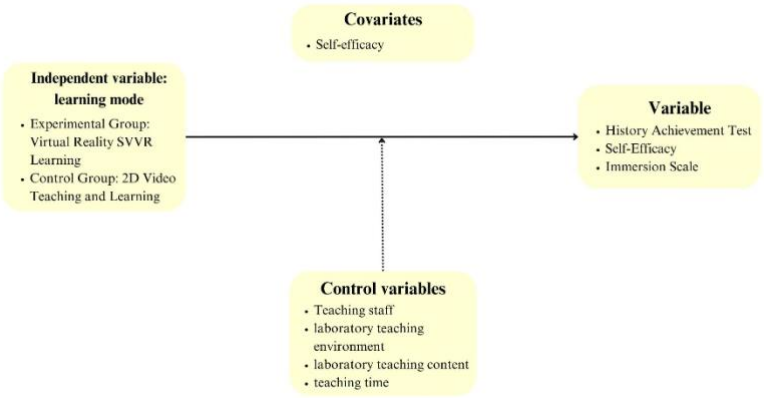

Figure 1: Research in Disguise

System Architecture and Process

This research uses the Uptale system as a development tool. Learners conduct guided tours of historical residences through the SVVR game. They enter the game screen at the beginning, learn historical knowledge through interactive objects (such as videos, slides, voice recognition, tests, etc.) and complete stars (task rewards). collect. Teachers can use the system to check whether students' learning effectiveness and learning behaviors have improved, so as to adjust the teaching material design. Teachers can use the system to evaluate students' learning effectiveness and monitor improvements in their learning behaviors, allowing them to adjust the design of teaching materials accordingly. As shown in Figure 2 below.

Figure 3 below is the research flow chart of this experiment. The entire experiment was conducted according to the following flow.

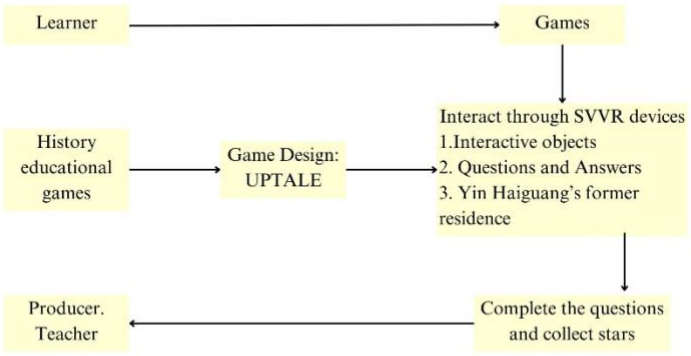

Figure 2: Teaching Material Design Structure

Experimental Flow Chart

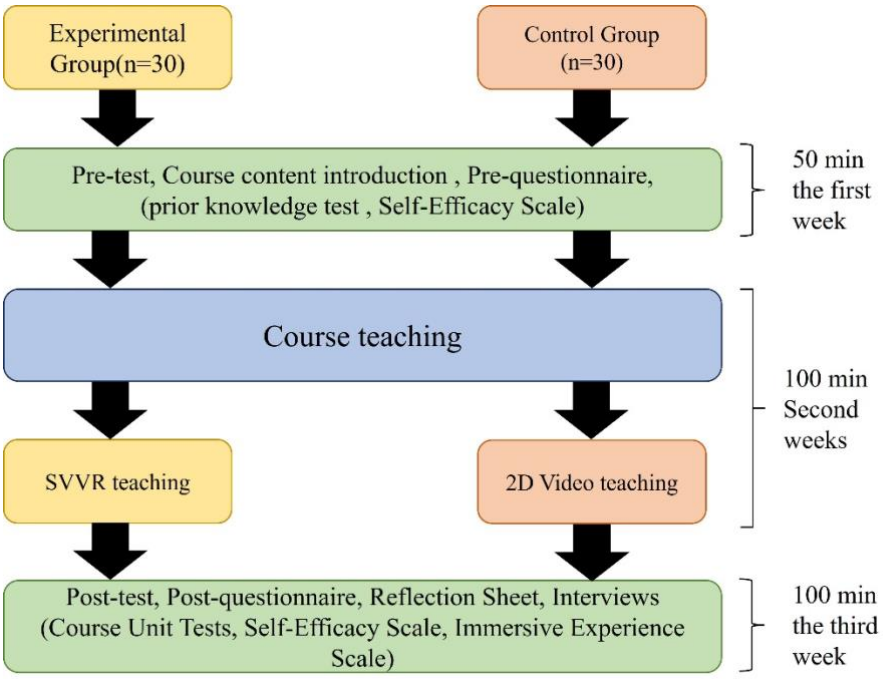

Figure 3: Experimental Flow Chart

Research Object

A total of 22 graduate students from a national university of science and technology in Taiwan participated in a three-week experiment. The subjects did not require prior knowledge and were divided into an experimental group and a control group. The experimental group utilized SVVR for learning, while the control group received instruction through 2D video teaching.

Experimental Design

The following six pictures are the game screens of the SVVR teaching materials, namely Figure 4, Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9. Figure 4 is the first scene when learners enter the screen. Learners can get a preliminary understanding of Yin, Hai Guang's introduction in this scene. Figure 5 further presents Yin, Hai Guang's relevant information through pictures and text, and there are similar introductions in subsequent scenes.

Figure 6 is in Scene 3, which shows important scenes leading to various parts of the former residence, and includes photos and newspaper introductions related to Yin, Hai Guang. The video in Figure 9, also located in this scene, mainly introduces Yin, Hai Guang's life story and the reasons why he lives here.

Figure 7 is a question-and-answer area set up during the learning process, giving users the opportunity to learn more about Yin, Hai Guang's deeds. When the questions are answered correctly, the user can collect the stars needed to complete the level. Figure 8 introduces Yin, Hai Guang's political philosophy through voice. After the introduction, you can give a voice answer. Those who answer correctly can unlock the opportunity to go to other scenes.

Gameplay

Figure 4: SVVR Scene 1

Figure 5: Introduction of Yin, Hai Guang's Former Residence

Figure 6: Scene 3 and photo

Figure 7: Question

Figure 8: Photo and Voice Tour

Figure 9: Video

Research Results

Independent Two-Sample t-Test

This study adopted a quasi-experimental design. Two sets of independent sample t-tests were used for quantitative analysis in order to explain the differences in learners' prior knowledge and experience during the self-efficacy pre-test. This method can effectively ensure that researchers can exactly value the differences between the experimental group and the control group when conducting post-test analysis results.

Differences in Self-Efficacy Between Learning Styles

An independent samples t-test was conducted using the learning method as the independent variable and self-efficacy as the dependent variable. The results are presented in Table 1. The t-test analysis of the average self-efficacy pretest scores for different learning methods revealed that t(20)=0.97, p=.17 (p>.05). This indicates no significant difference in self-efficacy between the SVVR group (M=3.12, SD=0.37) and the 2D Video group (M=2.91, SD=0.62). Therefore, the pretest results show that the self-efficacy of participants learning history courses through SVVR and 2D Video is not significantly different.

Table 1: The t-Test Analysis of Pre-test Averages for Self-Efficacy Across Different Learning Methods

	n	*M*	*SD*	*t*
SVVR	11	3.12	0.37	0.97
2D Video	11	2.91	0.62	

*p< .05; **p<.01

Independent samples t-test analyses were conducted with learning methods as the independent variable and self-efficacy as the dependent variable. The results of the study are presented in Table 2. The t-test analysis of the mean self-efficacy post-test scores for the different learning styles yielded t(20)=1.76, p=.07, which is greater than .05. This indicates that the self-efficacy scores for the SVVR group (M=3.38, SD=0.34) and the 2D Video group (M=2.95, SD=0.75) were not significantly different. Post-test analyses revealed no significant difference in self-efficacy between the SVVR and 2D Video groups as two distinct learning methods for the history course.

Likewise, statistical analysis of the posttest produced non-significant results, identical to those of the pretest. It is assumed that the lack of significant differences in the posttest can also be attributed to the small sample size and issues related to the scale design. Therefore,

the results regarding research question 1 indicate that the differences in self-efficacy between different learning methods are not significant.

Table 2: The t-Test Analysis of Post-test Averages for Self-Efficacy Across Different Learning Methods

	n	*M*	*SD*	*t*
SVVR	11	3.38	0.34	1.76
2D Video	11	2.95	0.75	

*p< .05; **p<.01

Differences in Learning Behaviors Across Learning Styles

Using learning method as the independent variable and learning behavior as the dependent variable, an independent sample t-test analysis was conducted. The research results are shown in Table 3. The t-test analysis of the average learning behaviors of different learning methods shows that t(20)=0, p=.14>.05, and it can be found that SVVR (M=3.39, SD=0.56) and 2D Video (M=3.39, SD=0.90) The two groups were not significant in the learning behavior section. According to the post-test analysis results, it was found that there was no significant difference in the learning behavior of the subjects regarding the two different learning methods of SVVR and 2D Video used in history courses.

The insignificant results from the above analysis may stem from the limitations of the equipment used in designing the SVVR teaching materials, which hindered the full presentation of details. As a result, students may not have had the opportunity to thoroughly understand the introduction of certain monuments and artifacts, thereby diminishing their sense of immersion. Additionally, the timely provision of guidance is crucial in the effective implementation of SVVR teaching materials. Due to the experimenter's inexperience in administering the guidance portion of the experiment, some students were uncertain about the content of the teaching materials, leading to incomplete levels of understanding.

Table 3: The t-Test Analysis of Average Learning Behaviors Across Different Learning Methods

	n	*M*	*SD*	*t*
SVVR	11	3.39	0.56	0.00
2D Video	11	3.39	0.90	

*p< .05; **p<.01

Differences in Learning Performance Between Learning Styles

Independent samples t-test analyses were conducted using learning methods as independent variables and learning performance as dependent variables. The results of the study are presented in Table 4. The t-test analysis of the mean learning styles across the different groups indicated that $t(20)=0.89$, $p=.87$, which is greater than .05. This finding suggests that there was no significant difference in the learning styles between the SVVR (M=71.82, SD=11.46) and 2D Video (M=67.27, SD=12.52) groups. Furthermore, the post-test analyses revealed no significant difference in the performance of participants using the two different learning methods, SVVR and 2D Video, in the history course.

Kolarik et al. (2024) utilized immersive virtual reality (IVR) in logistics process training and compared its effectiveness to a traditional paper-based test. The findings indicated that there

was no significant difference in the learning test results between the two groups involved in the experiment. Consequently, this statistic suggests that different learning methods do not necessarily impact students' test scores in the subject.

In the future, the design of teaching materials should focus on the connection between the topic and the curriculum. This approach will more effectively demonstrate whether the SVVR teaching materials are appropriate for this type of curriculum.

Table 4: The t-Test Analysis of Average Learning Performance Across Different Learning Methods

	n	*M*	*SD*	*t*
SVVR	11	71.82	11.46	0.89
2D Video	11	67.27	12.52	

*p< .05; **p<.01

Discussion and Conclusion

Discussion

In the first question, we compared the effects of self-efficacy between students who learned through SVVR and those who engaged in conventional learning. The lack of a significant difference may be attributed to the small number of participants and the inadequacy of the scale questions, which were not sufficiently tailored to the content of the subjects taught. Additionally, the number of response options in the scale design may significantly influence the results of subsequent statistical analyses. Utilizing a 4-point scale for the self-efficacy measure may yield insignificant results due to either the limited number of participants or the reduced choices available to respondents when completing the scale. Similarly, the post-test of self-efficacy produced non-significant results, mirroring those of the pre-test in the statistical analyses. It is presumed that the lack of significant difference in the post-test is also a consequence of the small sample size and issues related to the scale design.

As mentioned in Question 2, the lack of a significant effect on learning behaviors between the two groups of students utilizing different learning methods may be attributed to some participants in the SVVR group experiencing moderate dizziness during the experiment. Consequently, the experiment was conducted using a website operation method instead. These factors may have contributed to the absence of a significant difference in the learning behaviors of the two groups.

Previous studies have indicated that motion sickness is linked to individual visual-vestibular perception and conflicts in visual cognition, which can result in symptoms of motion sickness (Drummond, 2005; Golding, 2006).

In the research question three, which compares the impact of learning performance between two groups of students using different learning methods and those employing traditional learning, the results of the historical test indicated that there was no significant difference in the learning outcomes between the two groups. This lack of difference may be attributed to the design of the SVVR teaching materials, which did not align well with the test questions. Additionally, the students exhibited a low level of engagement with the film materials, leading to increased cognitive load and negatively impacting their learning performance.

Conclusion

Although there was no significant difference between the two groups in terms of self-efficacy pre-test and post-test, the mean values indicated that the self-efficacy of the SVVR group was higher than that of the 2D Video group. This suggests that the SVVR group experienced greater self-efficacy with this type of teaching method. When designing the SVVR teaching materials, it was necessary to adjust the number of scenes. During the experiment, participants became disoriented due to the excessive number of scenes and experienced moderate dizziness, which adversely affected their learning behaviors. In the future, by refining the teaching materials and utilizing improved devices, the incidence of dizziness can be minimized. Additionally, due to the small sample size and the discrepancies between the questions of the performance test questions and the teaching materials, the performance component of the performance test was not significant. Therefore, adjustments must be made to prevent similar issues in future when conducting the follow-up studies.

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Contact email: leeteuk6521@gmail.com

Appendices

Appendix A: Post-test-Learning Performance (History Achievement Test)

The post-test consists of 10 multiple-choice questions (40%), 10 multiple-response questions (40%) and 5 essay questions (20%) for 100 points. Compiled by two teachers with 10 years of experience in teaching history.

1. Which philosopher primarily influenced Yin, Hai-Guang's liberal ideas?			
A. John Locke	B. Immanuel Kant	C. Plato	D. Aristotle
2. Yin, Hai-Guang's ideas are associated with which of the following movements?			
A. The Civil Rights Movement	B. The May Fourth Movement	C. The Xinhai Revolution	D. The Taiping Rebellion
3. In Yin, Hai-Guang's liberalism, what is the primary responsibility of intellectuals?			
A. To change social systems	B. To promote technological progress	C. To support government policies	D. To be the eyes of the time
4. What is Yin, Hai-Guang's core definition of freedom?			
A. Unlimited autonomy	B. Collective will	C. Protection of rights	D. Obedience to law
5. According to Yin, Hai-Guang, what is the foundation of democracy?			
A. Economic development	B. Universal education	C. Citizens' awareness of freedom	D. Military strength
6. What is Yin, Hai-Guang's view of democracy?			
A. Democracy is a compromise	B. Democracy is merely a tool	C. Democracy is a political ideal	D. Democracy is useless
7. Yin, Hai-Guang's liberalism primarily influenced which area in later generations?			
A. Political system reform	B. Transformation of educational philosophy	C. Intellectual enlightenment	D. Economic structural adjustments
8. What does Yin, Hai-Guang consider the main role of science to be?			
A. Solving all problems	B. Establishing social order	C. Supporting political authority	D. Providing correct methods of thought
9. How does Yin, Hai-Guang believe freedom should be critiqued?			
A. Through outright denial	B. Through rational discussion	C. By prioritizing practice	D. By integrating tradition
10. How does Yin, Hai-Guang interpret the "May Fourth" movement?			
A. A political movement	B. A literary revolution	C. A social reform movement	D. An intellectual enlightenment movement
11. What is Yin, Hai-Guang's view on tradition and modernity?			
A. Tradition should be fully preserved	B. Modernization should replace all traditions	C. Tradition should integrate with modernity	D. Tradition is a symbol of backwardness
12. In Yin, Hai-Guang's perspective, freedom is inseparable from which concept?			

A. Equality	B. Independence	C. Democracy	D. Authority
13. How does Yin, Hai-Guang suggest intellectuals should engage with society?			
A. Maintain neutrality	B. Stand on the side of truth	C. Follow the masses	D. Support the status quo
14. What is the philosophical foundation of Yin, Hai-Guang's liberalism?			
A. Rationalism	B. Empiricism	C. Skepticism	D. Metaphysics
15. In Yin, Hai-Guang's reflections on civil society, what does he emphasize most?			
A. Religious freedom	B. Social justice	C. Rule of law	D. Individual responsibiliy
16. In the practice of liberalism, which field is Yin, Hai-Guang most concerned with?			
A. Political reform	B. Economic freedom	C. Individual liberty	D. Cultural heritage
17. Why does Yin, Hai-Guang advocate liberalism?			
A. To oppose authoritarian	B. To preserve traditional culture	C. To support religious beliefs	D. Toemphasize national self-determination
18. What characterizes Yin, Hai Guang's academic style?			
A. Moderate and conservative	B. Radical and critical	C. Rational and rigorous	D. Emotional and romantic
19. What is Yin, Hai Guang's greatest contribution to modern society?			
A. Promoting science and technology	B. Establishing a philosophical system	C. Advocating intellectual freedom	D. Creating literary works
20. What is the relationship between liberalism and democracy in Yin Haiguang's advocacy?			
A. Freedom and democracy are unrelated	B. Freedom and democracy are opposed	C. Freedom must conform to democracy	D. Freedom is the foundation of democracy

Appendix B
Questionnaire

- Adoption of Schwarzer, R. (1993). Using a 4-point scale.
- General Self-Efficacy Scale (GSES)
- 10 questions
- Cronbach's αlpha reliability coefficient with values between .82 and .93

General Self-Efficacy Scale

General Self-Efficacy Scale (GSES), the term Self-efficacy was coined by Bandura, and many scholars have developed a variety of self-efficacy scales based on different domains. The GSES was developed by Schwarzer and Jerusalem (1993), with an initial version of 20 questions, which was later revised to 10 in 1997. The GSES has been translated into 25 languages in several countries and has been widely used.

Self-Efficacy Scale Questions

The Self-Efficacy Scale is a 4-point scale with feeling, thinking, and acting as the indicators. The criteria are "1" for completely incorrect; "2" for somewhat correct; "3" for mostly correct; and "4" for completely correct.

1. I can always manage to solve difficult problems if I try hard enough.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
2. If someone opposes me, I can find the means and ways to get what I want.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
3. It is easy for me to stick to my aims and accomplish my goals.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
4. I am confident that I could deal efficiently with unexpected events.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
6. I can solve most problems if I invest the necessary effort.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
7. I can remain calm when facing difficulties because I can rely on my coping abilities.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
8. When I am confronted with a problem, I can usually find several solutions.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
9. If I am in trouble, I can usually think of a solution.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.
10. I can usually handle whatever comes my way.			
1) Not at all true.	2) Hardly true.	3) Moderately true.	4) Exactly true.

Appendix C

Posttest-Immersion Experience Scale (Learning Behaviors)

- Refer to Jennett et al. (2008) "Immersion Experience Scale after Experiential Activities".
- Likert 5-point scale
- 12 questions
- Cronbach's αlpha reliability coefficient, with values ranging from 0.877 to 0.921.

Immersion Experience Scale after Experiential Activity

Jennett et al. (2008) explored the impact of personal emotion in their research and observed changes in users' immersion through three different experimental situations. They proposed the "Immersion Experience Scale after Experience Activities" to quantify and measure immersion experience. The scale covers six aspects: 1. Attention: refers to the degree to which the subject is absorbed in using the interactive navigation system; 2. Temporal dissociation: refers to the subject's ignorance of the surrounding environment or The passage of time and the degree of complete concentration on the interactive tour system; 3. Transportation: refers to the intensity of the subject's inner feelings after experiencing the

interactive tour system; 4. Challenge: refers to the subject's face The degree of challenge experienced by the interactive tour system; 5. Emotional involvement: refers to the degree to which the subject invests his or her emotions in the interactive tour system; 6. Enjoyment: refers to the subject's experience in the interaction The degree of pleasure experienced during the navigation system.

Likert 5-point Scale

Likert scales (named after their creator, American sociologist Rensis Likert) are very widely used because they are one of the most reliable ways to measure opinions, perceptions, and behaviors. Likert scale questions are widely used in many types of surveys because they provide quantifiable response options, making the data collected easier to analyze. It also provides multiple options covering a whole range of topics, allowing respondents to choose answers that are more closely related to their own feelings.

Historical Textbook Immersion Experience Scale

Attention

In the course materials, do you feel focused on the activity you are doing? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree
Does the content in the textbook hold your attention? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree

Temporal Dissociation

Do you feel the passage of time as you engage with the history textbook? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree
Do the experiences in the textbook make you forget about time in real life? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree

Transportation

Do you feel drawn into the plot of your history textbook? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree
Do the scenes and stories in the textbook make you feel like you are there? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree

Challenge

Did the tasks or challenges in the textbook excite and engage you? (1-5 points)				
1. Strongly	2. Disagree	3. Neither	4. Agree	5. Strongly

Disagree		Agree nor Disagree		Agree
Do you feel challenged by the level of difficulty in the history textbook? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree

Emotional Involvement

Did you have a strong emotional experience with your history textbook? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree
Do the characters and situations in the textbook resonate with your emotions? (1-5 marks)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree

Enjoyment

Overall, were you satisfied with your experience participating in this history textbook? (on a scale of 1-5)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree
Did the fun in the textbook meet your expectations? (1-5 points)				
1. Strongly Disagree	2. Disagree	3. Neither Agree nor Disagree	4. Agree	5. Strongly Agree

The Results of the Development of a Science Instructional Kit to Improve Teachers' Students' Memory and Understanding in Biology Courses

Phatcharida Inthama, Srinakharinwirot University, Thailand
Suwicha Wansudon, Srinakharinwirot University, Thailand
Sompong Jaideechoey, Srinakharinwirot University, Thailand
Trai Unyapoti, Srinakharinwirot University, Thailand

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Abstract
The objective of this research was to create a scientific learning kit that concentrates on improving the retention and comprehension of biological concepts, with a particular emphasis on the structure and function of cells, for students in the field of science education. Nineteen scientific education students from the Faculty of Education participated in the study, which utilized a one-group pre-test post-test design. The research instruments consisted of student satisfaction questionnaires, achievement assessments, and the scientific learning kit. The scientific learning bundle resulted in a statistically significant improvement in the academic performance of students. The pre-test score (26.74 points) was substantially lower than the average post-test score (43.89 points). The students expressed a high level of satisfaction with the learning kit, with an average satisfaction rating of 4 to 5, which indicates their adoption and approval of the developed package. The scientific learning program significantly enhanced learning achievement, particularly for students with lower pre-test scores, as evidenced by the average normalized gain of 0.73. Consequently, the scientific learning bundle that was developed effectively facilitated the comprehension and retention of biological concepts, as well as the development of students' analytical thinking abilities and the capacity to apply their knowledge. In order to evaluate learning outcomes in broader contexts, future research should consider expanding the sample size and adapting the learning package to more complex biology topics.

Keywords: Scientific Learning Kit, Memory Retention, Understanding, Biology, Learning Achievement

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Introduction

Higher education, particularly in the field of science, presents significant challenges due to its complex content and the need for deep understanding. Science teachers' students must acquire both theoretical knowledge and practical skills to prepare themselves for their future roles as educators. Science education emphasizes not only memorization but also fostering understanding that can be applied in real-world contexts. This is especially crucial in biology courses, which cover intricate topics such as cell structure, biological systems, and various processes within living organisms. These are essential areas of knowledge for science teachers' students to master in order to effectively transfer knowledge to younger generations.

The National Education Act B.E. 2542 (1999) emphasizes learner-centered education, recognizing individual differences and the belief that everyone can learn. Teachers play a vital role in enhancing learners' potential through learner-centered approaches (Ministry of Education, 2008). This principle encourages the development of flexible learning materials tailored to the needs of students. In biology courses, using diverse learning materials such as diagrams, models, and animations to illustrate cell structures and processes helps science teachers' students gain deeper understanding and apply their knowledge in real-life situations.

Learning through observation and hands-on practice enables students to better retain and comprehend content. For example, using microscopes to observe cell structures provides learners with a clear visual understanding that connects theory to practice (Institute for the Promotion of Teaching Science and Technology, 2003). Combining theoretical and practical teaching methods is thus an effective approach to fostering in-depth knowledge among science teachers' students, which is critical for enhancing the quality of future teaching.

This integration of media and hands-on activities aligns with research findings that visual aids and colors impact memory and understanding. Warm colors, such as red and yellow, stimulate the brain and increase alertness, which enhances content retention and deeper understanding (Wolters et al., 2005). Therefore, developing learning materials that incorporate visual aids, and hands-on activities can significantly improve learning outcomes.

Science learning kits that are specifically designed not only enhance science teachers' students' understanding of biological content but also help them develop teaching skills applicable to their future classrooms. Creating diverse and innovative teaching materials enables them to design engaging and effective lessons. This is particularly important in today's rapidly evolving knowledge-based society.

This research is significant in developing science learning kits that enhance memory retention and understanding in biology courses for science teachers' students. These kits aim to prepare them to become high-quality educators capable of effectively passing on knowledge to future generations.

Methodology

Phase 1: Preliminary Study

This phase involves gathering foundational information to guide the development of the instructional kit. The activities include:

1. Studying Relevant Theories and Research

Reviewing literature and research on biology education to understand effective teaching strategies.

2. Analyzing Curricula and Standards
   Examining biology course content, learning objectives, and assessing standards to ensure alignment.
3. Exploring Instructional Kit Design
   Investigating principles of instructional design to create effective and engaging learning materials.

Phase 2: Development of the Instructional Kit and Evaluation of Its Use

This phase focuses on creating and refining the instructional kit while assessing its effectiveness. Key steps include:

1. Sample Group
   The study targets undergraduate students majoring in science education, specifically those enrolled in science teacher preparation programs.
2. Development of Research Tools
   - Achievement Tests in Biology: Design tests to evaluate memory and understanding, focused on biological concepts.
   - Multiple-Choice Test Design: Develop multiple-choice questions covering key content areas to assess both recall and comprehension.
3. Testing
   Trial the tests with a small sample group to identify and address potential issues.
4. Implementation in the Main Sample Group
   Administer the finalized tests to the larger target group of students to evaluate the instructional kit's effectiveness.

Phase 3: Data Collection and Research Design

The research adopts an experimental approach using a One-Group Pre-test and Post-test Design, which includes the following steps:

1. Pre-test Administration
   Conduct a pre-test with the sample group to measure baseline knowledge and understanding.
2. Treatment (Use of the Instructional Kit)
   Implement the instructional kit with the sample group to teach key biology concepts.
3. Post-test Administration
   Conduct a post-test with the same group to evaluate improvements in memory and understanding.

Results and Discussion

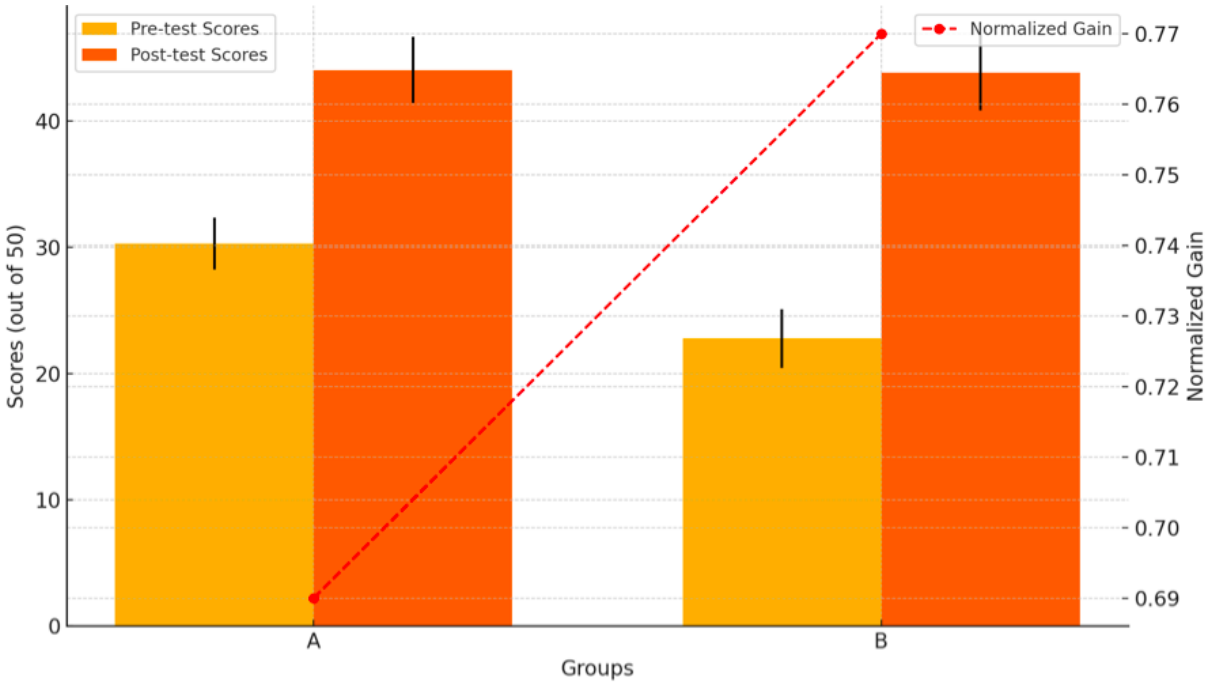

Figure 1: Comparison of Pre-test and Post-test Scores With Normalized Gain

The study analyzed the learning achievement in the biology topic "Cell Structure and Function" by categorizing students into two groups based on their Pre-test scores. The sample consisted of 19 science teacher students.

Group A (Higher Pre-test Scores) Students in this group demonstrated less score variation in the Post-test, indicating a more consistent level of performance after learning. And Group B (Lower Pre-test Scores) Students in this group showed greater improvement in learning outcomes after using the instructional kit.

Higher Normalized Gain for Group B

Group B (students with lower Pre-test scores) achieved a higher Normalized Gain (0.77) compared to Group A (0.69). This suggests that students starting with lower scores experienced greater improvement in learning ability after using the instructional kit.

Comparable Post-test Averages

The Post-test average score for both groups were very close44.00 for Group A. ,43.78 for Group B. This indicates that the instructional kit effectively supported both groups, leading to similar learning outcomes despite initial differences in Pre-test performance.

Conclusions

Improved Learning Achievement

The instructional kit focusing on cell structure and function significantly enhanced the academic performance of science teacher students, as evidenced by the marked improvement in post-test scores compared to pre-test results. This finding aligns with prior research by Tsai

and Chang (2005), which demonstrated the effectiveness of inquiry-based learning kits in improving scientific literacy and understanding. The integration of visual aids and interactive components in the kit contributed to better comprehension and retention of biological concepts, consistent with Mayer's (2005) multimedia learning principles.

High Satisfaction Levels

Students reported high levels of satisfaction with the instructional kit, citing the use of real-life tools and visual media as key factors in making the content more engaging and easier to understand. This is supported by Rieber's (1996) findings on the positive impact of interactive visualizations in enhancing learner engagement. The kit's engaging activities also align with Hofstein and Lunetta's (2004) research, which highlights the role of hands-on learning in fostering critical thinking and active participation.

Bridging Knowledge Gaps

The instructional kit effectively addressed disparities in prior knowledge among students. Those with lower pre-test scores showed significant progress, as reflected in their higher normalized gain compared to peers with stronger initial performance. This outcome resonates with Vygotsky's (1978) Zone of Proximal Development, emphasizing the importance of instructional support tailored to individual learning needs. Additionally, the results mirror the findings of Sundberg and Moncada (1994), who demonstrated that targeted teaching materials can bridge gaps in understanding complex biological processes.

The findings of this study corroborate existing research on the efficacy of well-designed instructional kits in science education. By combining visual aids, hands-on activities, and learner-centered strategies, the developed kit not only enhanced students' academic performance but also addressed diverse learning needs effectively. This reinforces the importance of innovative teaching materials in preparing science-teacher students to become competent educators capable of transferring knowledge to future generations.

Recommendations

1. Larger Sample Size Conduct studies with a larger sample to improve accuracy and broader applicability.
2. Complex Topics Adapt the instructional kit for advanced biology topics to test knowledge application.
3. Long-term Impact Perform follow-up studies to assess lasting effects on learning and future knowledge use.

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Contact email: phatcharida@g.swu.ac.th

Development of Behavior Regarding Socially Responsible Entrepreneurship Skills for Undergraduate Students in Bachelor of Education According to the Concept of Sustainable Corporate Development (ESG)

Suwicha Wansudon, Srinakharinwirot University, Thailand
Trai Unyapoti, Srinakharinwirot University, Thailand
Phatcharida Inthama, Srinakharinwirot University, Thailand
Ponpeera Wongpornpratheep, Srinakharinwirot University, Thailand

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Abstract
A study of the behaviour of undergraduate students in the graduate education programme in terms of the development of socially responsible entrepreneurial skills. It is a mixed-methods investigation that is based on the concept of sustainable corporate development (ESG). The investigation utilises both quantitative and qualitative research methodologies. Investigate the concept of integrated learning management. Technology utilization is critical for both project-based learning and learning management. We encourage students to develop the skills they need to become socially conscious business owners. Students acquire knowledge independently by adhering to the principles of sustainable corporate development (ESG). This is a conceptual framework for research. The sample group consists of 100 individuals, including teachers, educational personnel, and students, who were selected through purposive sampling after analysing the perspectives of informants affiliated with institutions that train teachers in four regions of Thailand. The research employs four distinct kinds of instruments. These are questionnaires and interviews. Basic statistics were implemented to analyse the data. The research findings revealed that entrepreneurial talents who prioritise social responsibility stand out. The following are the eight components: 1) Business operations that are equitable 2) Anti-corruption 3) Adherence to human rights 4) Equitable labour practices 5) Consumer accountability 6) Participating in community or social development; 7) Disseminating innovations from social responsibility implementation; and 8) Ensuring environmental care and resource utilization are efficient. The development has been improved.

Keywords: Behavior Regarding Socially Responsible, Entrepreneurship, Sustainable Corporate Development

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Introduction

In today's rapidly changing society, there is widespread economic competition. Youth should be instilled with the importance of and responsibility towards society and the environment of organizations and entrepreneurs by operating under ethical principles and good management, taking responsibility towards society and the environment, which leads to sustainable development. With awareness and importance in supporting activities for society and the community, in order to be responsible towards society that coexists together. Teachers are considered a very important part in strengthening the country. If a country has teachers who are knowledgeable and capable of teaching, that country will have human resources with knowledge and capability. Therefore, the production institutions must produce and develop teachers to be individuals with knowledge and capability according to professional standards, have the ability to teach and promote learning to students in various ways, and must also be good role models with morality, ethics, and professional ethics.

Organizational or environmental, social and governance performance and industry. The study period is from May 2021. The results show that the topic is relevant to the field of study. There is continuous growth and does not affect the concerns about ESG issues. Organizational competencies focused on ESG development, including corporate social responsibility, and technical, managerial and commercial capabilities, show a positive relationship between organizational performance and sustainable development. The discussion focuses on competencies that promote ESG and industry (Sierdovski, 2023). In the past, most investors chose to invest in businesses or companies that were mainly profitable. However, the analysis of many asset management companies has now indicated that investing in companies that focus on ESG concepts is a business that operates with sustainability in mind and generates better returns than companies that seek profits in the long run. This is consistent with surveys from many countries around the world that indicate that sustainable investment is increasingly influential in the investment market. Because investing in ESG business groups will be in the sustainable investment group, showing sustainable development resulting from investments that create positive impacts. Businesses can be managed systematically and with standards, not just focusing on performance. Therefore, it can be said that in the future, companies that can effectively identify ESG factors that are important to sustainability will have a clear impact on their business performance that is superior to their competitors. Sustainable development (ESG) is a concept about sustainable development of organizations. Without expecting only profit, taking into account 3 main factors: 1) environment, 2) society and 3) governance. Currently, ESG is an investment trend that is popular with investors around the world. This is because it is a concept that investors use in considering investing, as businesses with good ESG will reflect competitiveness and long-term growth potential.

The researcher therefore sees the importance of learning innovation. New things that are used to make learners learn. It can be seen that educational innovation is an innovation that is widely used in various aspects of education management. Learning innovation and learning innovation are considered the same type of innovation. It focuses on learning management to make learners learn. When it is linked with integrated learning management, which is teaching that relates and connects concepts of many subjects together, it will help learners connect the knowledge they have learned to real life. Learners can see the benefits of what they have learned and apply it in their daily lives. Integrated learning management will reduce the redundancy of content in various subjects in the curriculum, thus reducing the time spent learning some content and increasing the time for new content. Integrated learning

management will respond to learners' abilities in many areas, helping to create knowledge, skills, and attitudes of "multiple intelligences". Importantly, we have also developed the core competencies of learners to support the competency-based curriculum. For the integration of learning to be interesting, it is one thing that teachers should select and design appropriately for learners so that learners can learn according to their potential, aptitudes, and interests, resulting in sustainable learning and truly accessing that knowledge. Integrated learning management is teaching that relates and connects concepts of many subjects together. It will help learners connect the knowledge they have learned to real life.

From the study of the above related research, the researcher sees the importance of developing learners to have entrepreneurial skills that are socially responsible, consisting of 8 aspects as follows: 1) Operating a business with fairness 2) Anti-corruption 3) Respecting human rights 4) Treating labor fairly 5) Responsibility to consumers 6) Caring for the environment and using resources efficiently 7) Participating in community or social development and 8) Disseminating innovations from social responsibility through organizing a learning management process using an integrated learning management innovation based on the concept of sustainable organizational development (ESG) to promote socially responsible entrepreneurship. This research aims to develop undergraduate students in the graduate education program to be able to apply knowledge to design learning management and integrate it into the design of learning management units, integrated learning management, project-based learning, and learning management using technology to enable learners to have innovator skills through learning based on the concept of sustainable organizational development (ESG), allowing learners to learn by themselves and promote the learners' self-learning management process. Therefore, the research team is interested in developing an integrated learning management innovation based on the concept of sustainable organizational development (ESG) to promote socially responsible entrepreneurship for undergraduate students in the graduate education program.

Research Objectives

The research project aims to develop an integrated learning management innovation based on the concept of sustainable organization development (ESG) to promote socially responsible entrepreneurship for undergraduate students in an effective graduate education program. To study the efficiency of an integrated learning management innovation based on the concept of sustainable organization development (ESG) to promote socially responsible entrepreneurship for undergraduate students in a graduate education program. To study the development of behaviors in terms of socially responsible entrepreneurship skills of undergraduate students in a graduate education program.

Conceptual Framework

From the study of relevant documents and research, it was found that socially responsible entrepreneurial skills can be achieved through integrated learning designed through a blended approach to allow learners to develop diverse and holistic learning. Therefore, it leads to a conceptual framework for research in developing an integrated learning management innovation based on the concept of sustainable development (ESG) to promote socially responsible entrepreneurship for undergraduate students in the graduate education program based on the following 8 main concepts: 1) Fair business operations 2) Anti-corruption 3) Respect for human rights 4) Fair labor practices 5) Responsibility towards consumers

6) Environmental care and efficient resource use 7) Community or social development and 8) Dissemination of innovations from socially responsible practices.

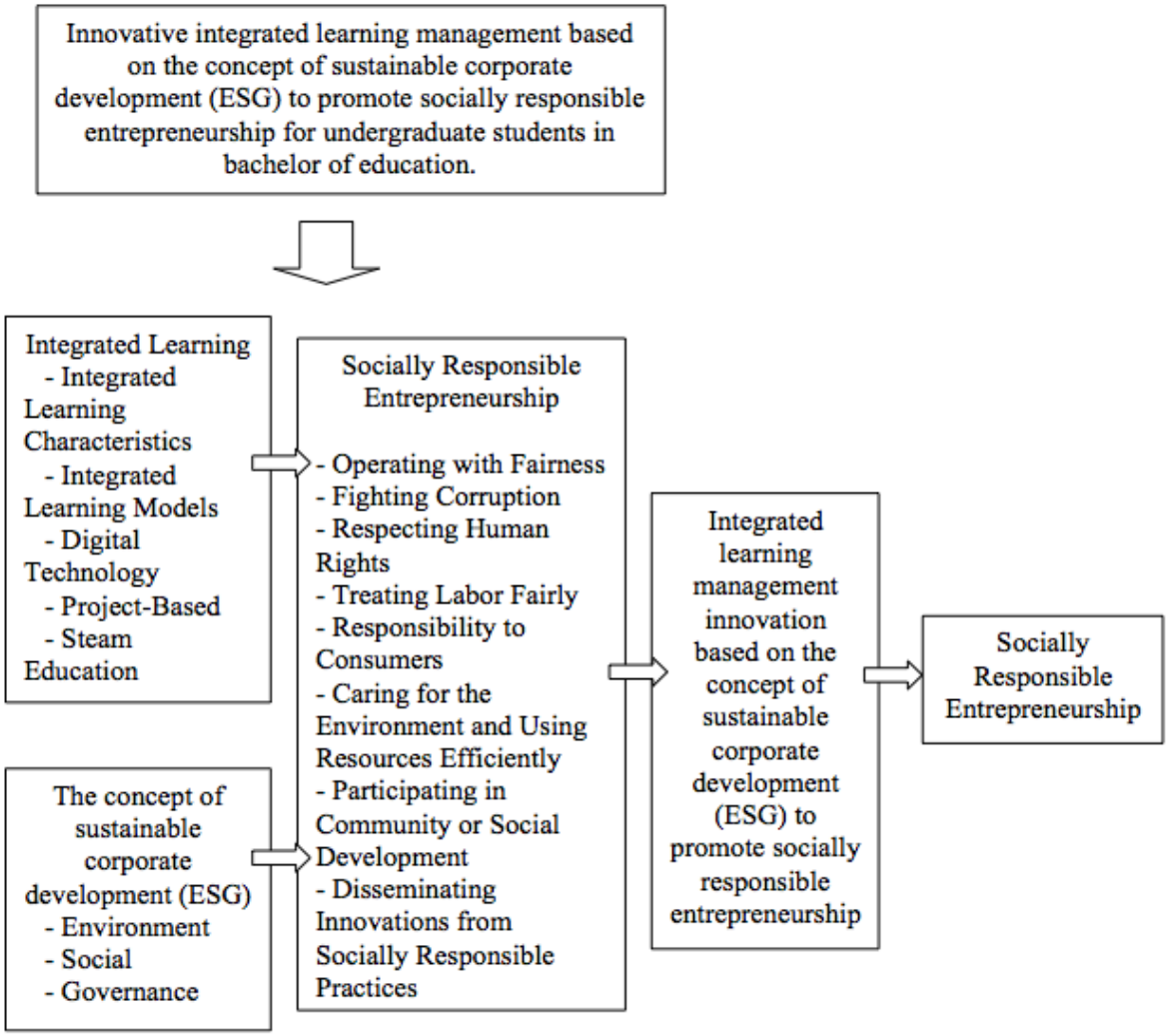

Figure 1: Conceptual Framework

Methodology

Step 1: A Fundamental Information Study

1. Investigate the concepts, theories, and principles underlying the development of educational materials and board games.
2. Examine the content of indigenous knowledge and the guidelines for creating learning media and educational board games.
3. Examine the perspectives of those involved with educational board game learning materials. To investigate the perspectives of individuals involved with educational materials and board games.
4. Utilize the study's findings, analysis, and synthesis of documents as guidelines for researching the opinions of those involved in learning media and educational board games. And educational personnel engaged in learning management in educational institutions via educational materials and board games Creating interview forms and questionnaires to collect feedback on educational materials and board games

Number of interviewees: 30 individuals 30 participants responded to the survey. Gather information in order to construct the next game board.

Step 2: The Design and Development of Educational Board Game Learning Media

The research tools consisted of 1) educational board game learning media and 2) a questionnaire to measure students' satisfaction with the board game educational media. The steps are as follows:

Educational Board Game Learning Media

1. Examine documents and research pertaining to the creation of educational materials and board games. and planning educational activities using instructional materials and educational board games.
2. Examine the content specifics.
3. Development of educational materials and board games
4. Using the ADDIE Model, this investigation developed an educational board game.
5. Bring along educational materials and game boards. Validate the content's appropriateness, the language's usage, the coverage, and the objectives' conformity. then make improvements.
6. Bring learning materials and educational board games for evaluation by five specialists. The specialists are experts in the creation of instructional materials and pedagogical board games.
7. Bring learning materials and revised educational board games to test with sixty students in order to improve.
8. Introduce instructional materials and educational board games.

A Questionnaire to Measure Students' Satisfaction With the Board Game Educational Media

The satisfaction survey was used as a measure of sentiment. Students have both positive and negative opinions of learning materials and educational board games. which seeks to measure the satisfaction assessment form's behavior The researcher determined the behavior to measure based on five factors: 1) learning media components, educational board games; 2) learner performance; 3) STEAM education concepts; 4) local wisdom; and 5) classroom environment. Using instructional materials, educational board games, and number 25 items in accordance with the steps below:

1. Examine the concept of developing a satisfaction evaluation form. and developing a satisfaction survey covering the content and objectives.
2. Develop a satisfaction evaluation form that expresses emotions. Students have both positive and negative opinions of learning materials and educational board games. The researcher establishes the measurement of behavior based on 5 factors with 5 items for each category, for a total of 25 items.
3. Present the satisfaction evaluation form to the research project consultant for verification of its contents.
4. Utilize the customer satisfaction evaluation form to evaluate the Index of Concordance by having five experts evaluate the questions' validity in terms of their content and clarity.
5. Twenty questions from the revised satisfaction assessment questionnaire were administered to 60 students, per the recommendation of the expert.

6. Using Cronbach's alpha coefficient procedure, the confidence value of the entire version of the satisfaction rating was calculated; this yielded the confidence value of the entire version. and to truly use the customer satisfaction survey.

Step 3: The Trial Use of Educational Board Game Media

This research is a quasi-experimental research in the form of One group pretest-post test design.

Step 4: The Evaluation of Learning Materials for Educational Board Games

1. The fundamental statistics used to interpret the satisfaction survey were: 1) mean, 2) standard deviation, 3) percentage, and 4) learning media effectiveness. Using E1/E2 formulas, comprehend the educational game board.
2. To calculate the content validity index (IOC) and to calculate the confidence value of the satisfaction questionnaire, the statistics were used to determine the quality of the instruments.
3. t-tests for dependent samples and t-tests for a single sample were used to verify the hypothesis.

Interview Questionnaire and Form

1. Examine concepts, theories, and relevant research.
2. A questionnaire and interview form were created for the research project consultant to review the content's accuracy and completeness.
3. Adjust the language of the acquired queries to be more succinct and clear before applying them in accordance with the suggestions of the experts.
4. Modify interview forms and questionnaires based on the suggestions of experts. The modified questionnaire was then utilized to acquire actual data.
5. Data Acquisition
6. Data analysis

Procedure

This research consisted of four steps: 1) Study the needs and Study the basic information. 2) Design and develop integrated learning management innovations; and 3) Introduce the integrated learning management innovation that has been developed for trial.

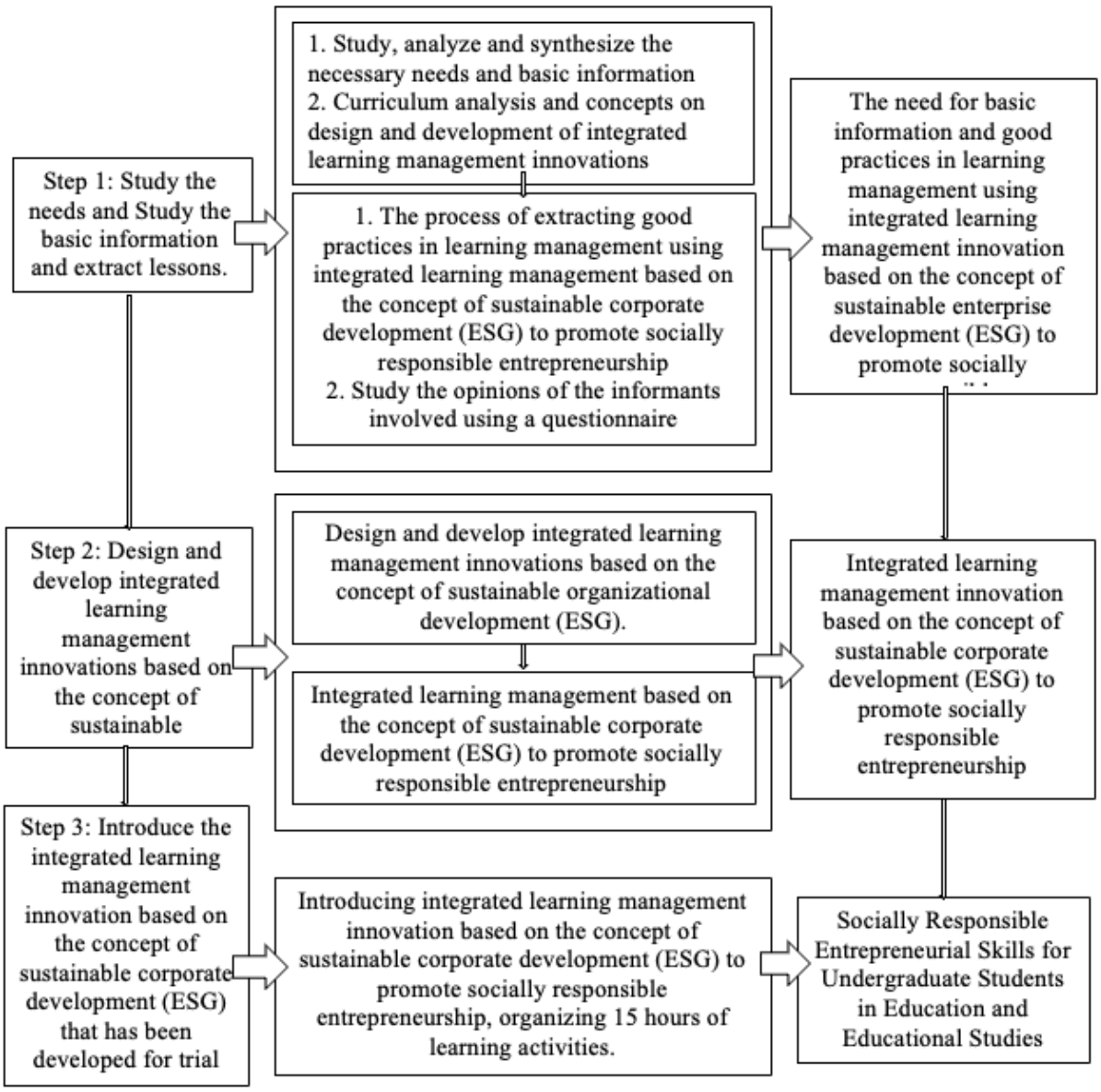

Figure 2: Procedure

Discussion

The best practices in STEAM education knowledge management utilizing local wisdom to cultivate innovator competency consisted of eight components. 1) Thai cultural communication and local wisdom; 2) engineering design methods. 3) Educational innovations 4) STEAM education learning activities; 5) integrated learning activities 6) Inventions of innovators 7) assessment, and 8) development.

Conclusion

Local philosophers and instructors from each of Thailand's four regions examined the best practices. The research utilized interview forms and questionnaires. The content analysis of the data revealed that the best practices in STEAM education knowledge management utilizing local wisdom to cultivate innovator competency consisted of eight components. 1) Thai cultural communication and local wisdom; 2) engineering design methods.

3) Educational innovations 4) STEAM education learning activities; 5) integrated learning activities 6) Inventions of innovators 7) assessment, and 8) development.

It is a challenge for elementary school instructors to design learning activities that combine STEAM education management with local knowledge about Thai handicrafts. Through the engineering design process, proactive learning management and local wisdom card games are used to help learners develop innovative competencies to inspire learners' inquiry and creativity.

Create a learning community for the transmission of knowledge, social processes, and local culture by means of local philosophers by taking systematic and scientific action and developing innovator competencies in conjunction with local wisdom.

The objectives of this research were: 1) to develop local wisdom board game media based on the STEAM education concept to promote efficient innovators' competency; and 2) to study the level of satisfaction of students towards the local wisdom board game media. Based on the STEAM education concept to promote innovators' competency. The tools used in the research were: 1) learning materials for board games of local wisdom based on the concept of STEAM education to promote innovators' competency; 2) handbooks for learning materials for board games of local wisdom based on the concept of STEAM education to promote innovators' competency; and 3) a questionnaire to measure students' satisfaction towards learning media for local wisdom board games based on the STEAM education concept to promote innovators' competency. The sample consisted of fifth-grade students. One study group of 30 students was obtained by simple random sampling. The results showed that evaluation results of the quality of learning media, board games, and local wisdom based on the concept of STEAM education promote innovators' competency. The quality is very good. And the students were satisfied with the learning materials, board games, and local wisdom based on the concept of STEAM education to promote innovators' competency. At the most satisfactory level. The results indicated that student satisfaction with the local wisdom board game in all five categories was as follows: The first aspect of learning media components, educational board games, was at a satisfactory level; the second was learner performance; the third was STEAM education concepts; the fourth was local wisdom; and the fifth was the classroom environment.

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Contact email: suwichaw@g.swu.ac.th

Problem-Based Learning Integrated With Augmented Reality: Development and Teacher Perspective

Risma Nurul Auliya, King Mongkut's Institute of Technology Ladkrabang, Thailand
Jirarat Sitthiworachart, King Mongkut's Institute of Technology Ladkrabang, Thailand
Thanin Ratanaolarn, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
The study aimed to develop a Problem-Based Learning (PBL) model integrated with augmented reality (AR) and to analyze teachers' perceptions of using the AR application for teaching mathematics. This research followed a Research and Development (R&D) design to develop and validate the PBL model using an AR application. Five experts evaluated the model, and fifty secondary school teachers tested the GLARE (Geometry Learning using Augmented Reality Experience) application. Data was collected using a 5-point Likert scale for expert evaluation and teacher perception scales. Experts reported the model, learning content, and AR application were implementable, with a mean score of 4.28 (SD=0.55). They reported that the PBL-based lesson plan provided a comprehensive overview of the learning process and clearly outlined the steps for using the model. They also found that the learning content was consistent with the learning objectives, and the PBL activities were clearly explained and relevant to the material. The illustrations in the learning materials were relatable to everyday life. Additionally, based on teacher perceptions, the total mean score was 4.43 (SD=0.59), indicating teachers provided positive feedback on using the GLARE for teaching. Most teachers agreed it would create a joyful, fun, and interesting learning environment and help teach geometry topics. However, some teachers were unsure if GLARE would simplify teaching, enhance effectiveness, or promote student self-learning. They were also uncertain about using GLARE regularly in their teaching or recommending it to colleagues.

Keywords: Problem-Based Learning, Augmented Reality, Learning Media, Teacher Perception

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1 Introduction

Mathematics is one of the most useful cognitive tools, which is crucial because it serves as the foundation for many fields and is crucial for the advancement of modern society (Poçan et al., 2023). However, many students mistakenly believe that success in mathematics requires memorizing countless unrelated facts, so they disengage, give up, and adopt a fixed mindset in mathematics (Hudson, 2021). The complex ideas in mathematics classes can frequently only be presented in a very abstract way because traditional teaching methods like blackboard lectures or remote classrooms due to the COVID-19 epidemic have limited visualization capabilities (Schutera et al., 2021). For these reasons, it is necessary to develop learning applications that offer an immersive and interactive environment because traditional books are insufficient for some topics that demand a high level of visualization in the 3D world (Gargrish et al., 2021). In this regard, Augmented Reality (AR) has been demonstrated to be a very effective method that not only captivates students but educates them on the importance of technology while improving their academic performance (Ab Halim et al., 2020). AR is a term that describes technologies that dynamically integrate real-world settings with context-based digital information (Ibáñez & Delgado-Kloos, 2018; Sommerauer & Müller, 2014). AR technology provides a better learning environment and experience and enables teachers to help students understand complex ideas and procedures more efficiently and effectively (Gargrish et al., 2021; Singh et al., 2019).

Problem-based Learning (PBL) refers to a learning environment in which problems become the main stimulation for learning (Roh, 2003). PBL is well suited to assisting students in becoming active learners because it grounds learning in real-world problems and ensures students are responsible for their learning (Hmelo-Silver, 2004). This approach enables students to actively engage with real-world situations while learning critical information and concepts from the lecture material to help students develop their critical thinking and problem-solving skills (Darhim et al., 2020). Although there are studies that integrate emerging technologies into PBL, there is currently not sufficient empirical research that provides adequate evidence for the integration of AR to support PBL at the middle or junior high school level (Fidan & Tuncel, 2019). Therefore, this study could be a beneficial resource for educators and educational technologists interested in integrating immersive technologies on PBL, specifically through realistic AR designs, to enhance students' comprehension of complex or abstract geometric concepts in mathematics. Because it was well-known that geometry required students to employ visualization skills.

2 Research Question

The purpose of the current study was to develop a PBL model integrated with AR and to analyze teachers' perceptions of using the AR application for teaching mathematics. The study's research questions are as follows:

1. How to develop the model of PBL integrated with AR for teaching mathematics?
2. What are teachers' perceptions of using the AR application for teaching mathematics?

3 Research Method

This study applied Research and Development (R&D) to develop and validate the PBL model using an AR mathematics learning instrument. The PBL model integrated AR and followed the six stages outlined by Fidan and Tuncel (2019): presentation of problem, definition of problem, determining the (un)known, data gathering and sharing, generating solution, and

reflection and evaluation. Additionally, it involves AR applications created to illustrate the learning content and support the stages of PBL related to identifying the (un)knowns, collecting data, reflecting, and evaluating within the PBL process.

Furthermore, the AR application was designed to introduce students to 3D geometry concepts covering several 3D objects, including the cube, cuboid, prism, pyramid, cone, cylinder, and sphere. Unity software had been selected as the tool for creating content within the AR environment. To ensure that users could easily access AR content in real-world scenarios, the Vuforia plugin served as the server for detecting target images through markers in the real-world environment. Android was selected as the operating system for the application because it is a preferred smartphone OS among Indonesian students.

The PBL model and AR application, including lesson plan, learning content, and activities, were evaluated by five experts who were all mathematics education lecturers. A group of fifty secondary school mathematics teachers then tested the AR application. They filled out a perception questionnaire to evaluate the AR learning materials, adapted from Faqih (2022); Pasalidou and Fachantidis (2021); Mutambara and Bayaga (2021); Cabero-Almenara et al. (2019); Su (2019); Weng et al. (2018); Rese et al. (2017) that consists of 21 items. A 5-point Likert scale rating system was used to anchor statements (1=Strongly disagree, 2=Disagree, 3=Neutral; 4=Agree, 5=Strongly agree). This study used quantitative data collection methods, such as expert reviews and percentages collected through the teacher perception scale.

4 Results and Discussion

RQ 1: How to develop the model of PBL integrated with AR for teaching mathematics?

This study aimed to develop a PBL model integrated with AR for teaching geometry topics. The model's feasibility was evaluated by five experts, who provided a total mean score of 4.28 with a standard deviation of 0.55, as shown in Table 1. Additionally, the PBL-based lesson plan received a mean score of 4.33 with a standard deviation of 0.62. The experts noted that the lesson plan offered a clear and comprehensive overview of the learning process, detailing the steps required to implement the model effectively. Regarding the learning content and activities in the PBL lesson plan, a mean score of 4.29 with a standard deviation of 0.46 was recorded. Experts highlighted that the learning assessments were well-aligned with the objectives, and the PBL activities were clearly described and appropriately linked to the learning content. They also commended the use of familiar illustrations that were relevant to real-life contexts. Based on this evaluation, the study implemented the PBL model proposed by Fidan and Tuncel (2019), which comprises six stages: (1) presentation of the problem, (2) definition of the problem, (3) determining the (un)knowns, (4) data gathering and sharing, (5) generating solutions, and (6) reflection and evaluation, as illustrated in Figure 1.

The AR application GLARE (Geometry Learning using Augmented Reality Experience) covered several topics related to 3D geometry, including surface area, volume, and the properties of 3D objects. It featured a variety of three-dimensional shapes such as the cube, cuboid, prism, pyramid, cone, cylinder, and sphere. As shown in Table 1, the application received a mean value of 4.20 and a standard deviation of 0.55, with experts agreeing that the learning objectives and GLARE content were well-aligned. They also rated the application as both useful and easy to use. This finding aligns with the study by Koparan et al. (2023), which demonstrated that AR-based materials are effective for teaching the surface area of a

cube. Furthermore, integrating AR into the teaching and learning process with a contextualized approach significantly enhances students' academic performance and attitudes.

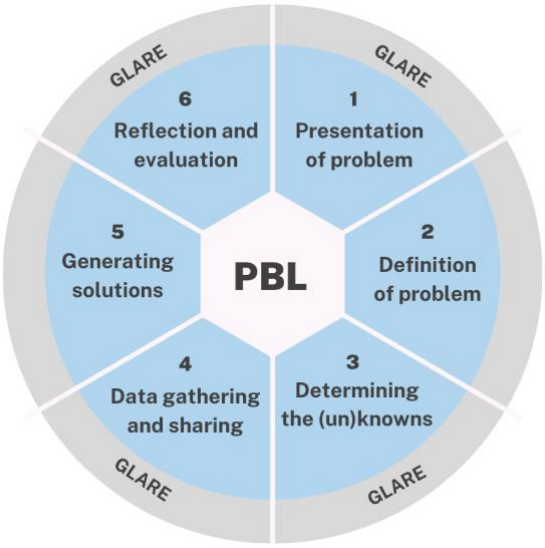

Figure 1: PBL Integrated With AR

Table 1: The Mean Scores of the Experts' Reviews

	Mean	SD
Lesson plan	4.33	0.62
Learning content and activities	4.29	0.46
AR application	4.20	0.55
Total	4.28	0.55

(Source: Authors)

RQ 2: What are teachers' perceptions of using the AR application for teaching mathematics?

The study also aimed to explore the perspectives of secondary school mathematics teachers on using GLARE for learning 3D geometry. Teachers participated by completing a questionnaire with a 5-point Likert scale, and their responses were used to construct a perception of the GLARE application for teaching mathematics.

According to teachers' perceptions, the total mean score was 4.43 (SD=0.59), revealed that most teachers gave good feedback regarding using GLARE in the mathematics class. Most of them believed that the GLARE application would positively affect the learning process, as proven by the mean scores above 4 for each item, which indicated that the GLARE application had significant potential for both effective teaching and enhancing academic achievement. They agreed that GLARE would create a joyful, engaging, and stimulating learning environment and believed it would be beneficial for teaching geometry concepts. Most teachers reported that the application had the potential to improve student performance and effectiveness. Additionally, they would frequently use GLARE and incorporate it into their lesson plans to foster students' interest in learning. Consistent with the findings of Cao and Yu (2023), integrating AR technologies in education could potentially engage and excite learners, fostering positive attitudes toward AR-supported learning.

On the other hand, some teachers were uncertain whether GLARE would foster independent learning in students and effectively simplify and enhance instruction. Compared to traditional

learning methods, some respondents questioned the application's flexibility and ease of use. Additionally, they were hesitant about recommending GLARE to their colleagues or using it regularly in their classrooms.

5 Conclusion

This study focused on developing a PBL model integrated with AR and analyzing teachers' perceptions of using the AR application for teaching mathematics. The findings indicated that experts observed that the lesson plan based on the PBL model provided a comprehensive overview of the learning process and clearly outlined the steps for using the model. It was well-organized, easy to follow, and facilitated active learning. Additionally, they found that the learning assessment material was consistent with the learning objectives, and the PBL activities were clearly explained and relevant to the material. The learning materials' illustrations were realistic and applicable to daily life. Moreover, most teachers expressed approval of GLARE's use in the classroom, affirming that it will improve geometry teaching and foster a fun, interesting, and engaging learning environment. However, some teachers were unclear if GLARE would make instruction easier, increase efficiency, or encourage students to self-learn. Also, they were unsure about GLARE's regular classroom implementation and whether to suggest it to their colleagues.

Acknowledgment

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Data Availability

The datasets generated or/and analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

None.

Statement of Ethics

This study protocol was reviewed and approved by The Research Ethic Committee Institute for Research and Community Service University of Bengkulu, approval number 21/KER-LPPM/EC/2023.

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Contact emails: 64603100@kmitl.ac.th
jirarat.si@kmitl.ac.th
thanin.ra@kmitl.ac.th

Design and Evaluation of the Educational Board Game for Teaching Conservation of Momentum

Trai Unyapoti, Srinakharinwirot University, Thailand
Suwicha Wansudon, Srinakharinwirot University, Thailand
Krirk Saksuparb, Srinakharinwirot University, Thailand
Arunee Eambaipreuk, Kasetsart University, Thailand
Thanida Sujarittham, Bansomdejchaopraya Rajabhat University, Thailand

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Abstract
This paper presents preliminary findings on an educational board game designed by the researchers. The game aims to enhance students' understanding of the concept of conservation of momentum through engaging and interactive gameplay, emphasizing hands-on learning. Tested in a classroom setting with undergraduate students, results show the game effectively improves understanding of conservation of momentum and boosts interest in physics. Students found the game satisfying and useful. Overall, the study emphasizes the potential of custom-designed board games as innovative tools for teaching complex scientific concepts.

Keywords: Educational Board Game, Game-Based Learning, Momentum

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Introduction

The conservation of momentum is a fundamental principle in physics, essential for understanding the behavior of objects in motion and their interactions during collisions. Despite its importance, many students face challenges in comprehending this abstract concept due to its reliance on mathematical equations and theoretical explanations. Traditional teaching methods often fail to engage students effectively, resulting in gaps in conceptual understanding and limited ability to apply the knowledge in practical situations (Singh, 2010; Doolittle, 1997).

Educational board games have emerged as an innovative tool for active learning, offering an interactive and engaging approach to teaching complex scientific concepts. By combining problem-solving scenarios, hands-on activities, and collaborative gameplay, these games provide students with opportunities to explore and apply theoretical knowledge in a practical context (Plass et al., 2015; Akl et al., 2013). The integration of educational games in physics education has shown promise in fostering deeper understanding, enhancing motivation, and improving learning outcomes (Clark et al., 2016).

This study focuses on the design and evaluation of an educational board game titled “The Momentum” aimed at teaching the principles of momentum and collision. The game is designed to address common learning challenges by providing a structured yet engaging platform for students to actively participate in the learning process (Banfield & Wilkerson, 2014; Zimbardo et al., 2003).

Research Objectives

This study aims to achieve two primary objectives:

1. Development of an Educational Board Game: To design and create an educational board game titled “The Momentum” with the primary purpose of enhancing students' understanding of physics concepts related to momentum and collision. This objective focuses on developing a game that provides an interactive, engaging, and hands-on learning experience while reinforcing theoretical knowledge.
2. Investigation of the Educational Board Game's Effectiveness: To evaluate the effectiveness of the board game in improving students’ conceptual understanding of the conservation of momentum. The investigation includes assessing learning gains through pre-test and post-test comparisons, analyzing students’ feedback regarding their gameplay experience, and conducting focus group discussions to gather in-depth insights about their learning experiences, suggestions for improvement, and the perceived impact of the game on their understanding of momentum.

Methodology

A mixed-methods approach was employed to design, implement, and evaluate the educational board game. The study involved two main phases: game design and classroom implementation with evaluation.

Game Design and Development

1. Identification of Learning Objectives: The first step in developing the game was to clearly define the learning objectives. This serves as the foundation for the

educational purpose of the game. In this case, the primary objective was to enhance students' understanding of the principle of conservation of momentum. This objective was established based on its importance in the physics curriculum and the need for students to apply this knowledge to real-world scenarios.

2. Game Conceptualization: Once the objectives were identified, the next step was to conceptualize the game. The researchers designed scenarios that involved problem-solving and hands-on activities to engage students in active learning. These scenarios were crafted to encourage participation and exploration, ensuring that players were actively involved in solving challenges related to the conservation of momentum. The game's concept emphasized experiential learning by integrating physics concepts into interactive gameplay.
3. Expert Review: Before creating the prototype, the game concept underwent a thorough review by experts in physics education and instructional design. These experts assessed the accuracy of the content, the pedagogical effectiveness, and the feasibility of implementation in a classroom setting. Their feedback provided valuable insights that were incorporated to refine the game's design, ensuring that it was both educationally sound and engaging for students.
4. Prototype Development: Following the expert review, an initial prototype of the game was developed. This prototype included key components such as game mechanics and problem scenarios related to momentum. It was then informally tested with a small group of students and educators. This pilot testing helped identify areas for improvement, including usability, content clarity, and the overall engagement level of the game. The insights gained from this phase were used to enhance the prototype, making it more suitable for practical use in educational settings.

Classroom Implementation

Once the board game was finalized and ready for use, it was introduced to a group of science teacher students in a classroom environment. This phase was critical for evaluating the game's effectiveness in conveying the intended learning objectives.

1. Introduction to the Game and Rules: The session began with a brief introduction to the game. Instructors explained the purpose of the game, highlighting its focus on the principle of momentum conservation. Students were given a clear and concise overview of the rules, objectives, and gameplay mechanics. This ensured that all participants had a baseline understanding of how to play and what was expected during the session. The introduction also emphasized how the game's activities were designed to relate directly to real-world physics concepts, helping to establish a meaningful connection between the gameplay and academic learning.
2. Group Division and Gameplay Session: To maximize engagement and facilitate collaborative learning, the class was divided into smaller groups. Each group had the opportunity to play the game during a 30-minute session. This structured gameplay period allowed students to explore the game mechanics, solve problems, and engage in discussions with their peers. By working in groups, students could share ideas, clarify their understanding, and collectively apply the principle of momentum conservation to the game's scenarios.
3. Instructor Facilitation: During the gameplay session, instructors actively facilitated the process. Their role was to observe the students' interactions, answer questions, and provide clarifications as needed. Instructors ensured that students were not only engaged in playing the game but also making connections between the gameplay activities and the underlying physics concepts. For example, they might guide

students to reflect on how their in-game decisions demonstrated the conservation of momentum or prompt them to discuss how the concept applied to real-life examples.

4. Focus on Conceptual Understanding: The facilitation emphasized linking the game experience to the learning objective. By contextualizing the gameplay within the framework of momentum conservation, instructors reinforced the educational value of the activity. This approach ensured that the session was not just an exercise in gaming but a meaningful learning experience where students could apply theoretical knowledge in a simulated, hands-on environment.

This method of implementation allowed students to actively engage with the concept of momentum conservation in an interactive and collaborative way. The structured yet flexible format of the session provided opportunities for both experiential learning and reflection, helping to deepen their understanding of the topic.

The Research Tools

The research instruments in this study consisted of:

1. The educational board game “The Momentum”: The custom-designed board game served as the central teaching tool for the study to deliver an interactive and engaging method for teaching conservation of momentum, fostering active participation, and reinforcing theoretical knowledge through hands-on learning:
   Playing time: 20-30 minutes
   Number of players: 2-6
   Subject: Physics
   Content: Momentum and collision
2. Conceptual Test (Pre-Test and Post-Test): The test focused on assessing students' understanding of the conservation of momentum before and after playing the game. To measure learning gains and the effectiveness of the board games in enhancing conceptual understanding.
3. Student Feedback Survey: A structured questionnaire with Likert-scale and open-ended questions to evaluate students' perceptions of the game.
4. Focus Group Discussion (FGD) Guide: A semi-structured discussion guide to facilitate in-depth conversations with a subset of students after gameplay. Questions focused on: Learning experiences, Suggestions for improving the game, The perceived impact of the game on understanding momentum.

Result

The study found a significant improvement in students’ understanding of conservation of momentum, with post-test scores showing a statistically significant increase compared to pre-test scores ($p < 0.05$). Students demonstrated better comprehension of fundamental concepts, including momentum equations, collision types, and real-world applications. Survey feedback revealed that most participants found the game engaging, enjoyable, and effective in facilitating learning, with a majority agreeing it made physics more accessible. Focus group discussions underscored the game’s strengths in simplifying complex ideas and fostering peer-to-peer learning. Overall, the game successfully enhanced conceptual understanding, boosted interest in physics, and provided an interactive.

Conclusion

This study demonstrates the power of educational board games in transforming complex physics concepts into engaging, hands-on learning experiences. The game significantly improved students' understanding of the conservation of momentum while fostering collaboration, critical thinking, and enthusiasm for physics. Students found the game not only effective but also enjoyable, making learning both interactive and accessible.

Acknowledgments

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Contact email: trai@g.swu.ac.th

Ensure Inclusive and Equitable Education: Who's Left Behind?

Freshy Windy Rosmala Dewi, University of Indonesia, Indonesia
Azka Muthia, University of Indonesia, Indonesia

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Abstract
There are numerous challenges for Indonesia to achieve inclusive and equitable education. One of the persistent issues is the high number of out-of-school children (OOSC). Therefore, this study aims to identify the determinants of OOSC among 7-to-18-year-olds in Indonesia, who are in the compulsory schooling age. Using a socio-ecological model approach, determinants of OOSC are examined across various levels: individual, household, and community. This study uses the head of household's education level and employment status as instrumental variables for per capita expenditure (a proxy for income), which is one of the independent variables. Other independent variables are child's sex, disability status, presence of biological mother in household, household size, and type of residence. Using IV-probit regression, results indicate that disability status is the strongest determinant of OOSC among 7-to-18-year-olds. Assuming average values of the independent variables, the likelihood of being OOSC for children with disabilities is 23.5% higher compared to those without disabilities. Another finding is that higher per capita expenditure is associated with a lower risk of children being out of school. Furthermore, boys, children not living with their biological mother, living in households with more than 4 members, and living in rural areas are at the higher risk of being OOSC. The study finally calls for government to; improve facilities and infrastructure, especially in rural areas; provide education assistance for those who are at high risk of being OOSC; and promote inclusive education programs for children with disabilities since they are one of the most marginalized groups.

Keywords: Out-of-School Children, Compulsory Education, Disability, IV-Probit

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Introduction

Development in the education has become a global goal, including Indonesia. In the target 4.1 of Sustainable Development Goals (SDGs), it is stated that by 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes. The Indonesian government's commitment to achieving this target is reflected in its consistent decision to maintaining the education budget at 20% of the national expenditure (Kemenkeu, 2023). This budget is allocated through policies aimed at increasing school participation, such as the Program Indonesia Pintar (PIP), Kartu Indonesia Pintar (KIP), School Operational Assistance (BOS), Early Childhood Education Operational Assistance (BOP PAUD), and others (DPR, 2023). From an economic perspective, these government policies aim to increase the demand for schooling.

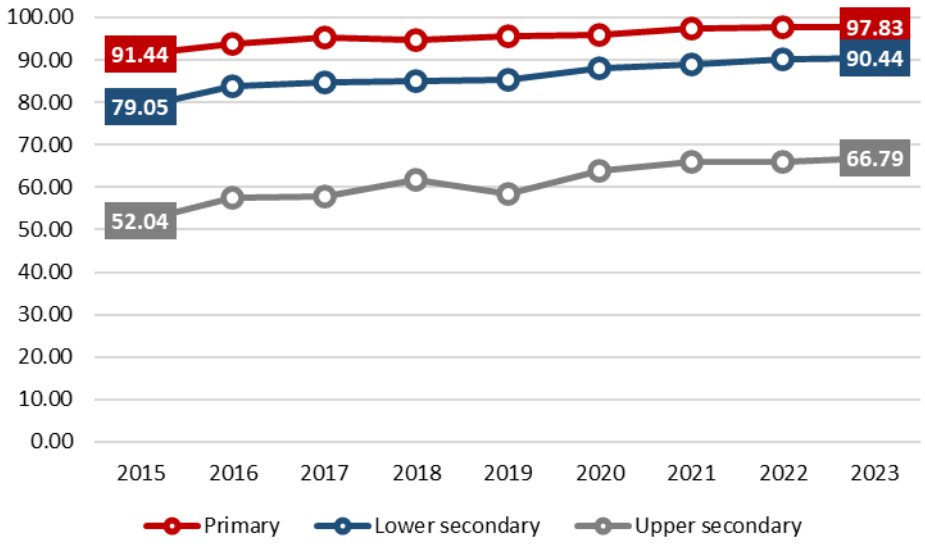

Figure 1: Completion Rate by School Level, 2015-2023
Source: Susenas 2015-2023

In fact, the educational attainment of the Indonesian population is still disappointing. As shown in Figure 1, school completion rates at all levels are still not 100 percent, particularly at the upper secondary level. Over the eight years since the SDGs were established, the upper secondary completion rate has increased by 14.75 percentage points (from 52.04 percent in 2015 to 66.79 percent in 2023). On average, the upper secondary completion rate has only increased by 1.8 percentage points per year. Considering there are only six years left until the SDGs deadline, an annual increase of 1.8 percent would only raise the upper secondary completion rate to around 80 percent by 2030. Without accelerated programs, achieving the SDGs target of ensuring all children complete primary and secondary education will be impossible.

One of the factors that can inhibit the attainment of completion rates is the issue of out-of-school children. According to Unicef (2015), out-of-school children can be divided into two groups based on their exposure to education: those who entered school in the past and dropped out, and those who have not entered school. Data from the Susenas from 2015 to 2023 shows that the rate of out-of-school children has remained quite stagnant for each school-age group over nearly a decade (Figure 2). The rate of out-of-school children tends to increase with age. In 2023, the out-of-school rate for the 16-18 age group was 21.61 percent.

In other words, about 1 in 5 children aged 16-18 in Indonesia were not attending school in 2023.

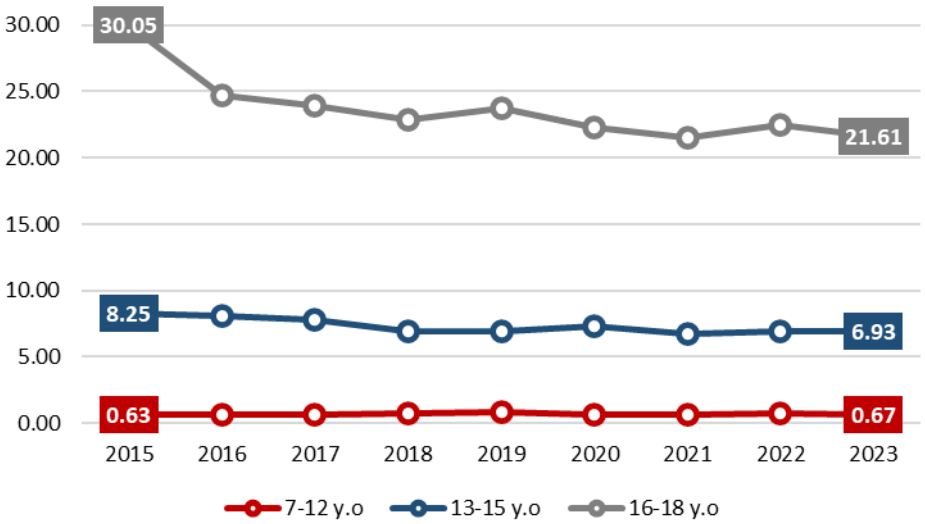

Figure 2: Out-of-school Children by Age-Group, 2015-2023
Source: Susenas 2015-2023

Children who never enter school will have no exposure to formal education at all and will bear the attendant lifelong consequences. For children who entered school but dropped out and those who will enter school in the future, the consequences vary according to the timing and extent of their exposure to education (Unicef, 2015). UNICEF (2022) formulated an educational attainment framework by adopting a socio-ecological model, where educational outcomes are influenced by factors at various levels, from the innermost level (i.e., individual) to the outermost level (i.e., environment/region). This study aims to gain a deeper understanding of the determinants of OOSC among 7-to-18-year-olds in Indonesia, who are in the compulsory schooling age. The paper is organized as follows: the next section, dedicated to literature review; methods, describes the IVP model, the data used, and the variables selected; results of the estimations are presented in the following section. Comments on the results and implications for health policies conclude the study.

Literature Review

As shown in Figure 3, out-of-school children can be divided into two groups based on their exposure to education: those who are in primary and secondary school age, have entered school in the past and dropped out, and those who have not entered school (Unicef, 2015). In Indonesia, the primary and secondary school age is 7 to18 years old. Children who never enter school will have no exposure to formal education at all and will bear the attendant lifelong consequences. Among children who will enter school in the future, their participation in primary education may be delayed by years after they reach the appropriate age for enrolment. An increase in this delay has been shown to place children at increased risk of dropout and low academic achievement (Unicef, 2015).

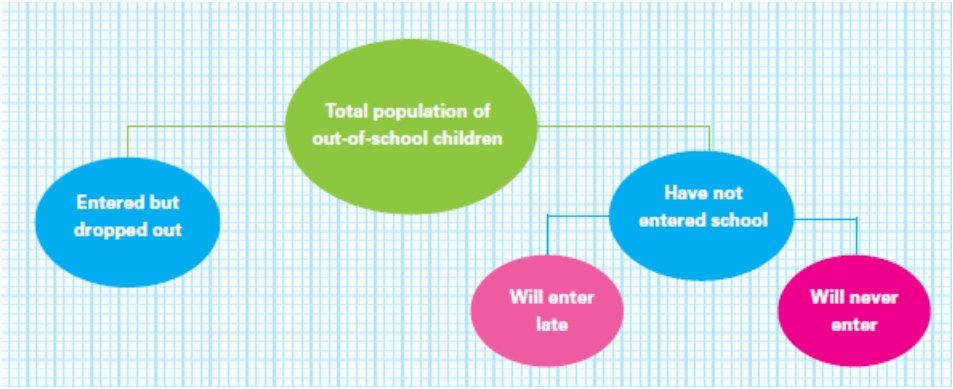

Figure 3: Classification of the Out-of-School Population, by School Exposure
Source: Unicef, 2015

Children who drop out in early grades are unlikely to have acquired even the most basic mastery of reading and writing, numeracy and other skills. All school leavers can, in theory, return to school in the future, but very few early school leavers continue their formal education (Unicef 2015). Using a socio-ecological model approach, determinants of drop out school amongst children are examined across various levels: individual, household, school, and community (Unicef, 2022) as shown in Figure 4. The socio-ecological model informs how student dropouts relate to various child-level characteristics (e.g., gender and age), family-level conditions (e.g., wealth, deprivation, parental expectations), school-level characteristics and practices (e.g., teachers' and directors' characteristics, supervision visits and school councils) as well as community-level variables (e.g., access to infrastructure and services). Factors facilitating or reducing students' school engagement and outcomes, such as dropout, can be found at each level of the interconnected dimensions (Unicef, 2022).

The social norms, beliefs, and growing traditions in society led to the emergence of educational discrimination against women. In addition, the phenomenon of school dropouts is often experienced by women in different regions. (Colclough et al, 2000 in Sabates et al, 2013). However, a study from Sabates (2013) showed that girls are 66 percent less likely to drop out of school than boys. Besides, UNICEF (2022) and Mike et al (2008) also found that school dropout rates are not very different between men and women.

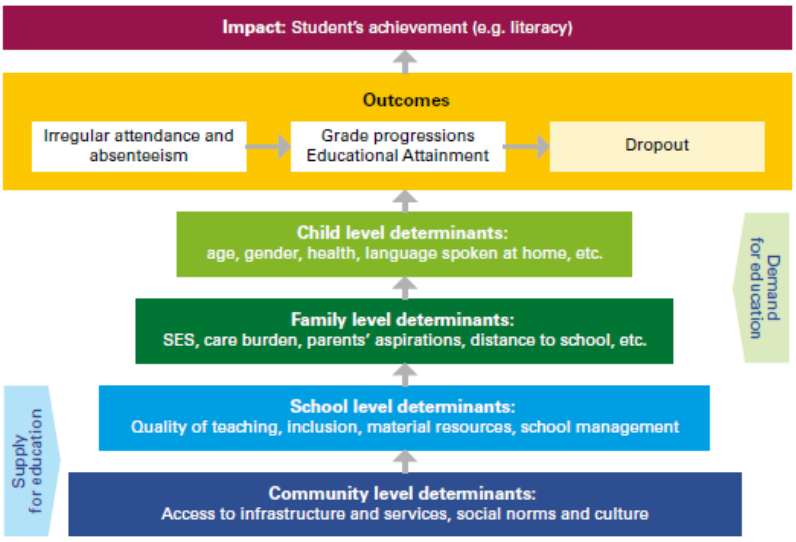

Figure 4: Unicef's Conceptual Framework of Drop-Out School
Source: Unicef, 2022

A factor that also determines the sustainability of a child's school is disability status. Assumed they have the same access and same educational facilities, children with disabilities have fewer chances of achieving education due to the barriers or functional difficulties they encounter (Peters, 2003 in Sabates, 2013). Research results from Sabates (2013) showed that disability status has a significant influence on school dropouts. Children with disabilities are 1.9 times more likely to drop out of school than non-disabled children.

Francavilla and Giannelli (2007) found that the presence of the mother in the household is crucial because a mother is the one who contributes most to the well-being of the child (in terms of affection, nutrition, education, and other needs). Branson et al. (2013) in his research explains that school dropouts are less found in children who live with both parents, and more found in children whose parents had died. The presence of a mother significantly reduces the chance of dropping out of school, whereas a father's presence has no significant influence on the chances of leaving school.

The size of the household is also assumed to be correlated with OOSC. Children from families with a larger number of household members have a higher likelihood of dropping out of school compared to children from families with a smaller number of household members, and this number of household members is statistically significant (Mike et al., 2008). Thus, the number of household members is positively related to the likelihood of children dropping out of school.

Haveman and Wolfe (1995) and Branson et al. (2014) found that household income is positively related to children's educational attainment and is statistically more significant compared to other variables. Parents with better economic conditions have more resources, making them more capable of sending their children to school (Huisman and Smits, 2015). Theoretically, the size of household income (approximately by expenditure) is influenced by the level of education of the head of the household. The head of a household with a higher education will be able to give a decent life to the members of his household compared to those with a lower education. (ILO, 2022).

The residential location of the child or parent determines the likelihood that a child will be out-ofschool. According to the report of UNESCO (2005), the proportion of children that are out-of-school in rural areas is about 30% while that of the urban area is 18%. Mike et al. (2008) found that the likelihood of children dropping out of elementary school is lower in urban areas compared to rural areas. This has been attributed to the lack of quality teachers, poor educational facilities, the high level of insecurity and the remote location of schools (OCHA, 2022 in Adeleke and Alabede, 2022).

Methods

Sample Selection

This analysis utilized data from the National Socio-Economic Survey (Susenas), a cross-sectional, population-based survey. The study utilized the 2023 Susenas data, collected through face-to-face interviews. The analysis focused on respondents aged 7-18 years at the start of the academic year, excluding those outside this age range to prevent bias associated with compulsory education. The final sample consisted of 277,276 respondents from a total of 1,223,377 observations.

Measures

Some information contained in the Susenas, related to residence, sex, disability status, work and education have been selected for the empirical analysis. The dependent variable in this study is the OOSC status of children, divided into two categories: (1) OOSC and (0) not OOSC, with the "not OOSC" as the reference category. OOSC refers to children aged 7-18 in the beginning of academic calendar who are not currently attending formal or non-formal education. Those who are aged 7-18 and are attending preschool or who are no longer in school but have graduated from upper secondary or equivalent are not counted as OOSC.

The determinants of OOSC are divided into three levels, i.e individual, household, and community level. For individual level, the independent variables are child's sex (a dummy variable assuming value=1 if the child is man and =0 otherwise), and child's disability status (a dummy variable assuming value=1 if the child is disabled and =0 otherwise). For household level, we use household number/size (a dummy variable assuming value=1 if the HH number >4 people and =0 otherwise), biological mother's presence in the household (a dummy variable assuming value=1 if the children are not living with their biological and =0 otherwise), and per capita expenditure as the independent variables. And for community level, we use type of residence (a dummy variable assuming value=1 if the children are living in rural areas and =0 otherwise) as one of the determinants of OOSC.

Household expenditure per capita may be influenced by unobserved factors like parental attitudes or cultural values and is often interdependent with dropout decisions. To address the endogeneity issue between household expenditure and out-of-school children (OOSC), instrumental variables are required. These variables must correlate with household expenditure but not directly with dropout decisions. This study uses the household head's education level (e.g., primary, lower secondary, upper secondary or higher) and employment status (e.g., unemployed, working in the informal sector, working in the formal sector) as instrumental variables, analyzed using IV probit estimation. The IV probit method is used to address endogeneity with the binary outcome of the dependent variable. The expenditure per capita is transformed into log-normal form because, theoretically, the distribution of consumption approximates a log-normal distribution (Battistin and Blundell, 2009), and will ease the interpretation of the result.

Table 1: Summary of Variables Used in this Study

Variables	Label	Coding
OOSC	Out-of-school children status	1) OOSC **0) Not OOSC***
Ln(Expend)	Log normal expenditure per capita	Scale
HH_Education	Head of Household's Education	1) **Primary*** 2) Lower secondary 3) Upper secondary and above
HH_Occupation	Head of Household's employment status	1) **Not working*** 2) Working in informal sector 3) Working in formal sector
Sex	Child's sex	1) Men 0) **Women***

Variables	Label	Coding
Disable	Child's disability status	1) Disabled 0) **Non-disabled***
HHNumber	Household number	1) >4 people 0) **<=4 people***
Mother	Biological mother's presence in the household	1) Not living with bio-mother 0) **Living with biological mother***
Urban	Type of residence	1) Rural 0) **Urban***

*Noted: * reference category*

The Statistical Model (IV-Probit)

The analysis used to identify the relationships between the dependent variable and the independent variables involves descriptive and inferential analysis. The descriptive analysis employed consists of cross-tabulation between the dependent variable and each independent variable, expressed as a percentage (%). To support the results of these cross-tabulations, further inferential analysis is needed.

As mentioned before, the dependent variable in this study is binary, while one independent variable, log-normal per capita expenditure, is endogenous. Due to endogeneity, OLS cannot be used. To address this and account for the binary nature of the dependent variable, the study employs the Probit Model with Endogeneity, utilizing the instrumental variable method. The general model for probit with endogeneity is as follows (Martens et al., 2006):

$$Y = \beta_0 + \sum_{i=i}^{k} \beta_i X_i + u \quad (1)$$

$$X = \delta_0 + \sum_{j=1}^{l} \delta_j Z_j + v \quad (2)$$

where Y is the dependent variable, X is the independent variable with endogeneity, Z is the instrumental variable, u and v are the error components, k is the number of independent variables, and l is the number of instrumental variables. When applied to the variables used in this study, the model can be written as follows:

$$OOSC = \beta_0 + \beta_1 Ln(\widehat{Expend}) + \beta_2 Sex + \beta_3 Disable + \beta_4 HHNumber + \beta_5 Mother + \beta_6 Urban + u \quad (3)$$

With the head of household's education level and employment status as the instrumental variables, the model for the log-normal per capita expenditure is as follows:

$$Ln(Expend) = \delta_0 + \delta_1 HH_Education + \delta_2 HH_Occupation + v \quad (4)$$

In this study, we apply the MLE method using stata software package Version 17.0. After the estimation, Wald tests for exogeneity were conducted to control if IVP regression might be a suitable approach. If it is not possible to reject the null hypothesis of exogeneity, there is no need for an IVP approach and estimates of a probit model are more efficient.

Results and Discussion

Table 2 displays descriptive statistics of all variables included in the empirical analysis. In general, the sample shows that 6.4 percent of children aged 7-18 years are not currently attending formal or non-formal education (being out-of-school children). At the individual level, 51.94 percent of children aged 7-18 years were male and more than 90 percent were not disabled. From the household level, children who do not live with their biological mother are 8.42 percent and 51.07 percent of children live in households with more than 4 household members. Meanwhile, if we look at household expenditure, the average monthly household expenditure per capita in the sample is around 1,2 million rupiah. At the community level, we can see that most of the children in the sample (59.79 percent) live in rural areas.

Table 2: Summary of the Sample (Unweighted)

Variables	Mean/Percentage	Min	Max
OOSC status of children			
Not OOSC (reference)	93.6		
OOSC	6.4		
Gender			
Female (reference)	48.06		
Male	51.94		
Disability status			
Not-disabled (reference)	99.51		
Disabled	0.49		
Biological mother's presence in the household			
Living with biological mother (reference)	91.58		
Not living with biological mother	8.42		
HH number			
≤ 4 people (reference)	48.93		
> 4 people	51.07		
Type of residence			
Urban (reference)	40.21		
Rural	59.79		
Expenditure (per capita) in rupiah	1,243,370	132,621	65,906,278

As we mentioned before in Figure 2, in general, about 0.67 percent of children aged 7-12 years old were out of school in 2023. This number grows larger as the age group of the children increases. Table 3 shows cross tabulation between OOSC status and each independent variable. From the individual level, the percentage of children who become OOSC is higher for males (than females), and for disabled children (compared to non-disabled ones). The percentage for children with disabilities are 29.42 percent. In other words, around 3 out of 10 children with disabilities are OOSC.

Table 3: Cross Tabulations (Weighted)

Variables	Not OOSC	OOSC
Gender		
Female (reference)	93.57%	6.43%
Male	91.93%	8.07%
Disability status		
Non-disabled (reference)	92.84%	7.16%
Disabled	70.58%	29.42%
Biological mother's presence in the household		
Living with biological mother (reference)	93.30%	6.70%
Not living with biological mother	85.74%	14.26%
HH number		
≤ 4 people (reference)	93.02%	6.98%
> 4 people	92.47%	7.53%
Type of residence		
Urban (reference)	93.83%	6.17%
Rural	91.27%	8.73%
Per capita expenditure (mean) in rupiah	1,306,527	1,179,259

At household level, children who do not live with their biological mother have a higher percentage of OOSC (14.26 percent), compared to those who live with their biological mother (6.70 percent). Based on the number of household members, the percentage of children with OOSC status is not much different between children living with household members of less than 4 people and household members living with more than four people. Meanwhile, from the average per capita expenditure per month, children who become OOSC tend to have lower per capita expenditure in their household than children who remain in school. From the community level, children who live in rural areas have a higher percentage of being OOSC (8.53%) compared to children who live in urban areas.

To support the descriptive statistics above, we use IV-Probit regression to know more about the determinants of children being OOSC in Indonesia. The final model from probit regression with endogeneity estimation is as follows:

$$Ln(Expend) = 0.1196\, LowerSecondary + 0.3334\, UpperSecondary - 0.0742\, Informal + 0.1270\, Formal \quad (5)$$

$$OOSC = 0.1193\, Male + 0.8777\, Disable + 0.3386\, Mother + 0.0173\, HHNumber + 0.1032\, Urban - 0.8797\, Ln(\widehat{Expend}) \quad (6)$$

Equation (5) demonstrates that the head of household's education level positively influences per capita expenditure. The initial estimation confirms that the household head's education level and employment status are valid instrumental variables for household expenditure. Higher education levels correlate with increased per capita expenditure, reflecting improved household welfare. Additionally, the employment status of the household head shows that formal employment increases per capita expenditure, while informal employment decreases it, emphasizing the role of formal work in enhancing welfare. The IVP estimation results, which address the endogeneity of log-normal per capita expenditure, are detailed in Table 4,

alongside an analysis of Indonesia's sociocultural and economic context to provide deeper insights into these determinants.

Table 4: IVP Regression With the "Log-Normal Per Capita Expenditure" As Endogenous Variable

Variables	Coefficients	Std Error	Marginal Effect
Gender			
Female (reference)			
Male	0.1193***	0.0065	0.0170
Disability status			
Not-disabled			
Disabled	0.8777***	0.0320	0.2349
Biological mother's presence in the household			
Living with biological mother (reference)			
Not living with biological mother	0.3386***	0.0101	0.0613
Household size			
≤ 4 people (reference)			
> 4 people	0.0173**	0.0068	0.0025
Type of residence			
Urban (reference)			
Rural	0.1032***	0.0075	0.0145
Ln per capita expenditure	-0.8797***	0.0146	-0.0041
Constant	10.6671***	0.2103	

IVP = Instrumental Variable Probit
*** significant at 99%; ** significant at 95%.

The findings reveal that disability status is the most significant factor driving children aged 7-18 to become out-of-school children (OOSC). Children with disabilities are 23.5% more likely to be OOSC compared to their non-disabled peers, highlighting a persistent educational gap in Indonesia. Participation rates for children with disabilities in mainstream education decline at each educational level, largely due to negative stigma that influences family perceptions and treatment. Many families hide children with disabilities from public spaces, including schools, viewing them as incapable or a source of shame. Although the Indonesian government promotes inclusive mainstream education, special schools remain the preferred option due to insufficient support for children with disabilities in inclusive settings. The study by Mizunoya et al. (2016) found that disability status is the main factor affecting school participation in developing countries, with a greater impact compared to household and other individual factors. Furthermore, Zablocki and Krezmien (2012) found that children with emotional and behavioral difficulties have a higher likelihood of dropping out of school.

Another individual-level factor affecting the risk of being OOSC is the child's sex. Boys have a 1.7 percent higher chance of becoming OOSC compared to girls. This is because boys are considered to have a more economic role within the household, so when have economic problems, boys are more likely to leave school to work compared to girls. In many Indonesian families, especially in rural or low-income areas, there is a cultural expectation for boys to contribute to the family income. This leads to boys leaving school early to work in agriculture, construction, or informal sectors. This finding aligns with studies from Alspaugh (2000) and Okumu et al. (2008), which found that dropout rates are lower for girls than for boys. This might be because boys are considered to have a more economic role within the

household, so when have economic problems, boys are more likely to leave school to work compared to girls.

Other findings in this study were seen at the household level. The higher the per capita expenditure, the lower the risk of a child becoming an OOSC. The UNICEF report shows that in Indonesia, children from poor families are four times more likely to drop out of school than children from rich families (UNICEF, 2013). This result is in line with a study by Garg et al. (2023) who found that the lower the spending quintile, the greater the chance of a child dropout from school. This suggests that the lower the economic condition of a household, the lower the risk of a child being able to pursue education. This condition is one of those affected by the cost of education that can't be afforded by poor households. Moreover, the data indicates that education costs in Indonesia remain relatively high, around 7.8 million rupiah per academic year for upper secondary school; 5.59 million rupiah per academic year for lower secondary school; and 3.24 million rupiah per academic year for primary school (BPS, 2021). For the richer households, those direct costs like fees, books, and uniforms, as well as opportunity costs like losing income from child labor may not be so important (Basu, 1999 in Huisman and Smits, 2015).

The size of the household is also a significant determinant for OOSC. Children living in households with more than four members have a 0.2 percent higher chance of becoming OOSC than children living with less than or equal to four household members. This is probably because any increase in the number of household members leads to higher expenditures due to additional costs and time demands. Having a large family often results in economic challenges, which limit parents' involvement in their children's education. The findings are in line with a study by Patrimos & Psacharopoulus (1997) who found that children in large family in both developing and developed countries have less schooling, are poorly nourished and perform poorly in achievements. According to Becker (1993), the number of children has a negative relationship with the economic status of households. Any increase in the number of children will increase the additional expenditure as there are additional costs and time for each child resulting in the total household expenditures becoming bigger.

The absence of a mother significantly impacts household dynamics, with children who do not live with their biological mother being 6.1% more likely to become out-of-school children (OOSC) compared to those who do. In many Indonesian households, mothers play a central role as primary caregivers, nurturing and guiding their children's educational development. They monitor homework, enforce discipline, and ensure regular school attendance. A mother’s presence also provides emotional security, which is crucial for academic focus and performance, especially in early education when foundational social and learning skills are being developed. Additionally, children without a father or mother in the household are more likely to miss school as they may need to take on responsibilities typically handled by their absent parent. Research indicates that children with absent or unknown parents are more likely to drop out of school, particularly girls. When a parent is absent, children may need to take on parental responsibilities, reducing their likelihood of attending school. Studies by Agustina et al. (2023) and Kuno et al. (2021) confirm that incomplete parental presence significantly decreases school continuation rates for children aged 7–18 in Indonesia. Becker's (1973) marriage theory suggests that complete parents provide greater parental endowment, leading to higher household productivity, including better education outcomes. Consequently, families with both parents present are more likely to ensure their children's school continuity compared to single-parent or incomplete-parent households.

This study highlights residence type as a key community-level determinant affecting a child's risk of becoming an OOSC. Children in rural areas have a 1.45% higher likelihood of being OOSC compared to those in urban areas. This disparity stems from better infrastructure and transportation in urban areas, making educational facilities more accessible. The education gap between urban and rural areas remains severe, particularly in Indonesia's Western and Eastern regions. While urban schools are often close to students' homes, rural schools are typically far, requiring long, costly, and sometimes unsafe commutes. Rural areas also face teacher shortages, leading to large class sizes, limited individual attention, and underqualified or inadequately trained educators. Samosir (2008) highlights stark disparities in school facilities between regions in Indonesia. For example, primary schools in Medan often have permanent buildings and adequate furniture, whereas schools in East Nusa Tenggara may have old, leaky roofs and insufficient tables and chairs. These differences in quality and quantity of resources pose significant challenges for the government in promoting educational equity. Mike et al. (2008) also found that children in urban areas are less likely to drop out of primary school than those in rural areas, partly due to better infrastructure and easier access to educational facilities (Huisman and Smits, 2009).

Conclusion

This study provides clear evidence that out of school children is a problem that needs to be addressed in Indonesia and affects progress in educational attainment. Children who are boys, disabled, not living with their biological mother, living in households with more than 4 members, have lower per capita expenditure, and living in rural areas are at the higher risk of being OOSC. Among those results, disability is the major reason at the individual level which increases the risk of being out of school. These results show that there are still educational gaps in Indonesia, where children with disabilities face difficulties in attending school.

This study finally calls for government to provide education assistance for those who are at high risk of being OOSC and improve facilities and infrastructure in rural areas to reduce the education gap between urban and rural areas. The government also needs to provide and promote inclusive education programs for children with disabilities since they are one of the most marginalized groups. These policies strengthen the resources available for children's education in Indonesia, so that can prevent children out of school and increase school participation. Considering that Indonesia comprises thousands of islands, conducting qualitative studies is essential to identify the most significant factors contributing to children being out of school. This will help the government in formulating the most suitable policies for each region.

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Contact emails: freshywindyrd@gmail.com
azkamuthia25@gmail.com

Appendix

Extended probit regression — Number of obs = **277,276**
Wald chi2(**6**) = **8935.76**
Log likelihood = **-296603.65** — Prob > chi2 = **0.0000**

	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
OOSC						
JK						
Laki-laki	.1193017	.0065475	18.22	0.000	.1064687	.1321346
disable						
Disabilitas	.8776528	.0320468	27.39	0.000	.8148423	.9404633
MOTHER						
Tidak ada Ibu	.3386468	.0101225	33.45	0.000	.318807	.3584865
HHNumber						
>4 orang	.0173224	.0068153	2.54	0.011	.0039646	.0306803
URBAN						
Perdesaan	.103163	.0074543	13.84	0.000	.0885529	.1177731
EXPEN	-.8797417	.0146385	-60.10	0.000	-.9084327	-.8510507
_cons	10.66708	.2103241	50.72	0.000	10.25486	11.07931
EXPEN						
KRT_EDUC						
SMP/sederajat	.1195535	.0028433	42.05	0.000	.1139807	.1251264
SMA/sederajat	.3333995	.0023453	142.15	0.000	.3288027	.3379963
KRT_OCCUP						
Kerja Informal	-.0741727	.0048332	-15.35	0.000	-.0836456	-.0646998
Kerja Formal	.1269528	.0049395	25.70	0.000	.1172715	.1366341
_cons	13.67485	.0047756	2863.49	0.000	13.66549	13.68421
var(e.EXPEN)	.3026125	.0008128			.3010237	.3042098
corr(e.EXPEN,e.OOSC)	.4682318	.0083396	56.15	0.000	.4517272	.4844161

Exploring Inclusive Evolution in Music Academia: Experimental Practices in Contemporary Music

Raushan Jumaniyazova, Kurmangazy Kazakh National Conservatory, Kazakhstan
Zhanel Safiyeva, Kurmangazy Kazakh National Conservatory, Kazakhstan

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Abstract
For individuals with disabilities, music lessons often serve as effective art therapy, a prevalent approach in Kazakhstan and globally. However, what if a student aspires to pursue music professionally? Are contemporary methods equipped to provide comprehensive music education to everyone, regardless of their physical or cognitive limitations? This paper examines inclusion issues in modern professional music education and practice. It suggests that contemporary music offers a pathway for the full participation and development of musicians with various disabilities, including conditions affecting strength, energy, or alertness, such as ADHD and multiple disabilities. Inclusive music teaching methodologies extend beyond technical accommodations in classrooms; they also involve the psycho-emotional literacy of educators and the use of adapted systems like Figurenotes, improvisation techniques, and specialized devices. This study analyzes available technologies, including music applications, that enhance contemporary music education and practice. The collaboration between contemporary music and inclusive practices holds potential for fostering new musical thinking, advancing professional music education, and benefiting society. The authors translate academic discourse into practical application, showcasing results from a collaboration between disabled musicians and a contemporary music ensemble at the Edinburgh Festival 2023. Through this practical experience, the paper aims to develop experimental musical practices and inclusive perspectives in education, science, and performance, highlighting the transformative power of inclusive evolution in contemporary music.

Keywords: Inclusive Music Education, Adaptive Music Methodologies, Music Education for Disabilities, Contemporary Music Practices, Music Technology and Accessibility

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Introduction

In the realm of professional music education, this paper explores teaching methodologies tailored for students with special educational needs – a topic of profound sensitivity. The discourse on inclusive education often includes personal examples, stories, and insights that underscore the pivotal challenges and potential strategies for fostering inclusivity. Our analysis is rooted in both the broad scope of music education and specific contemporary music practices, drawing from our direct experiences.

The Current State of Inclusive Music Education: Global and National Perspectives

As reported by the World Health Organization in 2023, approximately 1.3 billion people, or 16% of the global population, live with some form of disability or health limitation. This statistic represents roughly one in six individuals worldwide. When considering unreported cases of neurodivergence, this estimate could potentially rise to over 30% of the global populace. Specifically, in Kazakhstan, it is documented that over 160,000 children are living with disabilities. Despite national efforts aiming for full school inclusivity by 2025, the provision of music education tailored to students with special needs lags significantly, both within the nation and globally.

This paper identifies a significant disparity between societal expectations and the absence of a scientifically substantiated pedagogical framework for inclusive music education. We propose that musical inclusion should not merely be viewed as an approach but as a foundational paradigm that affords every child and youth the opportunity to participate, learn, and thrive in music based on their unique abilities. It is important to note that disability ceases to be solely a medical issue and becomes a matter of social organization (Abramo, 2012). A poignant example of this paradigm shift is the consideration of musical instruments: if an instrument is not designed for one-handed use, the limitation does not lie with the individual but with the instrument's design. Such insights drive the need for innovative educational methodologies that are both flexible and adaptable, thereby accommodating a diverse range of learners.

Educational initiatives aiming to integrate inclusive practices in music education have emerged globally. Notably, the Melody Music Birmingham (MMB) project and a Swedish initiative at the Academy of Music have gained academic attention for their innovative approaches. These projects exemplify how structured educational programs can adapt to the needs of students with disabilities, promoting inclusive practices within established curriculums.

The grassroots movement represents a significant shift towards creativity and innovation, unbound by traditional institutional frameworks. A prime example is the Monthly Music Hackathon NYC (Bell, 2020), an event that epitomizes this trend by bringing together diverse professionals to co-create new musical instruments, delve into emerging technologies, and tackle the educational barriers faced by individuals with disabilities. Such initiatives are pivotal as they foster a collaborative environment that encourages the rethinking of traditional educational methods and the creation of accessible musical experiences.

Several music institutions are at the forefront of developing contemporary methods tailored for musicians with disabilities. These include the Drake Music network, the Vancouver Adapted Music Society (VAMS) in Canada, the Resonaari Music Centre in Helsinki, the

Sibelius Academy, and Sweden's "Music Passion" program. These programs are critical in shaping educational practices that accommodate diverse learning needs and promote inclusivity within professional settings.

Adaptive Teaching Methods in Music Education

Despite these advancements, professional music education organizations often remain isolated from broader educational systems and lack comprehensive resources such as specialized textbooks, methodologies, or established traditions for teaching students with special needs. For instance, at the Kazakh Conservatory, while blind students are admitted under state quotas, their education is generally confined to vocal studies. The adaptation of teaching methods, including the use of the Braille system for music notation which students often have to transcribe themselves, remains limited and highlights the necessity for broader systemic changes.

Although general concepts of inclusive education have been applied to music education, as demonstrated in Table 1, they only address a fraction of the overall demand. The implementation of these principles varies significantly, indicating a need for a more robust integration of inclusive methodologies within music education frameworks.

Table 1: Inclusive Education Principles Applied in Music Education

Individualized Education Programs, IEPs	ABA and DTT Discrete Trial Training, DTT
Universal Design for Learning, UDL	The TEACCH Method
Peer-Assisted Learning Strategies, PALS	The Scope and Sequence Method
Child-Friendly School	The Holistic Method (Dalcroze Approach)
The Carl Orff Method	The Multisensory Approach

Recent advancements in music education have led to the development of specialized methods tailored to meet the diverse needs of students with disabilities.

- *String Instruments:*
  The shift from mainstreaming to true inclusion addresses individual needs. Methods include visual markers on instruments, alternative notation systems, and technology like iPads for students who cannot hold traditional violins. Violinist Adrian Anantawan, who uses a prosthetic to play, exemplifies how adaptive methods enable musical achievement (Bugaj, 2016).
- *Music Theory & Conducting:*
  Janna Saslaw emphasizes Braille for independent harmony exercises and low-tech tools for beginners unfamiliar with Braille. For conducting, a tactile method allows students to place their hand on the instructor's hand, learning gestures and patterns. Spatial perception challenges, due to the lack of visual experience, are managed with targeted adjustments and one-handed instrument exercises.
- *Inclusive Music Education (Russia):*
  Smirnov's long-term experiment (1994–2017) at A. Scriabin Music College highlights key components: continuity, multimodal perception, individualized learning paths, and collective music-making. These principles create an effective inclusive model in professional music education.

What approaches should be adopted when a student with disabilities aspires to pursue music as a professional career? This pivotal question challenges educators to extend beyond basic inclusive practices to more comprehensive strategies that facilitate not just participation but

professional proficiency in music. We will now highlight several crucial insights derived from contemporary research that underscore effective methodologies and best practices for supporting these students' professional ambitions.

1. Most inclusion models and methodologies in music focus on art therapy, emphasizing a “supportive environment” for self-expression. However, this approach often reduces music to a therapeutic tool rather than an academic discipline, limiting students' opportunities for professional growth or careers in music.
2. Specialized studies highlight the challenge of selecting repertoire for students with special educational needs (Wong, 2022).
3. Ensemble performance within the framework of inclusive music education is an optimal format.
4. An undervalued specialization for students with special educational needs is composition, which we believe to be the most promising.
5. Traditional non-European educational models hold great potential (such as Confucian traditions, folk ensembles (mariachi, steel bands, gamelan), or Kazakhstan's “Ustaz–Shakirt” oral teaching system).
6. Academic music education focuses heavily on the reproduction of musical works, while improvisation, being underintegrated into the curriculum, represents a missed opportunity.

Case Study: Collaboration Between Eegeru and Drake Music Scotland

The six theses outlined formed the foundation of an international collaboration between the Kazakh ensemble “Eegeru” and Scotland’s “Drake Music”. This partnership is founded on the hypothesis that contemporary *music as a field enabling full participation and growth for musicians with diverse disabilities, including conditions that limit strength, energy, or alertness, such as ADHD and multiple disabilities*. This collaboration has identified six strategic directions that we believe are crucial for empowering musicians with disabilities to achieve professional success and artistic fulfillment:

1. Building professional careers for musicians with disabilities;
2. Developing compositional skills;
3. Expanding the repertoire;
4. Emphasizing ensemble performance;
5. Effectively fostering improvisational skills;
6. Integrating and learning from non-European musical traditions.

The collaborative endeavor between the Kazakh ensemble “Eegeru” and “Drake Music Scotland” serves as a paradigmatic example of successfully integrating contemporary music with inclusive practices. “Eegeru”, an independent ensemble specializing in contemporary music, comprises eight professional musicians: a classical string quartet, a flutist, a clarinetist, a pianist, and a performer on the qobyz – a traditional Kazakh instrument. Each ensemble member boasts an impressive educational portfolio, having earned degrees and completed internships at prestigious institutions globally, such as the UCSC, Berklee College of Music, Conservatoire National Supérieur de Musique et de Danse de Paris, Harvard Summer School, and the Moscow State Conservatory. “Drake Music Scotland”, which represents Scotland in this partnership, is recognized as the nation's largest institution dedicated to inclusive music. The collaboration primarily occurred online, utilizing modern technologies and adaptive methods to surmount geographical and physical barriers. This virtual collaboration reached its zenith with a vibrant concert at the previous year's Edinburgh

Festival, which highlighted the talents of musicians with disabilities and underscored the efficacy of inclusive music education practices.

Technological and Methodological Innovations

The successful presentation at the Edinburgh Festival exemplified the tangible benefits of employing modern technologies and adaptive strategies in music education. This approach is particularly resonant with James J. Gibson's affordance theory. The theory of affordances links what objects offer to the possibilities for behavior that exist for a given creature. The theory "implies that to see things is to see how to get about among them and what to do or not do with them" (Gibson, 1979).

We can provisionally categorize research into three areas:

- Development of adaptive methodologies
- Creation of accessible instruments
- Application of software solutions

It is important to note that the first historical attempts at adaptive methodologies in music can be traced back to the 19th century. In addition to the well-known Braille system, the experience of the New York Institute for the Blind (NYIB, founded in 1832) is noteworthy. Today, even the significantly improved Braille music notation system, despite its obvious advantages, has limited effectiveness.

One of the most accessible adaptive methodologies is the system of music notation. Among the most effective alternatives to conventional academic notation is Figurenotes, developed in Finland. This system is based on the idea of using colored symbols to represent musical notes. Each symbol corresponds to a specific sticker on the instrument, allowing students, regardless of their ability to read traditional musical notation, to intuitively reproduce musical works. Symbols representing specific notes are color-coded for ease of recognition, while their shapes vary according to the octave, simplifying the learning process and minimizing confusion. This system is designed to be maximally simple, user-friendly, and intuitive.

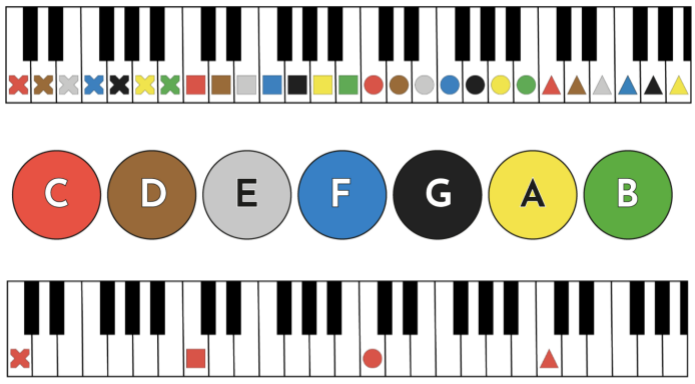

Figure 1: Figurenotes – System of Music Notation

Adaptive methods were integral to this project, encompassing individual lessons that preceded ensemble work and incorporating the use of Figurenotes for composition. These methods facilitated the inclusion and participation of musicians with disabilities. During performances, each musician received individualized support from an assistant, a standard

practice designed to ensure the smooth execution of musical pieces. Assistants played a critical role, not only in tasks such as page-turning for pianists but also in navigating complex musical scores. This was achieved through the use of specialized cards that indicated key entry points and segments of the musical text, a technique derived from Peer-Assisted Learning Strategies (PALS) and the Multisensory Approach.

Assistive Technologies and Digital Solutions

Adapted musical instruments are crucial for musicians with physical limitations (e.g., restricted limb mobility). Developing mechanisms enabling performance on traditional instruments using one hand, foot, or other body parts involves modifying valves, keys, and other components to facilitate play. A higher level of technology is applied in the development of adaptive devices such as MIDI controllers, which can be customized to individual needs, and devices operated by head movements, breath, or eye gaze (e.g., EyeHarp or Headspace, created by Rolf Gehlhaar, which uses sensors to detect head movements and breath for sound production). We utilized the Digital Harp, played by musician Rhona Smith using three physical buttons programmed to trigger responses, primarily in two programs: Notion and Ableton. Rhona controls playback and structure, while Ableton manages sound production.

Expanding on software solutions, we highlight the applications Harmonic Walk, Jazz Improvisation, and Following the Cuckoo Sound, developed by Italian researchers M. Mandanici, F. Altieri, A. Rodà, and S. Canazza (2018). These represent a unique adaptive environment aimed at developing various musical skills through full-body interaction. Harmonic Walk is designed to teach the basics of tonal harmony. In an interactive environment, “harmonic points” representing various chords are placed on the floor. Participants move across these points, and when stepping on a specific area, the system plays the corresponding chord.

Jazz Improvisation allows children to control multilayered musical compositions. On an interactive surface, zones correspond to different musical tracks (e.g., rhythm, bass, melody, accompaniment). By moving between these zones, children can toggle tracks on and off, creating their own arrangements and improvisations in real time. Following the Cuckoo Sound is designed for teaching visually impaired children. The game creates a sound environment where participants follow audio cues (the sound of a cuckoo). The sounds change based on their direction, guiding users when they deviate from the intended path.

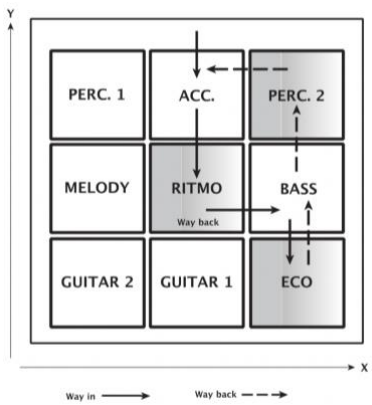

Figure 2: An Example of Child’s Route on the Responsive Space of Jazz Improvisation (Mandanici, M., Altieri, F., Rodà, A., & Canazza, S. [2018])

The use of specialized software, such as Soundbeam and GarageBand, has become an essential part of music education in modern progressive schools. This is not an exhaustive list of software for inclusive music education. Tools (like Ableton Live, Logic Pro, FL Studio, and GarageBand) allow students to create music interactively using samples and effects. The iPad, with its convenience and versatility, has become a key tool for integrating music and technology into education and performance. Nearly all the mentioned software is available for use on the iPad.

In our practice, the ThumbJam app was utilized extensively. This advanced music application provides access to over 40 high-quality instruments, each specially recorded for enhanced authenticity. It features a comprehensive library of hundreds of scales and modes, accommodating a variety of musical genres from rock to classical. The app's key attributes include authentic sound quality with layered samples, an intuitive interface that simplifies playability – even for individuals without musical training—and extensive customization options for scales, keys, and ranges. Additionally, it supports multitouch and accelerometer inputs, enabling expressive effects such as vibrato and tremolo.

Contemporary Music as a Framework for Inclusion

The focus on contemporary music is a deliberate alignment with our core principles, particularly within the context of postmodernism. This musical approach is characterized by its inclusivity and a propensity for experimental forms, sounds, and performance practices. Unlike traditional classical music genres that often adhere strictly to established structures and traditions, contemporary music encourages the challenging of norms and the adoption of innovative approaches. This orientation positions contemporary music as an optimal medium for integrating non-traditional performers and adaptive technologies. Such practices not only facilitate participation by musicians with diverse abilities but also contribute significantly to the enrichment of the contemporary musical landscape.

One of the intriguing research concept views disability as an analytical category in musicology, examining how it expands musical norms in contemporary music. Joseph Straus (2006) redefines disability as a cultural construct, not just a social or biological condition, and traces the evolution of “normalcy” and “deviation” in Western culture through music:

- *Late 18th Century*
  Until this time, disability in Western culture was seen as an immutable condition, perceived as a sign of divine punishment or a natural “defect”. It was considered a “natural and permanent” state beyond correction. This perspective extended to music, where deviations from traditional harmony were viewed as “violations” of the established order, reinforcing the continuity of natural laws.
- *Late 18th Century – Early 19th Century*
  The concept of disability began to shift, now understood as a deviation that could be corrected or “normalized”. The idea of "normality" became dominant and extended to musical structures. Musical deviations started to mirror cultural notions of disability – as states requiring correction. For instance, in Beethoven's symphonies, dissonances and unstable tonalities disrupt the norm temporarily but ultimately return to equilibrium, symbolizing the societal impulse to “correct” deviant conditions. This view also influenced 19th-century music theory, which focused on identifying and resolving “deviations” in tonality and harmony, paralleling cultural normalization efforts.

- *Early 19th Century*
  Schubert's music often features dissonances and tonal deviations that do not resolve immediately. These techniques suggest that musical works can remain in a state of "unresolved tension", metaphorically embracing deviation as part of a new state. In Schubert's compositions, anomalies are not "corrected" but integrated, representing a philosophy where deviation is a stable element coexisting with traditional harmony.
- *Early 20th Century*
  Schoenberg advanced the idea of anomalies as foundational rather than temporary deviations. In his twelve-tone system, departures from traditional harmonic structures became integral to the compositional process. This system treated all notes as equal, organizing anomalies into a new harmonic form. By redefining and "normalizing" deviations, Schoenberg established entirely new standards and norms.

Contemporary music serves as an inclusive space where unconventional features become part of the artistic vision. Its traits below emphasise how limitations can transform into artistic expression:

- *Clashing Musical Styles*
  Combining contrasting styles incorporates jarring clashes giving a vivid impression of heard voices. This reflects fragmented consciousness and allows everyone to find their unique "voice" within the music.
- *Repetition and Structure*
  Repetition in modernist music creates predictability, offering comfort and inclusion for those who thrive in structured environments. It transforms uniformity into a powerful tool for accessibility.
- *Simplicity and Minimalism*
  Simplified melodies, harmonies, and textures make music accessible. "Extreme simplification" (Howe, 2016) fosters engagement and creates a welcoming space for diverse abilities.
- *Improvisation as Collaboration*
  Improvisation encourages self-expression and teamwork. In "Eegeru" and Drake Music Scotland's concert, improvisational sections highlighted collective creativity and inclusivity in action.

These techniques align with contemporary music's broader tendency to find beauty where classical aesthetics saw deviation from the norm. "Disability aesthetics refuses to recognize the representation of the healthy body... as the sole determination of the aesthetic" (Howe, 2016). This assertion confirms that contemporary music offers a more open and inclusive space for all, allowing uniqueness to become a source of artistic value.

The composition by Claire Johnston, a musician with a disability, was performed by an ensemble that included flute, clarinet, two iPads, qobyz, a string quartet, digital harp, and piano. Of the eleven ensemble members, three were individuals with physical and psychological conditions. The musical score innovatively combined graphic and standard notation, incorporating improvisational fragments that necessitated comprehensive interaction among the musicians, a core element that significantly enhances the complexity and depth of chamber music. The composition was set in a simple tonality of G major, with one sharp, designed to facilitate equal participation from all ensemble members. Its structure was based on a three-part form that utilized repeating patterns to drive the development of the musical piece. Over the course of a year, the composer worked closely with a qobyz musician, integrating intonational elements that are characteristic of both Kazakh and

Scottish musical traditions. The piece notably featured overtone-rich sounds and utilized pentatonic scales, narrow-range folk modes, and was imbued with meditative imagery that focused on a singular reflective state.
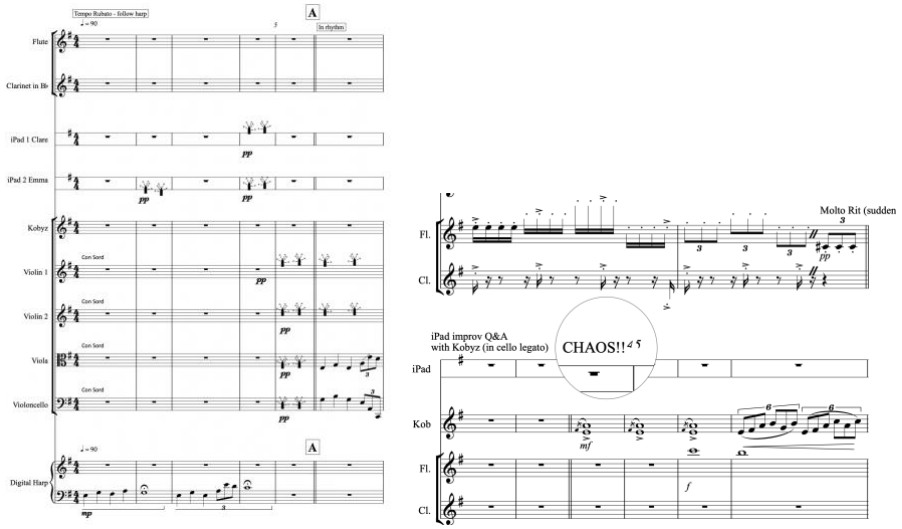
Figure 3: Call of the Mountains by Claire Johnston

Contemporary music's inclusivity lies in its embrace of unconventional forms, harmonic experimentation, simplicity, rituality, and “variations of difference” as artistic tools, fostering integration into academic and professional music fields.

Impact and Future Directions

The concert exemplified an effective integration of collaboration, modern technologies, adaptive methods, contemporary music, improvisation, and Kazakh traditions, culminating in a transformative experience. It was recognized with The Impact Award from the Royal Philharmonic Society, marking it as one of the most significant concert programs of 2023. In response to this achievement, the “Music Unbound” initiative was established. This community-driven effort in Kazakhstan is committed to promoting professional musicianship that transcends physical barriers. The inaugural event of “Music Unbound” showcased ensembles whose performances demonstrated that physical differences, such as congenital blindness, do not detract from musical talent. This initiative marks a critical advancement in redefining professional music engagement, emphasizing inclusivity and performance excellence.

Conclusion

This research has yielded several key insights into the integration of inclusive practices in music education:

1. There are musical genres that enable musicians with various disabilities to fully participate and develop. Contemporary music embraces diversity as a norm, not a deviation.
2. It is evident that a fully universal methodology is impossible. Adaptation is necessary depending on the type of disability and the musical instrument.
3. A promising idea is the use of traditional musical cultures in inclusive music education, particularly those historically developed as oral-professional traditions.

4. Significant reforms in the music education system, including higher education, are essential.
5. Including students with disabilities in the academic community can lead to greater isolation if it remains a nominal gesture without real changes.
6. Professional music education and the professional music scene are fundamental rights for every individual.

While our research findings and subsequent initiatives offer promising perspectives and inspire optimism, we must acknowledge the significant challenges and concerns associated with implementing transformative changes in music education. There exists a palpable apprehension that our innovative approaches may be perceived as too radical or may not adequately influence the entrenched norms within state conservatories. Additionally, we are acutely aware of the urgency of our mission and harbor concerns about the potential failure to effectively support the many aspiring musicians with disabilities. These fears underscore the complexities of advocating for substantial systemic changes and highlight the need for continued advocacy, research, and collaborative efforts.

To address these challenges, future research should focus on quantifying the impact of inclusive practices on student outcomes, exploring more adaptive technologies, and fostering broader institutional support. It is imperative that the music education community, policymakers, and educators collaborate to create more inclusive environments that not only accommodate but celebrate diversity in musical expression. By doing so, we can ensure that music education remains a dynamic and inclusive field that is accessible to all.

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Additionally, we extend our appreciation to the organizers of the IAFOR conference for providing a platform to present and discuss our research within a global academic community.

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Changing Students by Osmosis: A Literature Review of Nudge Theory in Educational Technology

Chengze Zeng, Peking University, China

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Abstract
Nudge theory is an influential theory in the behavioral sciences and related fields. With the development of information technology, its integration with the area of educational technology has received increasing attention. The purpose of this study is to explore the theoretical combination and practical application of nudge theory in educational technology. First, on the theoretical level, the integration of nudge and educational technology involves discussion of data-driven interventions, the proposal of online engagement frameworks, and integrated analysis frameworks. Further, in terms of the form of application, it can be categorized into three types: information nudges (e.g., email, short message service, and personal feedback), social nudges (e.g., social comparison and social norms), and digital nudges (i.e., user interface design). Finally, current empirical studies have shown that nudging strategies have significant positive effects on students' learning attitudes, behaviors, and effectiveness. However, the effects of nudging strategies in education are influenced by specific application contexts and individual differences, and it requires further clarification of the conditions under which this theory is applicable. Future research directions include exploring the effectiveness and differentiation of different nudging strategies, developing more personalized and interactive nudging tools, and optimizing nudging strategies with data analytics to build more inclusive and effective learning environments.

Keywords: Nudge Theory, Educational Technology, Information Nudge, Social Nudge, Digital Nudge

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Introduction

Eating unhealthy food, making poor economic decisions, and polluting the air, people often seem to make decisions that jeopardize their own or the public welfare (Grüne-Yanoff & Hertwig, 2016). In public policy making, governments are faced with the challenges of effectively guiding citizens to promote social well-being. Traditionally, governments have attempted to change people's behavior through conventional propaganda or educational campaigns. Although these methods convey information directly, they demand a high level of proactivity from individuals, requiring them to actively accept these decisions. And some people may even resist the propaganda, making the original intention more difficult to achieve. The proposal of nudge theory provides a new perspective on how to improve people's behavior without causing resentment.

Nudge theory is a term used in behavioral economics, decision-making behavior, and other behavioral sciences. It was clearly articulated in the book "Nudge: Improving Decisions About Health, Wealth, and Happiness" by Nobel Prize-winning economist Richard Thaler and jurist Cass Sunstein (2008). While nudging was originally defined as nudging another person with a body part, such as an elbow, to alert or draw attention to another person, the two authors define nudging as any aspect of a choice architecture that changes people's behavior predictably without prohibiting any choices or significantly altering their economic incentives. Nudging is different from mandating. For example, placing fruit at eye level is a nudge, whereas banning junk food is not (Thaler & Sunstein, 2008). Overall, the core of nudge theory is to guide decision-makers to make better decisions by changing the environment and information without restricting their choices.

With the election of Barack Obama, a former colleague of Sunstein's at the University of Chicago Law School, nudge theory rapidly became mainstream in American public policy, being applied in areas such as healthcare, financial reform, and healthy eating. The United Kingdom also established the Behavioural Insights Team in 2010 to start adopting nudging techniques and policies (Pedwell, 2017). In terms of healthy food choices, implementing digital salience nudges in online supermarkets can reduce the proportion of unhealthy food choices by 63% and increase the proportion of healthy food choices by 30% (Michels et al., 2023). In online shopping, displaying emotive warning messages and incompatibility information at the checkout page can reduce the purchase of incompatible items (Esposito et al., 2017). Besides, Gajewski, Heimann, Meunier, and Ohadi (2024) emphasized the potential of nudges in financial decision-making. Damgaard and Nielsen (2018) synthesized empirical studies on the application of nudges in education, finding that the effectiveness of nudges varies among individuals, with some specific groups, such as those with particular behavioral disorders, potentially benefiting more from nudges.

In an era of rapid technological development, the form of education is also evolving. Considering the critical role that information technology plays in applying nudge theory to the field of education, this paper will focus on the realm of educational technology, specifically examining the integration of nudge theory with educational technology. Given the broad scope of educational technology, which encompasses both general techniques and information technology, this paper will limit its focus to information technology to ensure a clearer structure and more focused content. As information technology intersects with education, nudge theory offers a unique perspective for understanding and adapting to changes in educational technology. Combining nudge theory with technology allows for the design of effective interventions, such as digital interfaces and interactive experiences

(Mitrovic et al., 2023), to subtly improve learners' behavior. The strategic application of nudges can promote key resources and activities to less-engaged learners and enhance their participation (Brown, Lawrence, Basson, & Redmond, 2022). The libertarian paternalism embodied in nudge theory is different from forcing students to change their existing habits or perceptions but rather preserves student autonomy, which may better align with the educational emphasis on free choice, and thus it is valuable to sort out its related research.

In general, this paper aims to discuss the combination of nudge theory and educational technology, including theory combination, intervention approach, and application effects. Through the discussion of this paper, we hope to provide new ideas and strategies for researchers and practitioners in the field of educational technology to design more attractive and effective educational products and services.

Theoretical Integration of Nudge Theory With Educational Technology

In exploring the theoretical integration of nudging and educational technology from a data-driven level, Thomas et al. (2013) proposed combining education with technological nudging through micro-education and cloud computing to enhance individual decision-making capabilities and support sustainable development. Knox, Williamson, and Bayne (2020) presented a data-centric perspective, arguing that the future of education may move towards "machine behaviorism", undermining students' autonomy and engagement, and shaping their behavior through data-driven technological interventions to meet anticipated educational goals.

In terms of students' engagement, Fritz (2017) emphasized using learning analytics tools to nudge students, enhancing their sense of responsibility for their academic progress, and serving as a method to extend student success. Similarly, Brown et al. (2022) combined learning analytics and nudging from the theoretical perspectives of critical discourse and communication theory, proposing a framework to promote online student engagement in higher education, where the nudge component is to motivate students to engage in key learning activities through personalized communication reminders, using course learning analytics data to provide personalized instruction and feedback to students.

Finally, Decuypere and Hartong (2023) offered a broader analytical perspective with their four-dimensional "Edunudge" framework, encompassing technological modes, political economy, spatiotemporal context, and pedagogy. It explores the implementation of nudging strategies in education, considering various technological approaches, the interplay with politics and economics, the influence of time and space, and their integration with teaching methods as educational tools.

Overall, these studies demonstrate the diversity and complexity of integrating nudging theory with educational technology. From data-driven interventions, how to influence student learning behaviors and comprehensive analytical frameworks, they provide theoretical foundations for subsequent researchers to design reasonable nudging strategies in education.

Intervention Types of Nudging With Educational Technology

Information Nudging

Information nudging primarily involves structuring the information environment in slightly different ways to provide clear and targeted information, helping individuals or groups make wiser and more rational choices (Thaler & Sunstein, 2008). Todd, Rogers, and Payne (2011) pointed out in the context of consumption that a better strategy is not to provide more information for consumers to make detailed product comparisons, but rather to design technological interventions that present sufficient information in the right form to facilitate correct choices. Information nudging focuses on the transmission and interpretation of information, aiming to reduce decision biases caused by insufficient information or misunderstandings. Currently, many studies have adopted information-nudging methods to guide individuals in making decisions that benefit their academic performance.

Providing information to students via emails and text messages is the most common form of nudging (e.g. Bälter et al., 2023; Chohan et al., 2019; Lichand & Christen, 2021; Plaxton, 2019). For instance, Matz, Mills, Derry, Hayward, and Hayward (2024) and Taback and Gibbs (2023) utilized general emails to provide students with resources that could potentially enhance their course engagement and learning attitudes. Plak, van Klaveren, and Cornelisz (2023) and Dart and Spratt (2021) explored the impact of personalized emails, tailored to different student characteristics, on improving learners' attitudes or outcomes. Additionally, Chohan et al. (2019) focused on the role of the source of information while employing email nudges and found that disclosures from expert sources were more effective.

Nudging targets are not limited to learners themselves. Several studies have also explored how nudges can have direct or indirect effects when applied to students' guardians or educators. Santana, Nussbaum, Carmona, and Claro (2019) sent text messages to the guardians of Chilean middle school students, encouraging participation in non-academic activities or merely providing administrative information, finding that students whose parents received the nudging messages had higher average math scores, and this effect persisted into the following school year. Furthermore, sending emails to parents about the parent portal information increased family use of the learning management system and modestly improved student performance (Bergman, 2020). Regarding kindergarten stages, Doss, Fahle, Loeb, and York (2019) found that providing differentiated and personalized text-message interventions to kindergarten parents significantly improves their children's reading abilities and increases parental engagement in literacy activities. For educators, Hanno (2023) evaluated the effectiveness of a light-touch text messaging intervention on early educators' knowledge, beliefs, and practices, finding that teachers in the treatment group spoke more to children but listened less. Wolf and Lichand (2023) further found that audio-text messages to parents had no impact on children's learning and slightly increased child labor, with benefits for low-achieving children in the parent group and negative effects for girls in the teacher group.

In addition to message notifications, some researchers have integrated learning analytics technology to prompt students about their learning status via personalized feedback on intelligent platforms, thereby motivating their learning enthusiasm. Zamprogno, Holmes, and Baniassad (2020) provided formative feedback to students through an automatic assessment tool, finding that high-level feedback helped students reassess their course learning outcomes and project standards. Rodriguez, Guerrero-Roldán, Baneres, and Karadeniz (2022)

combined artificial intelligence to develop an intelligent nudging system for guiding online learners, which can provide both general feedback (course-related information) and personalized feedback, and the results showed that it could positively impact their performance and satisfaction while reducing dropout rates and the effect significantly increased depending on the type of nudging. Additionally, Bobadilla, Glassey, Bergel, and Monperrus (2024) developed a bot named SOBO that automatically provides students with feedback on code quality to help them improve their coding practices.

Emails and text messages are commonly adopted means of implementing information nudges, with flexible intervention designs. The content sent may include general notifications or customized resource information, and the recipients are not limited to students but may also involve their guardians or teachers. Moreover, with the advancement of learning analytics technology, providing instant or final personalized feedback based on students' performance may become a more favored intervention approach.

Social Nudging

Social nudging can be described as taking advantage of people's sense of belonging to a group. Thaler and Sunstein (2008) proposed that a social man can be easily influenced by other people due to his tendency to follow the crowd and that nudges can be used to change people's behavioral patterns by telling them what other people are doing. Social nudging may encourage individuals to shift from an "I" frame to a "we" frame in social dilemmas, thereby increasing prosocial and group-oriented behavior (Nagatsu, 2015). Social nudges can be implemented in various forms, such as social comparison to stimulate students' competitive spirit, or social norms to emphasize common goals or showcase others' learning progress, thereby enhancing team collaboration awareness.

When engaging in social comparison, people tend to compare others' information with their own (Raue et al., 2020). The main point of social comparison nudging in education is to allow learners to learn about others, thus stimulating a sense of competition. Brown, Schiltz, Derry and Holman (2019) divided learners into three groups, with the control group not receiving any messages, and the researcher presented students with descriptive normative messages (the average start date of assignments by the deadline) and opinion leader messages (the average start date of assignments for students who performed the same as or better) respectively through an online system and found that opinion leader messages, namely social nudging, showed a greater effect. Schlegel, Schöbel, and Söllner (2023) similarly adopted comparative nudging by presenting better-performing peers on an online learning platform. In addition to presenting information about better-performing learners specifically, it is also possible to present the performance of students in general, such as the data visualization content constructed by Feild (2015), which provides students with comparisons to other students in the class and allows them to compare the amount of time spent on assignments in the course. The learning analytics dashboards devised by Fleur, van den Bos, and Bredeweg (2023) likewise presented learners with the performance of peers who had similar targets to elicit slight comparisons.

Moreover, Wambsganss, Janson, and Leimeister (2022) explored the combined impact of automated feedback nudging and social comparison nudging on undergraduate essay writing. They found that students who received both automated feedback and social comparison nudging produced more persuasive essays with higher-quality arguments compared to students who only received automated feedback or general feedback on grammar rules. This

study indicated that social comparison feedback can not only be utilized alone to stimulate learners' competitive spirit but also can be combined with other kinds of nudges to create a diverse range of nudging mechanisms. This combined approach provides students with more personalized learning support.

Unlike social comparison nudging, social norm nudging focuses on group identity rather than competitive awareness. Norms are formed during group interactions when members are exposed to others' opinions or observe their behaviors (Neville et al., 2021). Collaboration learning is a common way to exert social norm nudging. This approach helps students recognize the worthwhile characteristics of their peers, develop a tendency to imitate or to reflect on, and support each other in working towards a common goal.

In traditional collaborative settings, Buchs, Gilles, Antonietti and Butera (2016) divided students into three groups: those completing tasks individually, those in a cooperative dyadic instruction group (positive goal interdependence, individual accountability, and promotive interaction), and those in a cooperative dyadic interaction group which added cooperative nudging elements such as positive cooperative norms and specific cooperative skills to the cooperative dyadic instruction, and found that the benefits of cooperative learning in statistics increased with the enhancement of cooperative structure. Instead of using traditional forms of collaboration, Yokoyama, Misono, Inaba, and Watanabe (2020) and Kondo, Yokoyama, Misono, Inaba, and Watanabe (2021) respectively developed an application in tablets that incorporated a note visualization feature to visualize how often other learners took notes on the same section of study through shades of color to promote self-regulated learning. From the above study, it can be found that social norms nudging is no longer limited to traditional learning environments, but can be migrated to online platforms as technology advances so that learners can have appropriate knowledge of both their study partners and themselves.

Digital Nudging

Digital nudging employs user interface design elements to influence decision-making processes within digital environments (Weinmann et al., 2016). These design elements encompass graphical design, specific content, text, and minor functionalities (Mirsch et al., 2017). The objective of this approach is to render certain options on the interface more accessible or prominent than others, thereby steering individuals towards more advantageous decisions.

Digital nudging in existing research is often implemented through the development of platforms and systems. For instance, Yokoyama and colleagues (2020) developed a nudging system on tablets to enhance students' self-regulation skills. This system includes four components: note-taking, learning log collection, learning visualization, and learning log confirmation, where the visualization function can present others' note-taking areas by color shades. Similarly, Kondo and colleagues (2021) developed the learning strategy feedback system NoTAS on tablets, which also highlights areas where peers have taken notes.

Besides, a video learning platform called AVW-Space offers four types of personalized prompts: no comment reminder (encouraging students to comment), no comment reference point (reminding students to comment and providing examples), aspects under-utilized (prompting students to comment on the least commented aspects), and diverse aspects (positively reinforcing students). The platform also provides two visualization methods: a comment timeline (showing selected high-quality comments along the video's timeline) and a

comment histogram (indicating the part of the video with lots of comments) (Dimitrova & Mitrovic, 2022; Mitrovic et al., 2019). Additionally, AVW-Space has designed personalized comment displays (Dimitrova at al., 2017).

In terms of design style, Krath, Schürmann, and von Korflesch (2021) synthesized existing gamification theories and research on serious games, suggesting that gamification design can prompt users to take necessary actions to achieve goals, thereby realizing nudging effects. For example, Afshar (2019) successfully enhanced company employees' enthusiasm for knowledge sharing by meticulously designing a knowledge assessment and reward system that incorporated gamification elements such as achievements, points, levels, leaderboards, competition, and self-expression. This, in turn, significantly improved the organization's knowledge management and performance.

Summarizing the above research, digital nudging demonstrates immense potential in promoting user decision-making, enhancing learning outcomes, and improving user experience. Designers can employ various strategies, from platform design style to specific functionalities, to implement digital nudging effectively.

Effects of Nudging in Education

Attitudes Toward Online Learning

Nudge theory, combined with online learning tools, aims to enhance learners' learning attitudes. Fryer, Bovee, Witkin and Matthews (2023) examined the effects of a series of informational nudge videos on stimulating Japanese university students' interest in learning English. They categorized students into three subgroups: low motivation, moderate motivation, and high motivation, and found that the informational nudge videos had a small but significant impact on the English learning interest of the entire group and the moderate subgroup. Beyond language learning, Taback and Gibbs (2023) investigated the impact of weekly emails offering interesting and practical materials on students' attitudes toward learning statistics and found that this nudge did not improve students' learning attitudes, with similar results observed among students who opened at least one email. Overall, research on students' learning attitudes is still limited, and the effects of nudging on learning attitudes may vary depending on the subjects and nudging strategies. This suggests the need to consider more personalized factors when designing nudges.

Online Learning Behaviors

Nudging theory in the field of educational technology primarily focuses on online learning behaviors in higher education (e.g., Brown, Basson, Axelsen, Redmond, & Lawrence, 2023; Lawrence et al., 2019; Mohammadhassan et al., 2022). However, research on this topic, particularly regarding student engagement, shows mixed results.

On one hand, some studies indicate that nudging strategies can improve students' online learning behavior. Mitrovic and colleagues (2023) conducted a three-year study with undergraduate software engineering students using the AVW-Space platform to learn face-to-face communication skills. The platform encouraged critical commentary on educational videos and anonymous peer rating of comments and the results showed significant differences in engagement, impacting interaction time, the total number of comments, high-quality comments, and perceived learning effectiveness. Additionally, Brown and colleagues

(2023) proposed a nudging protocol for online courses to encourage students to use essential course resources and after three iterations, they found that finely-tuned nudges for a few critical resources effectively stimulated student engagement. Furthermore, Kay and Bostock (2023) sent automated text messages and emails to college students who were at risk of disengaging from the classroom, to encourage them to re-engage with the learning management system and found that nudged students were more likely to re-engage, spend more time on online materials, and maintain the effect for over two weeks. Blondeel, Everaert, and Opdecam (2023) also found that adding supplementary sentences with links in virtual learning environment announcements reduced student procrastination and improved class attendance and preparation rates. Finally, Gatare et al. (2021) highlighted that, from students' perspectives, nudges facilitating self-directed learning, such as social and reinforcement nudges, were most useful for planning and timely completion of assignments on online learning platforms.

However, several point out that nudging strategies are not always effective, and in certain cases, they do not significantly improve students' engagement. Weijers, de Koning, Scholten, Wong and Paas (2024) conducted two experiments to test the effectiveness of nudging prompts. In the first, they changed the virtual background of the instructor to a question prompt to encourage students to ask questions. While the number of questions increased significantly, this was primarily driven by a few active students and did not impact student performance. In the second experiment, setting a target number of questions for each class showed no significant impact on the number of questions, student engagement, or academic performance. Similarly, Baker, Evans, and Dee (2016) conducted a large-scale randomized experiment with 18,043 MOOC students who received emails with course scheduling surveys over two weeks. The nudge did not affect short-term engagement and showed a slight negative impact on long-term course engagement, persistence, and learning outcomes. Furthermore, Garbers, Crinklaw, Brown, and Russell (2023) used digital images of prior performance for public health masters and placed them in the learning management systems and the results indicated that linking course task completion with assessment performance did not significantly change student engagement.

Despite the high expectations, current research presents a complex picture. Existing studies demonstrate that well-designed nudging strategies can enhance online learning engagement through interactive mechanisms on online platforms, fine-tuned resource guidance, or automated text and email reminders. These strategies can increase student investment and perceived learning outcomes to some extent. However, other studies highlight the limitations of nudging. In some cases, nudges are not effective as expected and even have negative effects on certain metrics. This suggests that the effectiveness of nudging may depend on various factors, such as individual student characteristics, the logic of nudge design, and the implementation environment. Therefore, future research needs to delve deeper into exploring the effectiveness and applicability of nudging strategies.

Learning Outcomes

In addition to online learning attitudes and behaviors, studies have also focused on their effectiveness in improving learning outcomes. Regarding academic performance, Smith, White, Kuzyk, and Tierney (2018) developed software for online economics courses that attached personalized messages to each assignment, explaining how the assignment would affect the student's grade. The results showed that this grade nudge improved students' assignment scores by about 4%. Similarly, Motz, Mallon, and Quick (2021) used a mobile

app to send notifications when students had not submitted assignments close to the deadline. Compared to a control group receiving teacher announcements, the reminder system significantly reduced missed assignments and increased submission rates and course grades.

Dart and Spratt (2021) investigated the effects of personalized emails in two undergraduate mathematics courses. Their study found that personalized emails significantly improved final course grades in a scientific quantitative methods course, especially for students with less prior preparation. However, the emails did not significantly impact performance in introductory calculus and algebra courses. In essay writing, Wambsganss et al. (2022) found that combining social comparison nudges with automated feedback nudges, where students could see their peers' performance on the same assignment, led to more persuasive essays and higher-quality arguments.

These studies indicate that while the effectiveness of nudging strategies may vary depending on the subject and course design, they generally enhance student learning outcomes, particularly when the nudges are closely aligned with students' actual needs and learning environments.

Conclusion

This paper explores the multi-faceted applications of nudge theory in the field of educational technology from the perspectives of theoretical integration, intervention types, and effects. Existing research demonstrates the potential of combining nudge strategies with technological tools, highlighting their capacity to improve learning experiences at multiple levels, including attitudes, behaviors, and outcomes. However, these effects are not guaranteed; they may be influenced by the characteristics of the subject matter, individual differences among the targets, and the specific implementation of the nudge.

With the rapid development of artificial intelligence and big data technologies, nudge strategies can become more refined and intelligent, offering personalized learning strategies tailored to students' individual needs and learning habits. Additionally, current research has shown that diversified nudging methods may be more effective (Wambsganss et al., 2022). Researchers can leverage the advantages of social nudges alongside informational nudges to significantly impact learners' motivation. Furthermore, when integrating systems for digital interventions, it is essential to consider the design of interface elements and interactive content. Incorporating social nudge elements can help learners understand their peers' learning progress, thereby stimulating their motivation. While this paper synthesizes existing research in the field of educational technology, future studies could explore research widely adopted in other fields, or focus on how to ensure the long-term effectiveness of nudges (Beshears & Kosowsky, 2020).

However, nudge strategies have their limitations. Firstly, their implementation requires meticulous design to ensure effective intervention. Secondly, the ethicality of nudge strategies is a subject of ongoing debate. Kuyer and Gordijn (2023) proposed four main ethical issues associated with nudges, namely infringement on autonomy, actual welfare improvement, long-term negative impacts, and undermining democratic deliberation. Therefore, when implementing nudge strategies in education, it is crucial to consider whether these strategies violate the principle of learners' autonomous development and whether our nudges merely guide learners toward our expected outcomes.

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Contact email: cz.zeng@outlook.com

The Juggling Life: Investigating Work-School Conflict Among Thai Graduate Students

Siripreeya Chaiboonma, Chulalongkorn University, Thailand
Kanit Sriklaub, Chulalongkorn University, Thailand
Siwachoat Srisuttiyakorn, Chulalongkorn University, Thailand

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Abstract
Working students often face challenges in balancing their responsibilities between workplace and school. While the primary focus and goal of students are to complete the school program and earn a degree, they are still required to accomplish the objectives of their daily job tasks. However, when demands between both focuses become unbalanced, work-school conflict (WSC) arises. Thus, this study aims to develop a WSC instrument for graduate students and analyze it using qualitative and quantitative data. A two-phase exploratory sequential mixed methods design was employed. In the qualitative phase, semi-structured interviews were conducted online with 19 working graduate students, selected through purposive sampling, and were analyzed using conventional content analysis. The findings revealed three key components found in the development of a 13-item questionnaire: time-based conflict, strain-based conflict, and behavior-based conflict. Content validity was assessed using the content validity index (CVI) from five experts. In the quantitative phase, the questionnaire was refined based on experts' feedback and tested for reliability with 32 working students. The data were then collected from 160 working students for construct validity testing. The results showed that the instrument achieved I-CVI scores above .60; the S-CVI/UA was .62, and S-CVI/AVE was .86, and both indicated acceptable validity. Cronbach's alpha values for internal consistency were .89 for time-based conflict, .89 for strain-based conflict, and .86 for behavior-based conflict, respectively. The measurement model presented the acceptable construct validity: Chi-square (1, N=160)=1.831, p=.176, RMSEA=.072, SRMR=.015, CFI=.996, TLI=.989. Most participants were master's students (69.38%). Overall, students reported a medium WSC level (M=2.682, SD=2.613), with strain-based conflict being particularly prominent. Therefore, enhancing self-regulation skills and providing faculty support systems could help mitigate WSC for working students.

Keywords: Work-School Conflict, Graduate Student, Thai University

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Introduction

Graduate education is often seen as a gateway to enhance ones' career opportunities as well as personal growth, especially those working college students. However, their objective may not be completely fulfilled provided that they do not balance their academic responsibilities and professional tasks well, leading to a delicate juggling act - the challenge to cope with things at the same time.

According to Lindner (2024), in recent years, while the proportion of working students has increased up to 75% worldwide, their academic performance has slightly been lower than non-working students since they are required to manage a dual role, a student and a businessperson. Thailand is also unexceptional. Whereas graduate students are employed either part-time or full-time, they still need to govern other roles, such as a business entrepreneur and a parent. Nonetheless, the inter-role conflict occurs when they fail to accomplish all duties since they are studying and working simultaneously (Sheikh, 2015; Lui et al., 2001). The work-school conflict (WSC) is, therefore, a result of their inability to juggle responsibilities for both professional and academic tasks, eventually leading to the decreased level of well-being while academic stress increases (Rana, 2022).

While several international studies on WSC have investigated the experiences of students, the levels of WSC, the factors that influence it, and coping strategies for WSC, most of research papers in Thailand on the same topic have focused more on how to maintain and strengthen balance among work, life, and health. Based on Saengrotkittikhun and Choochom (2021), school work-life balance is significantly influenced by social support from work and family, problem-focusing coping, and conscientiousness. To support their statement, Sangnin et al. (2019) proposed different techniques to balance their work and life as follows: prioritizing tasks, adopting a positive attitude and behavior, promoting an organization's environment and atmosphere, establishing personal goals, and creating their happiness. Nevertheless, there are insufficient studies to elaborate the conflict between work and study of graduate students in Thailand. As a result, it is essential to broaden the scope of research in order to gain a deeper understanding of WSC in Thailand. Therefore, this paper aims to explore Thai graduate students' experiences of WSC and to develop its instrument based on their experiences.

Methodology

In this study, an exploratory sequential mixed methods design was employed, and it consisted of two phases. The first phrase was conducted with a qualitative study, which graduate students were interviewed about their experiences of studying, while the second phrase was implemented with a quantitative study, focusing on developing a work-school conflict instrument and investigating the level of conflict among these students.

The First Phase

This phase aims to study work-school conflict experiences among Thai graduate students. 19 working students participating in this phase consisted of nine master's degree and ten doctoral degree students. Semi-structured interviews were used for data collection from these participants. Each student was individually interviewed through the ZOOM program, and their conversation was recorded. The recordings were transcribed, and their personal data and filler and/or repeated words were removed for valid results. Conventional content analysis was utilized, and its codes were directly developed from the actual data. Then, the codes were

categorized into three themes: time-based conflict, strain-based conflict, and behavior-based conflict. Following these themes, a 13-item questionnaire was developed and tested for content validity through the content validity index (CVI) from five experts. This instrument was adjusted based on experts' recommendation, and the refined instrument was implemented further in the next phase.

The Second Phase

This phase aims to develop a WSC instrument based on graduate students' experience. Reliability was first tested with 32 working students, using internal consistency based on Cronbach's alpha values. Construct validity was then assessed through confirmatory factor analysis (CFA) based on the online survey data, which was created through the Microsoft Forms platform and collected from 160 graduate students. To explore their level of conflict, the data were analyzed through descriptive statistics (i.e. mean, mode, standard deviation), along with visual plots to present the findings.

Findings

This section presents the findings of the study with two main areas. The first one focuses on working students' experiences and the development of a WSC instrument based on their experiences, whereas the latter investigates the development of the instrument and evaluate it with an overview of its level.

Part 1: Studying work-school conflict (WSC) experiences among Thai students and developing a WSC instrument

The 19 working students participating in this phase online consisted of nine master's degree and ten doctoral degree students. According to Figure 1, which demonstrates the characteristics of graduate students, the majority of participants in the master's degree group, from year one to year four, were professional teachers while the rest worked in other careers. However, most of them were full-time working students. In the Ph.D. group, students from year two to year four, most of them were both full-time working students and professional teachers.

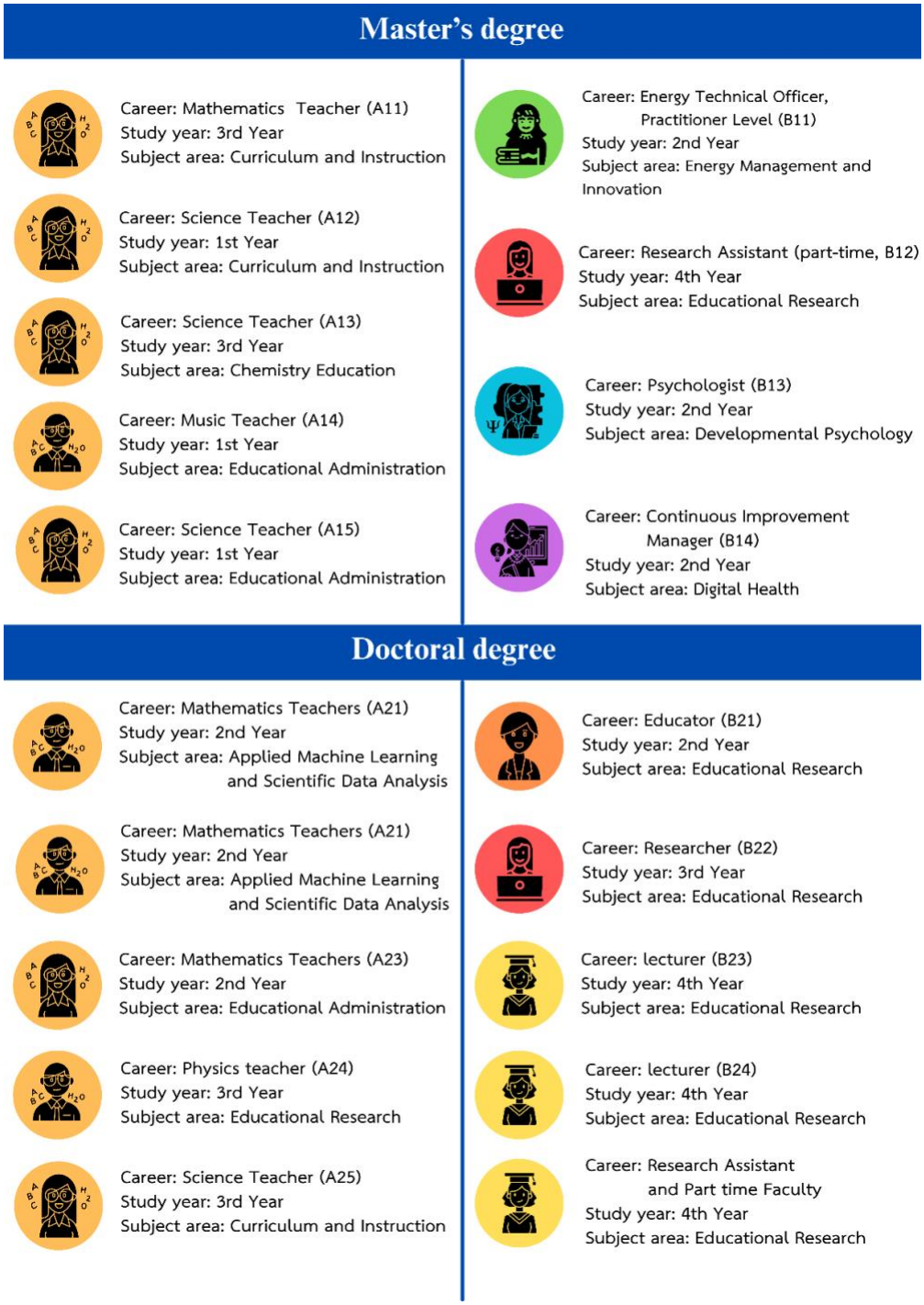


Figure 1: Participants Profile

The findings are summarized in Table 1 with the details of working students' experiences of studying and working.

Table 1: The Table of Theme, Category, and Code

Theme	Category	Code
Time-based conflict	Workload	Workload changed
		Schoolwork overload
		Organizing assignment
	Time management	Setting priority
		Using productivity techniques
		Working hours decreased
	Task management	Creating to-do lists
		Prioritizing the task
Strain-based conflict	Negative emotion	Anxiety / Distress
		Exhaustion
Behavior-based conflict	Preparing to learn	Lesson review
		Exam review
	Study and working behavior	Thesis related to work
		Multitasking
		Procrastination

Theme 1: Time-Based Conflict

A majority of participants mentioned having the limited amount of time for studying while working, and thus, it had been a challenge to maintain good balance between both tasks. In other words, time-based conflict occurred. Such a conflict fell into three categories: workload and schoolwork, time management, and goal setting.

Workload and Schoolwork

Most full-time working students were provided with some support from their workplace for their further education. That is, when they attended graduate school, their workload decreased since they gained some help from their colleagues in some parts of the works. However, some other students did not receive any assistance or support at all. Some embarked on a new role with more challenging projects while studying hard at the same time. Following this, one master's degree student explained further, as follows:

> "Before taking up a master's degree, I wasn't the head of the department, but when my colleague in that position resigned, I finally got promoted. Initially, I thought it wouldn't be much hectic, but once I became the head, everything ended up on me." [A15]

In terms of schoolwork, most working students also reported being overloaded with many class assignments, particularly from technical subjects, after their first year of study. With tight deadlines, it was challenging to complete these assignments on time while also working. One Ph.D. student expressed about her schoolwork overload, as follows:

> "When the second semester began, oh wow, it was even more like a battlefield. All the subjects were difficult! When I received assignments or group projects from multiple subjects, it turned into a lot of works." [B21]

Moreover, some students were required to complete many of their assigned projects or homework; as a result, they needed to manage the tasks with their classmates properly. They would meet with their classmates online or onsite to divide the tasks among group members by interest. Another Ph.D. student explained how she responded to group projects, as follows:

> "I usually volunteer to do the part that I want. I'm afraid that if I don't, some other classmates will take that part, and I have to complete the other part instead without my full potential and attention." [B24]

Time Management

Graduate students were questioned about how they normally balanced their time between studying and working. The majority of them mentioned that they employed the "Eisenhower Box", a task management tool, aiming to prioritize their tasks based on importance and urgency. Through this method, they considered their job duties a priority over their academic responsibilities because they were concerned about the problem that may occur with their coworkers if the work results would not be achieved successfully. A master's degree student disclosed her Eisenhower Box techniques, as follows:

> "My technique is like taking notes. I create a table with four components. I place things that aren't immediately important in one section, and the others that need to be done in another. It's now very clear which jobs in each of the four parts should be done first." [B11]

Furthermore, most of students managed their flexible schedule between their education and career tasks and endeavored to adhere to it. Despite so, they were urged to adjust their plan in case any unexpected assignments from work or school may occur. A graduate student who works as a teacher explained below how she would execute her time when the job and school tasks must be completed simultaneously.

> "When my school assignments and works overlap, I decide whether to spend the rest of the night working on teaching preparation or finishing homework. The fact is that I have to choose what the most priorities are. In the end, however, I have to always put aside my school project and focus on my responsibilities towards my students." [A25]

On the other hand, some students were required to maintain a work-life balance by managing both tasks between two roles as students and employees. They reduced their working hours while refusing to participate in some of the company's activities and/or leaving work early on some days. A Ph.D. student shared her experience concerning this issue, as follows:

> "Before I started my graduate school, I worked extra hours on weekends and earned a lot of money, but finally, I decided to stop that and give full concentration to my study for my future career." [B21]

Task Management

Working students demonstrated their task management skills for both studying and working in several ways. Most of them applied a simple method of implementing a to-do list while some only memorized things without taking notes. For the first group, a few techniques had

been employed - using paper (i.e., notebooks desk calendar), using electronic devices (i.e., tablet, telephones) by assigning colors to each task, and writing tasks on post-it notes and sticking them on their desk. Some Ph.D. students explained below how they usually create the lists.

> "I always have my planner with me, and I also use a desk calendar at my home and workplace to note my to-do list. I keep writing notes to remember." [A25]

> "I note down everything, otherwise, I would mess up tasks. The calendar app on my iPad works great for me. For each job, I use different colors: orange for work assignments, green for schoolworks, and purple for other tasks." [A22]

For the other group, one Ph.D. student who works as a Deputy Director of School pointed out that she tried to memorize all her tasks instead of employing any techniques. She expressed her thought as follows:

> "To be really honest, there is one disadvantage. I really want to take notes even if I rely too much on memory. That is a horrible habit, I know. Anyway, I have a team, and they also remind me of the tasks. But I really wish I could be better at note-taking." [B23]

In addition, the students explained further about their decision making when dealing with their tasks. Although they tried to maintain balance between their responsibilities, they ultimately decided to focus on the task that was nearly due for submission. Nevertheless, despite the fact that they were aware of the due date for each task, some students continued procrastinating their assignments until the last minutes before the deadline. A master's degree briefly commented on this issue, as follows:

> "I chose the most important thing to do first. I have homework due in two or three days, so I'll start working on it today." [A12]

Theme 2: Strain-Based Conflict

Most working students expressed some negative emotion towards their current situation, studying while working. It was a mix of two feelings: anxiety or distress and exhaustion. Since they were extremely concerned about their unfinished tasks, they encountered stress and strain during the exam period due to the fact that they were unable to concentrate on their take-home exams as they desired. A Ph.D. student shared her feeling, as follows:

> "During the exam periods, when there are many things to do on a daily basis, I feel worried all the time about whether I have time to study for the tests or finish my final project and turn it in on time. I think about it all the time." [B21]

Anxiety arose even more when the tasks overlapped, and students could not handle them. Consequently, they felt too overwhelmed by the strong demand of all tasks that need to be completed within the timeline. One master's degree student mentioned as follows:

> "In my mind, I just want it to be over. It's quite disruptive to my daily life, and I'm always worried. They are part of my study, so I have to keep doing them. I had to change the plan for the experiment several times, which took more time and cost a lot of money." [A13]

Apart from the above, students failed in their task and time management since they could not control all demands, and even worse, they gained unsupportive communication with their lecturers or advisors. As a result, they expressed being extremely exhausted and discouraged. Another master's degree student shared her feeling as follows:

> "Most of the time, I felt extremely exhausted with all these never-ending things. I couldn't even take a holiday over the New Year period because I needed to continue some part of my thesis and submit it to my advisor. However, he didn't review it right away, so I had to keep waiting. Again, there was another time that I had to work on the research tools part and skipped the break. Then, I submitted it, but there was still no comment back from him yet. This is really protracted! So, when I got his feedback, I was already busy with my job." [A13]

Theme 3: Behavior-Based Conflict

Most working students were questioned about their preparation for learning and their approach towards the way they balanced their work and study.

Learning Preparation

In terms of class preparation, some students studied their lessons, as part of class assignments, before the class, whereas some reviewed the lessons, especially previous ones, on their own. However, some spent even a day or two studying before the examination date. A Ph.D. student revealed below how she prepared for the exam.

> "I reviewed the lesson a day before the class or the test date. Also, I may have more time to go over the lesson during the break or holidays." [A24]

In addition to the above, the instructors may assign them to read some research papers for the next class. Even so, some of them may complete this assignment just an hour before the class. One working student shared their experience on this matter, as follows:

> "In one subject, the lecturer assigned me to study around 10 research papers in English, but I cannot finish them all on time. Reading an English article is pretty challenging for me." [A21]

Study and Working Behavior

Another important relevant factor is about students' performances on both professional and academic aspects, particularly when they needed to perform both tasks in parallel. It was always a challenge for them to succeed with both. One student working as a teacher revealed her thought, as follows:

> **"**There was a time when I had to conduct the class virtually online while attending the online class at the same time, using my iPad with the camera off. Then, the professor started the activity, requesting all students to join breakout rooms for a group discussion, but I didn't pay much attention to her instruction, so I didn't join the room. After my own class, the teacher texted me asking where I was. So, I told her the truth. She was very nice and fine with it." [A11]

Several students also mentioned about temporarily disconnecting with their advisor, leading to the delay of their thesis completion. A master's degree student disclosed her thesis progression, as followed:

> "In my second year during the pandemic, I couldn't meet with my professor in person. So, with no personal interaction, I lost focus and didn't pay much attention to my thesis. It wasn't until the following year that I started concentrating again. Somehow, it caused delays to my thesis." [A13]

Referring to the qualitative data, a 13-item questionnaire was developed based on working students' experiences and assessed through the content validity by five experts from Educational Research Methodology, Educational Measurement and Evaluation, and Psychological Counseling and Guidance. Following their recommendations, the instrument measured WSC sufficiently. The results of CVI are as follows:

- The I-CVI ranges from .60 to 1.00. Eight items shows an I-CVI equals to 1.00, one item is equal to .80, and five items is equal to .60. The majority of items are considered relevant.
- The S-CVI/UA across all items is equal .62. The Universal Agreement method indicates moderate content validity.
- The S-CVI/AVE is equal to .86. The Average approach presents high moderate content validity.

Part 2: Developing a WSC instrument based on the graduate students' experiences

Reliability Testing

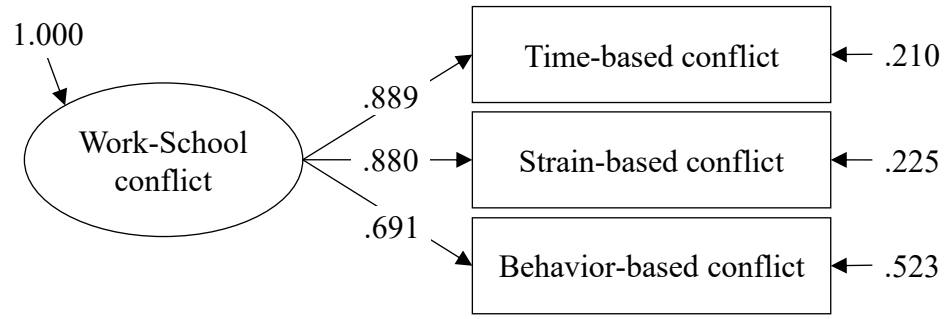
The questionnaire was piloted with 32 working students, and its reliability was assessed by using the Cronbach's alpha values for internal consistency. The time-based conflict subscale consisted of 4 items (α=.89), the strain-based conflict subscale consisted of 4 items (α=.89), and the behavior-based conflict subscale consisted of 5 items (α=.86). According to the result, the Cronbach's alpha coefficient above .70 indicates the reliable level of internal consistency.

Construct Validity Testing

The WSC instrument was complete with 160 different working students from the reliability testing. The Confirmatory factor analysis (CFA) was used to investigate construct validity of the instruments. According to Table 3, the fit indices for the measurement model are χ^2 with one degree of freedom=1.831, RMSEA=.072, SRMR=.015, CFI=.996, and TLI=.989. These numbers indicated that the model fit the data accordingly. The construct validity testing is presented in Table 3 as below.

Table 3: CFA Fit Indices for WSC Instrument

Component	Factor loading		t	R^2	Factor loading coefficient
	b(SE)	β			
Time-based conflict	1.000	.889	33.397	.790	.414
Strain-based conflict	1.016(.069)	.880	61.578	.775	.371
Behavior-based conflict	.707(.071)	.691	14.744	.477	.142
Chi-square(1, N = 160) = 1.831, p =.176, RMSEA = .072, SRMR = .015, CFI = .996, TLI = .989					



Chi-square (1, N = 160) = 1.831, p =.176, RMSEA = .072, SRMR = .015, CFI = .996, TLI = .989

According to Table 4, working students reported a medium WSC level (M=2.682, SD=2.613). The highest conflict level for both master's degree and doctoral students (was) occur from the Strain-based Conflict (M=3.119, SD=1.166), with master's students scoring an average of 3.146 (SD=1.165) and Ph.D. students scoring 3.056 (SD=1.180). The highest item in this category was WSEM1, where students were anxious about the unfinished workloads and schoolwork, with an overall mean of 3.556.

Next, students reported a medium time-based conflict level (M=2.748, SD=1.128), with quite the same level of master's degree and doctoral students. The highest item in this category was WSTM4, which indicated insufficient time to complete their tasks effectively while working and studying (M=3.063, SD=1.335).

Lastly, students presented a low behavior-based conflict level (M=2.279, SD=1.026), with master's degree students scoring an average of 2.238 (SD=1.010) and Ph.D. students scoring 2.371 (SD=1.065). The highest item in this category was WSBH5, which reported that students minimized their working standard to finish the tasks.

Table 4: Level of WSC's Items

WSC's items	Master's degree		Doctoral degree		Overall	
	M	*SD*	*M*	*SD*	*M*	*SD*
1. Time-based conflict (WSTM)	**2.748**	**1.126**	**2.750**	**1.143**	**2.748**	**1.128**
WSTM1: When schoolwork and workloads overlap, I cannot set priorities for my jobs well.	2.613	1.389	2.673	1.329	2.631	1.367
WSTM2: I cannot manage time for all tasks while studying and working simultaneously.	2.775	1.305	2.776	1.212	2.775	1.274
WSTM3: I cannot complete workloads and schoolwork on time while studying and working simultaneously.	2.532	1.327	2.510	1.260	2.525	1.303

WSC's items	Master's degree		Doctoral degree		Overall	
	M	*SD*	*M*	*SD*	*M*	*SD*
1. Time-based conflict (WSTM)	**2.748**	**1.126**	**2.750**	**1.143**	**2.748**	**1.128**
WSTM4: I have insufficient time to complete workloads and schoolwork efficiently while studying and working simultaneously.	3.072	1.353	3.041	1.306	3.063	1.335
2. Strain-based conflict (WSEM)	**3.146**	**1.165**	**3.056**	**1.180**	**3.119**	**1.166**
WSEM 1: I worry about unfinished workloads and schoolwork while studying and working simultaneously.	3.622	1.280	3.408	1.257	3.556	1.273
WSEM 2: I worry about incomplete workloads and schoolwork, and thus, I cannot concentrate.	3.270	1.286	3.306	1.294	3.281	1.285
WSEM3: I am worried that I will fail this semester.	3.018	1.465	2.755	1.422	2.938	1.452
WSEM4: I feel like a failure because I cannot reach my goals for working and learning.	2.676	1.453	2.755	1.507	2.700	1.466
3. Behavior-based conflict	**2.238**	**1.010**	**2.371**	**1.065**	**2.279**	**1.026**
WSBH1: I am unable to apply my knowledge from one setting to another.	2.099	1.213	2.163	1.328	2.119	1.246
WSBH2: My study or research topic is not related to my work.	2.126	1.329	2.408	1.471	2.212	1.375
WSBH3: I am unable to employ my problem-solving techniques from one setting to another.	2.144	1.212	2.184	1.202	2.156	1.206
WSBH4: I am unable to utilize working strategies from one setting to another.	2.162	1.140	2.224	1.212	2.181	1.159
WSBH5: I attempt to complete homework and workloads on time by reducing my working standard.	2.658	1.358	2.878	1.495	2.725	1.401

Conclusion

This study conducted the development of a questionnaire to determine work-school conflict (WSC) of working graduate students in the context of Thailand. The WSC 13-item questionnaire was generated based on three main challenges: time-based conflict, strain-based conflict, and behavior-based conflict, and the instrument was undergoing psychometric testing for validity and reliability. According to the survey data, strain-based conflict was the highest among other WSC categories, especially when students were concerned about incomplete tasks and could not concentrate on both of their work and class assignments.

Discussion

As the study of work-school conflict (WSC) in the Thai context was limited, this study would allow further investigation of working graduate students' experiences in WSC through the development of its instrument reflecting the Thai culture. The 13-item questionnaire was

developed based on the study by Greenhaus and Beutell (1985), which focuses on work-family conflict. According to students' overall experiences, the items were generated and validated; the psychometric analyses indicated that the instrument demonstrated good psychometric properties. The Cronbach's alpha values of all the subscale proved that the test achieved a high level of internal reliability, and the confirmatory factor analysis (CFA) supported the original three components of the measurement model.

Moreover, the questionnaire consisted of 13 bi-directional items, which enabled this instrument to evaluate the level of conflict that may arise during their studying and working at the same time. On the contrary, other studies employed the 5-item scale which was developed by Markel and Frone (1998), focusing only on one direction of conflict from work to school. Although this scale is widely recognized and most frequently used to assess WSC in other studies (e.g., Butler, 2007; Headrick & Park, 2023; Peng et al., 2022; Wan et al., 2021), it could not present the level of WSC in two ways.

Finally, graduate students who focused on their education and employment reported a medium WSC level (M=2.682, SD=2.613), with strain-based conflict being particularly prevalent. The previous literature revealed that working students had emotional sensitivity to develop academic burnout when the WSC is on the rise (Lingard, 2007; Shahzad et al., 2021). Therefore, this study recommends that graduate students ought to develop self-regulation skills to deal with conflict situations. Since such skills had an impact on academic achievement (Afandi & Asdalifa, 2022; Rahayu, 2024), Afandi and Asdalifa (2022) found that the level of role conflict was controlled based on how efficient working students could regulate their responsibilities. Furthermore, the support from the university is beneficial to help reduce the impact of WSC on working students. The study of Raboca and Cărbunărean (2024) suggested further that this should proceed together with both functional and psychological support for them to maintain their academic motivation. In the end, graduate education is a temporary phase of life; it is important to be patient, consistent, and mindful in order not to begin juggling.

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Using Flipped Classroom to Improve the Korean Reading Ability and Learning Motivation of First-Year Korean Students

Jun Wang, King Mongkut's Institute of Technology Ladkrabang, Thailand
Jirarat Sitthiworachart, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
The traditional classroom model no longer meets students' academic needs. Flipped Classroom offers a more innovative approach by allowing students to grasp knowledge before class. This study aims to determine the effectiveness of Flipped Classroom teaching methods for improving students' Korean reading ability and learning motivation among Korean Major students. This is an experimental research design. Forty first-year undergraduate students at a university in China were participated in this study. We adopted a two-group post-test design, with a Flipped Classroom for experimental group students, and traditional face-to-face teaching methods for control group students. Each group consisted of 20 students. The independent sample t-test was used to analyze the data. The descriptive statistics revealed that the mean score of reading ability for experimental group was 81.95 (SD=6.91661), and control group was 79.05 (SD=9.05815). While, for learning motivation score, the experimental group obtained 4.5 (SD=0.25597) and control group was 3.6214 (SD=0.32203). The independent sample t-test results revealed that there is a significant difference between two groups in reading ability and learning motivation, with p=0.04 and t=-2.119 for reading ability, and p= <0.001 and t=-9.551 for learning motivation. Scores of the experimental group are higher than those of the control group. Through this study, the Flipped Classroom teaching model is conducive to improving reading ability and learning motivation. For better Flipped Classroom effects, adding various teaching activities will mobilize students' learning motivation. Gathering students' learning experience and feedback for continues improvement is also necessary.

Keywords: Flipped Classroom, Korean Reading Ability, Learning Motivation, Educational Technology, Korean Language Major Students

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1. Introduction

In today's era of rapid information change and highly developed networks, the education industry is also constantly changing and innovating to adapt to the development and progress of the industry. Flipped Classroom subverts the traditional teaching model and enables students to transform the learning content that they originally passively accepted into the object of active exploration, which greatly stimulates students' learning enthusiasm and autonomy. Scott et al. (2016) Studies have shown that Flipped Classroom can significantly improve learners' reading comprehension ability and effectively improve students' learning motivation and participation.

Based on the research results of many scholars on the significant effect of Flipped Classroom on improving students' reading ability and learning motivation, I plan to innovatively apply it to Korean reading teaching. Although the application of Flipped Classrooms in English teaching has been widely recognized, I firmly believe that it can also significantly promote Korean teaching, which will become an important innovation in my research. I hope to stimulate Korean learners' interest in reading, improve their reading ability, and further enhance their learning motivation through the Flipped Classroom model, bringing new vitality and effect to Korean teaching.

2. Research Questions

RQ 1. Does using Flipped Classroom significantly improve students' Korean reading ability compared with students who receive traditional teaching methods?
RQ 2. Does using Flipped Classroom significantly improve students' learning motivation compared with students who receive traditional teaching methods?

3. Literature Review

3.1. Flipped Classroom

The Flipped Classroom is a teaching model pioneered by Jon Bergman and Aaron Sams. It uses electronic software, videos and other platforms to allow students to learn independently before class, use class time for interactive discussions and various classroom activities, and complete homework and consolidate knowledge after class. It aims to improve teaching effectiveness and students' enthusiasm for learning. Despite the challenges of technology acquisition, homework burden, and educational resource allocation, the Flipped Classroom is still regarded as an innovative teaching method that can enhance students' cooperation, initiative and critical thinking skills, and educators need to continue to explore and improve it.

3.2. Korean Reading Ability

Sung (2021) emphasized that reading Korean plays a vital role in daily life, not only helping individuals to easily obtain information, but also helping to promote effective communication and full participation in social life. Korean reading plays a key role in daily life, communication, and social integration. Chin & Kang (2022) further pointed out that Korean reading ability is an important criterion for measuring an individual's ability to understand and interpret texts.

However, despite the many benefits of Korean reading ability, there are also some disadvantages that need to be overcome. Jiyoung Bae (2013) pointed out that learners face multiple challenges in the process of improving their reading ability, including the accumulation of vocabulary and in-depth understanding of grammar. Improving Korean reading ability is a complex process that requires overcoming multiple challenges.

3.3. Learning Motivation

Many scholars have emphasized the importance of learning motivation in teaching. Filgona et al.(2020) et al. believe that learning motivation is the key to achieving learning goals, driving students to participate in the educational process and pursue academic success Lin et al. (2017) distinguished between intrinsic motivation (derived from the desire and pleasure of learning) and extrinsic motivation (affected by reward and punishment mechanisms). Huang et al. (2023) pointed out that both affect learning outcomes, but intrinsic motivation can increase learning pleasure. However, Felea & Roman (2023) also pointed out the challenges of understanding student diversity, motivation fluctuations, and creating an attractive environment, requiring educators to adopt a personalized approach, create a positive atmosphere, and help students combine learning goals with personal ambitions.

Many studies have shown that the flipped classroom model is an effective language teaching strategy, especially in improving reading comprehension. It can not only help students master language knowledge better, but also stimulate students' learning interest and independent learning ability, laying a solid foundation for students' language learning journey. Since flipped classroom has achieved remarkable results in English teaching, there is reason to believe that it can also be applied to Korean teaching and bring positive results. In Korean language teaching, flipped classroom can break the limitations of traditional classrooms and allow students to learn relevant Korean knowledge independently before class, while paying more attention to language exercises and problem solving in class to improve students' language abilities and learning interests. At the same time, this model can also promote the development of students' independent learning and cooperative learning abilities, laying a solid foundation for their future language learning. Therefore, applying the flipped classroom model to Korean teaching is not only a useful attempt, but also an important innovation in promoting language teaching reform.

4. Methods

4.1 Participants

The subjects were freshmen majoring in Korean at a university in Shandong province. There are 40 of them. There were 20 students in the experimental group and 20 students in the control group.

Table 1: Experimental Participant Demographics

Demographic Aspects		Number		Percentage	
		Experimental group	Control group	Experimental group	Control group
Gender	Male	8	6	20%	15%
	Female	12	14	30%	35%
Age	18 years old	15	12	37.5%	30%
	19 years old	5	8	12.5%	20%

4.2 Procedures

Research and integrate related literature on Flipped Classroom and formulate their own Flipped Classroom teaching model. The expert evaluates and modifies the experiment. After the experiment, the students were tested on their Korean reading ability and questionnaire on learning motivation.

The experimental group consisted of 40 people, divided into a control group and an experimental group, with the control group using face-to-face traditional lectures and the experimental group using a teaching method. This experiment lasts for three weeks.

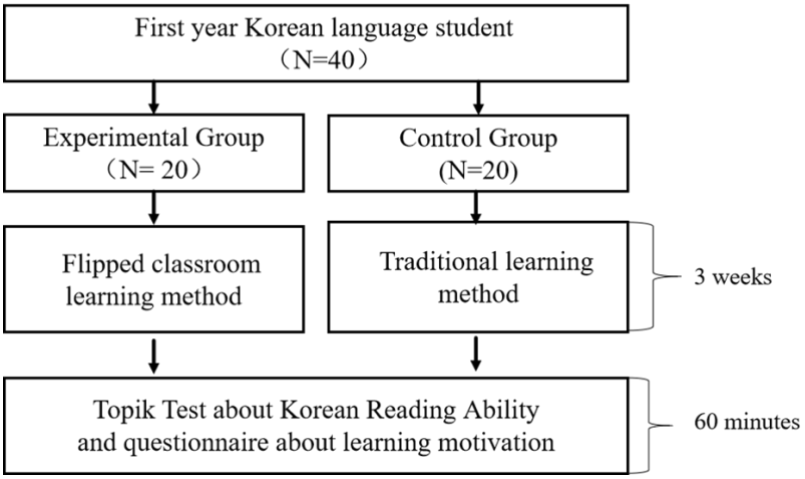

Figure 1: Research Procedure

4.3 Design

Research and integrate related literature on Flipped Classroom and formulate their own Flipped Classroom teaching model. To verify the effectiveness of this teaching model, I will invite three experts in the field of Korean language teaching to evaluate and score the model using IOC.

Flipped Classroom Steps:

- Pre-class: Sending learning videos to students, so that they can do independent study before class and get a preliminary understanding of the course content.
- In-class: In the classroom, students become the main body of learning and Role-play in groups.

- After class: After class, teachers release homework through the teaching platform. Students can submit their assignments on the platform, and they can also communicate with the teacher and answer questions through the platform when they encounter problems.

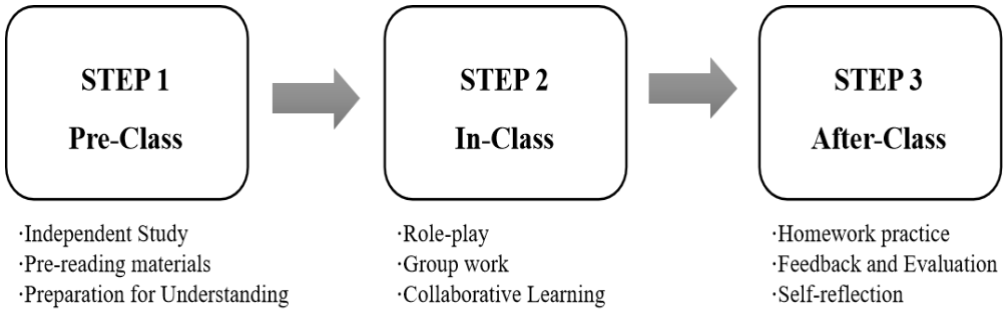

Figure 2: Research Procedure

4.4 Instrument and Data Collection

The research tools were academic achievement tests and questionnaires. Improvement in Korean Reading Ability is measured by a test with a maximum score of 100. The test questions will be evaluated and validated by three experienced teachers with the multiple choices key.

The test questions for Korean Reading Ability are based on the TOPIK test, a Korean language proficiency test administered by the Ministry of Education of Korea to assess the Korean language proficiency of non-native speakers and is an important tool for evaluating and certifying the ability to use the Korean language for academic, professional, or personal use Won (2016).

Learning Motivation questionnaire reference from Huang et al. (2023). This questionnaire contains seven questions that can be used to assess students' motivation after conducting a Flipped Classroom experiment.

All questionnaires as well as test questions are first evaluated by three experts for IOC. All questions and questionnaires are issued and collected offline.

4.5 Date Analysis

This study used an independent sample t-test to assess the effects of an instructional approach Flipped Classroom on students' Korean reading ability and learning motivation. The Korean reading scores of the experimental group and the control group were collected, as well as the mean and standard deviation of the questionnaires about learning motivation in two groups. T-test analysis was conducted using statistical software to test the significance of differences between groups. F-values and p-values were calculated, with a significance level of 0.05. If the p-value is less than 0.05, it indicates that there is a significant difference between the groups Flipped Classroom teaching methods in enhancing students' Korean reading ability and learning motivation.

5. Results

In this study, two sets of post-test design were used to compare the effects of flipped classroom teaching mode and traditional face-to-face teaching method on students' Korean reading ability and learning motivation. The data were analyzed by independent sample t test, and the results showed that the Korean reading ability and learning motivation of students in the experimental group (using flipped classroom teaching mode) were significantly higher than those in the control group (using traditional face-to-face teaching method). These findings suggest that the flipped classroom model has significant advantages in improving students' Korean reading ability and stimulating their learning motivation.

6. Conclusions

This study included only 20 students in each group, and the sample size was relatively small, which may have affected the generalizability and reliability of the research results. The experimental design adopted a two-group post-test design. Although it can preliminarily compare the differences between the flipped classroom model and the traditional face-to-face teaching method, it cannot completely rule out the influence of other potential factors on the experimental results. Despite these limitations, the flipped classroom model still shows broad application prospects. Future research can expand the sample size, adopt more complex experimental designs, and further explore the application effects and optimization strategies of flipped classrooms in different subjects and age groups to better meet students' needs and improve teaching effectiveness. This study found that flipped classrooms can significantly improve students' Korean reading ability and learning motivation, which is of great reference value to educational practitioners, policy makers and researchers.

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Contact email: 66036070@kmitl.ac.th

A Comparison of Visual Representations of Integer Operations in Middle School Mathematics Textbooks in the Turkish and United States

Ali Sabri İpek, Recep Tayyip Erdoğan University, Turkiye

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Abstract
Textbooks are the principal teaching material in mathematics, as in other subjects, and therefore it is one of the main reasons for analysing mathematics textbooks. Despite the increasing interest of teachers and students in the visuals in textbooks, further information about the representations is needed. The visualisation of mathematical concepts has always been a critical issue in teaching and learning processes due to their abstract nature. Hence, analysing visual representations brings with it the necessity to examine the learning and teaching opportunities that mathematics textbooks offer to both students and teachers. Visual representations are widely used in mathematics textbooks to facilitate students' understanding of integer operations, which they have difficulties with. The study comparatively analysed the visual representations of integers operations in Turkish and United States mathematics textbooks through content analysis using the visual representation analysis scheme in mathematics textbooks, which was formed from three categories considering the related literature. Findings of the study revealed that there were no statistically significant differences in the visual representations of the two countries' textbooks in integer operations. Diagrams are more prominent in Turkish textbooks, whereas pictures and manipulatives are more prominent in US textbooks. However, the visual representations in the textbooks of the two countries are generally used for informative and problem solving. The findings are discussed in terms of mathematics curriculum developers, teachers and researchers to improve the effectiveness of textbooks on teaching and learning.

Keywords: Visual Representations, Mathematics Textbook, İnteger Operations

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Introduction

In the mathematics, where students often have difficulty, materials such as textbooks have always been important. As a signifier of the teachind and learning process, the textbook is one of the most fundamental tools in the process (Van den Ham & Heinze, 2018). Sievert and colleagues (2019) state that the textbooks influence the learning opportunities and experiences offered to students. Textbooks are the most important reference source for both teachers and students. The fact that textbooks are so vital brings along debates on their content and quality. Despite having such a wide scope and importance, studies on textbooks have increased especially in recent years (Fan et al., 2013). In order to contribute to the gap in the literature on the comparison of visual representations (VRs) in textbooks, this study compares Turkish and US mathematics textbooks.

Visual Representations in Mathematics Textbooks

The abstract nature of mathematical concepts requires different ways of teaching or learning mathematics. Textbook content needs to support the presentation of these concepts in the most effective ways. Among these ways, VRs stand out as one of the most important aids for students in clarifying and understanding mathematical concepts (Presmeg, 1986). The purpose of the visuals in textbooks and their connections with the content should be organized in accordance with the principles of cognitive learning (Smith et al., 2021). Diezmann and English (2001) report that the development of VRs skills consists of three stages: understanding VRs, creating appropriate representations, and reasoning with representations. Emphasizing the importance of textbook representations for students, Vinisha & Ramadas (2013) report that the quality and use of VRs in mathematics textbooks have a direct impact on the learning environment.

Integer operations are among the topics that students have the most difficulties in school mathematics (Turan & Ipek, 2022). Stephan and Akyuz (2012) point out the difficulties in making sense of and modelling the concept of integers and operations with the numbers, which is focusing of students' first reasoning towards the concept of negative numbers. Mathematics textbooks and content contribute to the creation or elimination of difficulties in the subject.

The Cognitive Load Theory

Cognitive load theory was developed by focusing on how information is processed in relation to the capacities of long-term and working memory in general. Sweller (1988) defines cognitive load as the pressure on the learner's cognitive system during the learning process. The structure of the material presented to the learner has an impact on short-term memory and the content of this material creates a cognitive load as it is processed by this type of memory. If the load exceeds the limited capacity of short-term memory, learning cannot take place; however, if this cognitive load is reduced, learning is possible (Paas & Ayres, 2014). When learning materials are not well designed, the cognitive resource requires longer processing time and this leads to the serious problem of learning disabilities. According to a theory developed to control overloading of working memory by building strong schemas in long-term memory, each cognitive process in limited memory generates different cognitive loads.

A single mental representation can be constructed in the brain from verbal or visual information (Mayer, 2009). According to Paivio's (1991) dual coding theory, representation theories consist of two functions: verbal and visual cognitive processing systems. Paivio (1991) also argues that verbal stimuli such as speech and non-verbal stimuli such as touch, taste or sight are processed differently. The difference affects the speed at which information is processed in long-term memory and meaningful learning processes. In view of their importance in school mathematics, the visuals in textbooks should be examined in more detail in order to reduce the cognitive load of students.

The Conceptual Framework and Significance of the Study

Cellucci (2019) described visual representations in mathematics as a means of discovering and understanding mathematical knowledge. Due to the nature of mathematical concepts, it is inevitable to use the representations to understand and solve problems (Presmeg, 2006). In the respect, the use of VRs in mathematics textbooks is a topic that needs to be investigated. In the study, the visual representations used in Turkish and US middle school textbooks on operations with integers were compared. For the purpose, the factors towards the comparison of VRs in a mathematics textbook are listed. The research questions that frame this study are:

1. What is the general distribution of the VRs used in the textbooks of both countries on operations with integers?
2. What are the similarities or differences between the types of VRs (pictures, diagrams, tables, materials) of operations with integers in the textbooks of the two countries?
3. What are the similarities or differences between the roles of VRs (decorative, informative, interpretive) in the two countries' textbooks?
4. What are the similarities or differences between the purposes of VRs in problem solving (understanding, solve, self-regulate) in the textbooks of the two countries?

Method

Textbook Selection and Sampling

The Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) mathematics performances of students in different countries reveal that US students perform better in mathematics than Turkish students, but the difference is not very significant (Table 1 and Table 2). The scores reveal that the two countries are in a *'stand still'* in mathematics. The datas in Table 1 and Table 2 show that both countries are far from their intended levels.

Table 1: TIMSS Mathematics Performances of Turkiye and USA in Grade 4th and 8th

Grade	4			8		
Years	2011	2015	2019	2011	2015	2019
Turkiye	469	483	523	452	458	496
USA	541	539	535	509	518	515
Difference	72	56	12	57	60	19

Levels: Low (400-475); Intermediate (475-550); High (550-625); Advanced (625>)

Table 2: PISA Performance in Mathematics of Turkiye and USA

Years	2012	2015	2018	2022
Turkiye	448	420	454	453
USA	481	470	478	465
Difference	33	50	24	12

Levels: Level1(<420); Level2 (420-482); Level3(482-545);(Level4 (545-607);Level5 (607-609); Level6 (669>)

Textbooks in Turkiye are determined by the central government, while in the US they are determined by local governments and school districts. It is possible to argue that the selection of only one textbook from each country for analysis limits the representativeness of the textbooks available for comparison. However, concepts deal with integers are one of the core mathematical topics in middle school mathematics curriculum in both countries. The selection of middle school textbooks from Turkish and the US was based on the similarity of their content and their accessibility to students (Table 3).

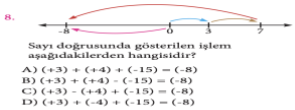
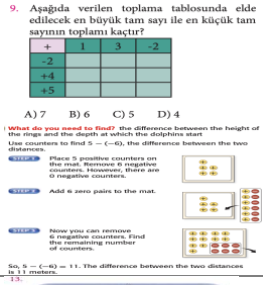
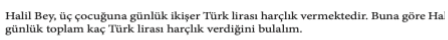
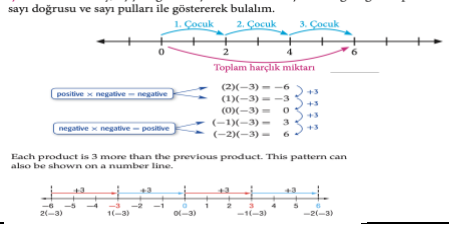
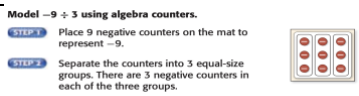
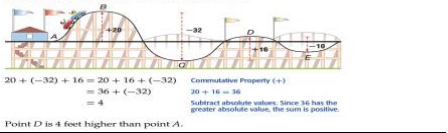
Table 3: Textbooks and Units Selected for Analysis

Country	Publisher Textbook title (Year)	Unit number and title	Pages
Turkiye	Ministry of Education Ortaokul matematik ders kitabı Grade 7 (2023)	1.Tamsayılarla işlemler	13-38
USA	McGraw-Hill Tennessee Math Connect Grade 3 (2012)	2. Add and subtract integers	86-99
		3. Multiply and divide integers	100-114

Data Analysis

As the VR_s in the textbooks contain different shapes and structures, a three-stage coding scheme was developed for the analysis of these representations by using the relevant literature (Carney & Lewin, 2002; Van Garderen, et al., 2021). The categories were revised in accordance with the content of operations with integers. In this context, a total of 111 visual representations were analyzed, 53 in the Turkish textbook and 58 in the US textbook. The categories and related subcategories used to code the representations are presented in Table 4. Also, a Chi-square test was applied to examine whether there were significant statistical differences between the variances of the VR_S in the textbooks of both countries.

Table 4: Framework for the Analysis of Visual Images

Category	Subcategory	VRs examples in math textbooks
Type of VRs	Picture	
	Diagram	
	Table	
	Manipulatives	
Role of VRs	Decorative	
	Informative	
	Interpretive	
Purposes of VRs	Understanding	
	Solve	
	Self-regulate	

Results

A total of 111 VRswere analyzed, 53 in the Turkish textbook and 58 in the US textbook. The findings on the distribution of the visuals used in the textbooks are summarized in Table 5.

Table 5: Summary of VRs Used in Math Select Textbooks

Country	Number of pages sampled	Total number of VRs	Average number of representations per page	% of pages with at least 1 representation
Türkiye	27	53	1.96	78
USA	28	58	2.07	97

Hence, the number of VRs per page in the textbooks of the two countries is quite close to each other. However, the distribution of representations in the US textbook is more balanced than in the Turkish textbook (Table 5). This is because almost 97% of the pages in the US textbook have at least one visual representation, compared to 78% in the Turkish textbook. The distribution of VRs types (pictures, diagrams, tables and manipulatives) is presented in Table 6. The frequencies and percentages of the representation types were analysed and the chi-square test was used to determine whether there was a statistically significant difference.

Table 6: Types of VRs in the Mathematics Textbooks

Country	Picture	Diagram	Table	Manipulative	Total
Türkiye	12 (%22.64)	23 (%43.40)	10 (%18.87)	8 (%15.09)	53 (%100)
USA	17 (%29.31)	15 (%25.86)	10(%17.24)	16 (%27.59)	58 (%100)

*$(X^2(3, 111)=685.57, p=.1719$ *(The result is not significant at $p<.05$)*

Table 6 shows that diagrams are used more in Turkish textbooks while pictures are used more in US textbooks. As the use of pictures and tables are close to each other in the textbooks, there are relative differences between the use of diagrams and manipulatives. In addition, a Chi-square test was conducted to determine whether there was a statistically significant difference between the types of VRs in Turkish and US textbooks. The results of the test ($X^2(3,111)=685.57$, $p>0.05$) reveal that the types of VRs do not differ significantly between the textbooks of the two countries. The distribution between the roles of the VRs (decorative, informative and interpretive) is presented in Table 7.

Table 7: The Roles of VRs in the Two Mathematics Textbooks

Country	Decorative	Informative	Interpretive	Total
Türkiye	12 (%22.64)	39 (%73.59)	2 (% 3.77)	53
USA	15 (%25.86)	39 (% 67.24)	4 (% 6.90)	58

*$X^2(2, N=111)=.7764, p=.6782$ *(The result is not significant at $p<.05$)*

From Table 7 it is shown that there is no significant difference between the roles of the types of VRs used in the textbooks of each country. In the textbooks of the two countries, VRs were mostly used as informative. More than 2 out of 3 representations used were directed in the direction. However, the rates and numbers of interpretive representations are very low. Only 2 (3.77%) visual representation in the Turkish textbook and only 4 (6.9%) in the US textbook are used in the role. Also, the results of the Chi-square test ($X^2(2, 111)=.7764$, $p>0.05$) reveal that the roles of VRs use do not differ significantly between the textbooks of the two countries.

The distribution between the purposes of visual representations (understanding, solve and self-regulate) is presented in Table 8. The frequencies and percentages of each of the purposes of using these representations were calculated, and the chi-square test was used to see if there was a statistically significant difference.

Table 8: Purposes of VRs in the Two Mathematics Textbooks

Country	Understanding	Solve	Self-regulate	Total
Türkiye	10 (18.87)	39 (73.59)	4 (7.54)	53
USA	17 (29.31)	36 (62.07)	5 (8.62)	58

X^2(2, N=111 = 1. 8244, p=.4016 (The result is not significant at p<.05)

Table 8 shows that VRs in both countries' textbooks are mostly used for problem solving. As 36 visuals (62.07%) of the representations in the USA textbook were used for problem solving, this rate was as high as 39 visuals (73.59%) in the Turkish textbooks. The use of self-regulation remained at very low levels in both textbooks. Also, a Chi-square test was conducted to determine whether there was a statistically significant difference between the purposes of visual representations in Turkish and US textbooks. The results of this test ($X^2(2,111)=1.8244$, $p>0.05$) reveal that the purposes of using VRs do not differ significantly between the textbooks of the two countries.

Conclusion

The multimodal nature of mathematical concepts is one of the main reasons for using representations. VRs are one of the most preferred types of representations. The results of the study reveal that there are some similarities and differences between the use of VRs in Turkish and US mathematics textbooks. In this context, the representations in the textbooks were analyzed in terms of presentation, type, role, and purpose in terms of operations with integers.

Firstly, it should be emphasized that both countries' textbooks use a large number of VRs in the content of operations with integers. The fact that the use of visuals is inevitable in some situations, as Jitendra and Woodward (2019) point out, is even more true for the topic of operations with integers, which is a very difficult topic for students and teachers. The results of the study show that there is no significant difference in the number of visual representations per page between the textbooks of the two countries. In other words, both textbooks have an average of 2 visual representations per page. However, while 97% of the pages in the US textbook had at least 1 visual representation, this rate was 78% in the Turkish textbook. This difference may be due to the different design logic of the school textbooks of the two countries, confirming Fan and colleagues (2013). It is important to use a variety of VRs in textbooks for understanding operations with integers because the representations contribute to meaningful learning when integrated into the text (Mayer & Moreno, 2003). VRs refer to any type of visual displaysuch as pictures, drawings, maps, diagrams, charts, tables and graphs (Eitel & Scheiter, 2015; Guo et al., 2018) and are presented with or separate from verbal representation (Roberts and Brugar, 2017). In the case of integers, the representations include pictures, tables and diagrams. When multiple representations are used in textbooks, students can more easily construct knowledge through associations between different types of representations. The data show that there is no significant difference between the two textbooks in the types of VRs used in operations with integers. However, the Turkish textbook used diagrams more extensively, whereas the US textbook preferred a more balanced use. Ainswort (1999) emphasizes the complementary nature of this type of representation, stating that diagrams are important because they reveal the relationships between the components that make up the content. While a diagram reveals all possible connections of a concept (Ge et al., 2018), other types of representations such as pictures can be easily misinterpreted if not clarified by text (Coleman et al., 2011). Cook (2006) points out that using diagrams requires less working memory and contributes to meaningful learning by

reducing cognitive load. At this point, focusing on one or more of the representation types may be related to the content or the mentality of the book authors. However, it is clear that a more balanced distribution of representation types in textbooks would contribute more to individual learning and equality of opportunity in learning. In the data obtained in the category of roles of VRs, it is noteworthy that the representations in both textbooks mostly have an informative role. The category implies that the representation is mainly used as an aid. Approximately 1 out of 4 images used in both textbooks is decorative. Chen (2017) considers the overuse of this type of representation, which does not have much effect beyond attracting the student's attention, as a common mistake for textbooks. This is because over-embellishing the content with such illustrations may distract the student from the main focus of the textbook. Interpretive roles, which have an important role in the problem solving process, were found to be given very little space in both textbooks. The situation reveals the need to improve the textbooks in the direction.

Finally, it is found that VRs were mostly used for problem solving in both countries' textbooks. Both 39 (73%) representations in the Turkish textbook and 39 (62.07%) representations in the US textbook were used for this purpose. Van Gardener (2021) draws attention to the activation of the solving angle in situations of justify, solve or explain thinking in the problem solving process. 10 VRs (18.87%) in the Turkish textbook and 10 (29.31%) in the US textbook are focused on organizing or making sense of information. However, VRs of self-monitoring or self-control were very low in both textbooks. In this case, VRs in problem solving processes in textbooks are considered as one of the areas that need to be improved.

The study examined how VRs of integer operations are presented in Turkish and US middle school mathematics textbooks. Since the study analyzed one textbook on operations with integers in each country, there is a limit to the generalizability of the results. The results of the study suggest a number of reasons for a more balanced distribution of VRs in textbooks, especially in the interpretive and self-regulated dimensions. Of course, studies on a broader scale (country, grade level, subject, etc.) need to be conducted. Researches on the relationship between visual representations in textbooks and students' and/or teachers' perspectives can also make a significant contribution to the literature in the context.

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Leveraging AI for MOOC Course Preparation: A Reflection From Online Instructors

Y. T. Chow, The Hong Kong Polytechnic University, Hong Kong SAR

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Abstract
Massive Open Online Courses (MOOCs) have entered their second decades of existence and continued to evolve. However, concerns related to their cost, quality assurance, and the problem of low participation rate still persist. While Artificial Intelligence (AI) is widely recognised as a powerful tool for enhancing productivity and even completing tasks that require human intelligence traditionally, the current discussion regarding the potential use of AI in online courses preparation remains fragmented and has yet to be explored. This paper examines the potential of adopting multiple AI tools inspired by the "AI family tree" model in the delivery of MOOC videos. Based on our experience in developing a small-scale private online course, we critically assessed the potential of technology based on different branches of the AI family tree. Our experiences reveal that the ever-evolving speech and natural language processing tools could reduce the time spent in preparing MOOC videos, while new generative text-to-image tools could address the cost concerns from using licensed materials. Meanwhile, an AI-enabled Avatar could encourage instructor's participation in online course development. Besides, this paper also discusses the potential and limitations of using other AI tools, such as machine learning and machine vision, to enhance instructor support and identify non-participative students. Our findings suggest a blended approach, leveraging multiple AI tools in establishing and running engaging MOOC courses, and provide practical insights in addressing cost and time constraints.

Keywords: MOOC, AI Family Tree, Instructor's Participation, Small Private Online Course

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Introduction

Massive Open Online Courses (MOOCs) are online courses that are open to the public (Rodriguez, 2012). The "open" nature implies that these courses are supposed to have low entrance requirements and offered at no cost. The MOOC model has been widely recognized by higher institutions across the globe since the 2010s (Reich & Ruipérez-Valiente, 2019) and is now at their second decade of development. Advocates of MOOC concepts often follow the constructivist theories and recognize the significant potential of MOOC courses in creating engaging online learning communities.

Throughout its years of development, MOOCs have taken on various forms. While some MOOC project initiatives could be considered as marketing projects of higher institutions (Paiva & Bittencourt, 2018), it is not uncommon to see MOOC courses now structured in a way that leads to higher online degree qualifications with prices. Additionally, MOOC content developed by institutions can complement regular courses they offered. Some institutions have also created private MOOCs, often referred to as Small Private Online Courses (SPOCs), which are not open to the general public (Thomas et al., 2016). In most cases, such courses adopted a blended learning approach. In other cases, private MOOC courses serve as pilot initiative before being made available to the public (e.g. Nidhom et al., 2022).

Meanwhile, some problems of MOOC courses are highly concerning. As these online courses are open in nature and offered at low cost, low completion rates are reported in many of these courses. Seeing a rather high drop-out rate of 40–80% in early MOOC courses, Kennedy (2014) pointed out that learners in MOOC courses could suffer from a lack of instructor support. Since many of the courses are only offered in English or other designated languages, depending on the instructors, the language barrier could be huge for learners who do not possess strong language skills.

In this modern age, AI is widely integrated into different tools that educators use, which potentially leading to wider access to education (Nidhom et al., 2022). However, Wilton and colleagues (2022) have pointed out that educators nowadays seem to lack awareness of the AI tools that are available to them. Therefore, the current research on AI applications in MOOC are at a fragmented state. Specifically, this study aims to address the following research questions:

1. What is the current utilization of different AI systems in online education video projects?
2. Reflecting on our experience, what are the essential AI tools in MOOC course preparation?

Artificial Intelligence Models

The concept of Artificial Intelligence (AI) is multifaceted. Taking on its literal meaning, Luckin (2018) defines AI as "technology capable of actions and behaviors requiring intelligence when done by humans", which differentiates AI-enabled technology from traditional machines that only complete designated tasks. However, although this definition explains the fundamental idea of AI well, educators seem to have difficulties recognizing the available AI tools in this time of technological advancement and the prevalence of AI tools (Wilton et al., 2022).

In fact, there are many models working on classifying different types of AI. For example, Lee Kai-Fu, a renowned computer scientist and venture capitalist who also served as the former President of Google China, describes that AI actually comes in "four waves" (Lee, 2018). The first wave startes with the Internet AI which refers to algorithmic systems used in search engines to generate personalized results. The next wave involves Business AI, which explores additional business value with the use of data. The third wave, Perception AI, focuses on AI technologies enabling accurate voice and image recognition within sensor ecosystems. The fourth and the last wave of AI technology is named as Autonomous AI, referring to the AI robotic technology that interacts with the physical world based on the perception.

AI systems can also be categorized by their capabilities (IBM, 2023). Artificial narrow AI, as known as Weak AI, refers to AI systems that were trained to perform narrow tasks, but are often more effective than a human mind in those specific tasks. Artificial General Intelligence (AGI), also known as Strong AI, is a theoretical AI system that can use previous learning to accomplish new tasks beyond the specified ones. This means that an AGI system could perform any intellectual task like a human being without requiring a human programmer to train them through data models. The Super AI is with the greatest capability that thinks, reasons and makes judgments beyond human capabilities. Super AI would also be capable to understand human emotions and possess beliefs and desires. AI systems could also be categorized by their functionalities (Rather et al., 2024). Reactive machine is an AI system that is engineered to response only to its environment in real-time. This system is not supposed to remember or record data beyond its established purposes. Limited Memory AI systems are trained by past data to make decisions. They have short-lived memories and cannot expand their experience library. Theory of Mind is an AI system with more advanced capabilities that understands the beliefs, emotions and intentions of other agents. Self-Aware AI possesses a real sense of self on its internal condition and limitations, along with its own set of emotions, needs and belief.

In the current research, the "AI family tree" model is used due to its suitability and simplicity. This model groups different AI applications, including machine learning, expert systems, planning, natural language processing, speech recognition, machine vision and robotics. Like other models discussed in the previous paragraphs, this model first appeared on the internet as a general opinion. The early trace of this model first appeared around 2016 in Thomson Reuters (Mills, 2016), yet it was later widely adopted in academic papers (e.g. Cai, 2020; Katz, 2021).

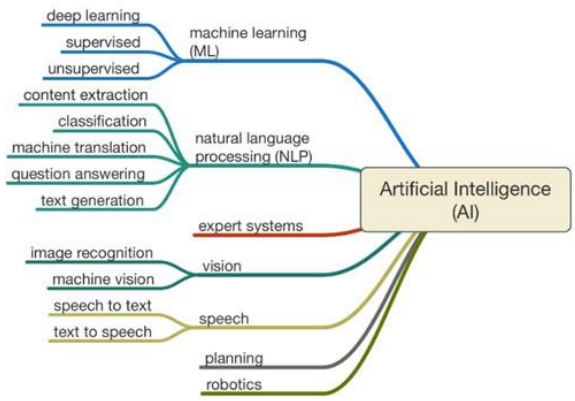

Figure 1: A Family Tree for AI
Source: Mills (2016)

When compared to others AI models, the "AI family tree" model is more straightforward due to the absence of abstract theoretical ideas, while at the same time being more practical because the usefulness of most branches in the family tree for MOOC course preparation can be assessed based on the current technological level. In online learning courses, there might not be any physical presence of activities. That makes this model particularly appropriate since many "AI family tree" branches pertain to the digital domain. While the physical robotic applications of AI will not be discussed in the current study, our discussion still covers most of the model. It is also noted that generative AI tools (e.g. ChatGPT) have not yet gained recognition and popularity yet when this model was developed. Still, most of the generative AI tools described by the academia nowadays could be seen as extensions of the natural language processing (NLP) technology (Iorliam & Ingio, 2024).

Methods

This study was driven by the critical reflection approach (Morley, 2008). Different from a positivist approach to research, the critical reflection approach deconstructs one's experience of a case of analysis and formulates new discourses that are more enabling. In the current research, we reflected on our experiences to reconstruct multiple concerns and constraints in the MOOC video preparation process. According to Ross and Call-Cummings (2020), research on limitations or failures is currently less addressed but is very useful in identifying broader resources and reconstructing new knowledge. Based on our reflection, we then critically assessed the potential of technology based on different branches of the AI family tree.

The Case Institution and Course Concerned

After the COVID-19 pandemic, certain teaching and administrative processes involving digital tools at our college remained in use, for example, the assessment submission and marking of students' results, and uploading teaching videos after each class. Capitalizing on the maturity of such digital tools at such time, the management at our college also explored new digital tools which can further support student learning. Viewing online and blended courses as new branding initiatives and business opportunities (Paiva & Bittencourt, 2018), the college decided to produce new learning video clips for certain established subjects. These video clips were supposed to have higher production quality when compared to general teaching recordings, making them suitable for branding purposes.

Our course is an introductory marketing course. Every year, the course is offered to around 2000 students by 10-15 teaching staff in face-to-face mode. Initially, the management proposed that video clips should cover 20% of the content for a 13-week semester course—equivalent to approximately 5 hours of teaching time. The task force, consisting of three teachers, began by identifying six potential topics for video production. Considering the typical length of MOOC video content, as well as resource and budget constraints, four video clips were eventually produced. One of these video clips provided a briefing on a key assessment item, while the other three videos covered topics that students often found challenging. Altogether, approximately 70 minutes of video content were created in the summer in 2022. Table 1 below provides a description of the content. With the help of our in-house studio, the video production costed $12940 Hong Kong Dollars (approximately USD $1650) of the internal budget.

Table 1: List of Video Content Created

Content	Length of video (mm:ss)	Major content
Group assessment	25:18	Assignment briefing, Assessment rubrics, Elements of marketing plan, FAQs
Marketing research	12:57	Teaching content of marketing research process, self-checking questions
Pricing strategies	15:05	Teaching content of Pricing strategies, role play, self-checking questions
Consumer behavior	16:21	Teaching content of Consumer behavior, role play, self-checking questions

Key Challenges in MOOC Project

In the production process, some immediate concerns were raised. Since the teaching team adopted teaching contents from a textbook, the teaching content was licensed. These copyright-protected materials were strictly for teaching purposes within the school context and should not be used to produce MOOC content. While many teaching materials related to marketing concepts are available on the internet, focused case studies and some related visual materials (e.g., mind maps, figures for illustration) could be strictly copyright protected. Therefore, the subject team created plots for role-playing and avoided using specific case studies. Additionally, for illustrative figures, the in-house production studio incorporated a lot of royalty-free stock video materials in the MOOC videos.

Another immediate concern was the relatively low willingness to participate in video shooting. The video shooting project was considered an extra, underpaid duty. Apart from that, some teachers are also concerned about the potential publicity of the video clips and feel embarrassed. They could be worried about their appearance. To create the video clips, team members divided their work and wrote the script and lines before they could be shown on the teleprompter. While the instructors had no experience in video shooting, the shooting process took 3-5 times the actual video length. After the editing process, the instructors also spent rounds checking the accuracy of the captions. Since there is only one in-house studio serving all video projects, the initial draft of the first video was available only after two months, while all the videos were finalized almost a year after shooting.

First established as a MOOC project, it eventually became an additional learning support source for students, and all face-to-face classes maintained the same coverage and time. Although the instructors included some self-checking questions and frequently asked questions (FAQs) in the videos, like other MOOC projects, further learning support could be limited (Kennedy, 2014). The video clips were hosted in a private video channel that provided basic metrics such as the number of views, viewers, and distribution of watch time; however, the instructors might still lack the resources to conduct in-depth analysis.

Usage of AI in Addressing Challenges of MOOC Projects

The following section maps the potential use of related AI technology within the AI family tree with the challenges of MOOC projects specified in the previous section. We intentionally and purposively searched for scholarly works related to specific AI applications regarding MOOC projects at each branch of the AI family tree. Table 2 below shows a summary of our

results. Additionally, we also group the limitations identified in the previous research at the end of our discussion.

Table 2: Summary of use of AI in Addressing Challenges of MOOC Projects

Branches of AI Family Tree	Challenges	Related Papers	Solutions established
Machine learning / Expert system / Planning	Low finishing rate (Rodriguez, 2012)	Paiva & Bittencourt (2018)	Developed the Pedagogical decision-making process (PDMP) - To use educational data analysis to detect performance and predict who is dropping out or underperforming
	Lack of instructor support (Kennedy, 2014)	El-Rashidy et al. (2023)	Used a new model to classify urgent posts in MOOC platforms
Natural language processing	Lack of instructor support (Kennedy, 2014)	Han et al. (2023)	Developed a chatbot that provides support to course administration matters
Natural language processing: Generative AI	Lack of instructor support (Kennedy, 2014)	Li & Xing (2021)	Developed a GPT-2 based model to reply to students' comments on the discussion forum
	Lack of instructor support (Kennedy, 2014)	Hu et al. (2024)	Incorporated Generative AI in classifying and understanding confusion of MOOC messages
Speech to text	Time consuming process in video editing Language barrier	Miró et al. (2018)	Reported a saving of 25%-75% of the time in post-editing MOOC videos with automatic speech recognition and machine translation while boosting student enrolment by 70%
Machine Vision	Time consuming process in video editing	Zhou et al. (2022)	Reenacted high quality video through gestures recognition and matching
	Low finishing rate (Rodriguez, 2012)	Espacenet (2021)	Patent established for eyeball tracking to track learning state.
Avatar	Instructors' embarrassment from the publicity	Adham et al. (2018)	Used Avatars to break the gender segregated online learning Within MOOCs
Text to image	Restricted use of copyright-protected material	N/A	N/A

The machine learning branch of AI has been widely adopted in MOOC administration. While low-completion rates have long been recognized as a major challenge with MOOC courses (Rodriguez, 2012), machine learning techniques have been used to analyse different data from MOOC platforms. These techniques help identify students who are at risk of

incompletion. For example, Paiva and Bittencourt (2018) developed a pedagogical decision-making process to help online instructors track the progress of their students. Besides, some machine learning solutions acted like virtual assistants, identifying each student's learning style and predicting potential dropouts. El-Rashidy and colleagues (2023) proposed a new algorithm to identify urgent posts in MOOC platforms for instructors managing large MOOC courses. They successfully filtered out around 20% of the total posts that required extra attention.

In the area of Natural language processing, Han and colleagues (2023) developed a Q&A chatbot for their MOOC courses. Focusing on the difference of expectations of native and non-native English users, their results indicated that the chatbot could provide essential help for learners. In terms of speech functions, Miró and colleagues (2018), in particular, investigated the transcription quality and translation quality of a multilanguage MOOC platform with open access tools by measuring the Word Error Rate (WER) and Translation Edit Rate (TER). While reporting satisfactory performance for both the transcription and translation tools, they stressed that even if automatic source subtitles are only available at moderate quality, they remain highly useful for learners whose first language is not English or for those with special needs.

Generative AI tools are highly regarded by educators today. Specifically, the word generation function is considered a branch of Natural Language Processing (NLP) in the AI family tree model. On one hand, some traditional AI functions, such as chatbot and translation can now be efficiently performed by Generative AI due to its enhanced capability and ease of use. For example, Li and Xing (2021) utilized a GPT-2-based language model to provide informational, emotional and community support by responding to learners on a MOOC platform. Hu and colleagues (2024) used a large language model (LLM) based on Generative AI technology to identify word-level indicators of confusion in MOOC messages. On the other hand, generative AI tools could serve more generic functions, including designing learning experiences, assessing student learning, and even content creation (Bozkurt & Sharma; 2023).

In video making, modern video taking tools often utilize certain level of machine vision to enhance video quality. Zhou and colleagues (2022) uses gesture matching technology to reassemble videos and synthesize video frames with audio tracks. However, traditional machine vision may be less relevant to MOOC course development because production studios can handle many tasks based on their expertise. This also explains a relatively fewer literature available on this branch of artificial intelligence. Another MOOC specific innovation involves a patent filed for eyeball tracking tools to monitor learners' states (Espacenet, 2021). Not only could this setting potentially raise privacy concerns, but there is also a need for specific equipment at the learner's premises. However, as an extension of machine vision, avatar creation could address the particular challenge from our case of instructors' reluctance to show their faces. Adham and colleagues (2018) used an Avatar tool to represent a female tutor in a MOOC course in Saudi Arabia as a gender-segregated society. The results indicated that most students were greatly interested in the videos. The teacher also believed that the Avatar contributed to the course's success by conveying teachers' presence and support, even though their faces were not shown.

With the increasing concerns and research for generative AI, Text-to-image as a related AI tool is still under-researched in educational research. To our best effort, no academic work focuses on the applications of such AI technology in creating MOOC content is found. As

pointed out by Vartiainen and Tedre (2023), teachers who use text-to-image technology do have their tensions. Not only did the teachers could create quality visualizations in a fairly short time, but the visualization process could also trigger new ideas. However, the teachers in this research also expressed their concerns about copyright related issues.

Limitations of Artificial Intelligence for MOOC

While artificial intelligence tools can generally address different challenges in preparing and administering MOOC courses, related studies highlight a few limitations. The first limitation lies in the practicality of some AI tools. For example, although gesture recognition tools are believed to enhance the quality of teaching videos when instructors film their own video clips or engage in video conferencing, MOOC video production is often supported by the institution. Besides, editing might still be necessary even when these machine vision tools are used. When avatars are used to replace instructors' faces, Adham and colleagues (2018) noted that such AI technology could incur additional time and effort.

The functionality of AI could be another area of concern, hindered by the quality of data and algorithm used for training. For example, newly deployed chatbot may only understand limited questions and provide standard answers. Since MOOCs are supposed to be held on open education platforms with low enrollment requirements (Rodriguez, 2012), online learners may not possess the same high cognitive and non-cognitive skills as the other learners in tertiary contexts. As described by Han and colleagues (2023), the chatbot they developed could not understand English questions of some non-native MOOC students. Despite the continuous development of new algorithms to detect weak learners, the dropout rate has remained high over the years (Reich & Ruipérez-Valiente, 2019).

The roles of AI and humans are also an area of concern. Users may not feel comfortable when they know certain activities, such as answering their questions and assessing learning progress, are provided by AI (Bozkurt & Sharma, 2023; Han et al., 2023). While overreliance on AI tools could lead to a lack of critical thinking and independent learning (Bozkurt & Sharma, 2023). Like all other AI tools, generative AI tools are trained on designated datasets, which bias in both data and algorithms presents a large area of concern for learning. To a certain extent, the creativity used by AI to generate new materials is based on a massive amount of resources available in the system's database. Lastly, ethical issues and copyright related to the use of generative AI, particularly image generation, are still under debate (Vartiainen & Tedre, 2023). Although the images generated are said to be created by AI, whether the author approves the data used to feed such a system remains a problem in many cases.

Conclusion

Our discussion suggests that different AI tools could potentially address different challenges identified through our critical reflection. AI-enabled technology holds significant potential for facilitating instructors to prepare MOOC video clips and run MOOC courses. In particular, the maturity of Natural language processing branch from the AI family tree could enhance instructors' efficiency. Avatar and text-to-image technology could address specific concerns related to the publicity of instructors and the restricted use of licensed teaching materials. Although the machine learning branch was adopted earlier in MOOC projects, its overall effectiveness for the MOOC community remains in doubt. Compared to other branches, the robotic and machine vision branches receive less attention, and their adoption

should be given lower priority. Still, we expect that a mixed use of multiple AI technologies tailored to the school context will be essential for successful MOOC project delivery.

This study possesses a few limitations. While the AI family tree model provides general guidance to several existing AI technologies for our discussion, it may lack imagination regarding the future work environment when AI technology becomes more mature and ubiquitous. The MOOC landscape could fundamentally change when strong AI and super AI are developed. Moreover, while authentic, the critical reflection approach is subject to bias. In the future, critical reflection research could be carried out in other higher institutions where MOOC projects are carried out. Furthermore, subsequent research could prioritize various AI tools, providing a priority list for MOOC project teams when resources are limited.

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Contact email: hester.chow@cpce-polyu.edu.hk

Designing an Educational Board Game Combined With Spherical Video Virtual Reality Scaffolding Mechanism for Learning Inhaled Drug Therapy

Tzu-Pei Wang, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
Inhalation therapy training encounters several challenges, primarily due to the intricate variety of drug types and methods of administration. These complexities often lead to cognitive overload and diminish student motivation. Moreover, there is a noticeable absence of effective contextual interaction and practical application scenarios within educational settings. To tackle these issues, this study introduces a tabletop educational game that incorporates Spherical Video Virtual Reality (SVVR) to authentically simulate clinical environments. The game involved 23 healthcare professionals, including physicians, pharmacists, respiratory therapists, specialized nurses, and medical students, who participated in the initial empirical evaluation. Participants were tasked with assessing and determining treatment regimens for two simulated patients concurrently, aiming to enhance their understanding of respiratory therapy medications and teamwork abilities. Results revealed that participants experienced high levels of flow, minimal anxiety, strong motivation, enjoyment, and expressed a desire to engage with the game again (all scores significantly above 3 on the 5-point Likert scale). Qualitative feedback also highlighted the effectiveness of the game relative to traditional courses in enhancing understanding of inhalation therapy concepts and clinical case evaluation.

Keywords: Educational Game, Board Game, Situated Learning, Scaffolding, Spherical Video Virtual Reality, Respiratory Therapy, Inhaled Therapy, Inhalation Drug Therapy

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Introduction

Experiential learning is a cyclical process encompassing four distinct stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). This model asserts that learning is achieved through experience and is characterized by its dynamic and continuous nature. In medical education, experiential learning strategies have been extensively implemented, with evidence suggesting that their application can significantly improve medical students' critical thinking abilities(Maudsley & Strivens, 2000). As the advantages of experiential learning become increasingly apparent, virtual reality (VR) has increasingly been incorporated into training methods. VR has been effectively utilized across diverse domains such as emergency responder training, medical training, interpersonal skills development, and educational instruction (Xie et al., 2021). Among the various VR approaches, spherical video virtual reality (SVVR) is particularly noted for its cost-effectiveness and its provision of a 360-degree panoramic view, offering a more immersive learning experience compared to traditional video-based methods (Hosseini & Swaminathan, 2016). From the standpoint of situative learning theory, SVVR presents a valuable educational environment that enhances both learning performance and motivation (Chang et al., 2022).

Among various digital training methods, game-based learning stands out as a trainee-centered approach that transcends time and space constraints. It enables trainees to engage in active learning within a safe environment while addressing clinical problems (Kim & Chun, 2022). According to Lampropoulos and Kinshuk (2024), incorporating virtual reality and gamification elements into education can significantly boost students' motivation, engagement, and learning outcomes. Board games serve as an excellent medium for educational purposes, offering high adaptability for teaching across different subjects (Cheng et al., 2019). One of the advantages of board games is their high level of interactivity; playing face-to-face allows students to actively explore concepts and share information with their peers (person-to-person interaction), while the game mechanisms can also provide feedback to players (interaction between players and the game) (Tsai et al., 2021).

This study has developed an educational board game called "Helps Quickly of Dyspnea," which integrates SVVR scaffolding mechanism for training in the use of respiratory therapy medications. The primary learning goals are to help students become familiar with different types of inhalable medications and to reduce their cognitive load. The game aims to enhance students' motivation to learn, reduce their resistance to learning, and develop essential clinical skills such as critical thinking, problem-solving, teamwork, communication, and collaboration.

Methods

This study explores the integration of a virtual environment scaffold mechanism into an educational board game. The participants included 23 healthcare professionals, such as physicians, pharmacists, respiratory therapists, specialized nurses, and medical students. We developed a board game titled *Helps Quickly of Dyspnea* (HQD), which incorporates the concept of inhaled medications into its gameplay. The game features three types of cards: Drug cards, Material cards, and Task cards, as illustrated in Figure 1. The drug cards represent various inhaled medications currently used in clinical practice in Taiwan, including different types and formulations. The material cards detail the components of these medications. The task cards, combined with the SVVR scaffold mechanism, simulate clinical scenarios in a three-dimensional space. This innovative approach merges SVVR technology with traditional board game elements, offering students an immersive learning platform. When players scan

the QR code on a task card, they enter a three-dimensional simulated clinical scenario that supports 360-degree panoramic exploration. This allows students to freely navigate the virtual environment, observe, and assess patient conditions, as depicted in Figure 2.

Players, divided into groups of 3-6, can engage in two gameplay modes. In the first mode, "Drug Development," players act as Clinical Research Associates (CRAs) and synthesize medications using the material cards they have. In the second mode, "Dyspnea Detection," players take on the roles of healthcare practitioners (doctors, pharmacists, respiratory therapists, or nurse specialists), and provide treatment recommendations after evaluating patients, thereby improving their clinical decision-making skills.

Combining SVVR scenarios with a board game brings distinct advantages and innovations. The virtual environment offers a highly realistic simulation platform, allowing students to practice and learn from mistakes without real-world risks. Additionally, the game maintains the social interaction typical of board games. In each round, players must evaluate two patients and decide whether to treat one or both, but with limited resources, they must communicate and strategize with other players to ensure that both patients receive treatment. Throughout the game, students can explore, interact, and collaborate, fostering a student-centered learning process that encourages independent thinking, strategic planning, value-based judgments, and decisive action.

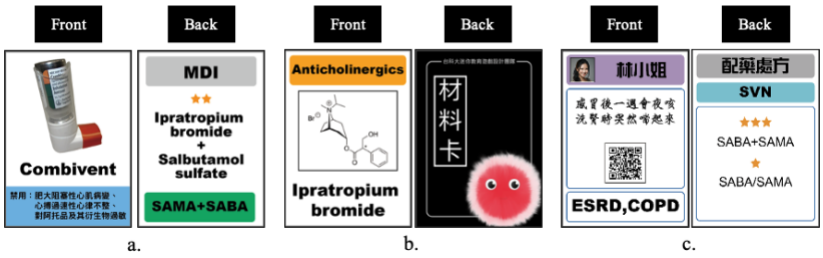

Figure 1: Playing Cards in the Board Game. (a) Drug Cards (b) Material Cards (c) Mission Cards

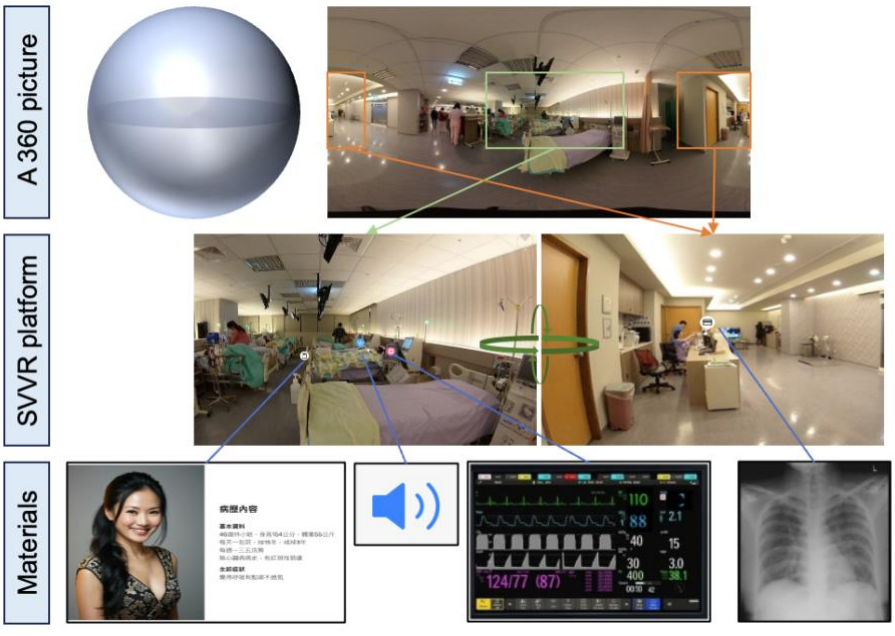

Figure 2: Spherical Video Virtual Reality Scaffolding Mechanism of Mission Card

Results and Discussion

"Helps Quickly of Dyspnea" (HQD) is an educational board game designed to teach respiratory therapy medications. In this game, learners engage in simulated patient assessments within a virtual environment using limited medical resources. They must collaborate with others to provide final treatment recommendations. Table 1 shows the descriptive statistics of the learners' flow state after playing the game. The overall flow state (M=3.87, SD=0.42) was significantly higher than the median score of 3 on a 5-point Likert scale. Both the flow antecedents (M=3.66, SD=0.55) and flow experience (M=3.31, SD=0.41) were also significantly higher than the median score. Sub-dimensions such as goals of an activity, unambiguous Feedback, and control in the flow antecedents were significantly higher than the median, indicating that learners understood the game's objectives and felt in control. The average scores for the challenge-skill balance (3.11±1.10) and playability (3.26±0.69) were not significantly higher than the median, suggesting that learners might have found the game challenging due to a lack of background knowledge about inhalation medications. Qualitative feedback from some participants described the game as "a bit difficult" and "challenging," with suggestions that prior instruction would make the game easier to understand and remember. Additionally, the average scores for concentration, time distortion, and autotelic experience were significantly higher than the median, implying that the game's integration of SVVR scaffolding deeply immersed the learners. Jong (2023) noted that SVVR can enhance students' immersion in the subject matter, thereby improving their flow and learning process.

Table 1: The Mean and Standard Deviation of Learners' Flow

(*N*=23)				
	M	*SD*	*Z*	*Sig.*
Overall Flow	3.87	0.42	4.20***	0
Flow antecedents	3.66	0.55	3.83***	0
Challenge-skill balance	3.11	1.10	0.59	0.558
Goals of an activity	4.22	0.67	4.41***	0
Unambiguous Feedback	3.70	0.88	2.97**	0.003
Control	4.00	0.92	3.42***	0
Playability	3.26	0.69	1.65	0.098
Flow experience	3.31	0.41	3.05**	0.002
Concentration	4.43	0.58	4.17***	0
Time distortion	3.98	0.75	3.70**	0
Autotelic experience	4.30	0.71	4.08***	0
Loss of self-consciousness	2.83	1.07	-0.72	0.471

*p <0.05, **p <0.01, ***p <0.001

Table 2 presents the descriptive statistical analysis of learners' game anxiety, game feedback, and game elements. Overall anxiety (M = 2.72, SD = 0.73) was below the median score (3) on the scale but did not reach statistical significance. Conversely, overall game feedback (M = 4.53, SD = 0.50), game usefulness (M = 4.60, SD = 0.50), game ease of use (M = 4.45, SD = 0.65), and game elements (M = 4.09, SD = 0.76) were significantly higher than the median score of 3. The study indicates that good game elements can enhance learners' engagement, sense of achievement, and motivation(Hassan et al., 2021).

Table 2: The Mean and Standard Deviation of Learners' Game Anxiety, Game Feedback, and Game Elements

(*N*=23)				
	M	*SD*	*Z*	*Sig.*
Game Anxiety	2.72	0.73	-1.15	0.13
Game Feedback	4.53	0.50	4.223***	0
Game Usefulness	4.60	0.50	4.27***	0
Game Ease of Use	4.45	0.65	4.173***	0
Game elements	4.09	0.76	3.93***	0

*p <0.05, **p <0.01, ***p <0.001

Conclusions and Limitations

"Helps Quickly of Dyspnea" (HQD) is a scenario-based game focused on "respiratory therapy medications," combining an online scaffolding system on mobile devices with a physical board game. Players can access real-time cognitive support through their mobile devices. Compared to traditional paper-based board games, mobile scaffolding is more dynamic and can integrate multimedia content (Hou et al., 2023). In summary, there are significant differences in flow performance, learning anxiety, game experience, and game elements. The preliminary results of this study suggest that combining clinical scenarios with a board game and SVVR scaffolding ccan maintain high flow states and increase learning motivation during the learning process. Future research could increase the sample size and further explore the effectiveness, realism, and practicality of the SVVR scaffolding mechanism for different learning groups (e.g., doctors, pharmacists, respiratory therapists).

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Using Experiential Learning Activities in Simulation Games to Predict Students' Scores

Nang Laik Ma, Singapore University of Social Sciences, Singapore
Ivy Sook May Chia, Singapore University of Social Sciences, Singapore

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Abstract
Analytical and problem-solving skills are crucial for thriving in the workplace instead of mere content knowledge. To better prepare our undergraduates for entry into the workforce in this tumultuous time, Experiential Learning Theory (ELT) has been employed in the business programs. A cloud-based simulation game called MonsoonSIM has been deployed in one of the introductory courses in the business school. The simulation game aims to allow students to explore a broad spectrum of business processes ranging from retail, e-commerce, wholesales, manufacturing, procurement, human resources planning, forecasting, accounting, and finance. Through experiential learning and collaboration with teammates via an online portal, students are encouraged to deepen their understanding by playing the game online. In this paper, we aim to analyze the students' activities in the simulation games and use it as a proxy to measure their engagement level and take preemptive action to harness students' problem-solving and data analysis skills. The authors have collected hundreds of students' data from two semesters and used anonymized students' activities and the pre-class quiz results to predict the student's final scores for the course. The regression model is proposed using input as the students' activities and one of the pre-class quizzes to predict the students' final scores. The model accuracy rate is measured using Mean Absolute Percentage Error (MAPE), which is less than 10% and is an excellent predictive model. It helps the educator to analyse the student's performance early in the course and improve their overall learning experience.

Keywords: Experiential Learning Activities, Simulation, Predictive Model

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Introduction

Every business school undergraduate must take our university's Business Skills and Management course. The course objective is to help students develop problem-discovery and problem-solving skills systematically using spreadsheets Excel. The course is the first course they take; thus, the successful completion of the course is vital for the students. The course focuses on experiential learning and problem-solving to prepare students to cultivate self-directed learning and equip them with the necessary skills to survive in challenging real-world situations.

The students come from various academic backgrounds, most of them from polytechnics, and thirty percent of them are from junior colleges. Many of them may need to gain prior knowledge in business to enable them to follow in class. In 2017, we first introduced a business simulation game called MonsoonSIM in the course to help students understand the overview of running a business. There are more than ten departments in the game, which range from accounting and finance, marketing, logistics, retail, wholesale, e-commerce, production and warehouse, manufacturing, service, and human resource departments. It allows students to explore the departments through experiential learning. Over the years, students find the simulation game engaging and enhancing their learning and understanding.

In our course, students learn to develop business models using Spreadsheets from scratch, making valid assumptions. The assessment criteria are based on three pre-class quizzes, individual assignments, and a class test. If a student fails the course, it could significantly impact their confidence and future studies. This underscores the importance of early intervention in identifying students who may need assistance in the course before it's too late, a key focus of our research.

The course is taught over twelve weeks of class over a semester. Six weeks before the start of the class, students will have access to the online learning portal, which they can self-study using a study guide, e-textbook, and PowerPoint slide. In the first lesson, students will be assigned randomly into groups of five, and they will play the simulation game for two hours. Recently, we found out that the learner activities report from the simulation game can be used as a proxy for their engagement and commitment to the course. Thus, in this paper, we explore using the learner activities and the first-pre-class quiz, which happens in the first week, to predict the student's final score. The outcome of this research will assist the lecturers in identifying students who may need assistance in the course before it is too late to do anything.

The rest of the paper is organized as follows. In section two, we will do a literature review to look at the predictive model to improve students' performance and outcomes in education. Next, we will discuss how to collect the data and share some preliminary data analysis and insight. In section four, we will develop predictive models using the input data such as learner activities count, pre-class quiz score, and final score. Finally, we discussed the model's accuracy and recommended actions required using the insights to improve the student's academic performance, highlighting the potential impact of our research on student outcomes.

Literature Review

Many researchers, such as Aldowah et al. (2019), and Chiappe & Rodriguez (2017), use the students' data from the learning management system to improve the students' academic achievement.

Barrows (1996) explained the importance of fully supporting faculty in developing a new curriculum based on a problem-based learning (PBL) approach. The faculty wanted to use PBL to see its impacts on students' learning capability and independent thinking.

Other authors, Ma & Chia (2020), developed a new learning analytics course for the master-degree program. The course mainly focuses on problem-based learning (PBL) to solve real-world problems in the classroom environment and has received good end-of-course evaluations from students. Ma & Chia (2023) developed a case study for the learning analytics course to predict the students' cumulative gross point average (CGPA) based on the five courses. Three predictive models, decision tree, regression, and neural network, have been developed, and the model performance based on mean absolute error (MAE) showed that the regression model yields the slightest error. Thus, it is the champion model.

Students are leaving digital traces online. Some of them, such as the number of pages read, days interacted, time spent, and the number of highlights, bookmarks, and notes, can be used as a proxy to determine the student's engagement level. Junco and Clem (2015), the authors use digital student information to identify at-risk students using digital course reading and engagement. Additional data sources include previous GPA, course grades, and demographic information. The result showed that the engagement and number of days students spent on reading were strong predictors of student performance. The developed system can help educators identify weaker students and provide additional coaching sessions to improve their academic results.

Data Preparation

Student ID is used as the key to match the student's score as well as the student's activity count. We have masked the students' information and created a new student ID to identify the students. There are nearly hundreds of students' records from the past semester. Students' ID is categorical; learner activity count is a numerical number greater or equal to zero. Pre-class quiz score is a numerical number between zero and 100. The final target variable is set as the final score for the course, which is numerical between zero and 100.

Table 1: Student Data

Description	**Data Field**
Student ID	Categorical
Learner activity count	The number of activities done by students in the first game.
Pre-class quiz score	Quiz score (0 - 100)
Final score (Target)	Final score (0 - 100)

Next, let us explore the descriptive statistics of the input variable. The mean activity count is 23.2, but the standard deviation is 19, meaning there is a high variation in the students' activity levels during the game. The minimum number is zero, and the maximum activity count is 85. However, the mean pre-class quiz score is 81.4, considered high. The average final score of the course is 71.2, the mode is 75.1, and the standard deviation is 8.33.

Table 2: Summary Statistics of Students' Data

	Learner activity count	**Pre-class quiz score**	**Final score**
Mean	23.2083	81.4063	71.1906
Standard Error	1.9447	1.6419	0.8508
Median	19.0000	85.0000	72.1250
Mode	20.0000	90.0000	75.1000
Standard Deviation	19.0539	16.0870	8.3365
Sample Variance	363.0509	258.7911	69.4964
Kurtosis	2.3092	12.2507	1.6563
Skewness	1.6080	-2.8724	-1.1333
Minimum	0	0	45.1
Maximum	85	100	88.9

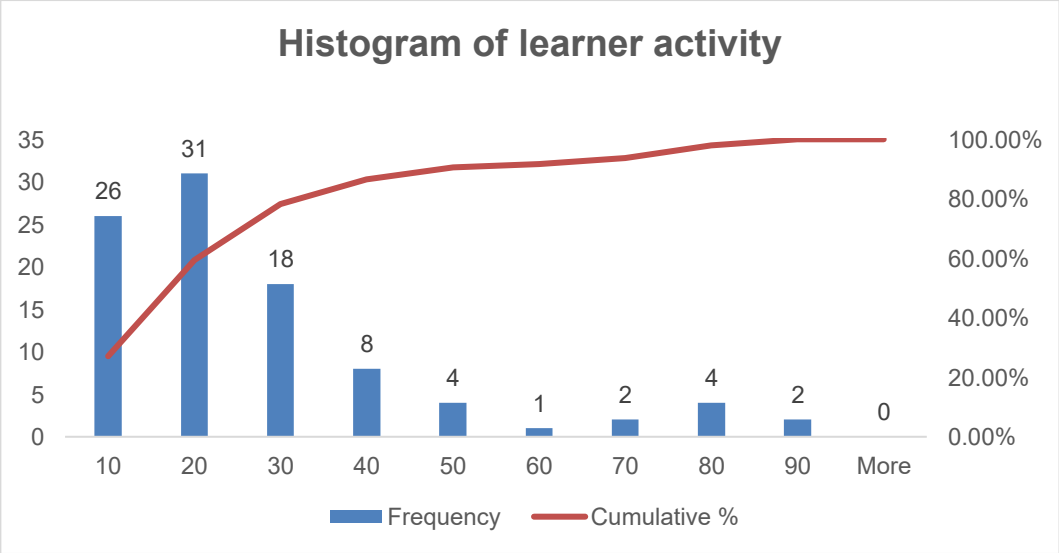

Figure 1: Histogram of Learner Activity

Figure 1 shows that 78% of the students contributed to the learning activity for 10 to 30 intervals. Less than 10% of the students have a learning activity above 50.

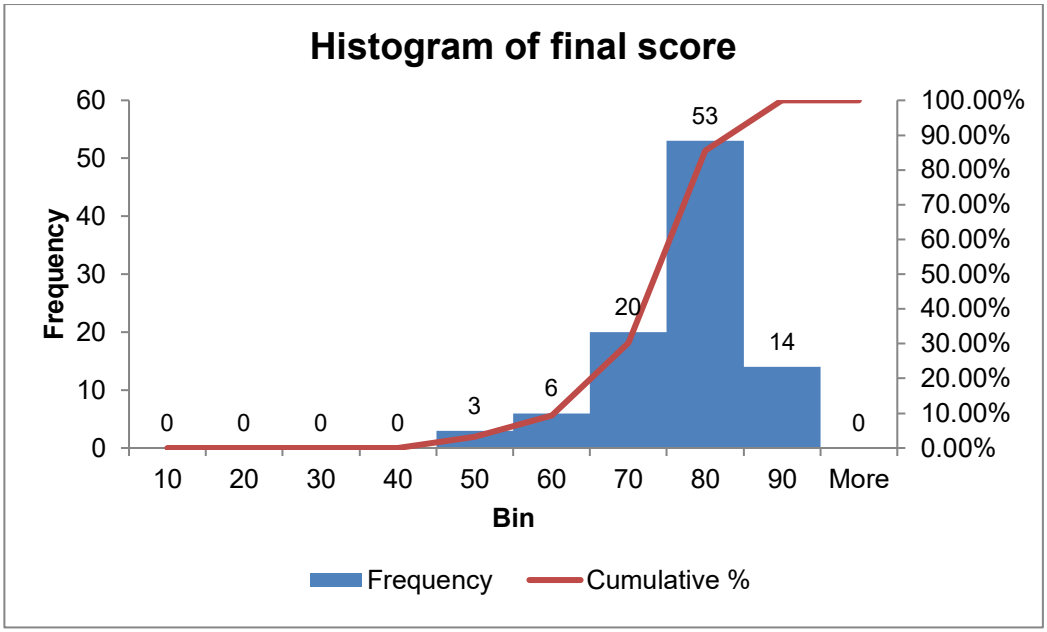

Figure 2: Histogram of the Final Score

Figure 1 shows the histogram of learner activity left-skewed, with the highest frequency between 10 and 20. However, the histogram of the final score, Figure 2, shows that the histogram is right-skewed, with the highest frequency around 70 to 80; 85% of the students scored less than 80, and only 15% scored above 80.

Regression Models and Computational Results

In this section, the authors showed how to develop the predictive model using input variables such as learner activity count. A regression model is chosen because it is easier to understand the relationship between the dependent variables (X's) and independent variable Y. It is one of the most popular predictive models deployed in real business scenarios.

Regression is a statistical model that finds the relationship between the independent variable Y and one or more dependent or explanatory variables X. The assumption is that a linear relationship exists between the dependent variables X's and the independent variable Y.

Let i be the students, i = 1 to N
Let Y_i be the final score of student i
Let $X1_i$ be the learner activity count of student i
Let $\hat{Y}_i$ be the predicted final score of student i

Model 1 is built only on the learner activity, where $\hat{Y}$ is the predicted final score. Using regression analysis, we can get the linear equation,

$$\hat{Y} = 0.0177\ X1 + 70.78 \quad (1)$$

We can use the equation to compute the predicted final score for all the students.

If X1 is 60, the predicted score is calculated using the equation $\hat{Y} = 0.0177*\ (60) + 70.78 = 71.84$. We can then compute the actual final score and the absolute percentage error. Assuming the actual score is 75, the absolute percentage error in this case is 4%.

$$\text{Mean absolute percentage error (MAPE)} = \frac{\sum_{i=1}^{i=n}\frac{|Y_i - \hat{Y}_i|}{Y_i}}{n} * 100\% \quad (2)$$

Using the above formula, we can compute the absolute percentage error for each student and calculate the average absolute percentage error. Model 1 yields a MAPE of 8.47%, which shows that students' activity counts can be used as a predictor for the final score. However, there is an issue with the model, as the student's activity count is between 0 and 85; using the equation, the minimum score for the students with no activity will be 70.78, which is the y-intercept. But it is not true as the students can score less than 70. Based on the historical data, the percentage of students who score less than 70 is about 30%. Thus, we need to add more variables in the next model.

We want to develop a predictive model to predict the final score using the learning activities during the simulation and pre-class quiz in the first lesson. Pre-class quizzes and simulation games are conducted in the same week during the first lesson. If we can use it to predict the students' final scores, we can preempt students who do not do well in these two components to put in more effort and improve the course outcome.

Let w_1, w_2 be the weight assigned to learner activity count and pre-class quiz accordingly.

Let i be the students, i = 1, 2, … to N
Let Y_i be the final score of student i
Let W_i be the weighted score of student i
Let $X1_i$ be the learner activity count of student i
Let $X2_i$ be the pre-class quiz score of student i
Let $\hat{Y}_i$ be the predicted final score of student i

Model 2 is built only on the weighted score of the learner activity and pre-class quiz, where $\hat{Y}$ is the predicted final score.

We initially set an equal weightage of 50% for each learner activity count and pre-class quiz score.

$$W_i = w_1 * X1_i + w_2 * X2_i \quad (3)$$

The general regression line to predict the student's score is $\hat{Y}$ = intercept + slope * weighted score. We can get the linear equation,

$$\hat{Y} = 0.2267\ W + 59.33 \quad (4)$$

Using regression analysis, we can use the equation to compute the predicted final score for all the students. Next, we want to add the mean absolute error above in equation (2).

Using equation (2), we can compute the absolute percentage error for each student and calculate the average absolute percentage error. Model 2 yields a MAPE of 7.96%, which shows that students' activity counts and pre-class quizzes can be used as predictors for the final score, and the error is smaller than just using one variable. We also want to find the optimal weightage for the two components, which minimizes the MAPE. The only constraint added to the model is that the sum of weight equals 1.

$$w_1 + w_2 = 1 \quad (5)$$

Using the Excel solver option, we can compute the optimal weight of 30% for the learner activity and 70% for the pre-class quiz. The minimum MAPE is 7.80%.

Figure 3 shows that by varying the weight for w1 from 10% to 90%, MAPE reduces from 7.93% to 7.8% as the minimum MAPE when w1 equals 30%. After which, MAPE increases to 8.43% when w1 = 90%.

Thus, the optimal weight for w_1, which is the weight for the learner activity, is 30% and 70% for w_2 for the pre-class quiz. This is the weight of the pre-class quiz and will yield the minimum MAPE of 7.80%.

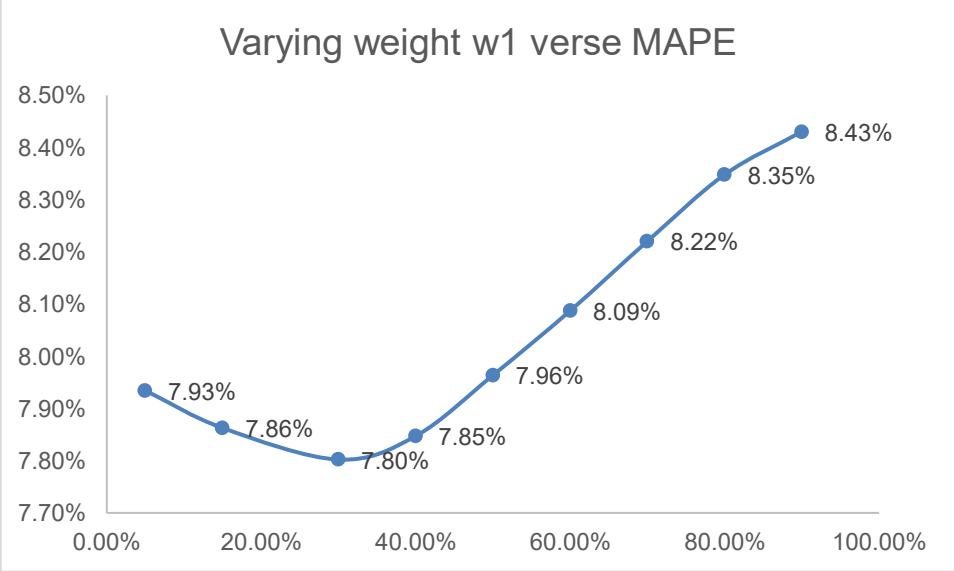

Figure 3: Varying Weightage for the Learner Activity Count and MAPE

Hypothesis Testing

a. We are only using the learner activities.

We are using hypothesis testing to determine whether there is any difference between the predicted and observed scores, where the predicted score is only based on the simulation learner activity.

Let d_i be the difference between the observed score and the predicted score
$d_i = Y_i - \hat{Y}_i$ where is the i = 1, 2, .., N

$H_0: \mu_d = 0$
$H_1: \mu_d \neq 0$

At α=0.05, we use a paired t-test as the data is dependent. The score follows a normal distribution, as we observed from the histogram.

Using Excel→ Descriptive statistics → t-test. We get the result as shown below.

t-Test: Paired Two Sample for Means

	Predicted score	*Final*
Mean	71.191	71.191
Variance	0.114	69.496
Observations	96	96
Pearson Correlation	0.04046	
Hypothesized Mean Difference	0	
df	95	
t Stat	1.3320E-14	
P(T<=t) one-tail	0.5	
t Critical one-tail	1.6611	
P(T<=t) two-tail	1.00	
t Critical two-tail	1.9853	

The p-value is nearly 1, which is more than α value of 0.05, thus we cannot reject H_0, thus accepting H_0. This means the difference between the predicted and actual scores is zero.

b. Using learner activity and pre-class quiz

We are using hypothesis testing to check for any difference between the predicted and observed scores, where the predicted score is the weighted score based on the simulation learner activity and pre-class quiz.

Let d_i be the difference between the observed score and the weighted predicted score
$d_i = Y_i - \hat{Y}_i$ where is the i = 1, 2, .., N

$H_0: \mu_d = 0$
$H_1: \mu_d \neq 0$

At α=0.05, we use a paired t-test as the data is dependent. The score follows a normal distribution, as we observed from the histogram.

Using Excel→ Descriptive statistics → t-test. We get the result as shown below.

t-Test: Paired Two Sample for Means

	Predicted score	*Final*
Mean	71.1906	71.1906
Variance	8.3071	69.4964
Observations	96	96
Pearson Correlation	0.34574	
Hypothesized Mean Difference	0	
df	95	
t Stat	1.122E-14	
P(T<=t) one-tail	0.5	
t Critical one-tail	1.6611	
P(T<=t) two-tail	1	
t Critical two-tail	1.985	

The p-value is nearly 1, which is more than α value of 0.05. Thus, we can't reject H_0 and cannot accept H_1. We accept H_0 such that $\mu_d = 0$.

Thus, there is no statistical difference between the weighted predicted and observed scores.

Conclusion

In conclusion, we developed regression models to use simulation game learner activity and pre-class quiz scores as predictors to predict the student's scores for the first course they took at our university. The models developed showed that the mean absolute percentage error MAPE is only 7.8% and can be used as an early indicator to estimate the students' scores. Those students who score less than 60 in the predicted score might be at risk of performing poorly in the course. Thus, as educators, we can take preemptive action to pay more attention to these students, provide guidance, and conduct extra lessons to enhance the student learning experiences and outcomes.

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Contact email: nlma@suss.edu.sg

Comparative Analysis of Educational Concepts and Outcomes Between Public High Schools in Heilongjiang County Town and New First-Tier Cities in Zhejiang Province, China

Jiwen Yang, Chinese University of Hong Kong, Hong Kong SAR

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Abstract
This study presents a comprehensive analysis of the disparities in educational concepts and outcomes between public high schools in Heilongjiang County Town and new first-tier cities in Zhejiang Province, China. The research explores academic performance, graduation trajectories, and resource allocation, utilizing a quantitative approach that focuses on standardized test scores, GPAs, and college entrance examination results. The findings demonstrate significant disparities, primarily due to variations in resource allocation, teaching quality, and socio-economic factors. The study underscores the need for culturally responsive policies and equitable resource redistribution to bridge regional educational gaps and foster a more equitable educational landscape across China. By doing so, it aims to provide actionable insights for educational policymakers and stakeholders to create an inclusive and fair education system that ensures equal opportunities for all students, regardless of their geographical background.

Keywords: Educational Disparities, Resource Allocation, Academic Performance, Quantitative Analysis, China, Educational Inequality, Policy Recommendations

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Introduction

Education quality in China varies significantly across different regions, influenced by geographical and socio-economic factors. This study examines the disparities in educational outcomes and concepts between public high schools in Heilongjiang County Town, a less developed region, and the economically advanced new first-tier cities in Zhejiang Province. By analyzing academic achievements, graduation trajectories, and resource allocation, the research aims to identify the root causes of regional disparities in educational quality and provide recommendations for policy intervention (Chen, Zhang, & Li, 2021; Hu, Liu, & Wen, 2020; Zhao & Zhang, 2018).

Educational concepts encompass the philosophies, attitudes, and expectations that inform teaching methods, curriculum design, and stakeholder engagement. Outcomes, on the other hand, refer to measurable indicators of student success, such as academic performance, graduation rates, and post-secondary trajectories (Smith & Johnson, 2019). Focusing on both educational concepts and outcomes allows this study to provide a holistic understanding of the disparities between the two regions. These differences are rooted not only in the availability of resources but also in the beliefs and expectations held by teachers, parents, and students, which ultimately influence learning efficacy (Jones et al., 2021). The analysis of educational concepts complements the quantitative measurement of outcomes, offering a deeper insight into the contextual factors affecting student performance.

The selection of public high schools in Heilongjiang County Town and new first-tier cities in Zhejiang Province is motivated by the contrasting socio-economic contexts of these regions. Heilongjiang County Town represents a region characterized by limited educational investment, rural socio-economic conditions, and infrastructural challenges. In contrast, Zhejiang Province's new first-tier cities are recognized for their rapid economic growth, urban development, and substantial educational investments (Feng, Zhang, & Liu, 2021; Li, Sun, & Wang, 2018). Previous research has established that regional disparities in educational funding and socio-economic status contribute significantly to differences in educational quality and student outcomes (Hu et al., 2020; Zhao & Zhang, 2018). By comparing these two distinct regions, the study provides a detailed analysis of how socio-economic factors impact educational quality, highlighting the need for policy interventions to mitigate educational inequalities (Wang & Chen, 2021; Xu & Deng, 2022). Furthermore, focusing specifically on public high schools allows for a clearer understanding of state-level policies and their implementation across different socio-economic environments (Yu & Zhang, 2020).

Educational Disparities and Socio-Economic Influences

Educational inequality is a pervasive issue in China, with rural areas often facing substantial challenges related to resource availability, infrastructure, and teaching quality (Chen, Zhang, & Li, 2021). Heilongjiang County Town exemplifies a region with constrained resources, whereas Zhejiang's new first-tier cities benefit from considerable funding and better educational opportunities (Zhao & Zhang, 2018). This study seeks to illuminate the discrepancies between these two regions and provide actionable insights for addressing these challenges to ensure more equitable educational opportunities (Smith & Johnson, 2019). The educational experiences of students in these contrasting regions illustrate the significant impact that socio-economic context can have on student outcomes, which has important implications for national education policy and development.

This study employs a rigorous quantitative research approach to compare educational outcomes between the two regions. Data sources include standardized test scores, GPAs, and results from the national college entrance examination. These data were obtained from local schools, and official educational databases (Feng, Zhang, & Liu, 2021; Xu & Deng, 2022). Descriptive statistics were utilized to summarize academic performance, while regression analysis was conducted to evaluate the impact of resource allocation on student outcomes (Hu et al., 2020). The use of regression analysis enables the identification of specific factors contributing to disparities, allowing policymakers to target interventions more effectively. Prior studies indicate that disparities in school funding, teacher quality, and infrastructure are significant determinants of educational inequality, thus making these variables critical for this analysis (Li, Sun, & Wang, 2018; Yu & Zhang, 2020).

In addition to academic performance, this study analyzed graduation trajectories, encompassing higher education enrollment rates, vocational training opportunities, and employment outcomes (Wang & Chen, 2021). The examination of post-graduation outcomes provides a comprehensive view of how educational disparities influence long-term student success and socio-economic mobility. Factors such as household income, parental education levels, and community support were also considered, as these socio-economic variables are known to significantly influence student performance (Feng & Sun, 2021; Smith & Johnson, 2019). By incorporating a diverse set of indicators, the study aims to provide a nuanced understanding of the factors contributing to educational disparities across different socio-economic contexts.

Key Findings and Regional Disparities

The findings reveal substantial disparities in academic performance between the two regions. Students in Zhejiang's new first-tier cities consistently outperformed those in Heilongjiang County Town in terms of GPAs and standardized test scores (Wang, Liu, & Chen, 2020). The higher education enrollment rate was significantly greater in Zhejiang, reflecting better access to high-quality education and post-secondary opportunities (Xu & Deng, 2022). These differences can be attributed to the presence of more experienced and well-trained teachers, advanced instructional resources, and a supportive learning environment in Zhejiang's schools. Schools in Zhejiang Province benefit from better-qualified teachers, comprehensive learning materials, and well-maintained infrastructure, which directly contribute to improved student outcomes (Zhao & Zhang, 2018). In contrast, schools in Heilongjiang face numerous challenges, including outdated facilities, a shortage of qualified teachers, and limited access to educational resources (Li & Huang, 2019). These challenges are further exacerbated by socio-economic factors, such as lower household income and limited parental involvement in education, which hinder student performance (Chen, Zhang, & Li, 2021).

The study also highlights disparities in graduation trajectories. Students in Zhejiang are more likely to enroll in higher education institutions or pursue vocational training, whereas students in Heilongjiang are more likely to enter the workforce immediately after graduation, often in low-skilled jobs (Huang & Yu, 2020). This disparity underscores the impact of educational quality on students' future opportunities and highlights the need for targeted interventions in underdeveloped regions to support students' career prospects. Addressing these disparities requires a focus not only on improving academic resources but also on cultivating aspirations for higher education and providing support systems that encourage students to pursue long-term career development.

Recommendations for Policy Interventions

The disparities observed between Heilongjiang County Town and Zhejiang's new first-tier cities are rooted in differences in resource availability, teacher quality, socio-economic conditions, and stakeholder expectations (Li, Sun, & Wang, 2018; Wang, Liu, & Chen, 2020). Schools in Zhejiang benefit from superior funding, better-qualified teachers, and enhanced learning facilities, all of which contribute to improved student outcomes (Hu et al., 2020; Xu & Deng, 2022). In contrast, schools in Heilongjiang struggle with limited resources and socio-economic barriers, leading to inferior educational outcomes (Yu & Zhang, 2020). Stakeholder expectations also play a crucial role in shaping educational outcomes. In Zhejiang, parents and teachers hold higher expectations, which fosters an environment where students are encouraged to pursue ambitious educational and career goals (Feng & Sun, 2021; Jones et al., 2021). Conversely, in Heilongjiang, the focus is often on securing immediate employment after graduation, which limits students' aspirations for higher education and long-term career growth (Li & Huang, 2019). This divergence in expectations is a key factor contributing to the observed disparities in educational outcomes (Smith & Johnson, 2019; Zhao & Zhang, 2018).

Previous studies further support the assertion that socio-economic factors significantly influence educational outcomes. Higher household income and greater parental involvement in education, as observed in Zhejiang, are correlated with better academic performance and higher enrollment in post-secondary education (Chen et al., 2021; Wang & Chen, 2021). Conversely, students in Heilongjiang often come from lower-income households with limited parental support, which negatively affects their academic success (Feng, Zhang, & Liu, 2021; Yu & Zhang, 2020). Addressing these socio-economic disparities is essential for creating a more equitable educational system. The socio-economic barriers in Heilongjiang reflect broader systemic inequalities that must be addressed at both the community and national levels to ensure equitable educational opportunities for all students.

To address these disparities, this study recommends the implementation of culturally responsive policies and equitable resource redistribution. Such policies should prioritize increasing funding for schools in underdeveloped regions, providing professional development opportunities for teachers, and establishing community support programs that engage parents in their children's education (Li & Zhang, 2019). Addressing both resource and socio-cultural factors is vital for creating a more equitable educational landscape across China (Zhao & Zhang, 2018). Additionally, the creation of mentorship programs and career counseling services can help raise aspirations among students in underdeveloped areas and provide them with the guidance needed to pursue higher education and meaningful career opportunities.

Conclusion

This study highlights significant disparities in educational outcomes between public high schools in Heilongjiang County Town and new first-tier cities in Zhejiang Province. Differences in academic performance are primarily driven by variations in resource allocation, teacher quality, stakeholder expectations, and socio-economic factors. Culturally responsive policies and equitable resource redistribution are essential to bridging these gaps. Ensuring adequate funding, teacher support, and community engagement initiatives in underdeveloped regions can foster a more equitable educational environment across China. By addressing both the resource and socio-cultural factors contributing to educational disparities, policymakers can create an education system that provides equal opportunities for all students, regardless of their geographic location. The implementation of long-term strategies to improve teaching

quality, infrastructure, and community involvement is critical to reducing these disparities. Through sustained efforts, educational equity can be achieved, ultimately contributing to greater social and economic mobility for students from disadvantaged backgrounds.

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Pre-service Teachers Undergoing a Second Teaching Practicum: Thoughts, Perceptions and Impacts on Future Careers as Early Childhood Educators

Menn Sze Chua, HELP University, Malaysia

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Abstract
As part of graduating requirements, the Diploma in Early Childhood Education (DECE) and Bachelor of Early Childhood Education (BECE) require all students to undergo 12-16 weeks of practicum training for each program. While most students enter into the BECE with a pre-university qualification, some students choose the route of undertaking both the DECE and BECE, thus they undergo the practicum twice. This study focused on the experiences of 4 pre-service teachers and investigated if the practicums played a role in ascertaining decisions to become Early Childhood Educators. 3 research questions were formulated to meet the study's aims; who were the pillars of support to the pre-service teachers throughout their journey, what were their perceptions of the teaching profession and how did the practicums impact on their intentions to pursue a career as a preschool teacher. Using the qualitative approach, data comprised individual reflective entries throughout their practicums and a focused group interview carried out after the practicum. Lave and Wenger's (1991) Community of Practice's provided the theoretical framework while a thematic analysis was used to analyse the data collected. Findings showed that the students found the practicum challenging and trying despite having prior experience in DECE. However, having their pillars of support such as peers and the community at the practicum centre helped make their practicum experiences bearable. Finally, results showed that most of them do not intend to pursue a career in becoming a preschool teacher.

Keywords: Early Childhood Education, Teaching Practicum, Teacher Education, Community of Practice

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Introduction

Teaching Practicum

Teaching practicum has always been a part of teacher education programme. It provides pre-service teachers with a glimpse of what a teacher's job entails, and it is an opportunity for them to put theory into practice (Buckworth, 2016).

Pre-service teachers often experience a transition from theoretical learning to practical application during their practicum, which is central to their training. It is usually perceived as intimidating as they need to be responsible for many stakeholders - the children, colleagues (teachers), school principals, parents of children they teach, as well as practicum supervisor from the university. They are also responsible for themselves, because their grades depend on it. Moreover, teaching practicum is also a time for employers to recruit teachers when they are placed at their nursery or preschool (Johnson, et al., 2019).

Overview of Early Childhood Diploma and Degree Programmes in Malaysia

There are generally two pathways to becoming a Degree Holder in Early Childhood Education in a private university in Malaysia (see Figure 1). Students must first obtain a Malaysian Certificate of Education (SPM) or O-levels equivalent certificate. After which, they could continue with a Diploma in Early Childhood Education (DECE) and proceed to the Bachelor of Early Childhood Education (Hons) (BECE) programme. Alternatively, they could continue with any Pre-University equivalent programme and proceed to do their BECE.

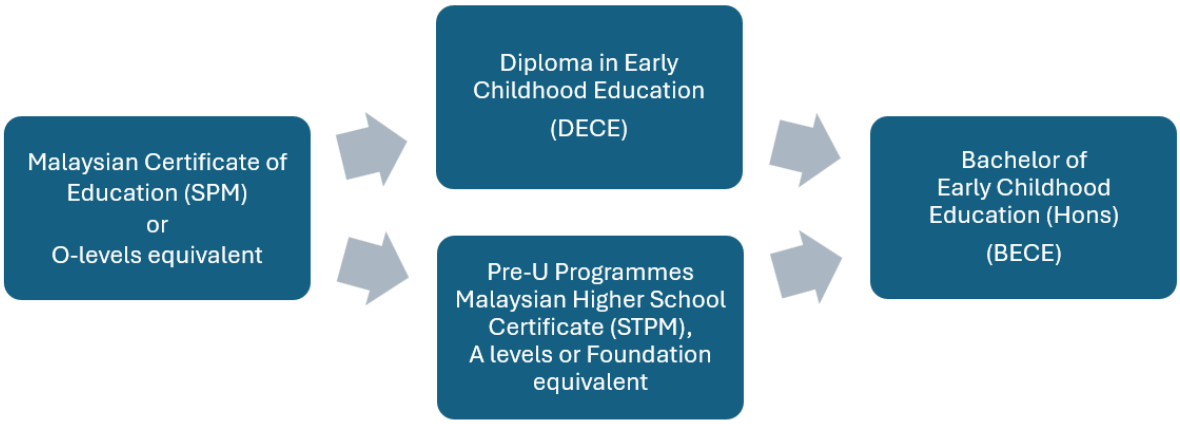

Figure 1: Pathways to Becoming a Degree Holder in Early Childhood Education in Malaysia

As part of graduating requirements, the DECE and BECE programme require all students to undergo 12 to 16 weeks of practicum training. While most students enter the BECE with a pre-university qualification, some students choose the route of undertaking both the DECE and BECE, thus, they undergo the practicum twice.

The practicum experience in DECE and BECE is mostly similar. Pre-service teachers have to plan 20 lesson plans for nursery children aged four and below, 20 lesson plans for preschool children aged between four to six. They are graded twice by their supervisor at the practicum centre and supervisor from the university. The difference lies in the duration of the practicum

experience, which is a total of 12 weeks and 16 weeks for the DECE and BECE programme respectively (see Figure 2).

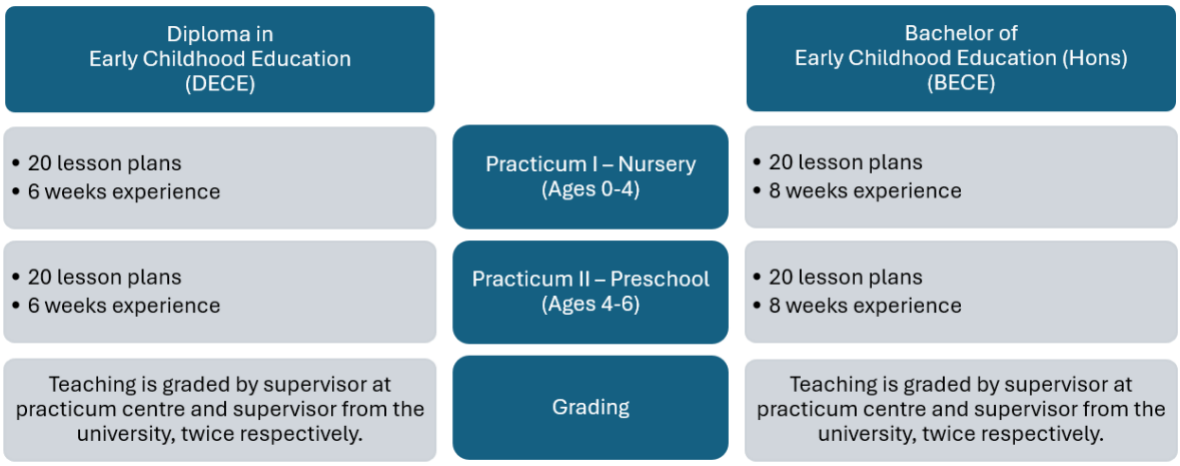

Figure 2: Overview of the Practicum Experience for DECE and BECE

Studies on teaching practicum has always been done and often revolves around pre-service teachers (Lawson et al., 2015; Matengu et al., 2020). They investigated how the school and university supervising staff perceive teaching practicum (Allen et al., 2013), the support pre-service teachers receive during practicum (Smith & Lev-Ari, 2005), the identity of pre-service teachers from learner to teacher (Trent, 2012) and how practicum could affect student retention in early childhood (Kirk, 2018).

A simple search on "Community of Practice in Malaysian school" would deliver many results (Ismail et al., 2020; Thang et al., 2011). But the focus on early childhood education (ECE) were limited. Additionally, pre-service early childhood teachers going through a second teaching practicum is not commonly investigated as well. As such, the research questions for this study are as follows:

1. What were pre-service teachers' perceptions of the teaching profession?
2. Who were the pillars of support to the pre-service teachers throughout their journey?
3. How did the practicums impact on their intentions to pursue a career as a preschool teacher?

Literature Review

Teaching practicum offers pre-service teachers insight into the realities of workplace practice in schools. While the importance of theoretical knowledge is acknowledged, many believe practicum experience is even more valuable than university classroom learning (Allen & Wright, 2014).

Research on teaching practicum is extensive. According to the systematic review research done by Lawson and colleagues, it appears that pre-service teachers are most researched on with a focus on teacher competency development, relationships with practicum supervisors, linking theory and practice, shifts in perceptions of the profession, and the significance of pillars of support. Matengu and colleagues' (2020) semi-systematic literature review too, produced similar results.

Pre-service teachers face a range of personal and professional challenges during their practicum. These include finding their teacher identity, aligning with societal expectations, staying true to their educational philosophy, and managing time and documentation requirements (Buckworth, 2016; Friães et al., 2018; Trent, 2012). These challenges can sometimes negatively impact their experience, leading to doubts about their commitment (Kirk, 2018).

Support for pre-service teachers varies across studies. Key sources include school-university partnerships (Allen et al., 2013), cooperating teachers (Ferrier-Kerr, 2009; Johnson et al., 2019), and peers or university supervisors (Smith & Lev-Ari, 2005). However, principals were often not seen as supportive (Smith & Lev-Ari, 2005).

Lindsay and Lindsay (1987) noted the undervaluation of early childhood teachers, a problem that persists. It is saddening to see how wages are not keeping up with today's inflation even after thirty years (Coffey, 2022). Teacher shortages and high turnover rates worsened post-pandemic, with many teachers leaving due to burnout, lack of support, and better career opportunities elsewhere (Pendola et al., 2023; Johnson, 2006).

Underpinning Theory

Community of Practice (CoP), introduced by Lave and Wenger (1991), is a social learning model where learning occurs within a cultural and historical context. CoP is defined as a group of individuals sharing a concern or passion, who learn to improve by interacting regularly (Omidvar & Kislov, 2013; Wenger-Trayner et al., 2023). CoP serves as the framework for this study, as the stakeholders work collaboratively to equip pre-service teachers with essential skills.

CoP has three key structural elements: domain, community, and practice (Farnsworth et al., 2016; Wenger-Trayner et al., 2023). The domain refers to the shared domain of interest within the community. In the context of this study, shared interested are knowledge and skills to care for and teach children up to age six and the ability to plan and implement developmentally appropriate lessons for diverse learners. The community in the CoP are members sharing the same interest (domain) that would interact with one another for knowledge sharing or to help each other improve. In this study, the community encompasses the principal of the practicum centre, colleagues in the practicum centre, practicum partners from the university (pre-service teachers as well) and practicum supervisor from the university. The practice in this context refers to the members of CoP learning from and with each other, building on their collective wisdom. These shared practices include problem solving, seeking advice and experiences, as well as engaging in discussions.

Methodology

Research Design

The aim of the study is to investigate the pre-service teachers' who have undergone both DECE and BECE practicums on their perceptions of the teaching profession, their pillars of support, and how the practicums impact their intentions to pursue a career as a preschool teacher. Qualitative research method was employed as it provides an in-depth, intricate and detailed understanding of meanings, actions, attitudes, intentions and behaviours to the study (Gonzales et al., 2008 as cited in Cohen et al., 2018).

Participants and Sampling

Purposive sampling was conducted as it enables researchers to select participants based on the characteristics sought to meet the study's specific needs (Cohen et al., 2018). This study included four pre-service teachers, who had successfully completed practicums in both DECE and BECE programmes at the same tertiary institution. Coincidentally, all four participants are female.

Data Collection

Qualitative researchers collect data by themselves through various channels. The multiple sources of open-ended data allow the researcher to have a rich set of data to review, make sense of and organise it into themes (Creswell & Creswell, 2018, p. 257). The source of data for the present study includes focus group interview and transcript, as well as reflective entries throughout the pre-service teachers' practicum.

Focus group is an interview for a small group of individuals formed by a researcher (Barbour, 2008 as cited in Lune & Berg, 2017). In this study, the interview was done after the students have completed both their DECE and BECE practicums. The researcher took on the role of a moderator to initiate a discussion within the set of interview questions prepared. The interview was recorded, and conversations were transcribed. One of the basic ingredients of an effective focus group interview is to ensure that the atmosphere and environment is a positive one (Lune & Berg, 2017). This was done by assuring them that their information would remain private, as protected through the promise of confidentiality. Hence, only pseudonyms were mentioned, namely BS, XT, EP, and NC.

Journal entries provide readers insights to the writer's thinking (Taylor, 1995). Pre-service teachers undergoing practicum were required to submit a weekly reflection, reflecting on their thoughts, feelings and opinions throughout the course of the practicum as part of their submission requirements. The reflective entries of the four participants were extracted, compiled and analysed.

Data Analysis

Thematic analysis is a "method for systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a data set" (Braun & Clarke, 2012, p.57). The thematic analysis done for the current study was applied to both the interview transcript and the reflective entries using Braun & Clarke's (2006) six phases of conducting thematic analysis. In which are familiarizing oneself with the data, generating initial codes, searching for themes, reviewing potential themes, defining and naming themes, and lastly, producing the report.

Findings

Perceptions of the Teaching Profession

All four pre-service teachers expressed a positive view of the teaching profession, describing it as a noble and important career. For instance, BS noted that she initially expected teaching to involve only classroom activities, but was surprised by the other responsibilities, such as diaper changing and attending to children's physical needs. XT, who completed her

practicum at a school with a different curriculum, described her experience as more focused on teaching than caring, highlighting the varying demands of different educational settings. EP previously worked as an enrichment class teacher for public speaking with children aged 7 to 12 and speech and drama for children aged 3 to 6. She finds the job exciting and was eager to start the practicum, as she already has a strong liking for children. NC on the other hand, sees teaching as a very professional role, equating it to writing a "paper" that students then learn from. She expresses concern about the possibility of teaching something incorrectly, fearing that children may adopt the wrong information.

Importance of Pillars of Support

The participants emphasised the importance of having pillars of support during their practicum. It acts as a safe space for them to express their thoughts and feelings. Family, friends, and practicum partners were identified as key sources of emotional support, providing reassurance and encouragement when challenges arose. Moreover, it also allows them to exchange and reflect on ways to help improve their teaching. NC described how she valued feedback and constructive criticism, as it helped her improve her teaching practices. The participants also valued the opportunity to reflect and exchange ideas with their practicum partners and mentors, which fostered a sense of professional growth.

Pillars of Support and Community of Practice (CoP)

The practicum journey involves both growth and challenges. The pre-service teachers were invited to rank their pillars of support throughout the journey (See Figure 3). They ranked their pillars of support, with family, boyfriends, and university practicum partners at the top, followed by the principal, colleagues, and university practicum supervisor.

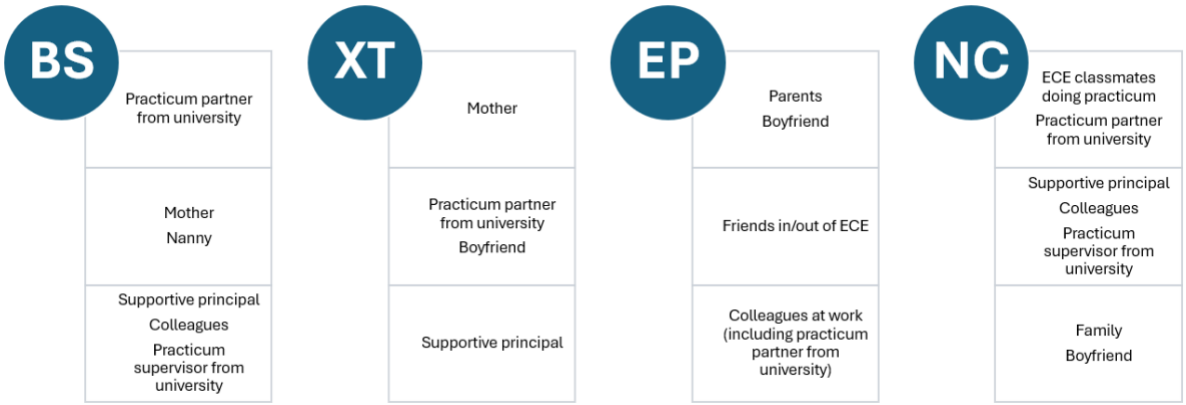

Figure 3: Pre-service Practicum Teachers' Ranking of their Pillars of Support

These pillars align with their Community of Practice (CoP), in which are principal of the practicum centre, colleagues at the practicum centre, practicum partner and supervisor from university.

The practicum centre principals organised workshops on lesson planning, classroom management, and parent communication. This support created a positive, encouraging environment where the pre-service teachers felt a sense of belonging. They also learned management skills, such as conflict resolution, and gained insights into the principal's role.

Colleagues at the practicum centre played a key role in building trust and supporting the pre-service teachers. Through daily interactions, they shared teaching ideas, strategies for managing diverse children, and tips for lesson planning.

The pre-service teachers BS and XT are practicum partners at one practicum centre, while EP and NC are partners in a different centre. The practicum partners shared the same experience, creating camaraderie and mutual support. They exchanged ideas and helped each other improve.

The practicum supervisor, visiting eight times during the practicum, provided moral support, feedback, and guidance on refining lessons. Their interactions also helped the pre-service teachers manage workload boundaries. For example, XT and BS learned to assertively discuss workload reduction with their principal, resulting in a better focus on their practicum reports and other tasks.

Impact on Practicums on Future Career Intentions as Preschool Teachers

Most pre-service teachers do not plan to pursue a long-term career as preschool teachers.

BS realised during her DECE Practicum II that she prefers being a carer over a teacher, especially for children aged four and below. She values the personal interactions and attachment she forms with the children, preferring the nurturing role over formal teaching.

XT expressed a willingness to stay in preschool teaching but is concerned about the salary not aligning with her future expectations and lifestyle. She would remain in the field only if the salary is adequate for her future needs.

EP, who has been teaching since 18, is uncertain about continuing in the field long-term. She enjoys teaching but worries about her knowledge and the high living expenses in Malaysia. She would only stay in preschool teaching if the salary package were sufficient to support her lifestyle.

NC, after a challenging DECE practicum, doubted teaching was for her but found renewed support and hope after the BECE practicum. She is seeking a supportive, non-toxic school environment. However, if she cannot find an ideal school or the job does not offer adequate compensation, she may leave teaching to work in her family's business.

The pre-service teachers were asked if they would still enrol in DECE then BECE if given the chance to turn back time. Only one said yes, two said no, and one was undecided.

BS is the only one who firmly said yes. Initially interested in management, she ended up in DECE due to her family's influence. Despite uncertainties during her studies, she does not regret her decision and values the experience over certification.

XT believes the practical experience gained is more important than the certification. While she appreciated the learning from DECE and BECE, she would have chosen a different undergraduate programme and returned to early childhood education (ECE) later, even without the certification.

EP, who originally wanted to be a teacher, would have preferred to do a Foundation (pre-university) programme to explore other areas before committing to DECE. She feels it would have given her more exposure and clarity about her long-term career path.

NC is undecided. After completing her BECE practicum, she questions whether teaching is the right career for her. She is torn between staying in the teaching profession, where she feels underpaid, and working in her family's business for better financial stability. She values the reflections and personal growth DECE and BECE provided but is concerned about the financial challenges in teaching. If no changes occur, she may leave the profession.

Discussion and Conclusion

All four pre-service teachers have generally positive perception towards the teaching profession. They perceive the teachers as a professional and in fact, a noble profession.

The findings from this study align with previous research by Allen and colleagues (2013), Ferrier-Kerr (2009), Friães and colleagues (2018) and and Johnson and colleagues (2019), who highlight the importance of having a supportive CoP during the practicum. The pre-service teachers in this study found that their family, practicum partners, and mentors provided crucial support that helped them navigate the challenges of their training.

The study also reveals that while the participants viewed teaching as a noble profession, they did not see it as a long-term career. While three would leave the field if not adequately compensated. One teacher is willing to stay if she explores other areas and the salary package meets her lifestyle needs. XT's perspective aligns with Allen & Wright's (2014) study, as she values practical experience over the theoretical knowledge gained through DECE or BECE certification. Salary concerns were raised by three teachers, who feel current preschool salaries may not support their long-term lifestyle. This reflects findings by Coffey (2022) and Pendola and colleagues (2023) as well.

The pre-service teachers had mixed opinions on re-enrolling in the DECE and BECE programmes. Two would not choose to study DECE again, one is undecided, and only one has no regrets. The practicum experience allowed them to experience the daily life of a preschool teacher and provided clarity on their long-term career decisions, either pursuing or abandoning the profession.

In conclusion, the study sheds light on the complex factors that influence pre-service teachers' perceptions of the profession and their career intentions from a private university in Klang Valley, Malaysia. While the practicum plays a pivotal role in shaping their views, external factors such as support systems and financial considerations also play a significant role in determining their long-term commitment to the profession. Future research could explore the experiences of male pre-service teachers and expand the sample size to provide a more comprehensive understanding of the factors influencing career intentions in early childhood education.

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Contact email: mennsze.c@help.edu.my

The Authenticity of EFL Summative Test-Task Items at a Senior High School in West Seram, Maluku Province, Indonesia

Hardianto Hitimala, Universitas Pendidikan Indonesia, Indonesia
Susi Septaviana Rahkmawati, Universitas Pendidikan Indonesia, Indonesia

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Abstract
The objective of this study was to find out the authenticity of the EFL summative test at one of the Senior High Schools in Seram, Maluku, Indonesia. The research design was a descriptive quantitative study. The data was collected from the documents of summative test items that consist of two major parts; forty multiple-test items and three open-ended questions. The instruments rubric was constructed to assess test authenticity. The analysis focused on test task authenticity, covering the setting, structure of the communicative event, input, and expected response. The rubric was constructed based on the characteristic of authenticity proposed by Bachman and Palmer (1996), and Brown and Abeywickrama, (2018). The finding showed that the summative test consists of 13 tasks using *9 short reading texts, 3 open-ended questions, and 2 short dialogue texts* that served different social functions such as s*hort message, self-introduction, recount text, announcement, narrative, argumentative text, invitation, recount text of personal experience, business letter, greeting,* and *turn taking*. Concerning task authenticity, there were 32 out of 43 items on all task components were identified as high while 11 items were low. The cumulative analysis of all tasks indicated that 77% (10 tasks covering 32 items) were highly authentic, while 23% (3 tasks covering 11 items) were low authentic.

Keywords: Test Task, Authenticity, EFL, Summative Test

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1. Introduction

Evaluation is an integral part of teaching English in schools, with testing being the primary instrument teachers use. Testing encompasses several interrelated aspects, including goal, and activity. The goal refers to the overall objective of the lesson at the end of the semester, while the activity pertains to classroom activities. Test policymakers have implemented testing to effect educational change (Shohamy, 2001 in Broad, 2003). Testing is an ongoing process employed by teachers to monitor and guide progress through quizzes, homework, and informal tests (Airasian, 2001). Like patients requiring a doctor's diagnosis, students need tests to assess their academic progress. Tests serve as a policy tool to measure student achievement and the success of teaching-learning programs and diagnose students' strengths and weaknesses. In designing and constructing tests, teachers must ensure that the level of difficulty is appropriate for their students (Hughes, 2003).

Generally, in Indonesian schools, a summative test is frequently conducted to show the standard, which the students have reached with other students at the same stages. The test is used at the end of the semester term to measure what has already been achieved both by groups and by individuals including tests, projects, and formal tests (Rajhy, 2014, cited in Sugianto, 2017). Besides, formulating authentic content is very important when designing tests for students, especially for EFL students. Bachman and Palmer (1996) argue that authenticity is the degree of correspondence between the characteristics of a given language test task and the features of the language task. It means that a language should connect to the real world. Furthermore, Bachman (1991) and Liu (2005) categorize test authenticity into two aspects: test text authenticity and test task authenticity. These aspects cover elements such as setting, test rubric, input, expected response, and the relationship between input and response (Bachman & Palmer as cited in Liu, 2005). These elements mean that test items should reflect the naturalness of language, and the relevance of the topic, be engaging, and represent real-world scenarios (Liu, 2005). A test task is realistic when we find it is authentic. In fact, many kinds of test items do not mimic what people do in real life. They might be fake or unnatural because they focus on a grammar rule or a word. The order of questions that have nothing to do with each other is not authentic. It is easy to find passages in skill tests that are not like real-world texts. (Brown & Abeywickrama, 2018). Concerning the authenticity of a test, Fauziah (2019), asserted that in designing effective and efficient tests, Indonesian teachers tend to consider aspects of validity, reliability, and practicality, rather than concerned about authenticity aspects, which produce tests that are not sufficient to fulfill the pedagogical elements.

Studies on summative test items analysis in Indonesia have been explored by (Bernasela, 2014; Ardhian et al, 2016; Sugianto, 2017; Semiun, & Luruk, 2020, Wisrance, & Napitupulu, 2022). There have been only a handful of studies (Fauziah, 2019), scrutinizing the authenticity of summative assessment in avocational schools in Bandung City. However, it is very rare for research related to summative test items analysis from an authenticity perspective. Those previous researchers focused on validity and reliability rather than authenticity. Moreover, the researcher was drawn to study the authenticity of English test items on summative tests at the Senior High School of West Seram, Maluku, Indonesia, to obtain more information about the quality of the test items. Some students at this school reported problems with the test content and stated that the questions were not suitable for their abilities. Many students complained about the suitability and relevance of the language test. The problem could be seen directly from the students' explanations through the researcher’s preliminary study (short interview). Most of them complained about the

suitability, relevance, and easy language of the test. The students said that the test still lacked authenticity and made it difficult for them to succeed. Therefore, in further research, the researcher is concerned with analyzing the authenticity of the EFL summative test designed according to one principle of language assessment, mainly focusing on the test task authenticity items on the English teacher test made (Bachman & Palmer, 1996; Brow & Abeyickrama, 2018). The researcher used descriptive quantitative. The researcher was curious about how far the effectiveness of tests was created for students. Therefore, the research questions are formulated as follows:

1. How authentic is the construction of the test task found in the EFL summative test?

2. Literature Review

2.1 Summative Test

Assessment has two purposes: to support learning and to summarize learning. The formative assessment is used to guide teaching and learning. On the other hand, the summative assessment is used to record and report (Allen, 2004). The summative test focuses more on students' achievement. The outcome of a summative test will be used to give grades to students. The summative test involves gathering evidence about students' achievement in a systematic way to be reported at a specific time based on teachers' professional judgment (Harlen, 2004). Summative assessment is a way of measuring or summarizing what students have learned. It evaluates how well students have achieved their goals, but it does not necessarily help them improve in the future (Brown, 2003). Spolsky and Halt (2008) also explain that summative assessment, or assessment of learning, is less detailed and aims to assess the outcomes of educational programs or students. Therefore, summative assessment is used to test different language skills and learners' achievements.

2.2 Authenticity

According to Bachman and Palmer (1996), the term authenticity as used in the context of testing can be understood to mean the degree to which a given test and set of materials corresponds to 'real life' context and interactions (Shomoossi & Tavakoli, 2010). Authenticity is an important quality for test development (Lynch, 1982). Morrow (1991) points to the overriding importance of authenticity, and Wood (1993) considers it as one of the most important issues in language testing. Also, Bachman and Palmer (1996) see authenticity as a critical quality of language tests (Shomoossi & Tavakoli, 2010). It means that when making and choosing tests, authenticity should be a priority in the practical phase of test creation. The main focus should be on controlling how authentic it is, which means how well a language test matches a real-life task.

2.3 Test Task Authenticity

Widdowson (1979; 1978) and Skehan (2003) point out that task authenticity entails "the learner's reaction or response". Morley (2000) elaborates further by stating that task authenticity is contingent on whether learners are engaged by the task. Therefore, a task may be authentic in relation to real-world situations, but it may seem inauthentic to some groups of learners. Task authenticity is a concept that relates to how well a language test simulates the real-world situations and tasks that test-takers will encounter in their target language use (TLU) domain. Task authenticity is important for measuring the test takers' ability to use language for communicative purposes and to engage with meaningful and relevant content.

Task authenticity can be divided into two types: situational authenticity and interactional authenticity.

2.3.1 Situational Authenticity

Situational authenticity is the perceived relevance of the test method characteristics to the features of a specific target language use situation (Bachman & Palmer, 1996, cited in Purpura & Kunnan, 2024). Thus, for a test task to be perceived as situationally authentic, the characteristics of the test task need to be perceived as corresponding to the features of a target language use situation. For example, one set of test method characteristics relates to certain characteristics of vocabulary (e.g., infrequent, specialized) and topics (e.g., academic, technical) included in the test input. If test takers were specialists in engineering, the inclusion of technical terms and topics from engineering would likely tend to increase the situational authenticity of the test. In contrast, we define the situational authenticity of a given test task in terms of the distinctive features that characterize a set of target language use tasks. Thus, in designing a situationally authentic test, we do not attempt to sample actual tasks from a domain of non-test language use but rather try to design tasks that have the same critical features as tasks in that domain. Language testers and teachers alike are concerned with this kind of authenticity, for we all want to do our best to make our teaching and testing relevant to our students' language use needs. For a reading test, for example, we are likely to choose a passage whose topic and genre (characteristics of the test input) match the topic and genre of material the test user is likely to read outside of the testing situation. Or, if the target language use situation requires reciprocal language use, then we will design a test task in which reciprocity is a characteristic of the relationship between test input and expected response.

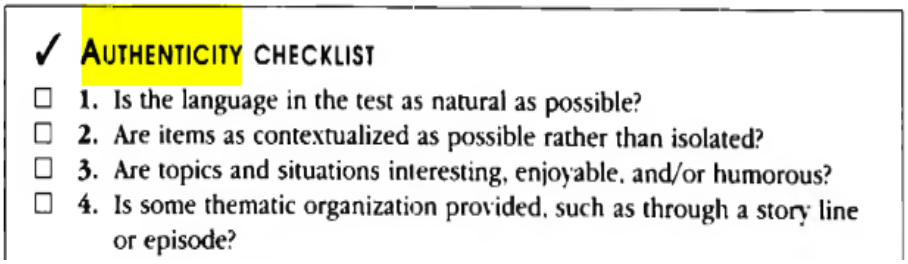
2.3.2 Interactional Authenticity

Interactional authenticity is essentially a function of the extent and type of involvement of task takers' language ability in accomplishing a test task (Widdowson, 1978). Assessing interactional authenticity and designing tasks that are interactionally authentic, however, is more complex, since this requires us to consider both the characteristics of the test task and the components of the test taker's language ability.

2.4 Theoretical Framework

Bachman (1990) and Bachman and Palmer (1996) developed a framework to describe language tasks, incorporating five key features. First is *the setting*, which refers to the environment where the task occurs, including details like location, participants, and timing. Second is *the rubric*, which includes the task instructions, detailing the situation, what students are expected to do, and how they will be evaluated. Third is *the input*, which encompasses the material that students need to process, whether it's auditory, visual, verbal, or nonverbal. Fourth is *the expected response*, which outlines what students are supposed to do with the given input. Lastly, *the relationship between input and response* is examined, considering factors such as the level of interaction, the amount of information to be processed, and the reliance on prior knowledge. This framework ensures that language tasks are realistic and effective in assessing language skills. In relation to this, Bachman and Palmer simplified the five points above into a checklist that can be used to analyze test task items.

- **Setting (Are items as contextualized as possible rather than isolated)?**
  Good test items are set within a certain context, not just stand-alone sentences or words. This helps students understand meaning within a broader situation. Example: A question asks students to complete a conversation in a restaurant, rather than translating random words.
- **Structure of communicative event (Is some thematic organization provided, such as through a storyline or episode?)**
  Questions that follow a storyline or theme make the test more structured and easier to follow. Example: A test includes a series of questions that tell a story about someone's journey, from planning a trip to returning home.
- **Input (Is the language in the test as natural as possible?)**
  The language used in the test should sound like everyday speech or writing, not overly formal or artificial language. Example: A question asks students to write an email to a friend, instead of a rigid formal letter.
- **Expected Response (Are topics and situations interesting, enjoyable, or humorous?)**
  Engaging or enjoyable topics make students more motivated to complete the test. Example: A question is about a vacation or popular movie instead of overly technical or boring content.



✓ AUTHENTICITY CHECKLIST

☐ 1. Is the language in the test as natural as possible?
☐ 2. Are items as contextualized as possible rather than isolated?
☐ 3. Are topics and situations interesting, enjoyable, and/or humorous?
☐ 4. Is some thematic organization provided, such as through a story line or episode?

Figure 1: Task Authenticity Guideline

3. Method

3.1 Research Design

The current study employed a quantitative research design to investigate the authenticity of the EFL summative test construction at the Senior High School in West Seram, Maluku Province, Indonesia. The investigation was done by studying the entire summative test focusing on the test tasks.

3.2 Data Source

The data used in this research was the summative test items document prepared by a teacher for first-grade students at the Senior High School of West Seram, Maluku, Indonesia, for the 2023-2024 academic year. The summative test has 43 question items, consisting of 40 multiple-choice test items and 3 open-ended questions. They were constructed by an English teacher at the school to measure students' English competence. The multiple-choice test is presented through three big tasks, consisting of short reading passages, short dialogues, and open-ended questions. Eight short reading texts indicate different social functions such as 1) a short message from a friend, 2) self-introduction (introduce name, address, age, favorite subject, and hobby), 3 and 4) recount texts (recount text 1&2), 5) announcement, 6) Folktale (Narrative) 7) argumentative text on 'smoking', 8) Invitation, 9) business letter (order good).

Meanwhile, the test has six *short dialogue* texts related to speech acts such as greeting, self-introduction, and turn-taking. Three *open-ended questions* are also constructed to test students' writing skills. The test items are classified in the following table.

Table 1: Reading Text (Monologue) Tasks

No	Theme	Item number of test					Total item
1	Short message	1	2	3	4		4
2	Self Introduction (introduce name, address, age, hobby)	8	9	10	11	12	5
3	Recount Text 1 (personal experience)	16	17	18	19	20	5
4	Recount Text 2	36	37	38			3
5	Announcement	25	26	27			3
6	Narrative (tale)	28	29	30			3
7	Argumentative text on " smoking"	31	32	33			3
8	Invitation	34	35				2
9	Business letter (order good)	39	40				2
Total Items							30

Table 2: Short Dialogue Text Tasks

No	Theme	Item number of test				Total item
1	**Greetings** Focus on opening and closing and the meaning of the phrasal expression (language function)	5	6	7		3
2	**Greeting (introducing others)**: language function, meaning, comprehension.	13	14	15		3
3	**Turn-taking** (matching)	21	22	23	24	4

Table 3: Open-Ended Question (Essay) Tasks

No	Theme	Item	Total
1	Self-description, Story genre, Describe school, and friends	1-3	3

3.3 Data Collection

In collecting the data, we used checklists as a rubric that was compiled according to the theory of authentic tests proposed by Bachman and Palmer (1996), and adjusted to the test specifications of the EFL summative test of the Senior High School of West Seram, Indonesia. The checklist or rubric was constructed to assess the authenticity of the test task,

consisting of 1) the contextualization (setting), 2) thematic organization (structure of communicative event), 3) the natural language use (input), and 4) interesting and enjoyable topics and situations (Expected response). These components of authenticity are employed to match the test items and ensure whether or not the items are suitable for authenticity. Table 4 is an example of the checklist used. It has four columns, the first for the test items, and the second for the element authenticity and description. The third and fourth columns were for the level of authenticity (Yes or No) utilized to match the component of authenticity.

Table 4: Sample of Checklist of the Test Task Framework

Test Items	**Theme task authenticity**	**Simplification**	**Authenticity level (Yes/No)**
Test Item 1	**Are items as contextualized as possible rather than isolated?** *(Setting)*	Contextual Items	**-**
	Is some thematic organization provided, such as through a storyline or episode? *(Structure of communicative events)*	Thematic Organization	**-**
	Is the language in the test as natural as possible? *(Input)*	Natural Language	**-**
	Are topics and situations interesting, enjoyable, and/or humorous? *(Expected response)*	Interesting topic	**-**

(Source: Adjusted from Bachman and Palmer 1996; Brown and Abeywickrama, 2018)

3.4 Data Analysis

As shown in checklist Table 4, it is utilized to check the content authenticity of the test items following task characteristics. To simplify the computation, the criteria for each element found in the test items were given “Yes/No” which was interpreted as (Yes: 2 which means high authentic & No: 1 which means low). This is enough to assess whether the items were authentic enough (Bachman & Palmer, 1990, 1991; Purpura & Kunan, 2024). This is also a common and frequent scoring and rating used in research, especially for data calculation and interpretation (Krippendorff, 2018) to quantify and capture the overall authenticity level of each item in a quantifiable way, making it easier to determine whether the item generally reflects authentic use. All the scoring data were then calculated using descriptive statistics manually to summarize and organize the data's characteristics by looking at measures like frequency and percentage (Bland, 2015). The analysis results were shown in tables and percentages, followed by explanations. The following table is the analysis example.

Table 5: Sample of Analysis

Components	Description	Low Authentic (1)	High Authentic (2)
Setting	Are items as contextualized as possible rather than isolated?	1	2
Structure of communicative event	Is some thematic organization provided, such as through a storyline or episode?	1	2
Input/Feature of context	Is the language in the test as natural as possible?	1	2
Expected Response	Are topics and situations interesting, enjoyable, and/or humorous?	1	2
Total Score		4 (Low)	8 (High)

As shown in Table 5, there are four criteria employed to measure authentic test tasks. Each criterion was given a score, 1 for low and 2 for high (Bachman & Palmer, 1990, 1991; Purpura & Kunan, 2024). All scores were analyzed using descriptive statistical analysis to summarize characteristics of a data set by using measures of frequency and percent (Bland M., 2015). To reach the level of authenticity in the form of a percentage, the researcher put the range category as follows: *4-6 is Low authentic and 7-8 is High authentic.* The data analysis process starts by examining each item in the test tasks using the given scoring criteria (See Table 5). After analyzing all the items, the researcher calculates the authentic results based on three task categories: *reading text, short dialogue text,* and *open-ended questions.* The calculation process involves counting the number of tasks that fall within a specified score range and then classifying how many tasks are high and how many are low. Then, the results of the analysis were presented in the form of tables, descriptions, and percentages.

4. Result and Discussion

4.1 Result

This section provides the information to answer the following research questions: How authentic is the construction of the test task found in the EFL summative test? The authenticity of a test item can be measured using the task authenticity framework by Bachman and Palmer (1996); and Brown and Abeywickrama, (2018). The detailed analysis of task authenticity within the EFL summative test reveals varying levels of authenticity across different themes. Each task was evaluated based on four elements of authenticity: *Setting (Contextualization), Structure of Communicative Events (Thematic Organization), Input (Natural Language),* and *Expected Response (Interesting Topic).* The analysis of the data is presented in the following descriptive statistic tables.

4.1.1 Reading Text (Monologue) Task

The analysis of task authenticity within Reading text items shows that the nine themes or tasks in this text reveal varying levels of authenticity.

Table 6: Result of Reading Text Findings

No	Theme	Authenticity Level (Overall Average)
1	Short message	**6.5** (Low)
2	Self Introduction (introduce name, address, age, hobby)	**5.8** (Low)
3	Recount Text 1 (personal experience)	**8** (High)
4	Recount Text 2	**6.66** (High)
5	Announcement	**6.66** (High)
6	Narrative (tale)	**8** (High)
7	Argumentative text on " smoking"	**6.66** (High)
8	Invitation	**8** (High)
9	Business letter (order good)	**6** (High)
N=9 Tasks		78 % High Authentic (7 Tasks)
		22 % Low Authentic) (2 Tasks)

As shown in Table 6, out of nine reading text tasks, seven (78%) were rated as highly authentic. These included tasks based on *recount texts, narrative texts, argumentative texts, announcements, invitations,* and *business letters*. Such tasks scored high in authenticity because they incorporated real-world language use and were contextually relevant. However, two tasks, *short message,* and *self-introduction,* were rated as low in authenticity (23%), indicating areas where the test content may not fully align with real-life language scenarios.

In terms of *recount text,* this theme consists of recount text 1 on personal experience (five items, each achieving a perfect score of 8, indicating high authenticity), and recount text 2 (three items achieving a score of 6.66, indicating moderate to high authenticity). The tasks in Recount 1 are well-c*ontextualized*, with a clear *thematic organization* and use of *natural language*, reflecting real-life personal experiences. In Recount 2, two (items 36 & 37) out of three, scored high (8/High), showing effective *contextualization* and *natural language* use. However, item 38 scored low (4/Low), suggesting a lack of *thematic structure* and *natural language* use. The average score for this theme is 6.66, indicating a moderate to high level of authenticity. In the *Narrative Text,* all three tasks in this theme received high scores (8/High) across all elements, showing strong contextual relevance, interesting topics, and natural

language. In Argumentative Text, two items (31 and 32) scored high (8/High), demonstrating thematic organization and natural language suitable for argumentative discourse. However, item 33 scored low (4/Low), lacking thematic relevance and natural language. The average score is 6.66, indicating moderate authenticity. Concerning, Announcement text Items, this theme includes three tasks, with two items (25 and 26) rated as highly authentic (8/High). They are contextualized and align with the thematic structure of real-world announcements. Item 27, however, scored low (4/Low), due to less natural language and less interesting content. The average score of 6.66 indicates moderate authenticity. In relation to Invitation Text, both items in this theme received high authenticity scores (8/High), suggesting effective contextualization, thematic structure, and engaging content that reflects real-world invitation contexts. The average score is 8, showing a high level of authenticity. In Business Text, the two tasks in this theme show contrasting results. Item 39 received a high authenticity score (8/High), reflecting appropriate contextualization and natural language typical of business communication. However, item 40 scored low (4/Low), due to limited thematic organization and lack of natural language. The average score is 6, indicating a moderate level of authenticity.

Meanwhile, in *short massage text*, two items (1 and 2) received the maximum score of 8, indicating high authenticity, as they provide contextualized scenarios, thematic structure, natural language, and interesting content. However, items 3 and 4 scored lower (5/Low) due to lacking *natural language* and *thematic organization* consistency. The average score across these items is 6.5, suggesting a moderate level of authenticity for this theme. In Self-Introduction, the five items on self-introduction vary in authenticity, with three items (9, 10, & 12) achieving a high authenticity score of 7. These items use *natural language* and *interesting and relatable topics* for students. However, items 8 and 11 scored lower (4/Low), indicating limited *contextualization and thematic connection*. The overall average for this theme is 5.8, highlighting a generally low to moderate authenticity level.

4.1.2. Short Dialogue Text

Table 7: Result of Short Dialogue Text Findings

No	Theme	Authenticity Level
1	**Greetings** Focus on opening and closing and the meaning of the phrasal expression (language function)	7.33 (High)
2	**Greeting (introducing others)**: language function, meaning, comprehension.	8 (High)
3	**Turn-taking** (matching)	5 (Low)
N= 3 Tasks		66 % High Authentic (2 Tasks)
		33 % Low Authentic (1 Task)

As shown in Table 7, among the three short dialogue tasks, two (66%) were rated as highly authentic, specifically, those *focused on greetings* and *introducing others*, which align well with everyday conversational situations. The *"Turn-taking"* task, however, received a lower

authenticity score (33%), suggesting it may lack situational relevance or sufficient interactional context to reflect real-world communication.

For the *Greeting text items*, three items were assessed. Items 5 and 6 achieved high scores across all four elements, each receiving a score of 8, indicating strong contextualization, clear thematic structure, use of natural language, and engaging topics. These items were well-designed to simulate real-life greeting scenarios, allowing students to experience relevant language use. Item 7 also achieved a high authenticity score of 6, though it scored slightly lower in *input (natural language)* and *expected response*, suggesting that while it was contextually appropriate, it lacked the full *natural language* flow seen in real conversations. Overall, the greeting tasks have an average authenticity score of 7.33, indicating that this theme successfully incorporates realistic language use and context, making it one of the stronger areas of authenticity in the dialogue section. In the *Short Dialogue of Self-Introduction tasks*, all three items (13, 14, & 15) received the maximum score of 8, reflecting high authenticity across all elements. These items effectively use *natural language*, t*hematic organization,* and *contextual settings* that mimic real-life self-introduction situations.

The *Turn-Taking* tasks display a wider range of scores, with mixed results across the four items. Item 21 achieved a high score of 8, showing strong contextualization and natural language, as it closely reflects real-life conversation exchanges where turn-taking is essential. However, the remaining items (22, 23, & 24) scored low (each receiving a score of 4), indicating weaknesses in thematic organization and natural language. These items lack the dynamic and interactive language elements typical of natural turn-taking conversations, which may make them feel less authentic and disconnected from real-world dialogue. This theme has an average score of 5, suggesting limited authenticity in capturing the essence of turn-taking, as the tasks may feel more mechanical and less engaging for students.

4.1.3 Open Ended-Questions (Essay)

Table 8: Result of Open-Ended Question Findings

No	Theme	Authenticity Level
1	Self-description, Story genre, Describe school, and friends	8 (High)
N=1		100 % High Authentic

As shown in Table 8, this section contained a single task focused on self-description, story genre, and descriptions of school and friends. It received a high authenticity rating, as it aligns well with students' personal experiences and allows for expressive language use relevant to real-world contexts. This section includes three items (1, 2, and 3), each receiving a very high score of 8, indicating that these test items are highly authentic in reflecting real-world contexts. Items 1, 2, and 3 show strengths across all four elements. The high score in *Setting (Contextual Items)* indicates that these questions are highly relevant to real-life situations, creating a realistic context for the test takers. The score of 2 for *Structure of Communicative Events* for each item reflects that the thematic organization of the questions is clear and logical, creating an easy-to-follow communication pathway. In terms of *Input (Natural Language),* all three items use natural and easily understandable language, consistent with how people communicate in everyday life. Finally, the high score in *Expected Response (Interesting Topic)* suggests that the topics presented in these items are engaging, encouraging test takers to provide thoughtful and relevant responses. An average score of 8/High (100%), indicates that the authenticity level of these test tasks is very high.

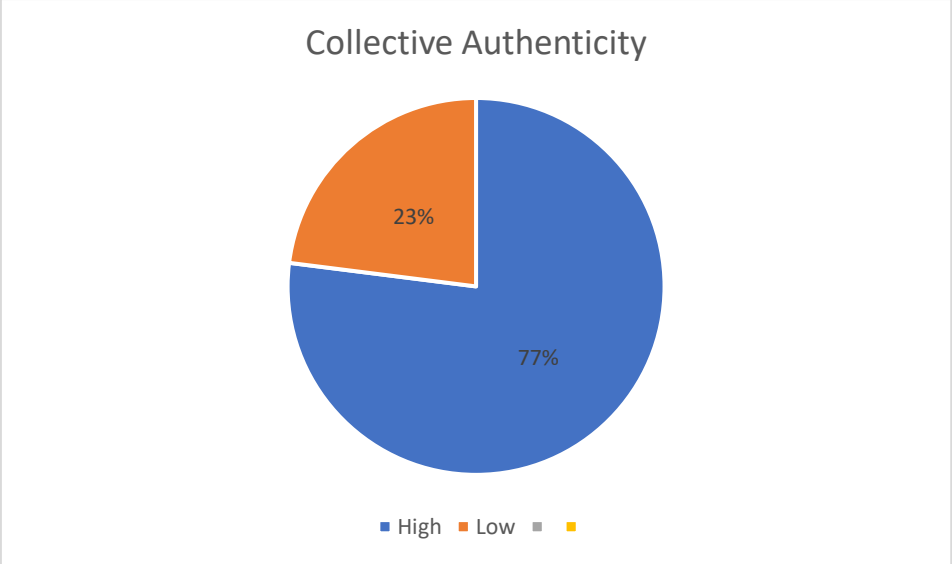


Figure 2: Collective Authenticity

Collectively, 10 tasks out of 13 tasks (77%) were at the level of high authenticity, while only 3 tasks (23%) were at the level of low authenticity.

4.2 Discussion

Based on the findings of this study on the authenticity of English summative test items at a Senior High School in West Seram, Maluku, Indonesia, the majority of test items exhibit a high level of authenticity. Approximately 77% of the test items received high authenticity scores, suggesting they align well with real-world language use contexts and meet the criteria of contextual relevance, thematic organization, natural language use, and engaging content. However, 23% of the test tasks still exhibit low authenticity, indicating areas for improvement in test design.

Most of the highly authentic tasks align positively with authenticity principles outlined by Bachman and Palmer (1996) and Brown and Abeywickrama (2018), who emphasize that language tests should closely replicate real communication situations (Liu, 2005). For example, tasks like "Self-introduction" and "Narrative" resonate with real-life scenarios where students introduce themselves or recount personal experiences, fulfilling both situational and interactional authenticity. Open-ended tasks, such as self-description or descriptions of school and friends, received particularly high authenticity scores, reflecting their suitability for evaluating students' language abilities in practical contexts. These types of tasks not only assess language proficiency but also increase student motivation by allowing them to relate test content to their own lives. Hood (1984) in Joy (2011) have placed the importance of authentic text on language tests as they believe that the authentic language of the text is natural and hence can easily connect students to the real world.

However, certain tasks, particularly those involving isolated dialogues or contextually less relevant themes, did not meet high authenticity criteria. For instance, tasks that emphasize rote grammar or vocabulary without embedding these elements into a meaningful communicative framework fall short in terms of authenticity, making them less relevant and potentially less engaging for students. Additionally, tasks like "Turn-taking" in dialogue settings received lower authenticity scores, which may stem from a lack of situational context or thematic connection. To improve these, more natural conversational scenarios or

interactive elements reflecting real-life language dynamics could be incorporated, as Skehan (2003) suggests regarding task authenticity.

Given these findings, test designers are encouraged to review and refine tasks that fall short of authenticity standards, ensuring that each task replicates real-world language use as closely as possible. Emphasizing thematic continuity, contextually relevant input, and engaging topics can further enhance the test's usefulness. While authenticity is essential, balancing it with other factors such as reliability and practicality is also necessary, especially in the high-stakes context of summative assessments. Nevertheless, ensuring tasks are both meaningful and communicatively relevant can significantly enhance their pedagogical value, making the test more relatable and manageable for students (Brown & Abeywickrama, 2018).

These findings somewhat contradict students' statements from the preliminary study, where they expressed that the test topics and language were difficult to understand. This discrepancy suggests that students' literacy and vocabulary skills in English are still limited, which likely affects their ability to comprehend test materials effectively. Consequently, there is a need to enhance students' English vocabulary and reading comprehension skills to better prepare them for assessments and help bridge the gap between test content and students' understanding. Strengthening vocabulary acquisition and literacy skills will enable students to approach test items with greater confidence and improve their overall performance in language assessments.

5. Conclusion

The analysis revealed that the test included 13 tasks based on 9 short reading texts, 3 open-ended questions, and 2 short dialogue texts that had different social purposes such as short message, self-introduction, recount text, announcement, narrative, argumentative text, invitation, recount text of personal experience, business letter, greeting, and turn taking. Regarding task authenticity, 32 items out of 43 in all task components were classified as high authentic, and 11 items were low authentic. The overall analysis of all tasks showed that 77% were highly authentic, while 23% were low authentic. These findings imply that the authenticity of test questions needs to be enhanced by revising their design to be more contextual, using natural language, and reflecting real-life situations that students encounter. Teachers should also receive specialized training to design questions based on authenticity principles as Bachman and Palmer proposed (1996). This process should involve ongoing training for teachers and be part of professional development programs to ensure consistency in applying authenticity in schools. Collaboration with language assessment experts is also a strategic step to evaluate and refine test questions. This can be achieved by adopting a more systematic and evidence-based evaluation approach. Integrating authenticity into national standards can enhance the relevance and impact of learning outcomes.

This study identifies several limitations and offers practical suggestions to improve the test quality and relevance. This research focuses exclusively on a single high school in West Seram, Maluku, Indonesia, which means its findings may not be fully applicable to schools with varying social and cultural contexts. Additionally, data collection occurred over just one exam period, limiting understanding of how test authenticity may shift over time or adapt to changing educational objectives. To address these, future research should involve multiple exam periods to observe changes in authenticity, use standardized evaluation criteria to reduce scoring subjectivity, and apply advanced statistical methods for a more detailed analysis. Expanding test tasks to include realistic scenarios from students' daily lives would

also enhance authenticity, as would teacher training on assessment design aligned with authenticity frameworks like those by Bachman and Palmer. Regular evaluations and collaboration with language assessment experts can ensure tests reflect real-life language use, and literacy programs in vocabulary and reading comprehension could better prepare students to engage with authentic test content.

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Contact emails: hardyantohitimala@upi.edu
susisr@upi.edu

Development of Infographics on Mental Health and Nutrition to Promote Health and Wellness for Secondary School Students

Ailin Chen, Rajamangala University of Technology Thanyaburi, Thailand
Naruemon Thepnuan, Rajamangala University of Technology Thanyaburi, Thailand

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Abstract
The research objectives were to: 1) develop infographics on mental health and nutrition, 2) compare students' knowledge of infographics on mental health and nutrition, and 3) study the satisfaction of students who using infographics on mental health and nutrition. The sample of this study was 20 students in grade 8 of No. 28 Middle School in Zigong City. They were selected students convenient and appropriate from a class or group that is easily accessible and suitable for the study's objectives. The instruments consisted of infographics on mental health and nutrition, an evaluation form regarding the quality of media and contents, an achievement assessment, and a student satisfaction assessment form. Statistics used for data analysis were mean, standard deviation, and t-test for dependent samples. The results showed that: 1) the infographics on mental health and nutrition to promote health and wellness achieved quality in media at is good level with an average score of 4.43 and quality in content at is good level with an average score of 4.20, 2) the students who learned via the infographics had an average pre-test score of 38.25 points and an average and post-test score of 48.25 points, respectively, when comparing the pre-test and post-test scores, so that the post-test scores were higher than the pre-test scores with statistical significance level is .05, and 3) the students were satisfied with infographics was found to be at a highest level with the average score of 4.90.

Keywords: Infographics, Mental Health and Nutrition Promote Health and Wellness, Secondary School Students

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1. Introduction

1.1 Background and Statement of the Problem

Zigong No. 28 Middle School is a middle school. In order to further understand the health status of students and explore the application value of health information graph in students' health education, this study carried out relevant investigation and analysis.

In the context of the research, we can see that with the development of society and the change of lifestyle, students' health problems have attracted more and more attention (Zheng Qing, Shen Hejun, 2019). However, many students have health problems such as insufficient exercise, mental health issues and malnutrition that need to be improved. Therefore, it is of great significance to understand students' health status and make health infographics suitable for students.

In the sense of research, we can see that the investigation and analysis of students' health status, it can provide a scientific basis for schools to formulate targeted health education measures (Beijing 24th Middle School research group, 2018). At the same time, as a data visualization tool, health infographics can convey health information intuitively and succinctly, improve students' health awareness and health literacy, and play a positive role in promoting students' health development. Therefore, the theoretical analysis and empirical research of health information graphs also have certain research value.

To sum up, some research results have been accumulated on the development of health and health information graphs for middle school students. However, there is still a need for in-depth research and discussion on the factors affecting middle school students' health, behavior habits, and the relationship with family factors (Qi Wenjuan et al., 2017). Therefore, further research and exploration are necessary in order to better understand the health status of middle school students and propose effective health promotion measures and intervention strategies.

Through the investigation and analysis of the health status of the twenty-eighth Middle School students in Zigong City, as well as the theoretical analysis and empirical research on the health information graph, this study aims to provide scientific and reasonable health education measures and health information graphs suitable for students. Through effective data visualization transmission, improve students' health awareness and health literacy, and promote students' healthy development. At the same time, the research results and evaluation results will provide reference and guidance for school health education in the future, and contribute to the healthy growth of students.

Through the analysis of the survey results of the health status of the students of No. 28 Middle School in Zigong, we can see that the student's physical education status is generally poor, there are more mental health problems, and the nutritional status is not ideal. This requires schools and families to work together and take corresponding measures to improve the health of students. In terms of the interpretation of the results, we will conduct a detailed interpretation of the survey results and an in-depth analysis of the causes and influencing factors of students' health problems. In the aspect of problem analysis, the problems existing in the investigation are analyzed, and the corresponding improvement measures and suggestions are put forward to provide a reference for students' health education.

1.2 Research of Objectives

1) To develop infographics on mental health and nutrition to promote health and wellness for secondary school students to have quality.
2) To compare students' knowledge of infographics on mental health and nutrition to promote health and wellness for secondary school students.
3) To study the satisfaction of students who use infographics on mental health and nutrition to promote health and wellness for secondary school students.

1.3 Research Hypothesis

Students who use infographics on mental health and nutrition to promote health and wellness for secondary school students know significantly higher at 0.50.

1.4 Conceptual Framework

Independent Variable: Infographics on mental health and nutrition to promote health and wellness for secondary school students

Dependent Variables: 1) Students' knowledge of infographics on mental health and nutrition to promote health and wellness for secondary school students, and 2) Satisfaction of students who use infographics on mental health and nutrition to promote health and wellness for secondary school students.

2. Research of Methodology

The population of this study was 60 students of No. 28 Middle School in Zigong City.

The sample of this study is 20 students in grade 8 of No. 28 Middle School in Zigong City.

They were selected by means of a purposeful sampling method.

2.1 Research Design

The researcher used a quantitative approach in the experimental design to conduct this study. The data was collected in a quantitative or numerical form derived from the test, and the researcher used a one-group pretest-posttest design. This design included a pretest measure followed by a treatment and a posttest for a single group. An illustration of the design is as follows:

Group: O1 x O2
O1 = Measurement of the pretest score
X = Infographics for Promoting Health and Wellness
O2 = Measurement of the Knowledge and understanding of the post-test score

2.2 Research of Methodology

Step 1: the 28th Middle School students of Zigong City filled in the questionnaire and then sent the health chart through the official WeChat account to improve the student's health knowledge. Then, the questionnaire test was conducted on the students again. Finally, the results of the two tests were compared to conclude.

This section was a closed questionnaire based on a five (5) point Likert-type scale where participants were asked to rate the degree of agreement with each statement on a scale of 1-5. The interpretation of each number is described below:

5 = Excellent
4 = Good
3 = Moderate
2 = Sufficient
1 = Improvement

Table 1: Range of Mean and Verbal Interpretation for Assessment of Quality

Range Value	Verbal Interpretation
4.50-5.00	Excellent
3.50-4.49	Good
2.50-3.49	Moderate
1.50-2.49	Sufficient
1.00-1.49	Improvement

This part is an open-ended questionnaire. Participants were asked to express their opinions and suggestions by using the WeChat public account to improve the efficiency of the students of the 28th Middle School in Zigong City.

Step 2: Before attempting the assessment, three measurement and evaluation specialists working in the field of measurement and evaluation or medicine were asked to check the appropriateness of the language used in the questionnaire. The resulting data were used to calculate the project Objective Conformance Index (IOC). Measurement and evaluation experts' evaluation of the quality of the content of the project Objective Conformance Index found that the value of the project objective conformance index was... The evaluation results are then submitted to the content expert for further evaluation, and the media quality evaluation results of the project objective conformity Index are obtained by measuring and evaluating the evaluation expert finds the project objective conformity Index value is... The results are then presented to media experts for further evaluation. The evaluation criteria are used to check consistency between test objectives and projects, as follows:

Table 2: Value of Item Objective Congruence Index and Verbal Interpretation

+1	item is considered congruent with the objectives.
0	item is considered neutral in terms of whether it was congruent with the objectives.
-1	item is considered not congruent with the objectives.

The total mean score of the Item-Objective Congruence (IOC) Index is supposed to be higher than 0.5 for acceptable data.

Step 3: The assessment will be used by experts. In order to improve the efficiency of the use of content experts by the students of the 28th Middle School of Zigong City, the quality of the content of the health charts on the Wechat public account was evaluated, and the quality of the health charts on the Wechat public account was evaluated to improve the utilization rate of the health charts by the students of the 28th Middle School of Zigong City.

2.3 The Achievement Assessment (Pretest and Posttest)

Pre-test and post-test share the same items. Both contain 28 aspects related to physical condition, lifestyle habits, diet health, exercise frequency, emotional status, study pressure perception, and how they improve sleep quality on WeChat public accounts, a total of seven aspects. Students take a pre-test before using the health scale to learn health knowledge on the WeChat public account and take a post-test after learning. The researchers went through the following steps:

Step 1: The researcher chooses the type of test to study multiple choice, fill-in-the-blank, and short-answer tests.

Step 2: The questionnaire is formulated according to the middle school students' health scale, aiming to measure students' physical health and enhance students' learning of health knowledge.

Step 3: Three measurement and evaluation specialists working in the field of measurement and evaluation or medicine are asked to check for consistency between test subjects and items. The data obtained were used to calculate the project Objective Conformance Index.

The evaluation criteria are used to check the objectives and for acceptable data, the overall average score of the project Consistency of Objectives index should be higher than 0.5.

Step 4: Pre-test and post-test were conducted on 60 students in grade 8 of No. 28 Middle School of Zigong City, but they were not samples of this study. The fifth step: Through the health chart based on WeChat, conduct pre-test and post-test with the participants to explore their health knowledge before and after learning the health scale, to enhance the health level of middle school students.

Step 5: Through the health chart based on we chat, conduct pre-test and post-test with the participants to explore their health knowledge before and after learning the health scale, to enhance the health level of middle school students.

2.4 Data Collection

Step 1: Online Learning Guide

The study of health knowledge aims to enhance students' physical fitness and stimulate their interest in health knowledge. To this end, we specially designed a series of health information graph learning resources for 20 students from Class 5, Grade 8, based on WeChat public accounts. By following the WeChat public account, students can get the latest health chart update tips for the first time, so that they can study anytime and anywhere.

Step 2: Pre-Test Evaluation

These 20 students were given a pre-test before learning the health infographic. The purpose of the pre-test is to know the student's initial level of health knowledge, so as to carry out more targeted teaching in the future. The results of the pre-test will provide valuable data support to help optimize the teaching content and methods.

Step 3: Learning with health infographics for learning activities

Based on the WeChat public account platform, a series of health information graphs have been developed, covering various health knowledge that middle school students should

master. We organized 20 students from Class 5, Grade 8, to study health infographics for one month. By constantly viewing and interpreting these charts, students can understand health knowledge more intuitively and improve their learning results.

Step 4: Post-Test and data analysis

After completing a month of study, the 20 students were given a post-test. The purpose of the post-test is to assess whether students have improved their mastery of health knowledge after a period of study. The post-test results were statistically compared with the pre-test results, and the influence of health infographic learning on students' health knowledge was objectively evaluated by means of data analysis.

2.5 Data and Statistical Analysis

In this study, mean difference, standard deviation, and T-test were used for analysis.

1) Evaluate the use of health charts through WeChat public accounts, and improve the use efficiency of students by means of mean and standard deviation.
2) The performance test before and after learning is compared with health infographics, and the T-test dependence method is adopted to improve the use efficiency of students.
3) Study students' satisfaction with health infographics using mean and standard deviation to improve students' use efficiency.

3. Research Result

3.1 Results of Evaluation of Infographics on Mental Health and Nutrition to Promote Health and Wellness for Secondary School Students to Have a Quality

Table 3: The Infographics on Mental Health and Nutrition to Promote Health and Wellness For Secondary School Students to Have a Quality From Three Media Experts

Item	$\bar{X}$	SD.	Meaning
1. Are the facts, statistics and information in the infographic accurate and reliable? Are they supported by reliable sources and evidence-based research?	4.67	0.38	Excellent
2. Is the information presented in a clear and simple way? Is it easy to understand and explain, even for those without a background in mental health and nutrition?	4.33	0.47	Good
3. How visually appealing is the infographic? Does it use color, images, and graphics effectively to attract attention and convey information?	4.33	0.58	Good
4. Does the infographic provide a balanced presentation of mental health and nutrition information? Are the two themes equally representative?	4.67	0.38	Excellent
5. Is the infographic tailored to the target audience? Does it take into account the age, interests and background of the target audience?	4.33	0.47	Good
6. Are there any interactive elements or features in the infographic that engage the reader and enhance the learning experience?	4.00	0.82	Good

7. Does the infographic always maintain consistency of information and reinforce key messages and objectives?	4.33	0.47	Good
8.Are infographics accessible to people with different disabilities, such as the visually impaired? Are there other formats or amenities available?	4.00	0.82	Good
9. Does the infographic include a clear call to action or practical steps that readers can take to improve their mental health and nutrition?	4.67	0.38	Excellent
10. Are infographics original and creative and stand out from other similar media? Does it use unique design elements or innovative approaches to convey its message?	5.00	0.00	Excellent
Total	**4.43**	**0.42**	Good

From Table 3 the overall results of the health infographic quality are good, with an average score of 4.43.

Table 4: The Infographics on Mental Health and Nutrition to Promote Health and Wellness for Secondary School Students to Have Quality From Three Content Experts

Item	$\bar{X}$	SD.	Meaning
1. Is the content a comprehensive overview of mental health and nutrition, covering all aspects, theoretical and practical applications?	4.33	0.47	Good
2. Is the language clear and concise enough to understand the main ideas and arguments? Are complex terms or concepts explained?	4.67	0.38	Excellent
3. How does the content integrate the two themes of mental health and nutrition to show the interconnectedness and mutual influence between them?	4.00	0.00	Good
4. Does the content introduce any ideas, assumptions, or perspectives that contribute to the understanding of mental health and nutrition?	4.00	0.00	Good
5. Does the content provide practical strategies, recommendations, or examples that can be implemented in real-world Settings to improve mental health and nutrition?	4.67	0.38	Excellent
6. Is the content internally consistent, with no conflicting information or arguments? Does it consistently maintain a coherent narrative that ensures a smooth reading experience?	4.33	0.47	Good
7. How relevant and timely is the content in terms of current mental health and nutrition research, practice and recommendations?	3.67	0.38	Good
8. Does the content cover a broad range of topics related to mental health and nutrition, including different aspects, factors and strategies?	4.00	0.00	Good
9. Does the content have a logical flow and structure that is easy to follow and understand?	4.00	0.00	Good

10. Does the content present a balanced view, acknowledge different perspectives, and take into account the positive and negative aspects of mental health and nutrition?	4.33	0.58	Good
Total	**4.20**	**1.64**	**Good**

From Table 4 the overall results of the health infographic quality are good, with an average score of 4.20.

3.2 Results of Compare Students' Knowledge of Infographics on Mental Health and Nutrition to Promote Health and Wellness for Secondary School Students

Table 5: Compare Students' Knowledge of Infographics on Mental Health and Nutrition to Promote Health and Wellness for Secondary School Students

Items	n	$\bar{X}$	SD.	t-test	Sig. (2-tailed)
Pre-test	20	38.25	6.13	6.402	.000
Post-test	20	48.25	3.35		

**p< .05

From Table 5 the average scores of the students in the pre-test and post-test were 38.25 and 48.25 respectively. Compared with the scores of the pre-test and post-test, it is found that the post-test scores are higher than the pre-test scores, and the statistical significance level is .05.

3.3 Results of Study the Satisfaction of Students Who Using Infographics on Mental Health and Nutrition to Promote Health and Wellness for Secondary School Students

Table 6: The Satisfaction of Students Who Using Infographics on Mental Health and Nutrition to Promote Health and Wellness for Secondary School Students

Option	$\bar{X}$	SD.	Meaning
1.You are satisfied with the overall content of the health infographic.	4.90	0.31	Highest
2. The clarity and comprehensibility of information in health infographics are high.	4.90	0.31	Highest
3. Health infographics offer practical tips for improving mental health.	4.85	0.37	Highest
4. The health information map provides useful nutritional information for health promotion.	5.00	0.00	Highest
5. Health infographics make you aware of new or different ways to incorporate healthy eating into your daily life.	4.80	0.41	Highest
6. The colors, fonts, and designs in the health infographic appeal to you.	4.95	0.22	Highest
7. The data content of the health infographic is accurate and easy to understand.	4.90	0.31	Highest
8. Health infographics feature trendy and interesting health topics.	4.90	0.31	Highest
9. After using the health infographic, you feel more knowledgeable about your health.	4.90	0.31	Highest

10. You will be happy to share this health infographic with your friends and family.	4.95	0.22	Highest
	4.90	**0.94**	Highest

From Table 6 it was found that the students are overall satisfied with infographics on mental health and nutrition to promote health and wellness at the highest level with an average score of 4.90.

4. Conclusion and Discussion

4.1 Conclusion

1) Quality of Infographics: The infographics on mental health and nutrition were rated highly by both media and content experts, scoring well on design, originality, and clarity. Media experts rated the quality as good (4.43), with creativity at an excellent level (5.00), while content experts emphasized practical application and comprehensive content integration, giving an overall score of 4.20.

2) Compare students' knowledge: Student knowledge significantly improved, with post-test scores rising from 38.25 to 48.25, showing the effectiveness of the infographics in enhancing students' understanding of mental health and nutrition topics.

3) Student Satisfaction: Students expressed very high satisfaction with the infographics, particularly for their visual appeal (4.95) and usefulness of nutritional information (5.00). Overall satisfaction was rated at 4.90, indicating that the infographics were engaging, informative, and easy to understand.

4.2 Discussion

1) Quality and Design of Infographics: Health and nutrition infographics for secondary students were rated highly for quality (average 4.43) and originality (5.00). This aligns with Zhang Yimian and Wan Xuan's (2021) study, which emphasizes the importance of unique design elements and innovative methods for effective health education communication.

2) Effectiveness in Knowledge Enhancement: Post-test scores showed a statistically significant improvement over pre-test scores, demonstrating the infographic's role in enhancing students' learning efficiency and engagement. This finding is consistent with Tang Ruohan et al. (2021) and LAN Yun's (2021) research on the expansive application of infographics in visual communication, showing that well-designed visuals promote learning and retention.

3) Student Satisfaction and Engagement: Overall student satisfaction was very high (average 4.90), with particular praise for visual appeal (4.95) and practical nutrition information (5.00). This supports Zeng Yi et al.'s (2023) findings that flexible, visually engaging health information charts improve comprehension, critical thinking, and user satisfaction, encouraging positive health behaviors.

5. Recommendation

5.1. Recommendations From the Research Results

1) Due to the small number of students participating in learning health infographics and the short learning cycle, the depth and breadth of the data collected by us may be restricted to some extent, affecting the quality and quantity of data.

2) The content of the health infographic is slightly thin, the collected data information is not rich enough, and the scope of the survey is relatively narrow.

3) Due to the limitations of personal ability and experience, the health infographic currently designed still needs to be further refined and improved. At the same time, there are still many shortcomings in the content of the developed health infographic, which need to be deeply analyzed and improved to improve the quality and practicability of the graph.

5.2 Suggestions for Future Research

1) Expand the sample range for evaluating health infographics by including diverse groups in online learning studies. Feedback from learners, health experts, and educators will be used to refine infographic designs.

2) Continuously revise infographic content based on user feedback, aiming to improve learning outcomes and information delivery efficiency.

3) Regularly update infographic content in line with the latest health industry developments, using advanced information technology to align school health education with current industry needs.

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Contact emails: ai-lin_c@mail.rmutt.ac.th
naruemon_t@rmutt.ac.th

Effects of Perceived Teachers' Autonomy Support on Motivation of Japanese Undergraduate With Mild Difficulties in Learning

Ryo Okada, Kagawa University, Japan

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Abstract
Research has suggested that students' motivation plays a critical role in achieving educational success. However, some students struggle to maintain their motivation for various reasons. Motivational research has revealed the effects of teachers' autonomy support on students' learning. This study examined the effect of perceived teachers' autonomy support on academic motivation among university students with and without mild difficulties in learning. The participants were 201 Japanese undergraduate students, all of whom were freshmen. The hypothetical model posited that perceived teachers' autonomy support is positively associated with students' intrinsic motivation and metacognition, which, in turn, is positively associated with their self-evaluated achievement. Based on self-rated scores of difficulties in academic learning, two groups were created: students with and without mild difficulties. A multi-group structural equation modeling analysis revealed that perceived teachers' autonomy support had a larger effect on intrinsic motivation in students with mild difficulties. The effect of autonomy support on metacognition did not differ between the two groups. Intrinsic motivation was associated with self-evaluated achievement in students without difficulties, whereas metacognition was associated with self-evaluated achievement in students with mild difficulties. The findings demonstrated teachers' role in supporting struggling learners in higher education. Teachers' autonomy support can promote intrinsic motivation and metacognition in students with mild difficulties in learning.

Keywords: Autonomy Support, Motivation, Mild Difficulties in Learning, Undergraduates

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Introduction

University-level learning requires a high level of motivation. Students are expected to be self-motivated in their academic learning and manage their own learning activities. Additionally, students' motivation affects their educational success. Students' motivation plays a significant role in determining their educational outcomes (e.g., Robbins et al., 2004). However, some students struggle to maintain their motivation for various reasons. Therefore, it is essential for higher education teachers to support diverse students' motivation.

Autonomy support is a type of interpersonal context that fosters intrinsic motivation and encourages people to make their own choices (Deci & Ryan, 1987). According to Black and Deci (2000), autonomy support means that an individual in a position of authority (e.g., an instructor) takes the other's (e.g., a student's) perspective, acknowledges the other's feelings, and provides the other with pertinent information and opportunities for choice, while minimizing the use of pressure and demand. Reeve et al. (2022) identified the following seven aspects of autonomy-supportive teaching in classroom: (a) taking the students' perspective, (b) inviting students to pursue their personal interests, (c) presenting learning activities in need-satisfying ways, (d) providing explanatory rationales, (e) acknowledging and accepting negative feelings, (f) relying on invitational language, and (g) displaying patience. Teachers can motivate students to learn by autonomy supportive teaching.

Several studies have verified the effects of teachers' autonomy support in the context of higher education. Teachers can conduct lectures in a manner supporting students' autonomy, which, in turn, motivates undergraduate students to engage in academic learning. Okada (2023) examined the effects of teachers' autonomy support on undergraduate students' educational gains through a meta-analysis. As teachers' autonomy support has primarily been measured in terms of students' perceptions (e.g., Filak & Sheldon, 2008; Levesque et al., 2004), the effect sizes yielded by perceived autonomy support were integrated into the meta-analysis. The findings revealed that perceived autonomy support was positively related to academic performance (r=.18) and intrinsic motivation (r=.41). Furthermore, teachers' autonomy support leads to self-efficacy (Overall et al., 2011), metacognitive activities (Okada, 2021), collaborative learning (Summers et al., 2009), and self-regulated learning (Miao & Ma, 2023). This suggests that teachers' autonomy support affects undergraduate students' academic success.

Some students struggle with academic learning for several reasons. One reason is learning difficulties or related characteristics. The Japan Student Services Organization (2023) reported that 254 undergraduates had specific learning disabilities. Although this number is very small compared with the overall student population, it is increasing annually. Additionally, some university students exhibit difficulties studying even though they have not been formally diagnosed. Some studies have reported that the percentage of undergraduates who have difficulties with learning (e.g., reading and writing) ranges from 10% to 16% (Itoi & Hanazuka, 2017; Matsuyama, 2022). Research addressing the relationship between learning difficulties and academic motivation (e.g., Deci & Chandler, 1986; Louick & Muenks, 2022) has found that some students face difficulties in sustaining motivation.

The effects of autonomy support on motivation have been verified in samples of general undergraduate students. By contrast, few studies have focused on undergraduate students who struggle or have difficulties with academic learning. Teachers' autonomy support can promote the motivation of struggling students in secondary education (e.g., Deci et al., 1992;

Patrizia et al., 2018). However, how teachers' autonomy support affects undergraduate students with mild academic difficulties has not yet been confirmed.

Therefore, this study examined the effects of perceived teachers' autonomy support on the academic outcomes of undergraduate students with mild difficulties in academic learning. It focused on students' intrinsic motivation and metacognition when examining the effects of teachers' autonomy support. Following Okada (2021), a model was hypothesized wherein teachers' autonomy support leads to self-evaluated achievement, mediated by intrinsic motivation and metacognition. This model was tested on a sample of undergraduate students with and without mild academic difficulties.

Method

Participants

The participants were 201 Japanese university students. All participants were freshmen.

Procedures

A questionnaire survey was administered using Microsoft Forms. All the participants were volunteers. The students were informed about the survey during a lesson. The aim, content, and anonymity of the participants were explained. Additionally, they were informed that their participation and the survey outcome would not affect their course grades. Students who agreed to participate accessed the page and filled out a web-based questionnaire. After completing the survey, participants were given quick feedback on the results during another lesson. By the time the survey was conducted in June, the students had experienced learning at university for approximately two months.

Measures

Target Lessons.

First, the participants were asked to select a lesson for evaluation. They were given the following instruction: "Remember the most impressive lesson you attended this week." As varied responses from the participants would best allow an examination of the effects of perceived teachers' autonomy support, the "most impressive lesson" was decided upon so that students could recall both positive and negative impressions, and rate them unequivocally. For ease of selection, lesson categories (e.g., language course, liberal arts course, etc.) were presented as options. These procedures followed Okada (2021).

Perceived Teachers' Autonomy Support.

Participants were asked to rate the teacher's autonomy-supportive behavior in the selected lesson. Okada's (2021) five items were used and were slightly modified to match the lesson in this study (e.g., "Teacher tries to listen to the opinions of each student," "Teacher tries to listen to how students feel and think," and "Teacher tries to make students think by giving quizzes and asking questions."). Each item was rated on a 5-point Likert scale ranging from 1 (*not true*) to 5 (*true*). Confirmatory factor analysis (CFA) was conducted to examine the one-factor structure. CFA using the maximum-likelihood method resulted in an acceptable fit as a whole: $\chi^2(5)=17.06$ ($p=.004$), CFI=0.95, RMSEA=0.11, and SRMR=0.05. The estimated

reliability coefficient (alpha coefficient) was .77. The RMSEA value was not acceptable; however, because the other fit indices and the alpha coefficient reached acceptable levels, the one-factor model was adopted. The descriptive score was calculated by averaging the scores of the five items.

Intrinsic Motivation.

Intrinsic motivation for the selected lesson was measured using Okada's (2021) intrinsic motivation scale. Four items were used (e.g., "I enjoy the lesson" and "I am interested in the content of the lesson"). Each item was rated on a 5-point Likert scale ranging from 1 (*not true*) to 5 (*true*). CFA was conducted using the maximum-likelihood method. The fit indices indicated an acceptable fit as a whole: $\chi^2(2)=39.95$ ($p<.001$), CFI=0.91, RMSEA=0.31, and SRMR=0.06. The alpha coefficient was .87. The RMSEA value was not acceptable; however, because the other fit indices and the alpha coefficient reached acceptable levels, the one-factor model was adopted. The descriptive score was calculated by averaging the scores of four items.

Metacognition.

Metacognition during the selected lesson was measured using Okada's (2021) metacognition scale. This scale measures metacognition at the beginning, during, and at the end of the selected lessons. Sample items include, "I try to remember what I learned last lesson (beginning of lessons)," "I try to think backward when I cannot understand something (during lessons)," and "I try to confirm the new things I learned in today's lesson (end of lessons)." Each item was rated on a 5-point Likert scale ranging from 1 (*not true*) to 5 (*true*). CFA using the maximum-likelihood method was conducted to confirm a three-factor structure corresponding to the three phases of the lesson. The fit indices reached a sufficient level: $\chi^2(24)=96.67$ ($p<.001$), CFI=0.89, RMSEA=0.12, and SRMR=0.08. Although the fit indices were low, they were acceptable overall. Thus, the three-factor model was adopted. Interfactor correlations ranged from .61 to .85. The descriptive scores of three subscales were calculated by averaging the scores of the three items (alpha coefficients ranged from .65 to .77).

Self-Evaluated Achievement.

Participants were asked to evaluate their level of achievement during the lesson (Okada, 2021) using two items: "I understood the content of the lesson" and "I'll be able to attain a high grade on this lesson." Each item was rated on a 5-point Likert scale ranging from 1 (*not true*) to 5 (*true*). The Spearman-Brown reliability coefficient was .78. The descriptive score was calculated by averaging the scores of the two items.

Difficulties in Learning.

Students' difficulties in learning were measured using four items proposed by Sato et al. (2012): "I make typos and omissions," "I misread letters and sentences," "I can't take notes while listening to a lecture," and "I find it difficult to write a report that includes my own opinions." Participants were instructed to think about academic learning in general and rate each item on a 4-point Likert scale ranging from 1 (*never*) to 4 (*often*). CFA was conducted using the maximum-likelihood method. The fit indices indicated an acceptable fit as a whole: $\chi^2(2)=18.41$ ($p<.001$), CFI=0.94, RMSEA=0.20, and SRMR=0.07. The alpha coefficient was

.77. The RMSEA value was not acceptable; however, because the other fit indices and the alpha coefficient reached acceptable levels, the one-factor model was adopted. The descriptive score was calculated by averaging the scores of the four items.

Analytic Procedures

A model showing the relationship between perceived teachers' autonomy support and self-evaluated achievement, mediated by intrinsic motivation and metacognition, was tested using multi-group structural equation modeling (SEM; Figure 1). Scale scores were used in the model, which was examined in students with and without mild difficulties in learning. Students who obtained scores higher than the mean + 1 *SD* (e.g., 2.95) in difficulties in learning were referred to as the difficulties group (*N*=31). The remaining students were referred to as the non-difficulties group (*N*=170). First, a model with no equality constraints on all paths and covariances was tested (Model 1). Next, a model with equality constraints on all paths and covariances was tested (Model 2). The analysis was conducted using the *lavaan* package in R version 4.3.3.

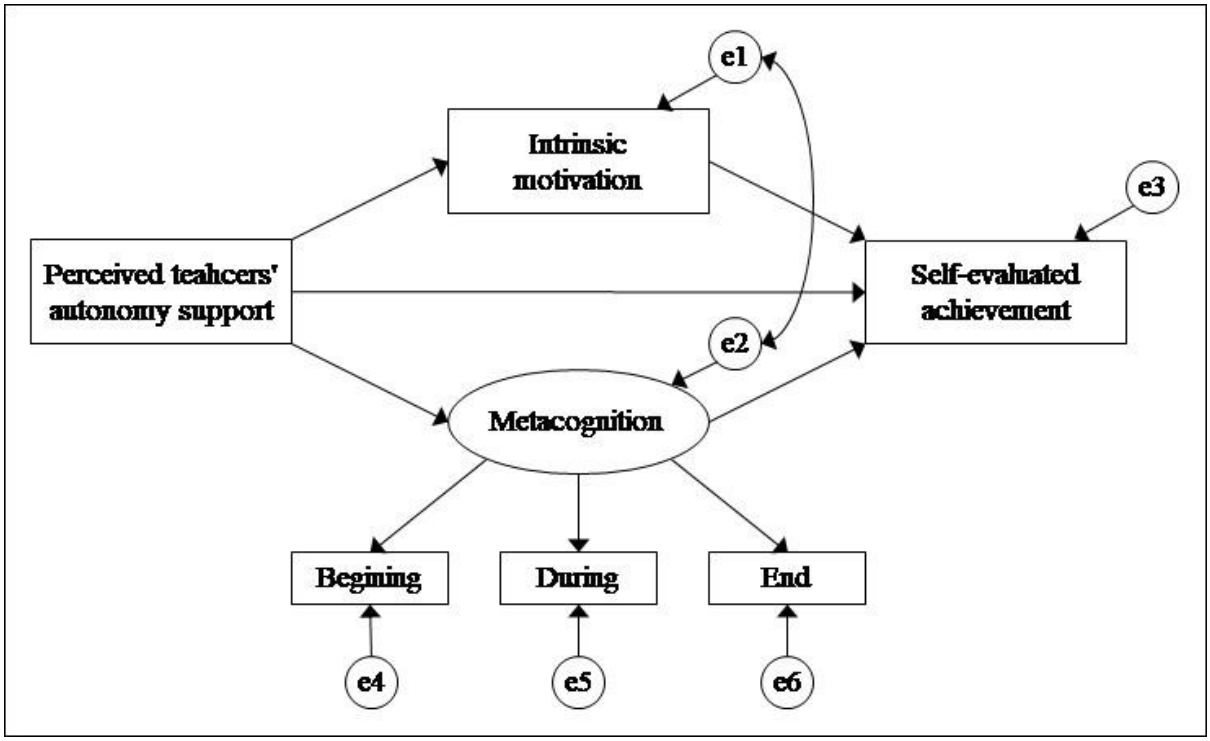

Figure 1: Hypothetical Model

Results

Frequencies of Difficulties in Learning

The frequencies and percentages of each response indicating difficulties in learning are presented in Table 1. The percentages of participants who answered "often" were 6.97% for "I make typos and omissions," 7.96% for "I misread letters and sentences," 3.98% for "I can't take notes while listening to a lecture," and 18.91% for "I find it difficult to write a report that includes my own opinions."

Table 1: Frequencies of Each Response Category in Difficulties in Learning

	Never	Rarely	Sometimes	Often
I make typos and omissions	44 (21.89)	73 (36.32)	70 (34.83)	14 (6.97)
I misread letters and sentences	40 (19.90)	79 (39.30)	66 (32.84)	16 (7.96)
I can't take notes while listening to a lecture	74 (36.82)	79 (39.30)	40 (19.90)	8 (3.98)
I find it difficult to write a report that includes my own opinions	38 (18.91)	48 (23.88)	77 (38.31)	38 (18.91)

Note. The values in brackets are percentages of categories.

Descriptive Statistics and Correlations Among Variables

Descriptive statistics and correlations between variables are presented in Table 2. Perceived teachers' autonomy support was positively related to intrinsic motivation (r=.31, p<.001), metacognition (rs=.26 to .31, ps<.001), and self-evaluated achievement (r=.35, p<.001). Additionally, intrinsic motivation (r = .51, p < .001) and metacognition (rs=.20 to .34, ps<.01) were positively related to self-evaluated achievement. Difficulties in learning was not significantly related to any variable (rs=−.07 to .07, ps=.31 to .78) except self-evaluated achievement (r=−.18, p=.01).

Table 2: Descriptive Statistics and Correlation Coefficients

	Mean	*SD*	1	2	3	4	5	6
1. Perceived teachers' autonomy support	3.60	0.83						
2. Intrinsic motivation	3.75	0.94	.31***					
3. Metacognition-beginning of lessons	3.20	0.95	.26***	.28***				
4. Metacognition-during lessons	3.59	0.84	.27***	.22**	.54***			
5. Metacognition-end of lessons	3.18	0.99	.31***	.34***	.64***	.51***		
6. Self-evaluated achievement	3.54	0.90	.35***	.51**	.26***	.20**	.34***	
7. Difficulties in learning	2.26	0.69	.07	−.07	−.06	.02	−.05	−.18*

Note. * p < .05, ** p < .01, *** p < .001.

Effects of Perceived Teachers' Autonomy Support

The model that showed the relationship between perceived teachers' autonomy support and self-evaluated achievement, mediated by intrinsic motivation and metacognition, was tested using SEM. To examine the effects of teachers' autonomy support between the difficulties and non-difficulties groups, a multi-group SEM was adopted. Models with no equality constraints (Model 1) and with equality constraints (Model 2) were tested.

The fit indices were compared between Models 1 and 2. AIC was lower in Model 1 (2920.12) than in Model 2 (2923.23). Conversely, BIC was lower in Model 2 (3035.54) than in Model 1

(3058.86). The difference in chi-square values between the models was significant ($\Delta\chi^2$=19.11, *df*=8, *p*=.01), suggesting that Model 1 exhibits a better fit than Model 2. Therefore, Model 1, with no equality constraints, was adopted. The other fit indices of Model 1 showed adequate values: CFI=1.00, RMSEA=0.00, and SRMR=0.03.

The results of multi-group SEM are presented in Table 3. The paths from perceived teachers' autonomy support to intrinsic motivation were significant for both groups (difficulties group: *B*=0.62, *p*<.001, 95% CI [0.25, 0.99]; non-difficulties group: *B*=0.32, *p*<.001, 95% CI [0.16, 0.48]). The paths from teachers' autonomy support to metacognition were significant for both groups (difficulties group: *B*=0.35, *p*=.03, 95% CI [0.04, 0.65]; non-difficulties group: *B*=0.33, *p*<.001, 95% CI [0.18, 0.48]). Regarding self-evaluated achievement, the paths from perceived teachers' autonomy support (*B*=0.51, *p*=.002, 95% CI [0.18, 0.85]) and metacognition (*B*=0.51, *p*=.003, 95% CI [0.24, 1.14]) were significant in the difficulties group. Conversely, the paths from perceived teachers' autonomy support (*B*=0.16, *p*=.03, 95% CI [0.02, 0.31]) and intrinsic motivation (*B*=0.42, *p*<.001, 95% CI [0.29, 0.55]) were significant in the non-difficulties group. In summary, the path coefficients from perceived teachers' autonomy support to intrinsic motivation and self-evaluated achievement were larger in the difficulties group than in the non-difficulties group although they were significant in both groups. Self-evaluated achievement was associated with metacognition in the difficulties group and intrinsic motivation in the non-difficulties group.

Table 3: Results of Multi-Group SEM

			Difficulties group		Non-Difficulties group	
			B	*β*	*B*	*β*
Perceived teachers' autonomy support	→	Intrinsic motivation	0.62 [0.25, 0.99]	.51**	0.32 [0.16, 0.48]	.29***
Perceived teachers' autonomy support	→	Metacognition	0.35 [0.04, 0.65]	.42*	0.33 [0.18, 0.48]	.35***
Perceived teachers' autonomy support	→	Self-evaluated achievement	0.51 [0.18, 0.85]	.44**	0.16 [0.02, 0.31]	.16*
Intrinsic motivation	→	Self-evaluated achievement	0.00 [−0.26, 0.26]	.00	0.42 [0.29, 0.55]	.44***
Metacognition	→	Self-evaluated achievement	0.51 [0.24, 1.14]	.44**	0.13 [−0.06, 0.31]	.11

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

Present Findings

This study examined the effects of perceived teachers' autonomy support on the academic outcomes of undergraduate students with mild difficulties in academic learning. Difficulties and non-difficulties groups were created based on participants' self-rated difficulties in learning, and the effects of perceived teachers' autonomy support were examined in each group.

Perceived teachers' autonomy support was associated with intrinsic motivation and metacognition in both groups. These findings are consistent with previous studies that have revealed that teachers' autonomy support positively affects learners' intrinsic motivation and metacognition (Howard et al., 2024; Okada, 2023). However, the association between perceived teachers' autonomy support and intrinsic motivation was stronger among students with mild difficulties. Autonomy support includes taking students' perspectives and presenting learning activities in need-satisfying ways (Reeve et al., 2022). This study measured students' perceived autonomy support as teachers taking students' perspectives and encouraging them to think in their own way. Such teacher attitudes can satisfy struggling students' basic psychological needs (i.e., autonomy, competence, and relatedness; Ryan & Deci, 2017), which, in turn, promote their intrinsic motivation. In other words, struggling students may require more need-satisfying support. They may face difficulties in the uniform manner in which all students learn. Thus, allowing such students to learn in their own way makes them perceive their needs as being satisfied, further motivating them.

In this study, struggling students' intrinsic motivation was not related to their self-evaluated achievement. This suggests that they may not expect to achieve their academic goals even if they are intrinsically motivated. Extant research on the relationship between intrinsic motivation and academic achievement in students with LD is inconsistent although most of the findings have focused on school children (Deci et al., 1992; Sanir et al., 2022). For undergraduate students with some difficulties, being intrinsically motivated in daily classes is important. However, they need additional support to obtain the academic skills that lead to academic achievement.

Perceived teachers' autonomy support positively affected metacognition in both groups in this study, consistent with previous studies (González & Paoloni, 2015; Okada, 2021). However, the effect of metacognition on self-evaluated achievement was found only in the difficulties group. A previous meta-analysis found a weak positive relation between metacognition and performance after controlling for the effect of intelligence (β=.17; Ohatani & Hisasaka, 2018). Although the relationship in the present study was not significant in the non-difficulties group, the results were consistent with previous findings. Notably, metacognition had a stronger effect on students with mild difficulties. This suggests that students who can cover their deficits in academic abilities by engaging in daily classes utilizing their metacognitive abilities feel their progress, which, in turn, leads to self-evaluated achievement.

Limitations

This study has some limitations. First, perceived teachers' autonomy support was measured using five items based on an existing scale (Okada, 2021). While they capture some aspects

of autonomy support in the context of higher education, the construct of autonomy support comprises seven aspects (Reeve et al., 2022), some of which seemed difficult to capture using a self-rated questionnaire. Future studies should measure teachers' autonomy support more comprehensively, incorporating additional measurement methods. Second, this study did not measure actual performance. As the questionnaire survey was administered during the academic term, the study focused on self-evaluated achievement rather than actual course grades. Although self-evaluated achievement can be a predictive variable for actual performance, future studies should include other performance indices, such as course grades or test performance.

Conclusions

This study addresses the importance of teachers' autonomy support in fostering motivation among struggling students. When students perceive teachers' autonomy support, they can become intrinsically motivated and metacognitively engage in their classes, even if they have mild difficulties in learning. Therefore, higher education teachers should manage their classes and interact with students in an autonomy-supportive manner. Such teaching can compensate for struggling students' academic motivation.

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Contact email: okada.ryo@kagawa-u.ac.jp

Development of Learning Innovation on Digital Learning Ecosystem to Promote Entrepreneurial Intent and Entrepreneur's Professional Skills

Sirimonpak Suwannakhun, King Mongkut's University of Technology Thonburi, Thailand
Sakesun Yampinij, King Mongkut's University of Technology Thonburi, Thailand
Naphatsanan Suwannawong, King Mongkut's University of Technology Thonburi, Thailand
Jiruth Patanachan, King Mongkut's University of Technology Thonburi, Thailand
Apichaya Panicnok, King Mongkut's University of Technology Thonburi, Thailand
Wallapa Wassanasompong, Srinakharinwirot University, Thailand

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Abstract
This research aims to develop and evaluate learning innovations within a digital learning ecosystem to promote entrepreneurial intentions and skills among diverse target groups, including the unemployed, farmers, the elderly, and families seeking income generation. The study's objectives are to develop digital learning innovations, assess their impact on entrepreneurial intentions and skills, and examine learning participation. Utilizing technologies like ZOOM and LINE, along with community libraries, the research supports the Next Normal transition with modern teaching media covering at least 10 occupations in Bangkok and local agencies. The mixed-method study, involving an initial 100 participants with plans for expansion to thousands of unemployed and 8,930 elderly individuals, collaborates with vocational training schools and local agencies. Key findings reveal excellent ratings for the developed innovations (mean=4.51, SD=0.43), high satisfaction with occupational media (mea=4.82, SD=0.41), and increased entrepreneurial intentions among participants. This research contributes to sustainable career development, enhances reading skills, and promotes self-development, ultimately benefiting both individuals and the nation through innovative learning approaches in the digital ecosystem.

Keywords: Digital Learning Ecosystem, Promote Entrepreneurial Intent, Entrepreneur's Professional Skill

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Introduction

The development of individuals' initial skills in studying basic information primarily comes from reading books to acquire knowledge in areas of their interest. This is considered crucial for the future development of education in Thailand. Reading skills are a fundamental base for analyzing various lesson contents, enabling the application of learned concepts to different fields of study. This aligns with research findings from academics and medical experts, who affirm that books are essential tools for promoting learning and enhancing life skills. Reading fosters brain development in various aspects, leading to a better quality of life, robust health, mental strength, critical thinking, and analysis skills, as well as mindfulness, adaptability, and good interpersonal relationships. Those who can read independently can seek knowledge on their own. However, Thailand faces a reading crisis primarily due to the lack of high-quality and appropriate books that meet the needs of people in different areas. Unlike TV or digital media, which are easily accessible and delivered directly to homes, books require motivation and reading promotion processes. There are challenges in sourcing quality books for target areas to conduct reading skill development activities. Moreover, the reading habits of urban populations have shifted from print media to digital media. Therefore, promoting reading among urban populations must adapt to the times. This research project recognizes the necessity and importance of improving reading skills across all age groups. By employing mixed-method research to create learning innovations within a digital learning ecosystem, the project aims to study the effects of developing learning innovations on this ecosystem. It also examines the learning engagement of these innovations in promoting entrepreneurial intentions and skills. The learning characteristics and structures of developing innovations in the digital learning ecosystem are emphasized in fostering entrepreneurial intentions and skills.

The research team has experience in academic service, integrating various disciplines, and receiving significant cooperation from local educational, social, governmental, private, and local administrative organizations. This research project will produce knowledge that benefits the unemployed, aiming to foster a reading culture, vocational skills, and learning engagement, leading to suitable career creation and sustainable income. The innovative outputs include learning innovations within the digital learning ecosystem to promote entrepreneurial intentions and skills. These innovations will cater to vocational training interests for sustainable learning. Individuals will be able to build upon their knowledge to design and create digital learning materials, sharing skills within the same field in a virtual environment. This exchange of learning experiences helps enhance vocational skills for income generation through digital learning material development. In terms of academic benefits, the research project will result in new innovations in vocational skill development, enhancing the learning structure within the digital learning ecosystem. This allows beneficiaries to apply this knowledge in daily life, further developing innovations that contribute to the country's future benefits. The policy benefits include supporting knowledge creation through diverse activities for sustainable vocational development.

The project aims to drive the development of digital learning ecosystem innovations to promote entrepreneurial intentions and skills in Thailand, with funding support from the New Career Path Development Fund for New Researchers. This supports research and innovation excellence for urban social development and decentralization of prosperity using science, research, and innovation. Under the research framework "Learning City Development," it aims to manage urban growth, income distribution, employment systems, and improve the quality of life for citizens, leading to sustainable urban growth. The project will continuously

support various activities, targeting the unemployed, subsistence farming, and elderly groups interested in generating family income. The initial phase will involve 100 participants from target groups, with plans to cover thousands of unemployed individuals, 8,930 elderly people, and those seeking additional income. Participants can select their books through various planned activities. The benefits of these activities include experience exchange and self-designed content creation to build new knowledge, shared with those interested in the same career through developed learning innovations.

Technology and innovations used include training tools through programs or applications such as ZOOM or LINE, utilizing community libraries to disseminate knowledge. This supports the Next Normal (transition period) by providing modern and relevant teaching materials. At least ten related professions include organic farming, local trades in Bangkok, makeup and beauty training, ornamental plant cultivation, fish farming, Thailand and international cooking, creating local products for family income, subsistence agriculture, tourism business, and selling coffee and beverages in cafes. This information comes from collaborations with the Bangkok Vocational Training School, Athon Sangkhawatana, and local organizations.

The COVID-19 crisis has exacerbated challenges faced by unemployed and out-of-school youth, highlighting a critical issue that remains inadequately addressed by the state. The causes of unemployment in the country may be numerous, including labor market shortages, inadequate national workforce planning, and an imbalance between vocational education graduates and the actual needs of the labor market. The development of children and youth is multifaceted, encompassing improvements in learning abilities, psychological well-being, and social skills, all of which contribute to their overall growth and adaptation to the world around them.

This encompasses various aspects, such as learning capabilities, which have shown improvement, psychological aspects like increased relaxation and reduced feelings of loneliness, and social aspects, including enhanced social interactions and broadened worldviews. Quality of life for adults is significantly influenced by factors such as workplace skills, particularly literacy, which enhances job performance, as well as by aspects that contribute to mental well-being, including stress reduction, decreased loneliness, and a lower risk of depression. In the work context, literacy skills significantly influence job performance, and in terms of overall quality of life, they particularly help in reducing stress, feelings of loneliness, and the risk of depression. The overall economic and social impact is profound, as limited literacy among adults not only reduces their participation in political and public policy changes but also hinders their ability to contribute effectively to societal progress. International studies have shown that adults who read less are less likely to believe they can participate in political changes, including public policy shifts, leading to lower engagement in political activities compared to those who read more.

In the digital age, learning resources have evolved to support digital workforce learners by providing accessible and flexible learning opportunities. These resources include online courses, webinars, and e-books that allow learners to study at their own pace. Interactive tools, such as simulations and virtual reality, enhance the learning experience by offering practical, hands-on training. Digital learning platforms also enable collaboration through discussion forums and peer-to-peer learning.

The adaptability of these resources ensures that they cater to various learning styles, promoting lifelong learning and continuous skill development essential in today's fast-paced, technology-driven world. As the digital workforce continues to grow, the focus on developing high-quality digital learning resources remains crucial to ensuring a well-equipped and adaptable workforce. Learning resources in the digital age are increasingly tailored to meet the needs of digital workforce learners, emphasizing flexibility, accessibility, and engagement through online platforms, multimedia content, and interactive tools Figure.1.

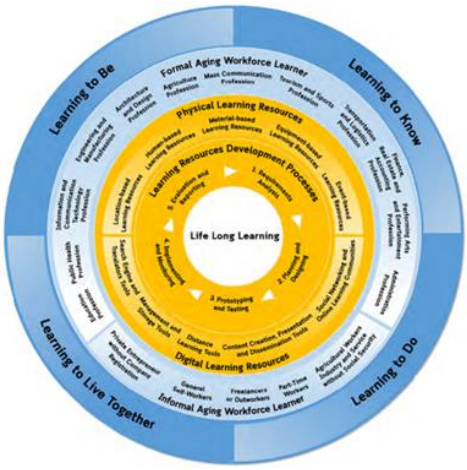

Figure 1: The Learning Resources in the Digital Age Suitable for Digital Workforce Learners

Reviewing Research Literature

Development of assessment model based on actual conditions for career learning and technology subject 3 information and communication technology grade 4 secondary education area office district 33. Srithai (2014) developed an assessment model based on the actual conditions of the career and technology learning group. Theme 3 information and communication technology by conducting research in 4 stages basic data study, creation and development of models, etc. Experiment with the model and improve the model into a complete format. The results of the research show that the developed model has 4 complete elements reason and background. Objective the method of assessment based on the actual conditions and the application approach by the model are of high quality in terms of composition. It has the most completeness in the 4 elements and good characteristics in terms of accuracy. The suitability, consistency, and feasibility are at the highest level. The confidence in the results of the model learner assessment is high, and the application process is convenient and streamlined, and the participants in the assessment include teachers, students and parents. The results showed that there was a high to the highest level of satisfaction. Reading behavior of graphic novel students at Chulalongkorn University demonstration elementary school. Samart (2017) conducted a study on the reading behavior of graphic novels among students at Chulalongkorn University demonstration elementary school, focusing on the reasons for reading, methods of obtaining graphic novels, language, content, types of graphic novels read, and the places and times of reading. The study employed a survey research method. The research findings revealed that most students at Chulalongkorn University demonstration elementary school read graphic novels in the science fiction genre, with the "Why? encyclopedia of scientific knowledge" series being the most popular. The content of the graphic novels primarily focused on science, mathematics, and technology. The graphic novels were in Thai. Students read these novels because of their interesting content. The methods of obtaining graphic novels included purchasing them and

borrowing them from the school library. Students typically read at home and in the school library. The time spent reading graphic novels was mainly during the lunch break on school days, with an average reading time of 6–10 hours per week. Components and system architecture of the digital learning ecosystem for managing teaching and learning through digital storytelling for teacher education students. Sarnok (2019) conducted a study on the model of a digital learning ecosystem for the design and definition of the components of the digital learning ecosystem for teacher education students, as well as the design of the system architecture for this ecosystem. The study's results revealed that learners are able to control the time, place, and direction of their learning independently. In this learning process, students have the opportunity to participate actively, presenting their own work through digital storytelling. This approach allows students to recognize their potential and develop skills in information search, storytelling, data analysis, data synthesis, communication, presentation, organizing thoughts, questioning, and teamwork. It also fosters awareness of lifelong learning. This system serves as a management tool for learning through digital storytelling within the digital learning ecosystem, designed for the teaching and learning of teacher education students in a digital ecosystem. Action research and collaborative research processes research methodology for stem education research in professional learning communities. Chaisat (2021) developed the human resources for STEM education, focusing on the development of the ability to integrate knowledge, skills, attitudes, and various characteristics in a holistic manner for work, problem-solving, and life. This teaching approach is connected to real-life experiences, where students work together in learning teams, with teachers as co-leaders and administrators serving as supporters to facilitate learning and professional development. This model aims to enhance personal quality and improve the quality of learning management, focusing on student success and learning outcomes, as well as the happiness of working together as members of a learning community. The appropriate research methodology for developing STEM education students consists of Action Research and Collaborative Research. Development of SQ4R format on social networks to promote reading culture. Thepnuan (2014) created the SQ4R model on social networks to promote reading culture to study the results of using the SQ4R format on social networks to promote reading culture with undergraduate students in the field of educational technology and computer education, faculty of education, Naresuan University. The results of the study showed that the SQ4R model on social networks to promote reading culture was appropriate. Students had a reading culture after school with the SQ4R model on social networks to promote a reading culture, which was statistically significantly higher than before class at the level of 0.05 and students are satisfied with teaching and learning with the SQ4R model on social networks to promote a reading culture at a high level.

Careers in the Digital Ecosystem

In today’s rapidly evolving digital world, new and innovative careers are emerging that combine technology with creativity. These careers not only offer opportunities for financial growth but also allow individuals to develop and enhance their professional skills. Whether it's in agriculture, culinary arts, beauty, or sustainable practices, each profession showcases how modern advancements can be leveraged to create sustainable and rewarding livelihoods. From hydroponic farming to digital marketing, these careers represent the diverse opportunities available in the digital era, making them both exciting and relevant for the future.

10 Interesting Careers in the Digital Era

10 Interesting Careers in the Digital Era, (1) Salad Vegetable Farming, this career is perfect for those with a passion for agriculture. Hydroponic salad farming is very popular nowadays because it's pesticide-free and easy to maintain. The produce can be sold to restaurants or delivered to supermarkets. (2) Vermicomposting**,** using earthworms to create compost is an emerging career, as it's environmentally friendly. The organic fertilizer produced can reduce costs and boost plant yields. (3) Banana Cake Baking**,** making banana cakes is a side job that can be done from home. With online marketing, your cakes can easily reach customers, and there's a high demand in the market. (4) Savory Dishes with Sweet Fish Sauce, Thailand dishes with a sweet and salty taste, like those made with sweet fish sauce, are popular with fruits or sticky rice. Selling them online can easily generate income. (5) Selling Tofu with Fruit Salad**,** tofu with fruit salad is a simple and popular dessert, especially during hot weather. This career can be profitable by selling in dessert shops or through online platforms. (6) Makeup Artist**,** makeup artistry is a craft that helps boost people's confidence. Makeup artists can work in entertainment, weddings, or fashion, promoting their work through social media. (7) Nail Technician, nail artistry is in high demand among beauty enthusiasts. Creating unique nail designs can be a lucrative career, both in salons and through mobile services. (8) Tie-Dyeing and Printing on Raw Fabric**,** the art of tie-dyeing is back in style. This career can generate income by selling beautifully dyed fabrics both domestically and internationally. (9) Fishing and Ecotourism**,** fishing remains a major occupation for Thais. Sustainable fishing combined with ecotourism related to fishing creates a stable income source. (10) Selling Drip Coffee**,** drip coffee is becoming increasingly popular. Selling drip coffee offers a unique experience for customers and can be easily marketed online or in cafés.

Summary, these 10 careers are great examples of how technology and creativity can be applied to various professions, enabling sustainable income and enhancing professional skills in the digital age (Figure 2).

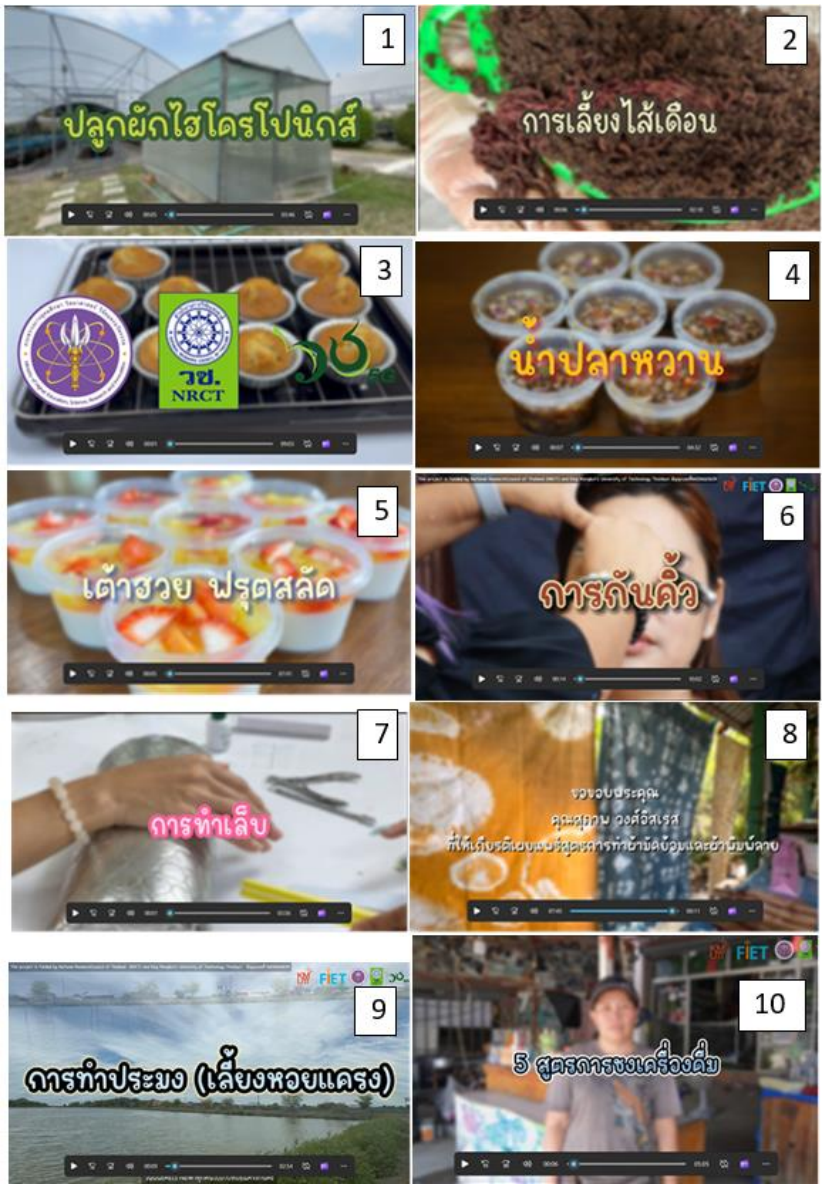

Figure 2: Examples of Infographic Media Used to Share Experiences Across Different Professions

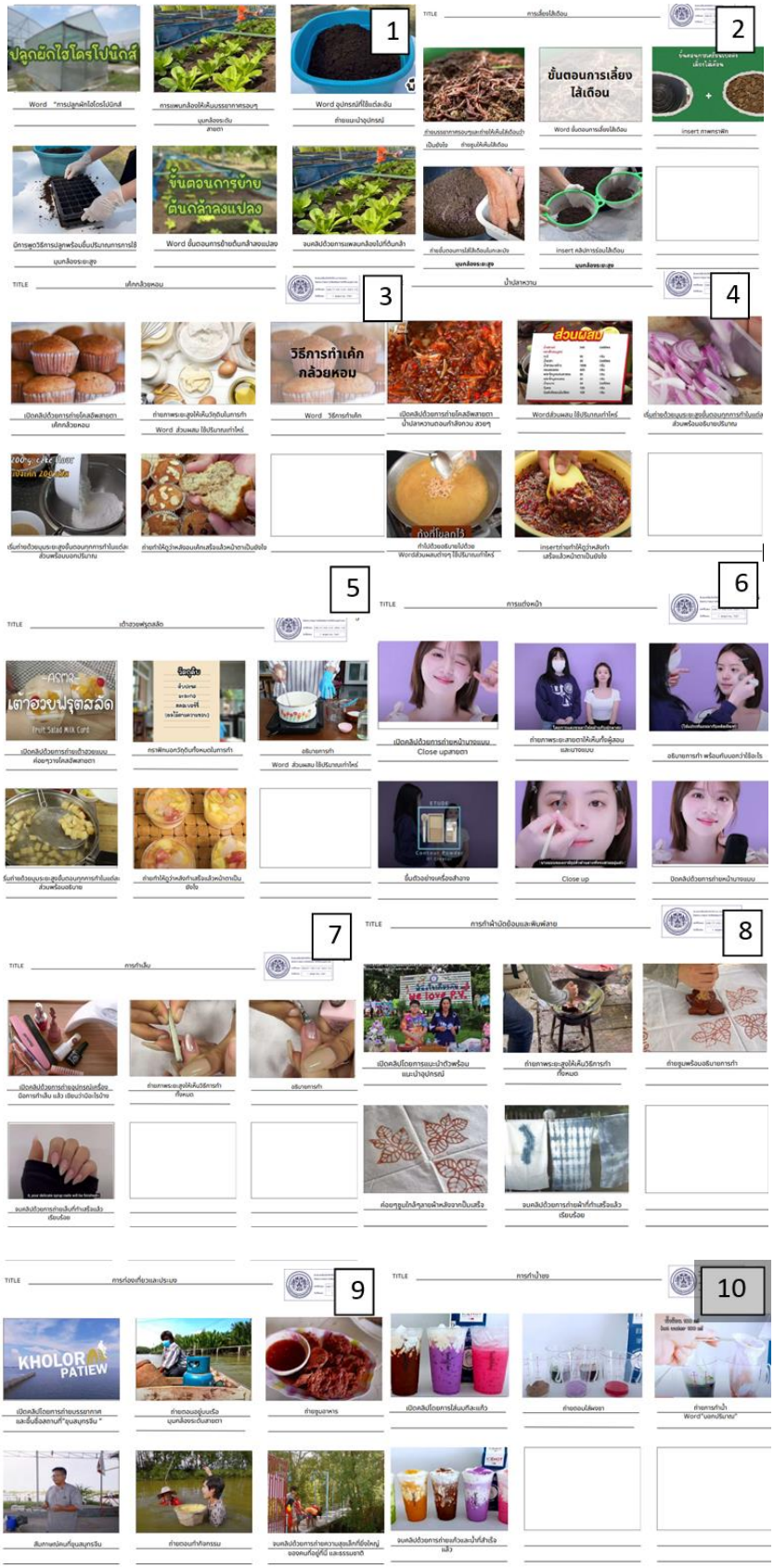

Figure 3: The Media Production Process Uses Storyboards to Convey Professional Experiences Across Various Professions

Learning Engagement

Affective or Emotional Engagement

- I was interested in learning on this learning platform.
- What I learned on this learning platform was interesting.
- I like what I learned on this learning platform.
- I like this learning platform.
- I was proud to have the opportunity to learn on this learning platform.

Behavioral Engagement

- I tried to learn the content taught on this learning platform as hard as I could.
- When I studied on this learning platform, my mind wandered. (R)
- I watched video lessons on this learning platform carefully.
- I kept watching video lessons on this learning platform although some of them were difficult to learn.
- I reviewed what I learned on this learning platform.

Cognitive Engagement

- To understand the content taught on this learning platform better, I tried to relate it with I already know.
- When I studied on this learning platform, I tried to match what I was learning with my own experience.
- I tried to summarize what I learned on this learning platform in my own words.
- I made up my own examples to better understand important ideas or concepts presented on this learning platform.
- When I studied on this learning platform, I tried to identify the similarities and differences between what I was learning and what I already know.

Methodology

Conceptual Framework

The Figure 3 presents a comprehensive framework for the “Development of learning innovation on digital learning ecosystem to promote entrepreneurial intent and entrepreneur's professional skills”. This framework is divided into two main branches learning innovation and digital learning ecosystem.

The learning innovation branch encompasses several key components. It includes Aims, which likely define the goals and objectives of the learning process. Contents refer to the subject matter and curriculum. Pedagogies involve the teaching methods and strategies employed. Learning technologies highlight the use of digital tools and platforms to facilitate education. Authentic assessments suggest the use of real-world, practical evaluations to measure learning outcomes. On the digital learning ecosystem side, we see a breakdown of its constituent parts. Living things refers to the human elements, specifically learners and learning facilitators. This acknowledges the crucial role of both students and teachers in the ecosystem. Non-living things are also included, recognizing the importance of physical and digital infrastructure.

This is further clarified by the inclusion of hardware, software, and network systems as essential components. The framework then outlines three main areas of focus, reading

culture, professional skills, and learning engagement. Each of these is further broken down into specific elements. Reading culture encompasses the behavior of accessing learning resources, reading behavior, and utilization of reading. This emphasizes the importance of developing strong reading habits and effectively using available educational materials. Professional skills are developed through seeking information about interested professions, creating suitable career paths for oneself, and planning and deciding on feasible career choices.

This highlights the framework's focus on practical, career-oriented outcomes. Learning engagement is divided into cognitive engagement, emotional engagement, and behavioral engagement. This holistic approach recognizes that effective learning involves intellectual stimulation, emotional connection, and active participation. Overall, this framework presents a comprehensive and integrated approach to digital learning, emphasizing both the technological infrastructure and the human elements necessary for effective education and professional development. It aims to create a learning environment that not only imparts knowledge but also fosters entrepreneurial skills and career readiness.

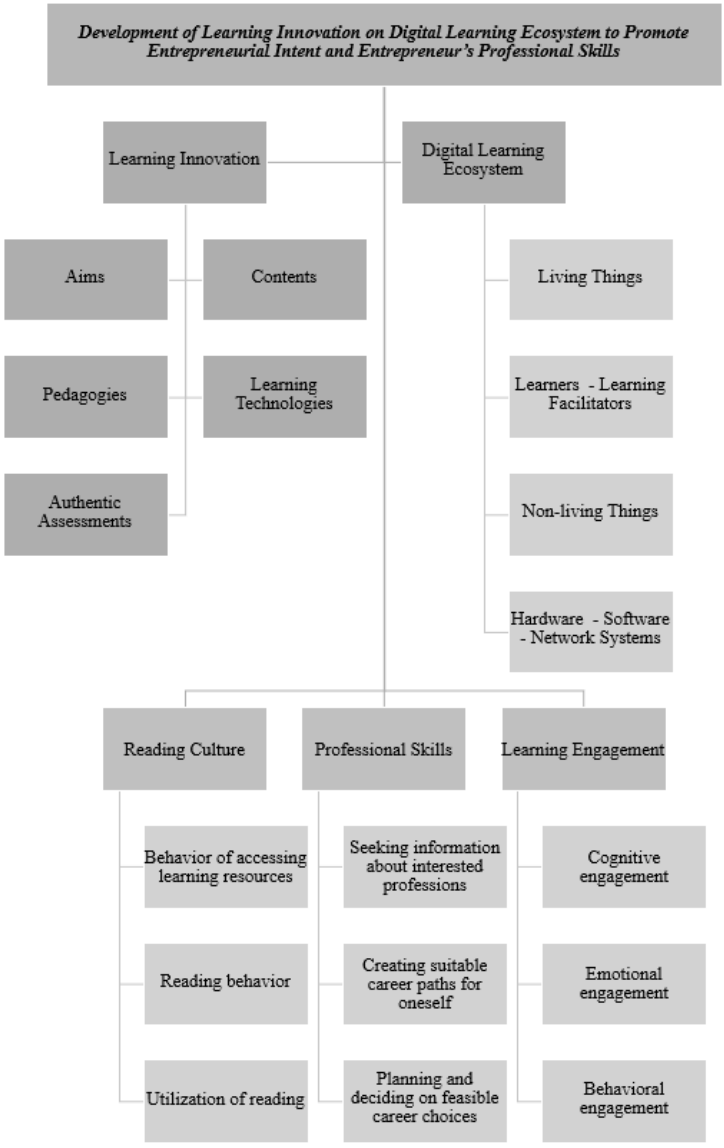

Figure 4: Conceptual Framework

Research Purpose and Questions

Using a multi-stage mixed method research design, this project aims to develop an online learning platform/system that is effective in promoting reading culture, professional skills, and learning engagement among the unemployed in Bangkok, Thailand. This aim falls into two main objectives: (1) evaluating the validity of the online learning platform and (2) implementing the online learning platform and assessing its effectiveness in term of the three types of learning outcomes. To guide this research project, four research questions are delineated. Questions 1 was for Objective 1 and Questions 2, 3, and 4 were for Objective 2.

1) To what extent is the designed learning model appropriate for the improvement in reading culture, professional skills, and learning engagement?
2) Is there a significant difference between pre-test and post-test reading culture?
3) Is there a significant difference between pre-test and post-test professional skills?
4) Is there a significant difference between pre-test and post-test learning engagement?

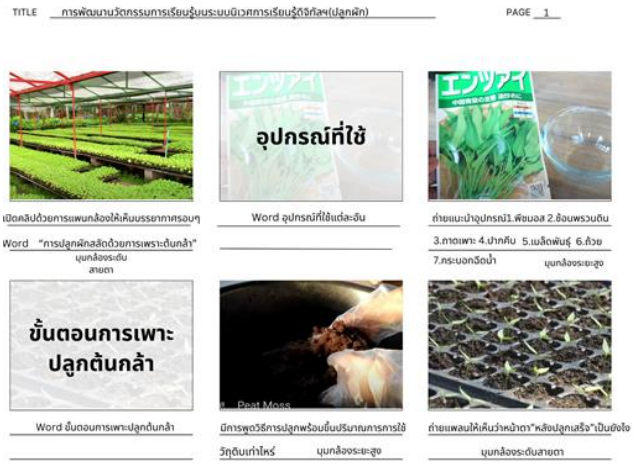

Figure 5: The Research Design for the Development of Learning Innovation

Methods

Sample and Procedures

This project recruited two groups of participants: (1) four experts in the field of XXX (00 males and 00 females) and (2) 100 participants who are the unemployed, farmers, … (male=00% and female=00%, mean=0.00 and SD=0.00). The experts were involved with the process of evaluating the appropriateness of the designed learning platform/system. The 100 participants were engaged in the process of implementing the model and assessing its effectiveness.

Ethical data collection was prioritized in this study. First, ethic approval was granted by the university's Board of Ethics (Certificate Number: KMUTT-IRB-2024/0806/247. Then, the experts were contacted for the evaluation on the appropriateness of the learning platform/system. After the learning model was hosted, the researchers announced …. Finally, 100 unemployed accessed the learning model to learn various course content. Participation was entirely voluntary and anonymous. The main data collection was administered before and after the implementation of the learning model using Google Forms. The average time used in completing the survey was 40 minutes.

Figure 6: The Rectangular Frame Surrounds the Research Design for the Development of Learning Innovation

Research Methodology

The research methodology focuses on developing learning innovation within a digital learning ecosystem to promote entrepreneurial intent and enhance entrepreneurial skills.

Research Qualitative Before Experiment

Phase 1 Research.

Conduct in-depth interviews with experts, perform a SWOT analysis to identify strengths and weaknesses of the reading culture related to vocational skills for digital citizens in collaboration with educators and academics from the Social Development Office, and facilitate focus group discussions with learners to assess their needs regarding reading culture and vocational skills.

Outcomes.

Learning innovations within the digital learning ecosystem include a model of learning activities, evaluation methods, and data collection tools such as a behavioral assessment form for reading practices related to vocational skills, and a knowledge test on vocational skills for digital citizens.

Intervention Design Research (Mixed Method Research)

Phase 2 Research.

Conduct an experiment with an intervention, using pre-test and post-test measures, by implementing the learning innovations and activity models with the experimental group and collecting data.

Outcomes.

Conduct an experiment with an intervention, using pre-test and post-test measures, by implementing the learning innovations and activity models with the experimental group and collecting data.

Qualitative During Experiment Research

Observe participants' learning behaviors during the experimental activities and conduct focus group discussions with the experimental group to gather insights on their experiences using the learning innovations within the digital learning ecosystem.

Outcomes.

Learning behaviors of the participants. Lessons learned from the application of learning innovations within the digital learning ecosystem and participation in learning activities. Leads to Guidelines for disseminating and transferring the learning innovations within the digital learning ecosystem and learning activities to other areas.

Potential and Readiness

Request cooperation from community members and relevant agencies to promote mutual assistance and increase daily reading among people in the Bangkok area. In addition to the design and development of innovations, factors such as flexibility in acquiring specialized materials and equipment for new innovations are considered. Research management strategies are implemented to ensure stability, with the project budget allocated according to the Sufficiency Economy Philosophy. Project progress is reviewed weekly to ensure alignment with the research plan, and a clear implementation plan is defined for each stage. The innovation model is continuously developed to stay aligned with current trends, and knowledge development activities are organized to ensure success within the research team.

Data Analysis

For the first phase, descriptive statistics were used to evaluate the validity of the designed learning platform/system. For the second phase, paired sample t-tests were used to compare pre-test and post-test scores in each subscale of reading culture, professional skills, and learning engagement.

Seedling Planting Guide

Banana Cake Recipe Guide

Ingredients

1. Red Lotus brand wheat flour, 90 grams (g)
2. Baking soda, 1/2 teaspoon
3. Baking powder, 1/2 teaspoon
4. Granulated sugar, 90 grams (g)
5. Salt, 1/4 teaspoon
6. Vegetable oil, 90 grams (g)
7. Large chicken egg, 1 piece
8. Finely mashed ripe banana, 100 grams (g)
9. Plain fresh milk, 30 grams (g)
10. Yogurt, 17 grams (g)

Steps

The Banana Cake Recipe Guide offers a detailed, step-by-step approach to creating a delectable banana cake. It begins with a precise list of ingredients.

1. It starts with preheating the oven to 200-210°C without the fan setting, followed by sifting and mixing the dry ingredients.

Figure 7: Sift the flour into a mixing bowl, then add the sugar and salt, mixing well before setting it aside

2. The next step involves mashing the banana and combining it with milk, yogurt, and banana flavoring.

Figure 8: Next, combine the vegetable oil and eggs in a mixing bowl and mix well

3. The wet ingredients, including oil and egg, are then mixed separately before being incorporated into the dry mixture.
4. The batter is carefully combined until smooth, then distributed into prepared cups, leaving a 2-3mm rim.

Figure 9: Then, distribute the mixture into the prepared cups, leaving a 2-3mm rim at the top

5. The baking process is precisely timed, starting at 200-210°C for 10 minutes, then reducing to 180°C for an additional 5-8 minutes until fully baked.

Figure 10: Then, reduce the temperature to 180°C and bake for an additional 5-8 minutes until fully cooked

This comprehensive guide ensures that even novice bakers can achieve perfect results, producing a moist, flavorful banana cake with a tender crumb and rich banana taste.

Figure 12: A Rectangular Frame surrounds the Research Design for the Development of Learning Innovation

Results of Research

Phase 1: Evaluating the Validity of the Designed Learning Platform

Q1: To what extent is the designed learning model appropriate for the improvement in reading culture, professional skills, and learning engagement?

Results From Expert Evaluation.

The expert evaluation results indicate strong support for the designed learning platform's appropriateness across multiple dimensions:

- Content Validity: The platform demonstrated high content validity with IOC values ranging between 0.80-1.00, confirming its alignment with intended learning outcomes for reading culture development, professional skill enhancement, and engagement promotion.
- Structural Appropriateness: Experts validated the platform's structural design, particularly noting the effective integration of interactive elements, self-paced learning modules, and professional development components.
- Pedagogical Framework: The learning model's pedagogical approach was deemed highly suitable, incorporating evidence-based strategies for adult learning and

professional development while maintaining engagement through varied content delivery methods.
- Technical Design: The platform's technical architecture received positive evaluation for its user-friendly interface, accessibility features, and robust learning management capabilities, though minor refinements were suggested for mobile optimization.
- Assessment Mechanisms: The embedded assessment tools and progress tracking features were validated as appropriate for measuring the three target outcomes (reading culture, professional skills, and engagement).

Phase 2: Implementing the Online Learning Platform and Assessing Its Effectiveness

Q2: Is there a significant difference between pre-test and post-test reading culture?

Table 1 presents the descriptive statistics for the pre-test and post-test of the subscales of reading culture (i.e., behavior of accessing learning resources, reading behavior, and utilization of reading) and significant levels. Paired sample T-tests revealed that post-test behavior of accessing learning resources, post-test reading behavior, and post-test utilization of reading were significantly higher than pre-test behavior of accessing learning resources, pre-test reading behavior, and pre-test utilization of reading, respectively. This finding suggests that the designed learning platform was effective for improving reading culture in (the sample).

Table 1: Descriptive Statistics for the Pre-test and Post-test of Behavior of Accessing Learning Resources (BALR), Reading Behavior (RB), and Utilization of Reading (UR) and Paired Sample t-Test Results

		Pre-test	Post-test	*t*	*df*			
Variable	N	M	SD	M	SD	*p*		
BALR	100	3.81	0.54	3.89	0.49	4.04	99	0.001
RB	100	3.42	0.66	3.70	0.52	6.79	99	0.001
UR	100	3.73	0.61	4.06	0.50	7.43	99	0.001

Q3: Is there a significant difference between pre-test and post-test professional skills?

Table 2 presents the descriptive statistics for the pre-test and post-test of the subscales of professional skills (i.e., seeking information about interested professions, creating suitable career paths for oneself, and planning and deciding on feasible career choices) and significant levels. Paired sample T-tests revealed that post-test seeking information about interested professions, post-test creating suitable career paths for oneself, and post-test planning and deciding on feasible career choices were significantly higher than pre-test seeking information about interested professions, pre-test creating suitable career paths for oneself, and pre-test planning and deciding on feasible career choices. This finding suggests that the designed learning platform significantly improved professional skills in (the sample).

Table 2: Descriptive Statistics for the Pre-test and Post-test of Seeking Information About Interested Professions (SIIP), Creating Suitable Career Paths for Oneself (CSCP), and Planning and Deciding on Feasible Career Choices (PDFCC) and Paired Sample t-Test Results

		Pre-test	Post-test	*t*	*df*			
Variable	N	M	SD	M	SD	*p*		
SIIP	100	3.70	0.60	3.99	0.38	5.00	99	0.001
CSCP	100	2.82	0.79	3.50	0.49	9.85	99	0.001
PDFCC	100	3.97	0.63	4.24	0.48	5.06	99	0.001

Q4: Is there a significant difference between pre-test and post-test learning engagement?

Table 3 presents the descriptive statistics for the pre-test and post-test of the subscales of learning engagement (i.e., affective or emotional engagement, behavioral engagement, and cognitive engagement) and significant levels. Paired sample T-tests demonstrated that post-test affective engagement, post-test behavioral engagement, and post-test cognitive engagement were significantly higher than pre-test affective engagement, pre-test behavioral engagement, and pre-test cognitive engagement. This finding suggests that the designed learning platform significantly promoted learning engagement in (the sample).

Table 3: Descriptive Statistics for the Pre-test and Post-test of Affective Engagement (AE), Behavioral Engagement (BE), and Cognitive Engagement (CE) and Paired Sample t-Test Results

		Pre-test	Post-test	*t*	*df*			
Variable	N	M	SD	M	SD	*p*		
AE	100	3.99	0.61	4.22	0.48	4.91	99	0.001
BE	100	3.95	0.45	4.15	0.41	4.51	99	0.001
CE	100	3.55	0.64	3.97	0.51	6.14	99	0.001

Conclusions

This research aims to create a learning environment for developing innovative learning on a digital learning ecosystem to promote entrepreneurial intention and entrepreneurial skills. The goal is to excellently enhance the structure of innovative learning ecosystems. This innovation will enable beneficiaries to apply the knowledge gained in their daily lives and further develop it into innovations that can benefit the country in the future. From a policy perspective, it supports the creation of knowledge through diverse activities to build sustainable careers. It also aims to generate new knowledge through more effective reading skills, leading to sustainable self-development.

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Contact email: sirimonpak.sut@kmutt.ac.th

Designing a SVVR Educational Game to Cultivate Environmental Behavior Decision-Making Skills: A Case Study on Tropical Rainforest and Indigenous Issues

Kang-Miao Cheng, National Taiwan University of Science and Technology, Taiwan
Huei-Tse Hou, National Taiwan University of Science and Technology, Taiwan

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Abstract
Cultivating learners' environmental behavior decision-making skills is important for environmentally sustainable development. General lecture or discussion teaching methods lack realistic scenarios and interactivity in the experience design of environmental behavior decision-making. It is difficult to stimulate learners' motivation and enhance problem-solving abilities, leading to poor transfer of learning. To solve the above problems, this study designed an educational game with a realistic story context. The game employs game-based learning to promote learning motivation, combines Spherical Video-based Virtual Reality (SVVR) to provide realistic environments, and uses Google Forms to enhance interactivity to understand learners' environmental behavior decisions. In this game, learners can talk to non-learner characters (NPCs) in a complex tropical rainforest SVVR and engage in visual and auditory exploration to learn ecological knowledge and understand indigenous culture and challenges. Google Forms were used to solve puzzles and collect information about their personal environmental behavior decisions. An empirical evaluation involving 20 Taiwanese high school students revealed high levels of flow for the game. This indicated that the game could promote learning engagement. After playing the game, learners' academic achievement significantly improved, demonstrating the enhancement of knowledge acquisition. The results of the environmental behavior decision-making and environmental awareness assessments showed that the game effectively combines cognition and action. The learners were highly interested in exploring the rainforest and had negative feelings about the indigenous people's loss of homes. These results indicate that the game's realistic and interactive design can promote deeper understanding and experience and facilitate effective environmental behavior decision-making.

Keywords: Game-based Learning, Educational Games, SVVR, Environmental Behavior Decision-Making Skills, Flow

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Introduction

The development of environmental behavior decision-making skills is an important process for strengthening environmental education and maintaining sustainable development. (To elaborate further, in this study, we use the term “environmental behavior decision-making skills” to emphasize the specific decision-making processes related to environmental behaviors.) The purpose of environmental education is not only to transfer knowledge, but also to make students aware of environmental problems' seriousness to promote environmentally friendly behaviors. In addition, environmental knowledge alone is not enough to change an individual's behavior, but also involves other factors such as environmental awareness, psychology and socio-cultural factors (Colombo et al., 2023). However, the lack of experiential learning in which students interact with real-life situations (Kolb, 1984) in general lecture or discussion pedagogies restricts the possibility of applying knowledge in real-life situations, which prevents learners from truly understanding complex environmental problems and behavioral decisions and leads to poor performance in facilitating the transfer of learning. The development of virtual reality technology in environmental education can overcome the time and space constraints of fieldwork and increase the benefits of contextual learning to enhance student engagement and motivation (Cho & Park, 2023). However, past research on virtual reality in education has focused on user experience, with fewer applications in environmental education (Cho & Park, 2023). The simulation and interactive design of environmental behavioral decision-making experiences are insufficient. This makes it difficult to stimulate learners' motivation and limits the enhancement of their problem-solving abilities.

To solve this problem, in addition to virtual reality technology, Lin and Hou (2023) pointed out several advantages of game-based learning. They noted that it not only improves learning effectiveness, motivation, and engagement, but also promotes reflective behaviors. Furthermore, it supports and assists learners through scaffolding guides in the game, as compared to traditional lecture-based instruction. A blended learning approach that combines inquiry-based learning and experiential learning can be effective in improving environmental awareness, students' decision-making skills, and environmental concern (Miyaji & Fukui, 2020). Teaching strategies that combine simulation and problem-oriented learning can improve students' motivation, self-directed learning, and problem-solving skills more than traditional lecture methods (Roh & Kim, 2015). Thus, these strategies can be integrated into the design of virtual reality teaching applications to enhance learning benefits.

In addition, Spherical Video-based Virtual Reality (SVVR) technology and equipment are easier to popularize in teaching and learning (Wu et al., 2022) and can bring more self-regulation and exploration experiences (Wang et al., 2023). Tropical rainforests are rich in both biological diversity and cultural diversity, and the close connection between indigenous cultures and ecosystems is one of their characteristics. However, current environmental education focuses on scientific data and ignores the traditional ecological wisdom of indigenous peoples (Ardoin et al., 2020). By focusing on the relationship between indigenous people and the rainforest, we can promote a deeper understanding of the complex interactions between people and nature, providing valuable lessons for addressing modern environmental challenges (Malone, 2022).

In summary, this study aims to design and evaluate an educational game that combines SVVR technology and game-based learning to promote learners' environmental behavior decision-making skills on the topic of rainforests and indigenous peoples. The study

measured academic achievement, flow, environmental awareness, and environmental decision-making behaviors. Through simulated storytelling scenarios in virtual reality, learners were able to better understand environmental problems on both emotional and cognitive levels and explore effective solutions. This approach will serve as a reference for environmental educators in developing innovative pedagogical approaches.

Methods

This study adopted a one-group pre- and post-test design with a 40-minute gameplay session. The participants were 20 high school students aged 15-16 years old who had not recently completed any courses related to the study topic.

In this study, we designed the "Love Rainforest" SVVR game, in which learners are led by a Penan guide into the Borneo rainforest. The game aims to teach about the five vertical layers of the rainforest, explore the relationship between the rainforest and the lives of the indigenous people, and understand the impacts of corporate deforestation on these communities.

The game incorporates various challenges. For example, learners must interact with the tour guide and identify specific plant or animal sounds to progress. In another scenario, when indigenous people face dilemmas due to corporate deforestation, learners are guided by a rainforest conservator to choose actions that can support the indigenous people's livelihoods. These challenges not only help learners understand the relationship between rainforest ecology and indigenous life but also enhance their problem-solving and critical-thinking skills.

The game was developed using the Thinglink VR platform, as shown in Figure 1. It consists of one rainforest entrance scene (with five rainforest vertical layered sub-scenes) and three indigenous life scenes. Learners interact with five non-learner characters (NPCs) that reflect the crises encountered by indigenous people, their voices, and key figures that can help learners make decisions to enhance their understanding of environmental issues.

The game design follows the principles of virtual reality and simulation, combining 360-degree photographs, visual and auditory elements, and digital game-based learning (Çatak et al., 2020; Prensky, 2003; Wu et al., 2022). The scenarios are designed to guide users step-by-step through exploration, connecting relevant knowledge points and creating an environmentally interactive link between indigenous life and the tropical rainforest. Interaction and decision-making behaviors are facilitated through Google Forms.

Upon completion of the game, learners will have gained an understanding of the challenges faced by indigenous people in the rainforest and developed related environmental behavioral decision-making skills.

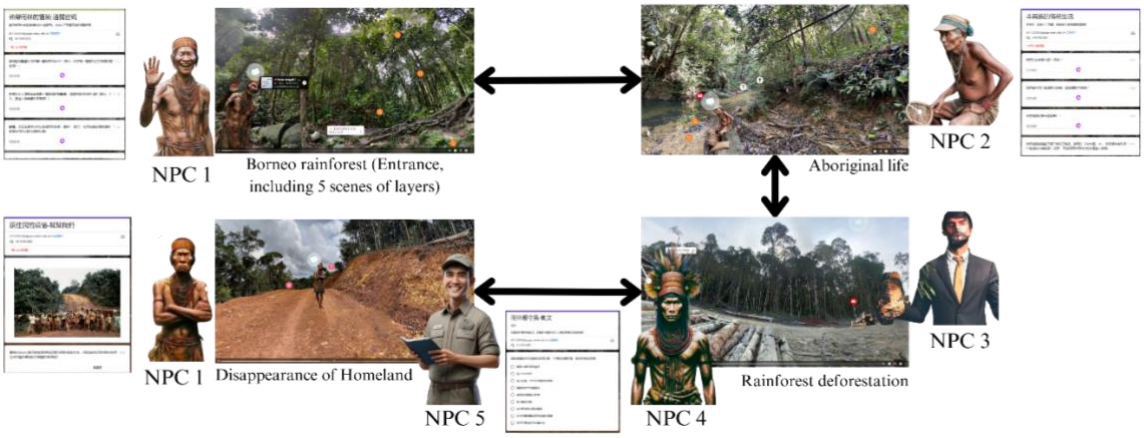

Figure 1: SVVR Game Scenes and NPCs in "Love Rainforest" Using Google Forms for Interaction

Results and Discussions

The results of this study showed that the mean pre-test score and the mean post-test score for academic achievement in the Love Rainforest SVVR game were 52.90 (*SD*=16.29) and 65.90 (*SD*=16.25), respectively, reflecting an improvement of 13.00 points (Table 1). A paired-samples t-test revealed a significant difference between pre-test and post-test scores (t=4.036, p=0.001). These results suggest that the game is effective in enhancing learners' academic achievement, demonstrating significant pedagogical benefits.

Table 1: Academic Achievement in the Love Rainforest SVVR Game: Cognitive Test Results

Dimension	**post-test (N=20)**		**pre-test (N=20)**			
	M	*SD*	*M*	*SD*	*t*	*p*
Overall	65.9	16.254	52.9	16.293	4.036**	0.001

***p <0.01, ***p <0.001*

In the "Indigenous People's Problems - Help Us!" game questionnaire, learners demonstrated a significant awareness of indigenous people's challenges and decision-making skills regarding environmental actions. The results are as follows:

- Awareness of indigenous people's life difficulties: 74 points (mean score=37.0 out of 50 possible points)
- Decision-making on environmental actions to help indigenous people: 74 points (mean score=37.0 out of 50 possible points)
- Overall performance: 74 points (mean score=74.0 out of 100 possible points)

These results indicate that most learners gained increased awareness of the challenges faced by indigenous people after participating in the game. Moreover, learners actively engaged in problem-solving processes related to environmental issues affecting these communities.

Analysis of open-ended responses revealed that learners primarily considered factors such as education, economy, resources, and ecosystem in relation to indigenous peoples. Learners generally perceived their decisions as reasonable and potentially impactful.

The game appeared to foster empathy among learners, as evidenced by their engagement with the game's narrative. This led to increased awareness of rainforest ecosystems and indigenous livelihoods. Furthermore, learners demonstrated reflective thinking about the impact of their own actions on environmental protection.

In terms of environmental awareness, the present study adapted measures from Han & Lin (2012) to assess the level of environmental exposure and affect. The results of the analyses (Table 2) showed that, when comparing the scores of each dimension with the median of the scale (i.e., 3), the mean value of the item "I like the tropical rainforest" was significantly higher. This indicated that learners generally had a high level of interest in exploring the tropical rainforest environment. However, the mean value of the item "I am familiar with the tropical rainforest" was relatively low (M=3.25) and not significantly higher than the median of the scale (p=0.262).

This discrepancy may be attributed to the fact that the high interest in the tropical rainforest stemmed from the visual and experiential appeal of the game. However, due to the limited scope of the game (focusing only on the rainforest of Borneo) and the time constraints of the game experience, participants' familiarity with tropical rainforests remained relatively low.

Table 2: Results of One-Sample t-Test Analysis for Environmental Exposure and Affective Level

Dimension	***(N=20)***				
	M	***SD***	***t***	***P***	***ES***
Environmental Exposure and Affective Level	3.53	0.77	3.053**	0.007	0.53
I am familiar with the tropical rainforest	3.25	0.97	1.157	0.262	0.25
I like the tropical rainforest	3.80	0.77	4.660***	0.000	0.80

*p <0.05, **p <0.01, ***p <0.001*

In addition, none of the nine scenarios preferred by learners in the storyline exceeded 50%, demonstrating a high level of diversity in scenario preferences. The most favored scenes were the entrance to the primary rainforest and the emergent layer (20% each). Furthermore, the entrance to the primary rainforest was considered by learners to be the most representative of the tropical rainforest (30%). In contrast, the least preferred scene was the one depicting the indigenous people's loss of home (45%), suggesting that learners had a strong emotional response to the negative emotions evoked by this scene. This result reflects that the study successfully designed scenarios to evoke emotional responses in learners, helping them understand the complexity of environmental issues and the impact of human activities from an emotional perspective, which in turn encourages reflection and action on environmental behaviors. Overall, the analysis indicated that learners were highly interested in the tropical rainforest, although their familiarity with it was low. Additionally, the diversity of scene designs was significant, especially as the scene portraying the loss of the indigenous people's home evoked a particularly strong negative emotional response.

The results of the analysis of the Flow Questionnaire (Hou & Li, 2014) in this study showed that the overall flow (M=3.95, SD=0.60) and the mean scores of all sub-dimensions were significantly higher than the median of the scale (i.e., 3) (p<0.001), as presented in Table 3. This indicates that the game could effectively enhance both learning motivation and effectiveness. Among these, the highest mean value for overall flow experience (M=3.96) suggests that learners generally experienced a stronger flow state during gameplay. This

implies that the game design was effective in promoting learners' entry into a flow state, maintaining a high level of concentration and engagement. Notably, the highest mean value (*M*=4.25) for the "Autotelic experience" sub-dimension indicated that learners set and pursued personal goals during gameplay. This clear goal orientation helped learners overcome challenges and achieve a sense of success and satisfaction, which in turn deepened their flow experience, making it easier for them to remain in the desired learning or gaming state.

Table 3: Results of One-Sample t-Test Analysis for Learners' Flow *(N=20)*

	M	***SD***	***t***	***p***	***ES***
Overall Flow	3.95	0.60	7.138***	0.000	0.95
Flow antecedents	3.88	0.67	5.824***	0.000	0.88
Challenge-skill balance	3.90	0.75	5.339***	0.000	0.90
Goals of an activity	4.03	0.91	5.037***	0.000	1.03
Unambiguous Feedback	3.83	0.73	5.051***	0.000	0.83
Control	3.80	0.78	4.559***	0.000	0.80
Playability	3.83	0.83	4.437***	0.000	0.83
Flow experience	3.96	0.58	7.360***	0.000	0.96
Concentration	4.00	0.73	6.126***	0.000	1.00
Time distortion	4.00	0.83	5.407***	0.000	1.00
Autotelic experience	4.25	0.72	7.754***	0.000	1.25
Loss of self-consciousness	3.58	0.94	2.748*	0.013	0.58

*p <0.05, **p <0.01, ***p <0.001

Conclusion and Limitations

This study utilized SVVR technology and game-based learning theory to develop the "Love Rainforest" educational game, which was applied to tropical rainforest and indigenous peoples' issues to cultivate learners' environmental behavioral decision-making skills. The results showed that the SVVR game significantly improved learners' learning effectiveness and effectively enhanced their awareness of the indigenous people's living difficulties as well as their decision-making abilities regarding environmental behaviors. Learners expressed a high level of interest and emotional connection to the rainforest environment, although there remains room for improvement in their familiarity with it. The diversity of scenarios in the game design elicited various emotional responses from learners, especially the scene depicting the indigenous people's loss of home, which triggered strong negative emotions. The game's performance in fostering a flow experience with autotelic experience was outstanding, demonstrating a high level of self-directed learning engagement. This study highlights the potential of SVVR technology in environmental education and provides a preliminary reference for environmental educators to develop innovative teaching methods. Future research could increase the sample size and include a control group to enhance reliability and validity. Additionally, extending the duration of the game may improve learners' familiarity with the tropical rainforest environment, and deepening the game design with relevant psychological factors could strengthen the assessment of attitudinal and behavioral changes.

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Contact email: hthou@mail.ntust.edu.tw

Teachers' Perspectives in Promoting English Listening Skills Among Young Learners in Indonesia

Munirotul Fatimah, Universitas Negeri Yogyakarta, Indonesia
Jamilah, Universitas Negeri Yogyakarta, Indonesia

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Abstract
This study aims to explore how teachers' perspectives on improving English listening skills among young learners in Indonesia. In this context, where English is still considered a foreign language (EFL), developing listening skills becomes challenging for teachers. A qualitative approach was used to collect the data through interviews with six teachers from formal and non-formal education settings. The interview results were analyzed using thematic analysis to identify the main themes and patterns. The findings showed that common challenges include students' limited focus during learning, unfamiliarity with English, and lack of listening to learning media. To overcome this problem, teachers implemented strategies such as integrating mostly the English language in class, playing English songs frequently, and doing more kinesthetic activities like games to increase engagement. In addition, the role of parents was highlighted as important in supporting language acquisition. English could be taught at home through direct interaction and the use of child-friendly educational videos. A dual strategy that includes home-based support and school-based techniques is necessary to provide a comprehensive learning environment. This study fills knowledge to inform and improve future educational practices and policies on improving English listening skills among young learners in Indonesia.

Keywords: Listening Skill, EYL, Teaching Challenges

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Introduction

Language education begins as early as infancy, paralleling the development of the first language. As learners get older, they are gradually introduced to second languages, particularly foreign languages such as English. The primary objective of teaching English in the early stages of schooling is to prepare young learners to be prepared for and confident in learning English at the next level of education (Hashemi & Azizinezhad, 2011). Another reason that it is suggested that learners begin learning English at a young age because your learners's cognitive abilities are still at their most advanced throughout this era of growth. However, since learners are the intended audience for learning, the implementation of teaching English to young learners is not as widespread as one might expect. As a result, teachers face particular challenges.

Teaching English as a foreign language is challenging, especially in situations in which English serves such a limited role (Songbatumis, 2017). Teachers face the challenge of during the period learners through the complex process of linguistic development, especially in the field of spoken language acquisition. According to Aprilliani (2021), teaching English to young learners who have no prior knowledge, a different first language and diverse personalities is difficult. Some teachers struggle with how to connect the subject, suitable the technique, and explain effectively. Sometimes teachers are aware of the challenges. They assumed the topic would be simple for them, but learners unfamiliar with the language teachers would be confused. Those who study a foreign language, such as English, find it difficult to develop a large vocabulary. It is easy for teachers but challenging for learners.

Nevertheless, learning a foreign language, such as English, entails more than simply gathering a large vocabulary. It is also important for young learners to develop good listening skills. Effective listening improves not only their language comprehension but also creates a solid foundation for overall language competency. Listening comprehension, according to Allen (2014), is an active and dynamic process that relies on oral cues and builds on the student's background knowledge and experiences in various domains. The development of listening English skills in young learners plays an important role in the continually evolving field of language education. Kurita (2012) argues that learning how to build individual listening techniques helps learners become proficient listeners. According to Vandergrift (2004), learners should practice listening to improve their ability to listen while learning.

Young learners are already obligated to understand English, partially because of listening activities that their teachers offer. However, this presents some difficulties for teachers. Field (2003) highlights the following listening-related challenges: Students are aware of the word yet misunderstand it. The written form of the word is known to learners, but not the spoken form. It is challenging for learners to understand a word from a speech that is related, like a conversation. Kurita (2012) provides various recommendations based on a review of recent studies for both advanced and beginner-level listeners. She recommends dictation, particularly for younger learners, and believes that lowering anxiety can greatly benefit both learners' listening skills. To further the literature, this study investigates the teacher's views of teaching English listening to young learners in an elementary school level.

In this study, two research questions are addressed:

1. What are the challenges do teachers have when teaching English listening comprehension to young learners in elementary school level?
2. What are the strategies teachers must use for deal with the challenges?

Literature Review

Studies concentrating on challenges in teaching English language skills have received a great deal of consideration. Pertiwi and colleagues (2022), for example, investigated the teachers' perceptions of teaching English to young learners in Indonesia to discover what challenges teachers experience in the classroom. This study used a case study design and a qualitative approach. The data was gathered through interviews with six English teachers from different educational institutions. According to the interview results, teachers face several challenges in implementing instruction, including non-English prior knowledge, a lack of interest, negative attitudes toward English, a lack of suitable learning materials, a chaotic classroom environment, and speaking anxiety. The researchers found that the teaching and learning process may exist conditionally if there is collaboration among teachers and other people, as well as teacher creativeness.

In addition, Utomo and colleagues. (2019) carried out more focused study on English listening skills at the junior high school level. They outlined the method of teaching listening and noted the challenges associated with doing this in a junior high school in Kudus. This study investigated the English language teaching and learning process and indicates the demand for English language materials using an exploratory research design and qualitative approaches. The subjects of this study were five English teachers in Kudus with more than ten years of teaching experience. According to the results of questionnaires and interviews, most teachers believed that time management was the most difficult aspect of organizing classrooms. Although the lesson plans have been established, there were instances when the plans were not followed specifically. Teachers must deal with learners who come from different backgrounds, have learning limitations, and mixed levels of proficiency. It was their primary responsibility to accommodate all learners. While most learners can learn a foreign language to a certain extent, there were also several reasons why their progress is not made substantially.

Another earlier study by Alrawashdeh & Al-zayed (2017) investigated the challenges faced by English teachers in teaching listening comprehension as well as their opinions toward the topic. To meet the research's goals, the researchers employed two instruments: informal interviews with seven English instructors who responded to three questions, and teacher surveys that examined the challenges teachers have when instructing listening comprehension. The findings demonstrate the numerous issues with listening comprehension teaching in schools. First, issues with teacher competence. They realized that the teacher needed more lesson plans to help them improve their poor performance. Second, discussions about educational environments and the availability of learning resources and learning aids are related to the decreasing number of students in classrooms and the increasing number of students enrolled in summer school. These resources include learning resources, learning aids, teaching materials, and audio-visual facilities that serve as English language laboratories.

The three studies including this one was similar in that all of them identified the difficulties teachers faced when teaching English. However, it was focused on elementary school-level listening abilities at this point. With teacher participants who attend both formal and non-formal educational institutions.

Research Methods

Research Design

This study employed a qualitative approach. Structured interviews were conducted, and the data was collected in written form using a Google Form. The researcher asked participants to respond in either English or Bahasa Indonesia to eight open-ended questions on challenges in teaching listening to young learners.

Participants

The participants in this research were six English teachers at the elementary school level from both formal and non-formal education backgrounds. They were selected voluntarily through an Instagram story where the researcher invited interested individuals to participate. Their teaching experience ranged from one to four years.

Data Analysis

Thematic analysis was used to examine the data in the present study. The researcher identified the code based on the transcript of the written interview that demonstrates the challenges that teachers face when teaching listening English to young learners. ln order for the researcher to gather more detailed information from the participants on how teachers manage all these challenges when teaching listening to their learners.

Results and Discussion

Teachers' Opinion About Teaching English Listening for Young Learners

According to the responses provided by the participants to the inquiry, "What is your opinion about teaching English listening comprehension at the elementary school level as you teach?", most teachers have the opinion that teaching young learners listening was fun but quite challenging.

(1) "In my opinion, teaching English listening comprehension to elementary school learners is one of the fun learning activities. Most learners prefer listening learning comprehension because it is more interesting than monotonous activities such as teachers who continue to explain learning verbally."
(2) "Teaching listening comprehension in elementary school is very important because it is at this age that they have to start giving lessons. But it's not easy to teach English at elementary school level, especially since they don't have any knowledge of English."
(3) "My opinion as I teach; the learners happy but it's too hard to understand what the speaker speak."

Despite a variety of challenges, it was discovered from multiple perspectives that teachers enjoyed what they did and thought listening was important. The researcher then reposed the question to participants, "What are the factors that make you enjoy teaching English listening comprehension?" to ascertain why teachers persevere in the face of several challenges.

(1) "It's a passion that comes from the deepest heart."
(2) "It's easy to find the sources especially the children song."
(3) "I love my children's joys. The way they are serious about listening to a song, the way they ask their friend to be quiet, and the way they wait for the chorus to sing the

song. I also think this way is one of a good step to improve their vocabulary and listening comprehension."

The sample responses lead to the inference that teachers find happiness in their profession because they are sincere and engage with their learners and since it is not difficult for them to find materials for elementary level.

Teachers' Challenges When Teaching English Listening for Young Learners

Following the teachers' opinions that there are many challenges in the classroom, the author attempts for information by asking the question "What challenges do you encounter when teaching English listening at the elementary school level?" to find out more about the challenges concern.

(1) "Sometimes the challenges take from of conditions such as learners lacking concentration."
(2) "The learners are not familiar with the native pronunciation."
(3) "Learners have difficulties in some vocabulary and how to spell the words. (E.g.: We listen 'The Wheels on the Bus's song, and they don't know how to spell 'Wheels')"

These responses indicate that the most frequently encountered challenges have to do with the skills of the learners. The researcher then asked, "Do the challenges teachers face come from the learners themselves?" for further verification.

(1) "No, the challenges are not only face come from the learners, but also come from the other, for example the situation and the teacher."
(2) "Yes, those challenges can arise from the learners themselves when they don't get enough understanding about listening."
(3) "Sometimes it comes from learners because teaching in the current generation has its own challenges, and you have to be patient with them."

The following analysis showed that, in these teachers' thoughts, most of the challenges began with the learners. However, this cannot imply that the teacher was the sole one who posed the challenge.

Teachers' Attitudes Towards the Challenges in Teaching English Listening for Young Learners

The question "How do you as a teacher overcome the challenges?" was utilized by the researcher to reconsider the data regarding teachers' strategies for overcoming the challenges that they experienced. Quite a few of the answers can be gathered by the researcher from this question.

(1) "I teach them using English for more than 50% during the lesson to improve their vocabulary and then influence their listening skill and their understanding."
(2) "I ask them to replay the song, if they have stuck, I give them a clue, or we guess the spelling together."
(3) "Usually, I introduce vocabulary, the meaning and way of pronunciation first. Then after that, I gave training by dictating/reading a sentence/paragraph that they had to write."

The challenges that teachers have when teaching listening appear to be multifaceted. Since learners are still young, teachers must also use more inventive methods to stimulate their

interest in learning. Some of these methods include teaching basic vocabulary, helping learners learn how to spell and become familiar with speaking English, and having teachers repeat song screenings during listening sessions to ensure learners can more immediately remember every spoken word.

In addition to these methods, the researcher was intrigued to learn if these teachers need help while handling the class. Through the question " Do you as a teacher need other teachers' help in handling the challenges? Why?" The researcher can discover more specific methods for overcoming these challenges.

(1) “No, I don't. Because I rarely meet another teacher, we manage our class by ourselves.”
(2) “Actually, I don’t need other teachers to help me handle the challenge. So far, I can handle it by myself.”
(3) “Of course, especially the child's parents and homeroom teacher. Parents and homeroom teachers can work together with English teachers to use English vocabulary in every conversation both at school and at home.”

Since they believe it is their responsibility, most teachers suppose they can overcome the challenges without assistance from others. Despite this, certain teachers also suggest that collaborating with fellow teachers is important. For young teachers, senior teachers with greater experience may have solutions to provide. Aside from that, this has an unbreakable connection to the parental role, as parents are expected to assist their learners in developing their skills at home.

Finally, after learning about the challenges that teachers face while teaching English listening to young learners, the researcher asked, "What are the suggested solutions to help your learners become good listeners and overcome negative attitudes?" to elaborate on the previous inquiry.

(1) “Having as much discussions as you can with your peer, listen to English podcasts, and always listen to the advice from your parents.”
(2) “Learners can be accustomed to doing things they like, such as watching English movie, listening to English songs/podcasts. Of course, this must be supported by their parents at home.”
(3) “We're not just giving them material that we have, but we’re also teaching them about manners, time management, independence, responsibility with everything that we already gave such as classwork and homework.”

Learners' interest in learning will be stimulated more when teachers engage with them consistently. Teaching listening skills might involve simple conversations, watching child-friendly movies, and listening to music and podcasts. Along with transferring information, educators encourage learners to follow the advice of their parents to act as an example of good behavior.

Conclusion

Based on the interviews, the teachers seemed to be pleased with their profession despite the numerous challenges they encountered when teaching and learning English listening to young learners. Beginning with the young learners’ limited knowledge of vocabulary. Since several learners still struggle with word spelling, teachers must go beyond what is necessary to help them understand. The next challenge is having issues concentrating in the classroom.

Particularly at this age when they still prefer to play over listening to lessons, young learners become easily distracted when learning in the classroom. Also, a lack of familiarity with the spoken language's pronunciation. Although almost all the listening material is provided by native speakers, EFL learners often have difficulty distinguishing accents that are still unfamiliar to them.

With this condition, the teacher tries to better understand each student's unique abilities. Listening and speaking in English can help with vocabulary growth and pronunciation practice. Following by playing the music more than once can help learners become familiar with the lyrics. To get learners motivated about learning, the instructor can offer hints when they are unable to determine the meaning of a word. If it is possible, the teacher can subsequently give a reward.

In addition to teacher roles, parents play a very important role in their children's education. Parents can help their children practice English at home and teach them the value of being polite to teachers and paying attention in class. Since they still spend a lot of time outside of school, which tends to be a setting that influences how they behave. Learning English, particularly listening, will be more effective if all parties involved are on board, including the parents of the young learners and the school.

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Contact email: munirotulfatimah.2022@student.uny.ac.id

The Impact of AI Writing Tools on Academic Writing: The Perspective of Higher Education Students in Indonesia

Noviyanti, Universitas Negeri Yogyakarta, Indonesia
Dwiyani Pratiwi, Universitas Negeri Yogyakarta, Indonesia
Suci Apriani, Universitas Negeri Yogyakarta, Indonesia

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Abstract
AI's advancement can raise the quality of students' writing and increase the demand for educators to understand how to use AI approaches in classroom to achieve educational success. In this study, researchers conducted the use of digital tools to organize the writing of higher education students. This expanding phenomenon has initiated discussions regarding the influence of technologies on the academic field. The primary goal of this study is to investigate types of AI writing tools and their impacts on academic writing. This research was conducted through a qualitative method using a case study design regarding students' perspectives on AI writing tools to assist their academic writing. Data were analyzed through thematic analysis and interpretation of the interview transcripts. The participants were six Indonesian students with different educational backgrounds (undergraduate, graduate, and postgraduate). The findings showed that students had pros and cons to the use of AI. They argued that AI had positive views as helpful tools for checking spelling, grammar, paraphrasing and summarizing, translating, proofreading, citing, and managing references. Despite these benefits, there are concerns regarding whether ideas from users are collected into the AI database and possibly shared with other users due to copyright and plagiarism issues. This question became their concern when students wanted to convey ideas to AI. It was concluded that AI's role in improving academic writing had a significant impact on generating ideas and revising students' writing. This research will be valuable for future investigations in exploring the utilization of AI in generating writing assignments.

Keywords: Academic Writing, AI Writing Tools, Higher Education, Impacts of AI Writing Tools

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Introduction

There is evidence that AI (Artificial Intelligence) plays a pivotal role in managing various aspects of education, especially in higher education context, including paperwork and individualized learning. Given AI's potential to raise the quality of education and the increasing demands on educators to understand and successfully use AI approaches in the classroom to achieve academic success (Zhai et al., 2021), further attention is required. Its practical, for instance, speeds up tasks such as building curriculum-based, distinctive designs for students, hence improving efficiency and flexibility in the learning process (Bisen et al., 2021). Moreover, it demonstrates that AI in academic writing is relevant to its practical use and is of concern when everyone relies on technology (Tang et al., 2024). With AI's ability to construct ideas and edit their writing for students, using it to help them complete their papers has also grown in popularity. With an extensive range of software and tools designed to aid writers in managing all aspects of the writing process, AI has become increasingly common in writing (Morrison, 2023). Several AI features have been proposed to make writing easier for students and scholars. In narrative writing, they demonstrate how AI and human beings may work together on any task up to the paraphrasing stage (Coenen et al., 2021).

Recent studies continue to debate the practical application of AI in writing, particularly for published works and academic writing. Many studies have been carried out regarding the impact of AI use. One of these includes the effects of AI on pedagogy, automation management, ethics, and social issues, which have spurred discussion on the possible application of AI and robotics in higher education (Cox, 2021). It has also previously been observed that students' usage of AI writing tools may improve the quality of their writing in many aspects. As Storey (2023) has argued, the investigations might become more accurate and reliable when AI is integrated into the dissertation writing process. Its usage in academic writing, for instance, significantly influences the learning environment and raises academic achievement, seen from the teachers' perspective (Marzuki et al., 2023). This milestone is also perceived in other parts of writing, such as the variety of words employed and its ability to rephrase the sentences cited.

Despite its integration helps in enhancing qualities like creativity, integrity, and critical thinking (Zhai et al., 2021), it also provides threats like the effect on laws concerning the copyright and the recognition of authors and ownership of AI-generated work (Mazzi, 2024). As stated by Castellanos-Gomez (2023), there is now a legitimate debate concerning the possibility that it should be used as co-author articles, which raises potential copyright issues. It is also related to the growing concern that individuals could abuse it to generate excellent writing and essays under their own names as AI technology advances and becomes more competent (Jarrah et al., 2023). In addition, its application greatly decreases accuracy concerning the paraphrase-writing phase when employing AI (Krishna et al., 2024). Indeed, as stated by (Gayed et al., 2022), guides for educators using AI for writing are also required to support the use of digital writing.

Unfortunately, studies addressing the impacts of AI writing tools on academic writing implementation in various English education students' educational backgrounds, from undergraduate to postgraduate in Indonesia, are still lacking. Scholars have encountered a range of impacts on the application of AI writing tools in education, both positive and negative sides. Since AI writing is an intrinsic technology, there is still much to learn about its applications, especially for English education students in Indonesia, and further discussion is needed.

This study seeks to understand the impacts of AI writing tools on academic writing by Indonesian higher education students, ranging from undergraduate to postgraduate. It focuses exclusively on the ways in which AI writing tools influence and enhance writers' writing practices at different phases, ranging from conceptualization and choices of words to AI's capacity to summarize or paraphrase their work. By examining the potential benefits and the drawbacks of its practices in greater detail and examining how they relate to integrity, honesty, and originality in writing, this study will contribute to a better understanding of how Indonesian students employ these actions.

This study aims to address the following questions:

RQ1: What are the types of AI Writing Tools Used by Higher Education Students in Indonesia?

RQ2: What are the Impacts of Using AI Tools Used by Indonesian Education Students for Their Academic Writing?

Literature Review

AI for Academic Writing

Artificial intelligence (AI) has had a significant impact on our daily lives, influencing our thought processes, behaviours, and interactions in profound ways (Chen et al., 2020). The engagement of artificial intelligence (AI)-based writing tools has attracted students to prepare their academic writing, suggest sentence structure and style recommendations, and facilitate content creation. The evolution of AI provides learners with personalized learning opportunities and tutors for written jobs to help them generate ideas and innovations. In 2022, the Journal of Nature indicated that researchers were already using chatbots as study aids to assist them organize their thoughts, receive feedback on their appointments, write code, and even outline study literature. Dergaa and colleagues (2023) reported that it has been evident that AI can create coherent language, and it is challenging to differentiate AI sentences from those made by humans (Dergaa et al., 2023). In addition, Tu and Nguyen (2023) also stated that artificial intelligence is a helpful instrument that can significantly reduce individuals' time and efforts spent on tasks and addressing problems.

The implications of AI-based tools for academic writing offer opportunities and considerations. The potentially positive impacts on writing showed a richness of insights to develop and be creative in exploring ideas (Mazzone & Elgammal, 2019) and improving languages with recommendations (Malik et al., 2023). Tools to produce student writing may be a threat in the future. As educators, we must have a comprehensive understanding (Gayed et al., 2022) and must explore how to apply the use of digital tools in student writing to prevent loss of originality in authorship and creativity. In addition, students' work has an impact on copyright and plagiarism. This phenomenon happens due to the ideas that are generated from digital writing tools need to be clearly referenced.

Higher Education Students' Perspectives on AI

Artificial intelligence (AI) is indispensable in modern academia, facilitating improvements in educational efficiency, effectiveness, and productivity (Baidoo-Anu et al., 2024). The use of computer-based applications and tools powered by artificial intelligence (AI) is becoming more common among educators and students at both the school and university levels. These include intelligent machines and adaptive learning systems. Technology-based learning offers

the potential benefits of facilitating personalized learning, enabling students to meet their needs (Chen et al., 2020).

The rapid advancement of new technologies forces industries worldwide to innovate continuously to remain competitive and relevant in the ever-changing global market. Students and lecturers are therefore called on to act as pioneers in integrating digital tools such as AI, ensuring that its safe and proper use is supported to benefit teaching and learning. A few studies reported that ChatGPT could be employed by students engaged in higher education as a tool for independent study. AI has the capacity to gather and convey knowledge. However, more initiatives need to incorporate AI into learning tasks about specific subject matter domains. Integrating AI into such tasks is of paramount importance, for it reflects the manner in which humans address real-world problems (Rashid & Kausik, 2024).

Methods

Research Design

This study was conducted through qualitative research using a case study, in which a small amount of data was gathered through observation, recordings, interviews, and documents (Travers, 2001). To address the research questions, the interview was conducted to gather students' perspectives on AI writing tools to assist their academic writing. The interview data collected was analyzed using thematic analysis techniques, which involved identifying codes and themes in the data obtained from the participants.

Data analysis techniques are explained in the following illustration.

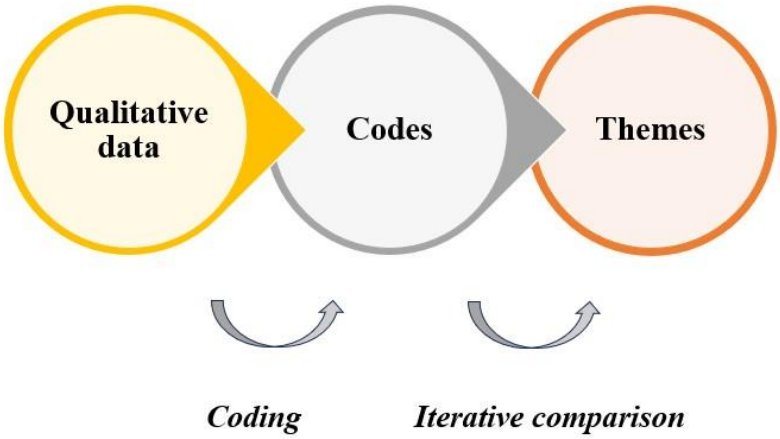

Figure 1: Research Design

Research Participants

This study focuses on the perspectives of students from various educational backgrounds, undergraduate to postgraduate, about using AI writing tools to support their academic writing. Six participants, two from each educational background, shared their views about the use of AI writing tools. The participants' demographic data is as follows:

Table 1: Participants of the Research

Name	*Gender*	*Educational background*	*Major*
HA	Female	Undergraduate student	English Education
UA	Female	Undergraduate student	English Education
SH	Female	Graduate student	English Education
AN	Female	Graduate student	English Education
MF	Male	English Education	Post Graduate
A	Male	Sport Science	Post Graduate

Instruments

We created two different kinds of tools to address the two research issues in this study, as well as the potential of AI as a tool with both benefits and drawbacks. We identify six concerns when examining the various forms and uses of AI to support academic writing. The kinds of AI functions in writing support and references that we employ to elicit additional information from participants are as follows.

Table 2: Types of AI Writing Tools

Theme	*Subtheme*	*References*
Spell and Grammar Checking	Types of accuracy User experience	Dale & Viethen (2021); Fitria (2021)
Online translation tools	Types and accuracy Lexical complexity	Burkhard (2023); Chung & Ahn (2022)
Paraphraser and summarizer tools	Types of the tools and accuracy	Burkhard (2023)
Proofreading and Editing Tools	Types of the tools and accuracy and writing errors	(Magulod Jr et al., 2020); Al-Ahdal (2020)
AI-based content generators	Types of the tools and accuracy and ethical concerns	(Burkhard, 2023); Anderson et al. (2023)

We identified six concerns when examining the various forms and uses of AI to support academic writing. The kinds of AI functions in writing support and references that we employ to collect additional information from responders are as follows.

Table 3: The Benefits and Drawbacks of AI Writing Tools

Theme	*Subtheme*	*References*
Potential Benefits of AI Writing Tools	Accessibility Efficiency and Feedback Synthesize Materials	Gayed et al. (2022); Algerafi et al. (2023); Almaiah et al. (2022); Dangin et al. (2023)
Drawbacks of AI Writing Tools	Originality of writing Creativity of writing Ethical consideration	Livberber & Ayvaz (2023); Makarius et al. (2020); (Almaiah et al., 2022);

Findings and Discussion

RQ1: What are the types of AI Writing Tools Used by Higher Education Students in Indonesia?

Many kinds of AI writing tools were put out by undergraduate, graduate, and post-graduate students with a range of educational experiences. Six purposes of AI, particularly used in academic writing, were identified by the researchers, spell and grammar checking, online translation, paraphrase and summarize, proofreading and editing, content generator, and citing and reference management. Undergraduate theses, theses, and articles for SINTA and Scopus-indexed publications are the types of academic writing produced by the students.

Table 4: AI Writing Tools Used by the Students

Students	*Spell and Grammar Checking*	*Online Translation*	*Paraphraser and Summarizer*	*Proofreading and Editing*	*Content Generators*	*Citing and Managing References*
HA	Grammarly	Google Translate	Quillbot	Microsoft Word	Chat GPT Perplexity	citethisforme.com MyBib
UA	Grammarly	Google Translate Quillbot	Quillbot	-	ChatGPT	Mendeley References
SH	Grammarly	ChatGPT DeepL	Quillbot ChatGPT Humata	Quillbot Grammarly Google Doc	ChatGPT	Mendeley References
AN	Thesaurus	Google Translate DeepL	Quillbot	Google Doc	ChatGPT Perplexity Notion	Mendeley References
MF	Grammarly	DeepL	Quillbot	-	Scite.AI	Mendeley References
A	Quillbot	Google Translate iOS Translation	ChatGPT	ChatGPT	-	Mendeley

The most common tool for students to check their spelling and punctuation is Grammarly. However, students also frequently find that it provides a lot of feedback when it come across complex sentence, even though their writing is grammatically correct.

RQ2: What are the Impacts of Using AI Tools Used by Indonesian Education Students for Their Academic Writing?

To examine both the benefits and the drawbacks of employing AI in academic writing, this section explored how higher education students in Indonesia use it. It discusses the broad and general viewpoints of six students from various educational backgrounds.

Potential Benefits of AI Writing Tools

Three areas were highlighted in the analysis of the potential benefits of using AI in assisting academic writing by students: the accessibility of each AI for each purpose, efficiency, and feedback, and the way AI writing tools synthesize the contents for writing.

1. The Accessibility of AI Writing Tools

We found accessibility to be one of the advantages of adopting AI writing tools for academic writing (Gayed et al., 2022). The majority of participants who shared their views on the availability of AI writing tools concurred that these tools are highly beneficial for writing, particularly when it comes to editing and proofreading.

> Yes, it supports producing writing. (HA)

Additionally, SHM clarified in its assistance to help writers write that this might also be a problem for humanity since we might grow overly reliant on AI. Despite its simplicity of use in assisting users with writing, AI poses a risk to people due to the potential for over-reliance. Furthermore, this concept of originality is a recent issue for academics.

> So far it really helps, even if we are careless, we can depend on AI. (SH)

> The impact is quite significant but it requires detailed writing that is not obtained through AI because it is based on my personal experience. (MF)

According to the majority of users, AI writing tools are helpful and readily available anywhere, at any time. When it came to employing AI writing tools to assist with their academic writing, none of the participants reported any issues when implementing it. Nevertheless, to develop their ideas, users must be proficient in precise writing, which is what the AI requires.

2. The Efficiency and Feedback Given by AI Writing Tools

On the effectiveness of AI writing tools and user feedback. Four issues are emphasized in this sub-theme. The first question concerns the participants' perceptions of AI as a tool that may enhance writing efficiency. There are four concerns found in this aspect.

Firstly, as a means of increasing writing productivity, according to several participants who voiced their ideas, the practicality of AI makes it highly beneficial to access the questions they pose, and access to journals is also possible.

> It can search for related references quickly; of course, it helps the author review an article quickly. Feedback in the form of relevant and trusted journal sources. (MF)

The second one is how AI writing tools are regarded as a technology that can assist in the development of writing or productivity and offer its users insightful feedback, particularly when it comes to identifying instances of plagiarism.

> Quite efficient, because sometimes now there is also an AI detector, it looks like we are just copying and pasting. Now, how do I learn a lot? I am also inquisitive, and now ChatGPT is getting more advanced to the point where it can give the sources, which is very beneficial for me. (UA)

> Maybe it depends on the person; the answer is efficient, in my opinion, because in terms of time, yes, from the knowledge, yes; for feedback, I want to, for example, if I want to search for this in detail, like the sources, even the book, for example, where to download it, right? It's the same as what we ask; it can be answered directly; sometimes, what we ask doesn't match what we want. (SH)

The third one is the involvement of users in the writing process for better quality. User instructions and directions impact AI's writing outcomes while exploring or generalizing ideas. Despite the benefits of AI tools for paraphrasing, hand paraphrasing remains the primary method for maintaining the writing's originality. There needs to be a balance maintained between depending on AI and controlling writing outcomes smartly from both AI and humans.

Lastly, users' satisfaction with AI writing tools sometimes does not meet their expectations. They think that occasionally while employing AI writing tools, the tools may need to provide the answers that users have requested accurately. As stated by the participants, it also increases the possibility that AI will cause issues with plagiarism in writing.

3. Synthesize and Materials

The way AI synthesizes user-provided materials is the third. Based on the data analysis findings and the themes identified in the interview data, three issues regarding the use of AI in material synthesis can be emphasized. The ability of AI writing tools to generalize user ideas or notions to get answers or explore their ideas is the first case. When coming up with writing ideas, users believe AI can respond to questions or orders from both a positive and negative perspective. Because users refrain from making precise or explicit inquiries, AI tends to generalize concepts unambiguously.

> AI can give more specific ideas depending on how clear the command is. (HA)

The second is practical academic writing, which includes references and citations specifically. AI writing tools respond to user commands with concepts, thoughts, or responses. It involves using AI as a citation tool to make academic writing easier. Users think that mentioning academic writing can be done more quickly with AI. It is the user's responsibility to confirm that the responses provided by AI are reliable and not computerized, as people also feel that too general AI responses are not providing the details that they want.

> Yes, the discussion is simple overall. Usually, I know what the subject is about, so I ask the chat what may be discussed about the certain theme. The answer is provided, but occasionally, it is too general so it is our responsibility to be specific to find more references. (SH)

The last is the incapability of AI writing tools to expand on user-provided ideas. They contend that there are still cases in which AI writing tools are unable to connect concepts with writing structure. It lacks specificity and simply concentrates on broad topics. They think that humans and AI still speak differently at times and that AI might not comprehend user intent or inquiries.

> There is less bridging between ideas and writing organization. Because AI only focuses on general things, not as detailed as what humans do. It is based on my personal experience. (MF)

When using AI in writing, particularly for academic writing, humans occasionally have limitations when it comes to synthesizing user-provided ideas for writing. They assert that AI has limitations in providing replies, meaning that not all of the information we provide can be fully comprehended by AI.

Drawbacks of AI Writing Tools

In addition to serving as a writing assistant, AI writing tools fall short in offering users a comprehensive range of benefits. This is because AI and technology have the potential to endanger humans. After examining the potential drawbacks of AI writing tools, researchers discovered that there are at least three issues that could arise. Three points, originality of the writing, creativity, and ethical consideration, are also emphasized in this study's analysis of the drawbacks of employing AI writing tools. The following explanation applies to the theme analysis of the interview.

1. The Originality of Writing

Every participant has a distinct perspective on how to avoid plagiarism and preserve the originality of their writing when using AI writing tools to write an article. The first is the feeling that users or students are dependent on AI writing tools for their writing. This issue comes up because AI can easily provide any response. Furthermore, relying too heavily on AI may raise concerns about the quality of writing. Students' or scholars' critical thinking abilities and academic work will be doubted.

> If students use AI too often, it is feared that they will feel dependent on the tool, which can affect the quality and skills of students' writing as well as originality because it involves too much AI in writing. Teachers can educate about plagiarism and implement clear policies and consequences for students whose work is proven to contain a lot of plagiarism. (HA)

The second is users' uncontrolled use. Users are prompted to contribute by writing and compiling articles. Excessive use not balanced by personal ideas can weaken critical thinking abilities and worsen people's writing. When using AI to make their work easier, participants contended that each person's initiatives must also be considered.

2. The Creativity of the Sentences

The second issue concerns the writer's originality in exploring and developing the phrases or sentences. This challenge presents two concerns: the lack of filtering of responses or writings by students and the incompatibility of AI-generated solutions with field data. First, they argue that most people still rely on AI without filtering the data provided. They feel that relying on AI does not mean copying and pasting, but how AI writing tools can assist and explore ideas. They demonstrate that, although certain negative aspects of AI in generating responses, the input of each human should remain the main foundation in writing.

> I sometimes filter out what ChatGPT provides, but I rely on ChatGPT and AI. However, as previously said, it can be overly generic at times and fail to match. It implies it's not as detailed as we'd want. Therefore, I filter and test it thoroughly, just like I would with other sources. (SH)

The second is AI's inability to offer adequate answers. Participants believed that most AI-generated answers could not be more specific and were still excessively broad. In addition to AI processing, individuals had to search for more relevant and reputable sources manually.

> I sort it out because AI concepts can be too robotic, as if they don't comprehend, or aren't human. (UA)

> Still need to read the AI-provided literature and modify the field data to real-time conditions in order to provide a thorough discussion. (MF)

3. Ethical Considerations

The primary challenge pertains to collecting human ideas within the AI database and vice versa. A participant expresses concern regarding the potential for AI to serve as a repository for ideas to be integrated into its database, similar to how humans extract ideas at no cost from AI.

> Yes, I also have concerns about whether my ideas will end up in the database or to the people who ask. I also limit myself from giving or asking for everything in the chat. (UA)

The second is the occurrence of original works that are easily spreadable. Artificial intelligence's simplicity of use may also be abused concerning potential plagiarism. AI-generated content can be claimed or copied by others. It raises questions about the person's character and integrity.

> In my opinion, misusing AI, such as producing fake works, spreading irrelevant data, or copying, can be problematic. People can ethically claim AI work as their own, which raises doubts about integrity. It is crucial to employ AI sensibly and truthfully if it is not used transparently. (AN)

The final issue is the lack of AI detectors for tracking and identifying writing. Overuse can also run the danger of harming creativity and critical thinking abilities, and it might raise doubts about a work's originality.

> When there is no supervision and AI detector, it will undoubtedly raise concerns regarding the originality and level of creativity of a piece of writing. (MF)

Conclusion

AI has become more and more involved in scholarly contributions over time. Considering the benefits and drawbacks of AI itself, the application of AI in the industry is becoming a significant topic for discussion. This study investigates two research questions concentrating on the different types of AI writing tools Indonesian students use and their points of view regarding both the benefits and drawbacks of AI's use in higher education. According to the analysis's findings, Chat GPT is the most often used AI, particularly among Indonesian students, primarily because of its primary purpose of generating content. Students believe that using Chat GPT for writing is a great way to explore concepts and find answers.

Although students frequently use Grammarly, another well-known AI writing product, such as Ms. Word Translation, may also be a choice. Additionally, Mendeley References is the most popular citation tool of all the AI technologies that students utilize, particularly for academic writing.

Analyzing the use of AI technologies for academic writing reveals benefits and drawbacks for users. These resources are beneficial for proofreading, translating, paraphrasing, and even citation. The advantages include time efficiency, feedback, easy access to the instruments utilized, and how AI aids in material synthesis. Regarding the drawbacks, particularly the

text's originality, users will likely continue depending on AI for unrestricted writing use. If AI users incorporate AI concepts into their writing without filtering them, their originality may be questioned.

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An Empirical Analysis of Islamic Leadership: Mediating Role of Teacher Well-being

Rita Pusvitasari, King Mongkut's Institute of Technology Ladkrabang, Thailand
Chantana Viriyavejakul, King Mongkut's Institute of Technology Ladkrabang, Thailand
Piyapong Sumettikoon, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
Purpose: This study investigates how Islamic leadership affects teacher well-being, commitment, and performance. Further, this study examines teacher well-being's mediating function in the relationship between Islamic leadership and commitment.
Design/Methodology/Approach: Data from 237 teachers at private Islamic schools in the border south of Thailand were gathered via a self-administered survey. This study's data evaluation method utilized SPSS and structural equation model-partial least square (SEM-PLS).
Findings: The findings of the path analysis showed that Islamic leadership (ISL) positively affects teacher well-being and commitment. ISL insignificantly affects performance—teacher well-being positively intercourse between commitment. In addition, teacher well-being has mediated Islamic leadership and commitment. Utilizing importance-performance map analysis (IPMA) and SEM-PLS demonstrated that Islamic leadership and commitment are critical factors in determining teacher performance at private Islamic schools. Therefore, Islamic leadership (ISL) encourages teachers' well-being to enhance their performance through commitment to reaching the organization's goals.
Originality/Value: This research provides novel insights into the theory and practice of Islamic leadership at private Islamic schools. Furthermore, empirical data is provided to support the proposed paradigm. The study also provides evidence for the teacher's well-being mediation role in Islamic leadership, commitment, and performance.

Keywords: Islamic Leadership, Teacher Well-being, Commitment, Performance

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Introduction

Leadership is crucial in determining the dynamics and results of the organization. Effective leadership is essential in the educational setting for attaining academic achievement and creating a supportive work climate that enhances teachers' performance, commitment, and well-being. A different leadership paradigm that can meet the particular cultural and spiritual requirements of educators in settings where Muslims predominate has recently gained popularity in Islamic leadership. A solid moral compass, a feeling of collective responsibility, and an emphasis on the whole development of the individual define this type of leadership.

A network of Islamic institutions serves the educational and spiritual needs of the community in southern Thailand, home to a sizable Muslim population. These schools are distinctive in offering students a comprehensive education by fusing academic courses with religious teachings. Islamic leaders lead these institutions, create an environment consistent with Islamic beliefs and principles, and oversee academic governance. Islamic leadership strongly emphasizes virtues like justice, integrity, compassion, and consultation since it is based on the teachings of the Quran and the Sunnah. Leaders who uphold these values must be role models, encouraging their organizations and students to pursue greatness and moral integrity. This leadership approach is especially pertinent in Islamic schools, where teachers' professional and spiritual growth are closely linked to their observance of Islamic principles.

The growing complexity of educational settings, especially in Islamic institutions, necessitates leadership that considers teachers' overall well-being in addition to administrative and instructional difficulties. Teachers frequently deal with high levels of stress, task demands, and emotional exhaustion, all of which can harm their well-being and, in turn, their dedication and output. Teachers may feel less engaged, have lower job satisfaction, and perform worse if they do not have effective leadership that meets their emotional, mental, and spiritual requirements.

Islamic leadership provides a leadership approach that may help with these issues because of its focus on moral, ethical, and spiritual principles. However, there is a dearth of empirical data regarding how Islamic leadership affects teachers' well-being and whether or not this well-being improves their dedication and output. In particular, little research has been done on the mediating function of teacher well-being in the connection between Islamic leadership and teacher commitment. This study investigated two queries:

1. How does Islamic leadership influence teacher well-being, commitment, and performance?
2. Does teacher well-being mediate influence Islamic leadership and commitment?

Literature Review

Islamic Leadership

Islamic leadership is based on the values of Tawhid (the oneness of God), Adl (justice), and Taqwa (piety). It is distinguished by moral behavior, justice, consultation (Shura), and responsibility (Karim et al., n.d.). These guidelines influence how administrators and teachers interact, which affects the school's general climate and organizational culture (Ezzani et al., 2023). Islamic leadership fosters a welcoming atmosphere where educators feel appreciated and respected by strongly emphasizing compassion, justice, and moral integrity. This kind of leadership might lessen stress and burnout, which are frequent problems in the teaching

profession. Research indicates that work happiness and emotional health increase when leaders show concern and care for their teachers (Hoogeveen et al., 2023; Sak et al., 2024). Teachers feel more invested in and committed to the school when they participate in decision-making processes, which is made possible by the *Shura*, or consultation, principle (Abdel-Monem et al., 2020). Studies reveal that dedication to the establishment grows when educators acknowledge and appreciate their opinions (Heidari et al., 2022; Hosseingholizadeh et al., 2023). Islamic leadership places a strong emphasis on Amanah, or trustworthiness. This encourages leaders to be open and reliable, motivating educators to devote more time to their jobs (Chaudhary et al., 2023). Effective Islamic leadership could bring higher satisfaction, motivation, performance, positive energy, and organizational loyalty (Karadağ et al., 2020). It can positively influence followers' attitudes by conducting various managerial activities based on ethical standards (Brooks et al., 2020). Therefore, we hypothesized.

- H1: Islamic leadership positively and significantly impacts teacher commitment
- H2: Islamic leadership positively and significantly impacts teacher well-being
- H3: Islamic leadership positively and significantly impacts teacher performance

Teacher Commitment

Teacher commitment indicates the level of commitment and caring a teacher has for their pupils, career, and educational establishment (Abdulaziz et al., 2022). Commitment to the teaching profession, the school, and student success are only a few elements it includes. Committed to their work, they dedicate time, energy, and emotional resources to fulfilling their teacher responsibilities, considering it more than a job (Brooks et al., 2020). Teacher commitment could boost performance and connect it to other organizational phenomena (Van Waeyenberg et al., 2022). An organization's members maintain better performance levels as their levels of commitment rise (Karrasch, 2017; Shu, 2022). Woods (2021) and Al-Maamari and colleagues (2021) revealed that teacher commitment positively influences job performance. In light of this, we developed the following hypothesis.

H4: Teacher commitment directly influences on performance

Teacher Well-being

Teacher well-being encompasses educators' standards for their personal, professional, and interpersonal lives. The emotional component is essential to a teacher's well-being within the educational cycle (Dreer, 2024). Well-being is vital for teachers to effectively educate at various levels since it can encourage creativity and build positive relationships with students, improving students' success (Benevene et al., 2020). Higher levels of well-being among educators are associated with stronger emotional ties to their jobs and organizations. Due to their increased sense of fulfillment and satisfaction in their careers, this attachment encourages loyalty and dedication. Positive feelings like happiness, excitement, and contentment increase the likelihood that teachers will be involved in and committed to their profession (Huang et al., 2019; Thien & Lee, 2022). Teachers who are in good health are more productive in the classroom (Zee & Koomen, 2016). They can create dynamic and exciting courses and improve the learning environment for students when they are in a positive emotional. Teachers who are happy and feel well-supported to teach with passion and inventiveness directly affect students' results and teachers' performance (Cuevas et al., 2018). Teachers' ability to continuously provide high-quality education depends on their well-being, and practical instruction is a significant component of their performance (Carroll et al., 2021; Chen & Chi-Kin Lee, 2022). Thus, we hypothesized.

- H5: Teacher well-being positively and significantly influences teachers’ commitment

- H6: Teacher well-being positively and significantly influences performance
- H7: Teacher well-being mediated relationship between Islamic leadership and commitment

Methodology

Participants

Two hundred thirty-seven teachers' questionnaires were from Islamic private schools in Songkhla and Narathiwat provinces, South Thailand. Based on the analysis, gender has 99 males and 138 females. The range of teachers' ages is 21 to 55 years old. The education background is 189 bachelor's and 48 master's degrees (see Table 1).

Table 1: Demographic Data

		Frequency	Percent
Gender	Male	99	41.8
	Female	138	58.2
Age	21-26	23	9.7
	27-32	64	27.0
	33-38	73	30.8
	39-44	37	15.6
	45-50	15	6.3
	51-55	25	10.5
Education	Bachelor's degree	189	79.7
	Master's degree	48	20.3

Data Analysis

The researchers used two statistical tools, partial least squares (PLS), also known as variance-based SEM via SmartPLS 3.0 software, and descriptive statistics using SPSS to verify the validity and reliability of the current conceptual framework and test its hypothesized relationships. The PLS-SEM modeling procedure consisted of two primary components (Hair Jr. et al., 2020). The first step was evaluating the measurement model to look into the proposed model's psychometric characteristics. After the measurement model was carried out, the structural model was assessed to examine the proposed relationships, and its psychometric qualities were confirmed (Hair Jr. et al., 2020).

Results

Measurement Model

The measuring model was used to evaluate the psychometric qualities of the current model before the hypothesized model was put to the test. Four factors that made up the measuring model for this study were Islamic leadership (ISL), teacher well-being (TW), commitment (CT), and performance (PF) (Figure 1).

Hair and colleagues (2020) states that factor loadings for each variable and average variance extracted (AVE) for each latent construct, which should be >0.60 and >0.5, can be used to access the convergent construct validity. Construct reliability can be evaluated by looking up the composite reliability (CR), which needs to be more than 0.7. As shown in Table 2, all of

the constructs in the current investigation had AVE values better than 0.5 and composite reliability values greater than 0.7. As a result, all loadings kept in the model were above the cut-off value (0.60) after eliminating all the problematic elements. The recommended values for AVE and CR were >0.50 and >0.70, respectively. Thus, there were no problems with the measurement model's reliability or convergent validity in the current investigation.

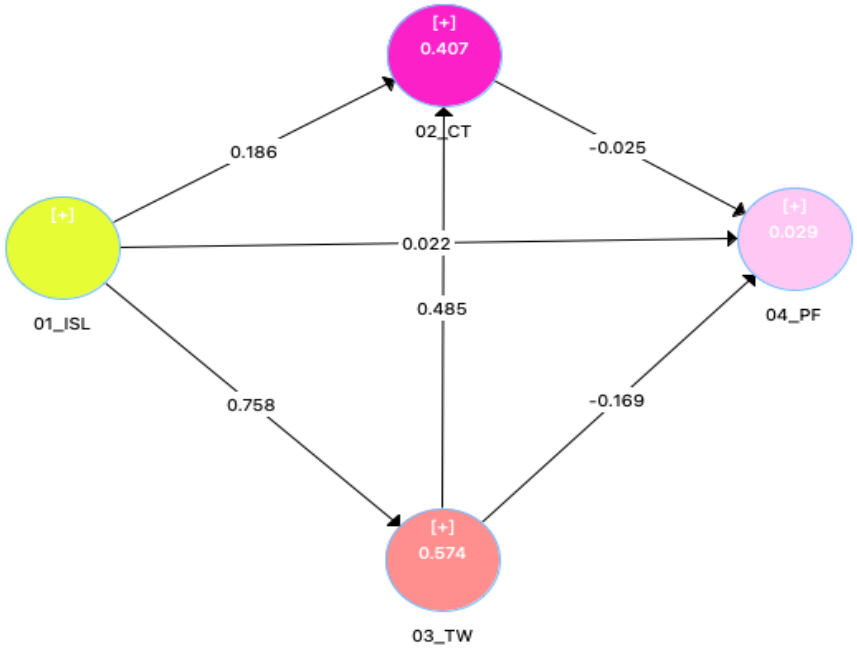

Figure 1: Measurement Model

Table 2: Descriptive Statistics of Variables

Construct	Items	Loading	CR	AVE
Islamic Leadership (ISL)	ISL-01	0.748	0.907	0.709
	ISL-04	0.865		
	ISL-06	0.867		
	ISL-08	0.881		
Teacher Well-Being (TWB)	TW-01	0.883	0.906	0.707
	TW-03	0.903		
	TW-07	0.805		
Teacher Commitment (CT)	CT-01	0.840	0.899	0.748
	CT-02	0.811		
	CT-03	0.831		
	CT-04	0.878		
Performance (PF)	PF-01	0.765	0.910	0.772
	PF-02	0.928		
	PF-03	0.933		

Furthermore, the AVE was checked to determine the divergent validity, a prerequisite for evaluating the measurement model (Hair Jr. et al., 2020). For divergent validity to be

established, the extracted average variance must be higher than the squared correlations. The square root of the AVE was compared with the correlations as an additional method of evaluating the measurement model's discriminant validity (See Table 3). Therefore, given that the requirements were satisfied, the discriminant validity of the current model was guaranteed. The results demonstrated a legitimate and trustworthy measurement model, enabling the researchers to proceed with PLS-SEM's second phase, which involves verifying the proposed model.

Table 3: Discriminant Validity

		ISL	CT	TW	PF
Fornell-Larcker Criterion	ISL	*0.842*			
	CT	0.554	*0.841*		
	TW	0.758	0.626	*0.865*	
	PF	-0.120	-0.119	-0.168	*0.879*
Heterotrait-Monotrait Ratio (HTMT)					
	ISL				
	CT	0.626			
	TW	0.879	0.729		
	PF	0.141	0.118	0.181	

Note: The square values for the AVE of each variable are shown in bold.

Structural Model

Examining the structural hypothesized or inner model was the next stage in performing the variance-based SEM analysis. Before analyzing structural links, assess collinearity using the variance inflation factor (VIF) to guarantee objective regression results. Less than three should be the VIF value (Hair Jr et al., 2020). This investigation had no collinearity issue because the VIF value was below the designated level (1.000–2.750) (See Table 4). In addition, the structural model's evaluation criteria comprise effect size (f^2) and the coefficient of determination (R^2). F^2 is categorized as significant when it exceeds 0.35, medium when it surpasses 0.15, and small when it is less than 0.03 (See Table 5). This allowed one to look at the links suspected by the investigation. Therefore, the researchers proceed to the following phase, employing Smart-PLS version 3 to explore the hypotheses after justifying the psychometric qualities regarding the model's construct reliability and validity. Following Hair and colleagues' (2020) recommendation, a bootstrapping technique with a resample of 10,000 was applied.

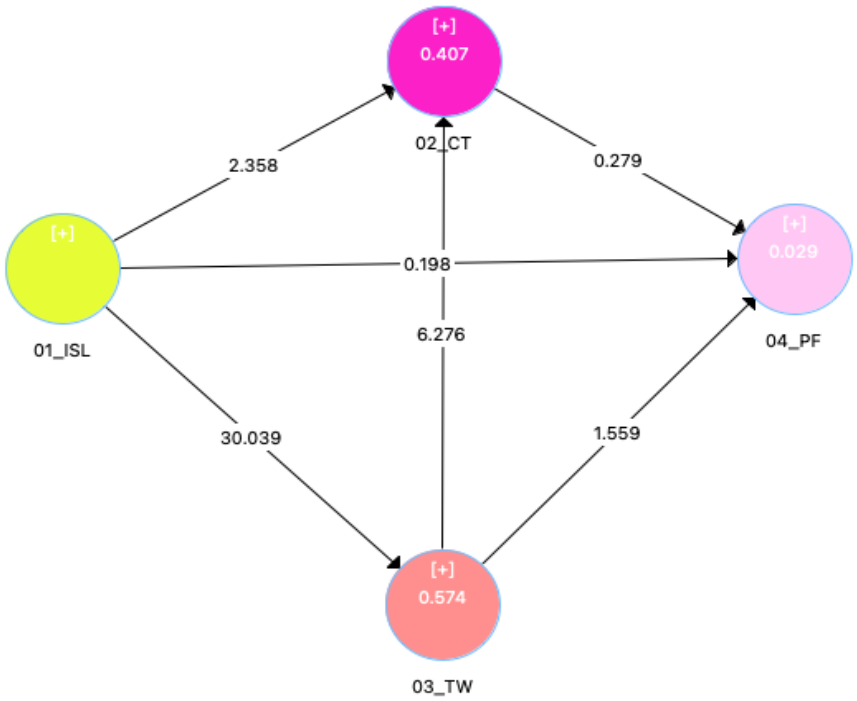

Figure 2: The Structural Model

Hypothesis Testing

The structural model assessment yields the hypothesis test findings, as Table 4 illustrates. First off, both H1 and H2 were statistically significant ($p<0.05$) in terms of the variables that directly affect teachers' commitment. H1 is the relationship between Islamic leadership and teachers' commitment ($\beta=0.186$, $t>1.96$, $p<0.05$), while H2 is the intercourse between Islamic leadership and teachers' well-being ($\beta=0.758$, $t=30.039$, $p<0.05$). Islamic leadership positively and insignificantly influences performance ($\beta=0.022$, $t=0.198$, $p>0.05$). Second, all two hypotheses, H4 and H6, were rejected concerning the factors that positively and insignificantly influence performance. H4 is the relationship between teachers' commitment and performance ($\beta=-0.025$, $t=0.279$, $p>0.05$), and H6 is the relationship between teacher well-being and performance ($\beta=-0.169$, $t=1.559$, $p>0.05$). Third, teacher well-being positively and significantly influences teachers' commitment ($\beta=0.485$, $t=6.276$, $p<0.05$). Thus, H5 was statistically significant. H7 is supported for teacher well-being mediated positively and significantly impacts on Islamic leadership and commitment ($\beta=0.368$, $t=5.790$, $p<0.05$).

Table 4: Hypothesis Result

	Hypothesis	Beta (β)	T-value	VIF	P-value	Decision
H1	ISL -> CT	0.186	2.358	2.347	0.018	Yes
H2	ISL -> TW	0.758	30.039	1.000	0.000	Yes
H3	ISL -> PF	0.022	0.198	2.405	0.843	No
H4	CT -> PF	-0.025	0.279	1.686	0.780	No
H5	TW -> CT	0.485	6.276	2.347	0.000	Yes
H6	TW -> PF	-0.169	1.559	2.744	0.119	No
H7	ISL -> TW-> CT	0.368	5.790		0.000	Confirmed

Table 5: Effect's Size (f^2) and Coefficient of Determination (R^2)

	Hypothesis	f^2	R^2
H1	ISL -> CT	0.031	0.025
H2	ISL -> TW	1.373	1.347
H3	ISL -> PF	0.006	
H4	CT -> PF	0.005	
H5	TW -> CT	0.179	0.169
H6	TW -> PF	0.016	

IPMA

IPMA was utilized to assess constructs with high significance and performance at an average to low level (Hair Jr. et al., 2020). The significance and performance values for the target constructs of teachers' performance are shown in Table 6. The highest priority for commitment is 0.686, with Islamic leadership coming in second (0.617). In the meantime, both structures perform about average. Because of this, putting Islamic leadership and commitment first is essential for increasing teachers' performance, considering their noteworthy significance despite average performance.

Table 6: IPMA

	Teachers' Performance	
Construct	Important	Performance
Islamic Leadership	0.617	72.526
Teacher Well-Being	0.360	77.239
Commitment	0.686	79.213
Performance	-	47.831

Discussion

The research findings found that Islamic leadership positively correlated with commitment and teacher well-being. Prior studies indicate Islamic ethical principles, commitment (Budur, 2024), instructional leadership (Hallinger et al., 2018), and spiritual leadership are associated with well-being (Binu Raj et al., 2023; Li et al., 2024). Teacher well-being positively mediated Islamic leadership and commitment. Islamic leadership produces an atmosphere where teachers are emotionally and intellectually committed to their jobs and content with their positions (Amaliah et al., 2015; Bibi et al., 2019). Dedicated teachers are more likely to find fulfillment in their work, positively affecting their well-being and mental health. On the other hand, teachers in good health are more likely to remain dedicated to their jobs, perform better, and favorably impact the school's performance. IPMA analysis indicates that Islamic leadership and commitment enhance the performance of teachers.

Conclusion

Islamic leadership significantly improves the commitment and well-being of teachers. Such leadership strongly emphasizes justice, compassion, and respect for one another by creating a morally sound environment based on Islamic principles. Teachers' commitment to their jobs and obligations is strengthened by this method, which also improves their moral and spiritual well-being. Islamic leadership, teacher well-being, and commitment may not always result in quantifiable gains in teacher performance, but it successfully creates an ethical and encouraging work atmosphere. Other elements, including resources, instructional techniques,

and organizational objectives, may significantly impact performance outcomes. The state of well-being among teachers has a significant effect on commitment. Teachers in a state of well-being are defined as having a good work-life balance, emotional support, and job satisfaction to be dedicated to their jobs. A strong sense of connection to the school is fostered by a positive state of well-being, which increases teachers' commitment and loyalty. This link emphasizes prioritizing teacher well-being to boost commitment, resulting in a more reliable and driven teaching profession.

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Contact email: chantana.vi@kmitl.ac.th

Academic Writing Across Traditions: How Doctoral Candidates Navigate Local and International Research Paradigms in Kazakhstan

Askat Tleuov, KIMEP University, Kazakhstan

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Abstract
In an increasingly globalized academic environment, doctoral candidates in Kazakhstan face the challenge of navigating parallel research paradigms—local scholarly traditions and international academic standards—particularly as the country aligns its higher education system with Bologna Process requirements. This study employs interpretative phenomenological analysis to explore how eight recent PhD graduates in humanities and social sciences, who have published in both local and international venues, reconciled these divergent expectations in their dissertation writing and publication endeavors. Data collected through semi-structured interviews in March 2024, analyzed via thematic and constant comparative techniques, revealed three interlinked themes: initial recognition of divergent writing expectations, development of adaptive writing strategies, and navigation of publication-specific challenges. Participants' strategies progressed from basic adaptations—such as creating separate sections for national policy references and international theoretical debates—to more sophisticated, integrative approaches that synthesized the practical and theoretical dimensions of their work. These adaptive frameworks enabled candidates to respond effectively to diverse supervisory feedback, satisfy local regulatory requirements, and position their studies within broader global research conversations, while meeting publication demands in both local and international journals. Ultimately, this negotiation process facilitated the emergence of integrative scholarly identities, demonstrating that navigating parallel research paradigms can strengthen doctoral candidates' writing practices and enhance their engagement with multiple academic audiences. The findings contribute to discussions on academic literacies, scholarly identity formation, and global-local knowledge dynamics, offering insights for doctoral programs in transnational contexts.

Keywords: Parallel Research Paradigms, Kazakhstani Doctoral Education, Academic Writing Development, Scholarly Identity Formation, International Publishing

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Introduction

The landscape of doctoral education has transformed dramatically in recent decades, shaped by the forces of internationalization and globalization. This transformation has created new opportunities for cross-border collaboration and knowledge exchange while introducing complex challenges for doctoral candidates navigating diverse academic traditions. In particular, the demands of writing for different academic audiences have become increasingly significant as doctoral students engage with multiple research paradigms and scholarly communities.

The internationalization of higher education has reshaped doctoral education through enhanced mobility programs, cross-cultural partnerships, and evolving academic standards. These changes have fostered rich opportunities for knowledge exchange and intercultural learning (Cutri & Pretorius, 2019; Kraja et al., 2024). At the same time, this transformation has introduced complexities, particularly in contexts where traditional academic models intersect with emerging international standards. Doctoral candidates must now develop complex approaches to academic writing that accommodate diverse scholarly traditions and reader expectations (Brinkschulte et al., 2018; Golebiowski, 2018). This challenge is particularly pronounced in multilingual contexts, where scholars must navigate not only different languages but also distinct rhetorical structures and communicative goals (A. S. Canagarajah, 2006; Englander, 2014).

The evolution of doctoral education in Kazakhstan exemplifies these global-local dynamics. Since gaining independence, Kazakhstan's higher education system has undergone substantial reforms aimed at aligning with international standards while preserving national characteristics (Agbo et al., 2023; Nurgaliyeva et al., 2025). These changes have particularly affected doctoral education, as the country transitions from its Soviet-era system to a Bologna-aligned model emphasizing research-based PhD degrees. The transformation has introduced new requirements for doctoral candidates, including the need to publish in both local and international venues (Auanassova, 2023; Fimyar et al., 2023). This dual expectation creates unique challenges for doctoral students who must navigate parallel research paradigms and different academic writing traditions.

Despite growing scholarly attention to doctoral education in international contexts, gaps remain in our understanding of how doctoral candidates navigate parallel research paradigms in their academic writing practices (Kimmons & Johnstun, 2019; Kivunja & Kuyini, 2017). While previous research has examined the challenges of working across different research paradigms, these studies have primarily focused on methodological choices rather than the lived experiences of doctoral candidates managing multiple academic writing traditions. Moreover, the experiences of scholars in Central Asian contexts remain largely unexplored, despite the region's unique position at the intersection of various academic traditions (Frick & Pyhältö, 2022; Waheed et al., 2021).

The present study addresses these gaps by examining how doctoral candidates in Kazakhstan navigate parallel research paradigms in their academic writing practices. This investigation is guided by the following research question: *How do doctoral candidates in Kazakhstan navigate parallel research paradigms in their academic writing practices across local and international academic contexts?* Through semi-structured interviews with eight recent PhD graduates who have published in both local and international venues, this investigation reveals how scholars develop strategies to navigate different academic expectations. The study's timing, coinciding

with developments in Kazakhstan's academic publishing requirements, provides insights into how doctoral candidates adapt to evolving institutional demands while maintaining scholarly integrity.

Drawing on academic literacy theory, scholarly identity formation frameworks, and perspectives on global-local dynamics in knowledge production, this study employs an interpretative phenomenological analysis approach to understand participants' lived experiences. This theoretical integration provides a framework for examining how doctoral candidates develop their academic writing practices while negotiating different scholarly traditions. The analysis reveals scholars' progression from initial recognition of divergent expectations through the development of intricate writing strategies to successfully navigate publication requirements in different academic contexts.

The findings from this investigation contribute to both theoretical understanding and practical applications in doctoral education. The project attempts to shed light into how emerging scholars navigate parallel research paradigms. Additionally, the study offers insights for improving doctoral writing pedagogy and support systems. It advances our theoretical understanding of academic writing development in contexts characterized by competing scholarly traditions. The focus on humanities and social sciences disciplines, where theoretical and methodological negotiations are particularly complex, provides insights for institutions supporting doctoral candidates across different academic traditions.

Methods

This study employed a qualitative research design utilizing interpretative phenomenological analysis (IPA) to examine how doctoral candidates in Kazakhstan navigate parallel research paradigms in their academic writing. The selection of IPA as the methodological framework aligned with the aim to understand participants' lived experiences while acknowledging the dual role of the researcher in making sense of participants' meaning-making processes (Smith & Osborn, 2015). This methodological choice facilitated a deep exploration of the complexities inherent in navigating multiple academic traditions.

Research Context and Participant Selection

Situated within the context of Kazakhstani higher education institutions operating under the national regulatory framework for doctoral education, this investigation adopted a purposive sampling approach (Patton, 2017). Through this sampling strategy, I recruited eight recent PhD graduates (designated as Participants A through H) who had successfully defended their dissertations in humanities and social sciences within the past two years. The deliberate selection of this two-year timeframe served multiple purposes: it ensured participants could provide detailed accounts of their experiences while their memories remained fresh yet afforded sufficient temporal distance for meaningful reflection on their doctoral journey. Moreover, this period coincided with developments in Kazakhstan's academic publishing requirements, thereby offering insights into how doctoral candidates navigated these evolving expectations.

The selection criteria stipulated that participants must have defended their dissertations in Kazakhstani institutions and published both in local journals from the approved list of the Ministry of Education and Science and in international peer-reviewed journals with impact factors, as mandated by national regulations. The deliberate focus on humanities and social

sciences emerged from these disciplines' distinctive challenges in reconciling local and international academic traditions, particularly regarding theoretical frameworks and methodological approaches.

Data Collection

The primary data collection instrument comprised semi-structured interviews, an approach that facilitated both coverage of key topics and exploration of emerging themes (Brinkmann, 2016). Through an iterative development process, the interview protocol emerged from pilot interviews with two doctoral candidates and incorporated feedback from senior researchers well-versed in the Kazakhstani doctoral education system. This carefully crafted protocol encompassed five principal thematic domains: demographic background, doctoral study experience, dissertation defense process, perspectives on research quality, and research dissemination practices. The questioning strategy progressed methodically from descriptive to increasingly analytical inquiries. This encouraged participants to engage in reflection about their experiences navigating differing academic expectations and research paradigms.

The data collection phase commenced in March 2024 and continues to evolve. From an initial pool of 42 potential participants meeting the established criteria, eight have thus far contributed through interviews. The ongoing recruitment and interview process adheres to theoretical sampling principles, proceeding until theoretical saturation materializes—that critical juncture at which new interviews cease to yield substantively novel insights into doctoral candidates' navigation of parallel research paradigms (Charmaz, 2006).

Each interview spanned 60 to 90 minutes and was conducted in the participant's preferred language (Kazakh, Russian, or English), acknowledging the inherently multilingual nature of Kazakhstan's academic environment. All interviews underwent audio recording with participant consent and subsequent verbatim transcription. For narratives captured in Kazakh or Russian, certified translators performed the English translation, with rigorous back-translation verification ensuring semantic fidelity.

Data Analysis

The analytical framework integrated thematic analysis, following Braun and Clarke's (2006) six-phase approach, with elements of constant comparative analysis (Kolb, 2012). This methodological synthesis facilitated the identification of patterns in participants' navigation of parallel research paradigms. The analytical journey commenced with open coding of the initial three transcripts, from which emerged a preliminary coding framework subsequently applied to the remaining narratives. Dedoose, a web-based qualitative data analysis platform, supported the organization, coding, and analysis of the dataset while maintaining a comprehensive audit trail.

The pattern identification process unfolded across three distinct analytical planes. Initially, I identified recurring linguistic and conceptual elements across individual transcripts, generating preliminary descriptive codes. Subsequently, these codes underwent cross-case examination to unveil relationships and connections suggestive of broader patterns. Finally, through an iterative process of aggregation and refinement, related patterns coalesced into potential themes, continuously validated against the primary data.

In examining emergent patterns, particular attention was devoted to contradictory or divergent cases, viewing these apparent anomalies as opportunities for theoretical refinement rather than analytical impediments. When participant experiences deviated from established patterns, detailed comparative analyses clarified the contextual factors underlying these variations. This nuanced approach revealed that seemingly contradictory experiences often represented different phases in participants' developmental trajectories rather than fundamental inconsistencies.

The progression from raw data to theoretical constructs involved multiple iterations of increasingly abstract coding and analysis. Through axial coding, initial descriptive codes gradually consolidated into broader categorical frameworks, examining relationships between categories and their properties. Subsequently, selective coding facilitated the integration of these categories around core themes that captured the essence of participants' experiences. Throughout this analytical journey, meticulous documentation of decision-making processes was maintained, with regular returns to the primary data ensuring interpretative validity.

Ethical Considerations

The investigation adhered to the ethical guidelines established by the American Educational Research Association (AERA Code of Ethics, 2011), which provides guidance for educational and social science research, particularly regarding the protection of participants in qualitative studies. Participation in the study was entirely voluntary, and participants were informed of their right to withdraw from the study at any time without any negative consequences. Each participant received a detailed information sheet outlining the study's purposes, procedures, and their rights, followed by signing an informed consent form prior to their involvement.

Multiple layers of anonymity protection were implemented throughout the research process. Internal anonymity was ensured by removing all references that could identify participants within their institutions, including their specific departments, research topics, or unique academic trajectories. External anonymity was maintained through the use of alphanumeric codes (Participants A through H) rather than pseudonyms, as even fictional names could potentially reveal gender or ethnic background. All participating institutions were anonymized, with any potentially identifying characteristics (such as location within Kazakhstan, size, or specific institutional policies) omitted from the manuscript. All identifying information was removed during the transcription process, and any quoted material was carefully screened to ensure it contained no identifying markers. Institutional names, specific journal titles where participants had published, and other contextual details that could compromise anonymity were either omitted or replaced with generic descriptors.

Findings

Analysis of interview data from eight recent PhD graduates (Participants A through H) reveals how doctoral candidates in Kazakhstan navigate the complex terrain of parallel research paradigms in their academic writing. Through thematic analysis of interview transcripts, involving iterative coding and constant comparison, three distinct but interconnected themes emerged from the data: initial recognition of divergent writing expectations, development of adaptive writing strategies, and navigation of publication-specific challenges. Together, these themes illustrate the progression from early awareness to elaborate management of dual academic writing contexts.

Theme 1: Initial Recognition of Divergent Writing Expectations

Doctoral candidates in Kazakhstan first encounter parallel research paradigms through contrasting writing expectations and feedback on their early doctoral work. These initial experiences shape their understanding of how they need to approach their dissertation writing to satisfy different academic audiences.

Encountering Divergent Academic Writing Conventions.

The first indication of parallel paradigms emerges when students receive conflicting feedback on their writing style, structure, and research framing. This phenomenon emerged clearly in Participant B's account: "I had never heard of the phrase 'theoretical gap' until I took a research methods course with a visiting professor. I realized later that my local mentor and my international tutor were talking about research in completely different ways." This observation highlights how fundamental writing conventions—even at the level of identifying research problems—differ between paradigms.

These divergent expectations manifest in multiple aspects of academic writing. Several participants described receiving contradictory guidance about essential components of their work. For instance, Participant C explained that "I had to include a special section on how my study aligns with a state policy document," while simultaneously addressing their international supervisor's requirement to "identify a current debate in international journals." This dual demand reveals how students must navigate competing priorities in structuring their written work from the earliest stages.

The clash between writing conventions becomes particularly apparent in the organization and presentation of research proposals. Participant A's experience illustrates this tension: "I was surprised by the tight departmental protocols," which prescribed specific formats for dissertation structure, even as her international supervisor emphasized that "structure was flexible and could be adapted to the research question." This dichotomy between rigid local formatting requirements and more flexible international standards presents an early challenge that students must navigate throughout their writing process.

Furthermore, these tensions extend to citation practices and engagement with literature. Analyzing the participants' responses shows a consistent pattern: local supervisors often emphasize practical applications and statistical evidence, while international mentors stress theoretical framing and critical engagement with global scholarship. As Participant C observed: "I was panicking. Which approach should I prioritize? If I disappointed my local committee, I might not pass the department review. But if I ignored international standards would I be able to publish in a high-impact journal." This quote exemplifies the anxiety that emerges when students first realize they must satisfy two distinct sets of writing expectations.

Initial Response to Writing Challenges.

As doctoral candidates become aware of these parallel expectations, they begin to recognize the need for strategic approaches to their writing. While their initial responses may be characterized by confusion and anxiety, this recognition serves as a crucial turning point. As Participant D notes, "I eventually saw it as a chance to strengthen my thesis." This perspective shift marks the beginning of students' journey toward developing more sophisticated writing approaches that can bridge different academic expectations.

The early recognition of divergent writing expectations serves as a foundation for understanding how doctoral candidates in Kazakhstan approach their dissertation writing. These initial encounters not only shape their immediate writing practices but also prompt the development of more elaborate strategies that will be essential throughout their doctoral journey.

As participants moved beyond their initial recognition of parallel expectations, they began developing increasingly complex approaches to manage these divergent demands. Their strategies evolved from basic coping mechanisms into complex frameworks that effectively integrated multiple academic perspectives. While initial recognition of parallel paradigms marked participants' early doctoral journey, their subsequent development of adaptive strategies revealed a more advanced engagement with these competing demands.

Theme 2: Developing Adaptive Writing Strategies

Building upon their initial recognition of divergent expectations, doctoral candidates begin developing refined writing approaches that bridge different academic requirements. These strategies evolve from basic coping mechanisms into complex frameworks that effectively integrate multiple academic perspectives.

From Basic Adaptation to Strategic Integration.

The writing approaches that doctoral candidates devise tend to be straightforward adaptations to immediate challenges. An early challenge emerges in balancing theoretical engagement with practical applications. International supervisors typically emphasize theoretical framing and engagement with global literature, while local supervisors prioritize practical implications and policy relevance. This tension is eloquently captured by Participant G: "My local professor would ask, 'How does your research help Kazakhstan?' Meanwhile, my external supervisor kept pushing, 'Which global debates and discussions are you contributing to?'"

As students gain experience, their approaches become more elaborate. Rather than simply alternating between different writing styles, successful candidates develop what might be termed "adaptive writing frameworks." Participant F explains this evolution: "I moved from writing separate versions for different audiences to developing an integrated approach. I structured my thesis to include a national relevance chapter—citing governmental strategies—followed by a chapter emphasizing the broader theoretical debate." This strategic organization demonstrates how students learn to layer different types of academic discourse within their dissertations.

Advanced Integration Strategies.

The development of adaptive writing strategies extends to methodological presentations, where students learn to present their research methods in ways that satisfy multiple academic audiences simultaneously. Participant H describes this approach: "I ended up coding and re-coding my data in two ways: first in purely statistical terms, to show that I had 'hard evidence,' and then thematically, to present richer narratives that connected my findings to wider theoretical debates." This dual approach reflects an advanced pattern where students learn to layer their methodological discussions, incorporating both the precise statistical reporting valued by local supervisors and the theoretical justification expected by international mentors.

The most nuanced strategy that emerges from the data is what Participant B terms "progressive integration." This approach moves beyond simple combination of perspectives to create a truly synthesized narrative. "I learned to weave together practical implications and theoretical insights," explains Participant G, "creating a narrative where each strengthens the other rather than competing for space." This represents the highest level of writing development, where students can seamlessly integrate different academic expectations into a coherent whole.

The progression from basic adaptation to strategic integration suggests not just a linear development of writing skills, but rather a fundamental transformation in how doctoral candidates conceptualize their role within multiple academic communities. While these adaptive writing strategies proved effective for dissertation writing, participants soon discovered that the publication process presented unique challenges requiring additional specialized approaches. The transition from dissertation writing to publishing demanded even more precise calibration of their writing strategies.

Theme 3: Navigating Publication-Specific Challenges

Having developed strategies for navigating different publication requirements, participants began to see broader benefits beyond just successful publication. Their experience with managing parallel publication demands contributed to their overall development as scholars.

Distinct Demands of Publication Writing.

Publication venues in Kazakhstan's dual academic context demand fundamentally different approaches to presenting research. As Participant E explains:

> A local journal submission focuses heavily on practical outcomes and policy recommendations, while an international journal requires extensive theoretical positioning and engagement with global debates. Unlike in my dissertation, where I could balance both, each article needs to be precisely calibrated for its specific audience.

Building on this observation, Participant C describes the specific challenges of reviewer feedback: "International reviewers pushed me to strengthen theoretical frameworks, while local reviewers wanted more emphasis on immediate applications. Unlike supervisor feedback, which I could integrate over time, journal revisions demand immediate and precise responses to sometimes contradictory requirements."

These distinct publication demands required participants to move beyond the integrative strategies they had developed for dissertation writing. While their earlier approaches provided a foundation, the specificity of journal requirements and the immediacy of reviewer feedback necessitated more targeted and flexible writing strategies. Participants responded by developing approaches that allowed them to maintain the integrity of their research while meeting diverse publication expectations.

Developing Publication Strategies and Outcomes.

Participants developed strategies to navigate these publication challenges, moving beyond simple adaptation to create flexible approaches that could be deployed strategically across different publication contexts. Participant F articulates a common approach: "I developed a

core argument that could be framed either theoretically or practically, depending on the audience. The evidence and findings stayed the same, but the entry points and emphasis would shift completely depending on the publication venue." This strategic flexibility in framing research appear to point to an evolution of the integration strategies developed during dissertation writing.

The development of publication-specific strategies often involved careful consideration of how to position research for different audiences. Participant D notes: "By developing different versions of my research for different publications, I've actually strengthened my overall argument. Each version helps me see new aspects of my research that I can incorporate into future work." This reflection suggests that the process of adapting research for different publication venues can enhance rather than compromise the quality of scholarly work.

The effectiveness of these strategies became particularly evident in how participants managed the review process across different publication contexts. Participant B describes this strategic approach:

> For international journals, I learned to foreground theoretical frameworks and situate my findings within global debates, while in local journals, I emphasized practical implications and policy recommendations. The key was maintaining the integrity of my research while adapting its presentation.

This ability to maintain research integrity while meeting diverse publication requirements emerged as a crucial skill.

The path to publication success involved learning experiences for all participants. Participant H describes the process: "It took several attempts to find the right balance between theoretical sophistication and practical implications that different journals require." While international journals demanded extensive theoretical framing, local journals emphasized practical applications. As Participant A reflects: "Managing these different publication demands made me a more capable scholar, able to communicate effectively with diverse academic audiences." These experiences suggest that navigating parallel publication requirements, though challenging, ultimately may contribute to researchers' development as versatile scholars capable of engaging with multiple academic communities.

Synthesis and Theoretical Implications

These three themes reveal a progression in how doctoral candidates develop their academic writing capabilities within Kazakhstan's dual-paradigm environment. Beginning with recognition of divergent expectations, they move through the development of adaptive writing strategies, and ultimately learn to navigate publication-specific challenges. This journey results in the development of elaborate writing approaches that allow them to contribute meaningfully to both local and international academic discourse while maintaining scholarly integrity.

The progression revealed in these findings reflects broader theoretical concepts about academic writing development and scholarly identity formation in contexts of competing academic traditions. The evolution from initial recognition through strategic adaptation to advanced integration mirrors what scholars have described as the development of academic literacy in multilingual contexts. However, the particular challenges of navigating parallel research paradigms in Kazakhstan's academic environment add new dimensions to our understanding

of how emerging scholars develop their academic writing capabilities. The strategies these doctoral candidates develop suggest that rather than simply choosing between competing academic traditions, they create innovative approaches that allow them to bridge different scholarly worlds while maintaining their academic integrity.

The findings from this study suggest that while managing parallel research paradigms creates additional complexity in academic writing, it ultimately leads to more robust and versatile scholarly communication skills. The strategies developed by these doctoral candidates not only serve their immediate academic needs but also contribute to their development as scholars capable of engaging with diverse academic audiences. Moreover, their experiences provide insights into how emerging scholars can successfully navigate the increasingly globalized landscape of academic publishing while maintaining connections to local academic communities.

Discussion and Conclusion

Understanding Academic Writing in Competing Scholarly Traditions

This findings explained academic writing development through an integrated theoretical framework that synthesizes three distinct yet interconnected perspectives: academic literacies (Lea & Street, 2006), scholarly identity formation (Gardner & Doore, 2020), and global-local dynamics in knowledge production (Alperin, 2011). Within contexts of competing scholarly frameworks, this theoretical synthesis reveals intricate interrelationships among literacy practices, identity construction, and power relations in transnational academic spaces. Through this multifaceted lens, our analysis revealed how emerging scholars' navigation of divergent academic expectations transcends mere linguistic or stylistic adaptation, embodying instead a fundamental process of academic socialization and knowledge construction.

Reconceptualizing Academic Growth.

Our analysis reveals that scholars' navigation of competing academic traditions follows more intricate pathways than previously theorized. Whereas existing models often posit linear progression in academic writing competence (González-Ocampo & Castelló, 2018), our findings point to a recursive, multidimensional process. The initial encounter with divergent expectations, rather than inducing cognitive dissonance, catalyzes what emerges as "adaptive metacognition" - a cognitive capability through which scholars actively reconstruct their understanding of knowledge creation and dissemination across diverse academic contexts.

This adaptive metacognition manifests not merely as awareness, but as a dynamic capability enabling doctoral candidates to strategically reconstruct their writing approaches while maintaining scholarly integrity. Nevertheless, this interpretation demands scrutiny through alternative lenses. Several participants' narratives suggest that navigating dual scholarly frameworks might initially constrain rather than enhance writing development, particularly in contexts of limited institutional support. This tension between enablement and constraint emerges as a critical factor in understanding how competing academic traditions shape scholarly development.

Identity Formation and Agency in Knowledge Production.

Our investigation unveils nuanced dynamics in scholarly identity formation that simultaneously reinforce and challenge existing theoretical frameworks. While extant scholarship emphasizes the potentially fragmenting effects of competing academic demands (Tran & Vu, 2017), our findings reveal the emergence of what we conceptualize as "integrative scholarly identity." This construct transcends mere adaptation, representing instead a fundamental reconceptualization of academic authorship in transnational spaces.

Our interpretative phenomenological approach revealed that scholars' exercise of agency manifests with greater complexity than previously documented in the literature. Moving beyond simple choice between traditions, doctoral candidates actively construct innovative forms of academic discourse that bridge established boundaries. Yet this manifestation of agency warrants examination alongside alternative explanations, particularly considering how institutional structures and power dynamics might shape these apparently autonomous choices.

Global-Local Dynamics: Transcending Traditional Academic Hierarchies.

The strategies developed by participants for negotiating publication requirements shed light on a transformation in global-local academic relations that extends current theoretical understanding. Transcending traditional center-periphery models (Alperin, 2011), our findings reveal the emergence of what we conceptualize as "transcultural scholarly spaces." Within these dynamic environments, the interplay between local and international academic traditions manifests as dialogic rather than hierarchical, fostering innovative approaches to knowledge creation and dissemination.

This reconceptualization of academic spaces emerges through scholars' strategic deployment of diverse discourse patterns. Through careful analysis of participants' experiences, we observe how these transcultural spaces facilitate not just the coexistence of different academic traditions, but their productive synthesis into new forms of scholarly communication. This synthesis manifests most prominently in how scholars reconstruct their research narratives for different audiences while maintaining intellectual coherence.

Implications

The emergence of adaptive metacognition and integrative scholarly identities suggests profound implications for transforming doctoral writing pedagogy (Gardner & Doore, 2020; Rahman et al., 2024). Central to enhancing writing pedagogy is the development of structured comparative analysis exercises, through which emerging scholars explicitly examine the underlying assumptions of different academic traditions (Lea & Street, 2006). This foundational approach, complemented by strategic integration workshops and dynamic peer learning communities, creates a framework for developing sophisticated writing capabilities (González-Ocampo & Castelló, 2018; Woloshyn et al., 2024). To implement these pedagogical innovations effectively, institutions could establish structures that acknowledge and validate diverse academic traditions while actively fostering their integration (S. Canagarajah, 2022). Such institutional frameworks should include multilingual writing support systems that recognize linguistic diversity as an intellectual resource rather than a barrier to academic development (Brinkschulte et al., 2018; Englander, 2014). Additionally, institutions could actively cultivate mentorship networks that span both local and international academic communities, while simultaneously supporting faculty development programs that prepare

instructors to guide scholars through competing academic expectations (Frick & Pyhältö, 2022; Thao & Trut Thuy, 2024). These support structures ensure that doctoral candidates can develop the necessary skills to navigate multiple academic traditions effectively.

Building upon these pedagogical transformations, this study's findings also suggest the need for reconceptualizing academic publishing in transnational contexts (Alperin, 2011; Lei, 2023). The development of hybrid publication formats emerges as crucial, creating spaces where different academic traditions can productively converge rather than compete (S. Canagarajah, 2022; Stornaiuolo & Leblanc, 2014). This transformation requires changes in how academic communities evaluate and disseminate knowledge, particularly through the establishment of reviewer preparation programs that enhance recognition of diverse academic discourse patterns (Amirbekova et al., 2022; Kaztayeva, 2024). Such programs can help reviewers appreciate and evaluate different approaches to scholarly writing, thereby enriching rather than constraining scholarly dialogue (Calle-Arango & Ávila Reyes, 2024). When coupled with mentoring networks and supportive institutional policies, these initiatives can foster more inclusive publishing practices that enhance global academic discourse (Dyussekeneva et al., 2024). The implementation of these innovations, working in tandem with the pedagogical transformations described above, could potentially create an ecosystem that supports doctoral candidates in developing truly transnational scholarly identities (Tran & Vu, 2017).

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Contact email: A.Tleuov@kimep.kz

Exploring Parent's Perceptions of Comprehensive Sexuality Education Among Early Childhood Students in Indonesia

Debri Pristinella, Atma Jaya Catholic University of Indonesia, Indonesia
Gabriela Brenda Nathania Sukmana, Atma Jaya Catholic University of Indonesia, Indonesia

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Abstract
The importance of sex education for children is one of the main mandates of the United Nations (UN) for its members; the UN mandates the governments of the member countries to provide sex education for students. Despite the mandate, sex education has not been implemented comprehensively in Indonesia and is seen as a controversial issue. Implementing comprehensive sexual beliefs is one of the valuable efforts to prevent the increase of sexual violence against children as well as preparing children with the knowledge and skills to achieve prosperity, health, and self-dignity. In implementing comprehensive sexual education, parents' perceptions are considered significant. This research aims to determine parents' perceptions regarding comprehensive sexual education for early childhood students. This research is qualitative research with a descriptive phenomenological approach. Participants were three pairs of parents who have young children (aged two to seven years) and have been married for at least seven years. The data collection method uses purposeful and convenient sampling and semi-structured interview techniques. Data was analyzed using the thematic analysis method. The research results showed that parents' perception of comprehensive sexuality education in early childhood was a combination of cognitive and affective components. In the cognitive aspect, parents perceive the existence of situations or opportunities that can be applied to teach comprehensive sexual education to their children. In the affective aspect, parents report both negative and positive emotions regarding their efforts to educate their young children about comprehensive sexuality education including worry, fear, joy, and pride.

Keywords: Comprehensive Sexuality Education, Early Childhood, Parents, Perception

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Introduction

Child sexual violence in Indonesia has seen a concerning increase in recent years. According to data from the Ministry of Women Empowerment and Child Protection (KemenPPPA), 9,588 cases of child sexual violence were reported in 2022, marking a rise of 4,162 cases compared to the previous year (Janah, 2023). Sexual violence has devastating physical and psychological effects, including trauma, making its prevention a critical issue. Sexual violence against children is a global and widespread problem because it is very detrimental to individuals and society at large**.** Sustainable Development Goals (SDGs) have the mandate to require countries to eliminate violence against children, including sexual violence against children (Qosyasih & Komariah, 2024). One effective preventive method is the introduction of Comprehensive Sexual Education (CSE) for young children.

CSE aims to provide children with the knowledge and skills needed to protect themselves and make informed decisions in the future and equip young individuals with appropriate knowledge and attitudes concerning healthy sexual development (UNESCO, 2024). Globally, it serves as a preventive method against sexual violence and promotes well-being among children. Studies have shown that early introduction of CSE can lead to better health outcomes and decision-making skills among youths (Banerjee & Rao, 2022). Studies show that early sexual education fosters self-confidence, positive personalities, and an understanding of one's rights, enabling children to recognize and avoid potential dangers. Based on Piaget's developmental theory, early childhood (ages 2-7) represents a critical period or "golden age" for learning, where physical and psychological growth lays the foundation for future development (Santrock, 2019). As such, providing optimal guidance and education, including sexual education, is vital during this stage (Yunesty et al., 2024).

CSE goes beyond basic knowledge of sexuality, focusing on understanding sexual and reproductive rights, making healthy decisions, and achieving a high standard of sexual health. The UNESCO International Technical Guidance on Sexuality Education emphasizes the role of CSE in promoting well-being, human rights, and gender equality. It also empowers children to make healthier decisions later in life. For young children, CSE incorporates lessons on respect, consent, safe practices, and gender equity (Banerjee & Rao, 2022). Given the holistic nature of CSE introducing it at an early age can significantly improve the quality of life for future generations (Nyimbili et al., 2019).

The family, particularly parents, plays a central role in delivering CSE. As primary educators, parents influence children's development and understanding of the world. Parental perceptions of CSE are crucial, as these perceptions shape their attitudes and behaviors in educating their children (Jeti et al., 2024). Previous studies reveal a wide spectrum of parental views on early sexual education. In Indonesia, some parents regard sexual education as taboo, opposing its implementation for young children. Results study by Qosyasih and Komariah (2024), found that cultural and normative norms are still inherent in conveying accurate and comprehensive information about sexuality for children, the findings indicate respondents are aware of the importance of sexual education but have difficulties in discussing gender because it is considered taboo, dirty and inappropriate.

In contrast, other studies highlight growing parental acceptance of sexual education for early childhood. A 2017 study in Bekasi showed that 67.36% of parents viewed sexual education as important and urgent for young children, a percentage that rose to 80% in 2022 according to further research in Indonesia (Nadar, 2018). Despite this increasing support, gaps persist in

parental understanding and attitudes, particularly concerning comprehensive approaches to sexual education.

Indonesia's rich cultural and religious diversity significantly influences parental perceptions of CSE. Sexuality remains a sensitive topic, often considered taboo, which affects the openness of discussions both at home and in educational settings. A study highlighted that while parents acknowledge the importance of sexual education, cultural norms often hinder open communication on the subject (Qosyasih & Komariah, 2024). Moreover, cases of sexual violence and the importance of sexual education cannot be separated from the cultural taboo that is still attached to openness in discussing sexuality. In addition, general existing research in Indonesia often addresses sexual education in a general context, without fully exploring its comprehensive aspects.

Therefore, this study aims to explore **parents' perceptions of comprehensive sexual education (CSE) for early childhood**. By understanding parental perspectives, this research aims to bridge existing gaps and develop culturally sensitive strategies to enhance the acceptance and implementation of CSE, ultimately contributing to the prevention of child sexual violence in Indonesia.

Method

This is a qualitative study using a descriptive phenomenological approach. The descriptive phenomenological approach aims to capture the essence of individual narratives from research participants without including external meanings (Willig, 2001). This type of research was selected because it can yield rich data concerning parents' perceptions regarding the implementation of comprehensive sexual education for early childhood. Perceptions are influenced by individual feelings, cognitive abilities, experiences, and knowledge (Walgito, 2010).

The criteria for participants in this study are as follows:

1. Parent with early childhood children (two to seven years old).
2. Parent with a minimum of seven years married. This research requires parents who have been married for at least seven years. According to Harrar & DeMaria, 2007 (Atkinson, 2021). This duration is significant because a seven-year marriage typically reaches the stage of cooperation, where couples are likely to have productive and satisfying relationships, and have acquired sufficient experience in managing a household or family. With this experience, parents can provide insights into how they perceive, as experience is one of the factors influencing perception (Langton et al., 2006).

Participant selection in this study utilized a purposive- convenience sampling method, whereby the researcher deliberately selects participants with specific characteristics to explore the research phenomenon by choosing those who are available and willing to participate (Creswell, 2012).

Data collection was conducted through semi-structured interviews using an interview guide, which included additional questions based on participants' responses (Magaldi & Berler, 2020, as cited in Mashuri et al., 2022). Subsequently, a coding process was undertaken to label the text, identify emerging themes within the data, and interpret the findings. The data analysis strategy employed was thematic analysis. Thematic analysis is a method for

analysing qualitative data to identify patterns or themes that facilitate an understanding of the thoughts, behaviours, or experiences of research participants (Kiger & Varpio, 2020).

Result and Discussion

Perception involves the relationship between cognitive and affective components. The cognitive component of perception involves the intellectual processing of information, understanding, reasoning, and interpretation which includes how parents understand and recognize the stimuli they encounter related to sex education (Jiang et al., 2021). Then, the affective component of perception involves parents' emotional responses or feelings towards the stimuli they experience, including positive or negative evaluations, feelings of joy or disappointment, or other emotional reactions to sex education (Gervasi et al., 2023). These two perception components are interrelated in forming a complete and complex perception of sex education.

The importance of sex education in early adolescents involves complex issues and is often related to diverse values and beliefs. Therefore, a comprehensive and family-focused approach to conveying information about sex education can help in understanding parents' needs and expectations. It is important to remember that parental views and perceptions can vary widely (Rifan Muhammad Rafi et al., 2024).

In the cognitive aspect, parents perceive the existence of situations or opportunities that can be applied to teach comprehensive sexual education to their children.

> Parents must be hands-on. If we want to instill a certain value, the child must first encounter the situation, and parents should be willing to seize that moment to impart the value. (Participant 1)

Broadly, participants considered these situations as appropriate when they were involved in children's real-life experiences. Such situations include parental work, physical, personal, and hygiene activities, as well as media usage. They associated these activities with daily contexts to explain roles and responsibilities differences related to gender.

In the affective aspect, parents report both negative and positive emotions regarding their efforts to educate their young children about comprehensive sexuality education. Firstly, participants expressed feelings of worry regarding the teaching of gender roles. This concern arose from their perception that their young children were already exposed to various media influences, despite not fully understanding sexual rights, particularly the boundaries involved in interactions with the opposite sex.

Parents recognize the importance of teaching reproductive health, human relationships—including romantic relationships—and sexual rights; however, they express uncertainty regarding their ability to convey this information to their children. There is a fear that their inability to effectively communicate such information to their young children may lead to misunderstandings and inappropriate attitudes in the future.

> For instance, I have taught my daughter the proper way to behave, especially in the presence of boys. Nevertheless, I still observe her sitting inappropriately when she was with her male friends.

> I am worried whether it is appropriate to discuss this topic at her current age, and to what extent I should explain the reasons. I worry that my words may be inadequate in providing valid explanations to my child. (Participant 1)

Concerning this issue, the research conducted by Morawska and colleagues (2015) indicates that parents may have planned to discuss sexual education with their children but have yet to find the appropriate opportunity. Additionally, they often feel a lack of confidence in dealing with this information (Morawska et al., 2015). An increase in parents' knowledge about their children's educational needs is expected to help them identify appropriate times to provide sexual education.

Participants also expressed feelings of joy and pride as their children began to understand the importance of the concept of consent concerning their bodies. Parents felt reassured by their success in teaching that their children have the right to refuse physical contact with others. Participants demonstrated confidence and happiness stemming from their children's ability to establish healthy relationships with others.

> It is as simple as hearing them say, 'You cannot touch my cheek; that is my right to say NO,' which makes me proud and optimistic that they will be able to protect themselves. (Participant 3)

Furthermore, parents possess perceptions of effective methods for teaching comprehensive sexual education. They believe that effective approaches to teaching gender aspects involve modeling through their own professional lives and household responsibilities, as well as engaging their children in practicing household chores. Parents illustrate the equality of men and women in rights and obligations within the formal sector and emphasize collaboration in household tasks, therefore encouraging all children, regardless of gender, to participate in domestic duties. This is an uncommon practice in most Indonesian communities that implement patrilineal cultural norms.

> We emphasize that both men and women, fathers and mothers, must work. Both parents must also manage the household. Therefore, we train all the children to help with tasks such as washing dishes, so they understand that both boys and girls should be willing to contribute to household chores. (Participant 2)

Moreover, the findings of this study indicate that the issue of sexual violence is a primary concern for all participants, leading them to decide to use media as a source of information (such as games and television) to educate about the dangers of sexual violence, as well as the importance of self-protection and seeking help when they feel threatened. Sexual education should be tailored to the child's abilities and understanding, necessitating careful consideration of communication techniques and language (Mukti, 2018). A child's ability to protect themselves from sexual harassment is influenced by parental communication regarding the prevention of such harassment and parental education (Zhang et al., 2013).

Conclusion

The research results showed that parents' perception of comprehensive sexuality education in early childhood was a combination of cognitive and affective components. In the cognitive aspect, parents perceive the existence of situations or opportunities that can be applied to teach comprehensive sexual education to their children. Participants considered these

situations as appropriate when they were involved in children's real-life experiences. Such situations include parental work, physical, personal, and hygiene activities, as well as media usage. In the affective aspect, parents report both negative and positive emotions regarding their efforts to educate their young children about comprehensive sexuality education. They perceived feelings of worry regarding the teaching of gender roles and feelings of fear related to boundaries involved with the opposite sex. Furthermore, parents perceived joy and pride, related to children's understanding of the concept of consent concerning their bodies and the ability to establish healthy relationships with others.

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Contact emails: debri.pristinella@atmajaya.ac.id
gbrendans2@gmail.com

The Impact of the Affective Filter in the Acquisition of English Among College Students in Kuwait

Eidah Al-Mutairi, Kuwait University, Kuwait

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Abstract
The study examines the impact of the affective filter on English language learning among college students in Kuwait, focusing on gender differences stemming from past gender-segregated school education. The research is based on secondary research, compiling data from scholarly publications, government reports, and educational statistics. The study found that anxiety and motivation significantly influence English language proficiency. Students with low anxiety perform 25% better than those with high anxiety, and female students show 20% higher motivation than male students. However, mixing male and female students increases male students' anxiety by 15%. The study suggests that Kuwait should change its approach to English language education by implementing mindfulness techniques and virtual instruction systems to reduce class tension. It also recommends gender-sensitive teaching approaches and the use of gender-appropriate materials to boost participation by 35%, depending on gender. The research stresses the complex relationship between cultural backgrounds, past school experiences, and affective variables in language learning. It proposes holistic changes in Kuwait's English language education system and suggests future research on longitudinal research designs and the impact of teachers' gender on students' anxiety and motivation.

Keywords: Affective Filter, Kuwait, English Language Acquisition, Gender Differences

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Introduction

Background

The affective filter hypothesis is a foundational concept in second language acquisition, asserting that affective variables play a crucial role in language learning and use. According to Krashen, factors such as anxiety, motivation, and self-confidence can either facilitate or hinder language input processing (Cimolin, 2020). Understanding this concept is essential for addressing the educational needs of different countries, particularly Kuwait. The affective filter is especially relevant for Kuwaiti college students as they transition from gender-segregated schools to mixed-gender universities, a shift that creates a complex psychological environment where prior experiences influence social interactions and language learning susceptibility (Alhammadi, 2019).

Examining the affective filter in this context is important, as its role in language acquisition has significant implications for both teachers and learners in Kuwait. Studies on Kuwaiti EFL learners' anxiety levels highlight the need for culturally appropriate strategies to alleviate tension-based affective constraints (Alhammadi, 2019). Investigating how emotional processes influence language acquisition in this setting can contribute to the development of more effective teaching approaches, ultimately enhancing English language proficiency among Kuwaiti college students.

Research Problem

The research problem explores the complex relationship between the affective filter hypothesis and English language learning among Kuwaiti college students, with a focus on gender disparities shaped by prior educational experiences. The transition from gender-segregated schools to mixed-gender universities affects students' affective states and may present challenges to language acquisition (AlJuhani, 2023). This issue is further compounded by the lack of research examining how early gender segregation influences affective factors in language learning at the college level.

Additionally, Aljaser (2015) highlighted that conventional teaching methods in Kuwait do not effectively support students' affective transitions, which may create difficulties for learners. Gender differences, particularly in terms of anxiety and willingness to communicate in mixed-gender English classes, are crucial aspects that require further investigation.

Thus, the research problem considers not only the role of affective factors in the learning process and their influence on language acquisition but also how gender and prior educational experiences shape these affective variables in the Kuwaiti context.

Objectives

1. To determine the influence of affective filter on English language acquisition.
2. To analyze gender-based differences in affective filter impact.

Research Questions

1. How does the affective filter influence English language acquisition among college students?
2. What are the gender-based differences in the impact of the affective filter?

Literature Review

Affective Filter Hypothesis

Krashen's Affective Filter hypothesis, which forms the basis of second language acquisition theory, asserts that affective variables significantly impact language acquisition. Subsequent research conducted by Saddiqa and colleagues (2024). also supports the applicability of the hypothesis above to the current context. Thus, the authors provide evidence of how "anxiety, motivation, and self-confidence operate as psychological enablers or constraints to learning a new language." This idea significantly impacts English language learning and teaching, especially in globalized, multicultural societies. Additionally, Huang and Zhang (2020) found that individuals with low thresholds for affective filter possess 30% greater learning advancement than their counterparts with high thresholds.

The applicability of the Affective Filter Hypothesis in Kuwait's educational context is particularly noteworthy due to its cultural and social specificities. Recent research suggests that conventional teaching practices in Kuwait fail to address the affective domain, which may hinder student progress: "Over-reliance on traditional teaching pedagogy in Kuwait might be a potential barrier to change in students' learning progress" (Alkandari & Al-Failakawei, 2022, p. 153). This oversight underscores the need to integrate learning teaching methodologies that mitigate affective barriers and promote a more supportive learning environment. Additionally, neurolinguistic research indicates that emotional states influence neural plasticity and language acquisition efficiency. This aligns with the Affective Filter Hypothesis, which emphasizes the importance of reducing anxiety and fostering motivation to optimize language learning outcomes.

Gender and Language Acquisition

In recent years, specifically regarding language use in Middle Eastern countries, an emerging interest in gender differences in language acquisition in multilingual settings like Kuwait has emerged. Altarah (2021) found that female Kuwaiti students exhibit 20% higher motivation in English classes compared to male students, a difference attributed to sociocultural factors and gender norms. However, the enforcement of gender segregation in Kuwaiti public schools further complicates this issue, reflecting broader cultural influences on language learning.

Mixed-gender interaction at the college level, transitioning from segregated classes, also influences affective factors. Research indicates that male students experience a 15% increase in language anxiety in such settings (Liu et al., 2022). Additionally, classroom dynamics reveal that gender-based participation patterns in mixed classrooms often reflect prior segregated educational opportunities, even when efforts are made to foster positive affective relations (Herr et al., 2020). These findings highlight the importance of considering gender as a key variable when analyzing the affective filters affecting second-language learning.

English Language Education in Kuwait

The current state of English language education in Kuwait is shaped by cultural, pedagogical, and organizational factors. Research indicates that "despite governmental efforts to enhance English language learning, Kuwaiti students' fluency levels remain below regional standards" (Alhashem & Alhouti, 2021). This disparity suggests that systematic issues hinder the learning process. One contributing factor the continued reliance on traditional didactic teaching methods, which fail to address students' emotional and psychological needs. As Bature and Campus (2020) highlight, "education systems across the globe still depend on conventional techniques that do adequately consider students' feelings and emotions." This rigid approach often fosters anxiety and demotivation, particularly due to excessive quizzes and high-pressure assessments.

The report highlights a significant shortage of qualified and certified English language teacher trainers, with only 60% meeting international certification standards (See et al., 2020, p. 263). This deficiency directly impacts the quality of teaching and learning, which, in turn, affects student performance.

A major concern is the disconnect between curriculum design and real-world language needs. Current English curricula in Kuwait primarily focus on scholastic English, neglecting practical interpersonal communication skills essential for social interactions (Alotaibi, 2021). These challenges underscore the urgent need for comprehensive reforms in Kuwait's English language education system, ensuring it effectively addresses affective factors and integrates modern language acquisition theories into classroom instruction.

Second Language Acquisition and Sociopragmatics in the Kuwaiti Context

Recent research in second language acquisition and sociopragmatics provides valuable insight into gendered learning patterns among Kuwaiti students. Al-Nasser (2015) found that female Kuwaiti EFL learners demonstrate higher integrative motivation than male learners, which correlates with lower affective filters and improved language performance. This finding supports Krashen's Affective Filter Hypothesis, explaining why female students tend to outperform their male counterparts in English classes.

Similarly, Al-Khawaldeh (2018) conducted a sociopragmatic study revealing that gender influences the realization of speech acts among Kuwaiti EFL learners. Female students exhibited greater competence in pragmatic aspects, particularly in overly polite language, which may contribute to lower anxiety levels in language classrooms.

Alrabah and colleagues (2015) examined the effects of gender integration, specifically the transition from gender-segregated schools to mixed-gender universities, on language acquisition. Their findings indicate that male students' language anxiety increased by 15%, highlighting the influence of cultural and contextual factors on second language acquisition (SLA). These results underscore the need for gender-aware practices in Kuwaiti EFL classrooms.

Additionally, Al-Nasser's (2015) study explored how sociopragmatic awareness can be integrated into the language learning curriculum to address gender differences in affective filter levels. This approach aims to enhance language acquisition outcomes for both male and female students.

Research Methodology

Research Design

This study employs a secondary research approach to examine the impact of the affective filter on English language learning among Kuwaiti college students. This method is effective because it aggregates existing knowledge, identifies gaps for further research, and provides a broader perspective on educational challenges, particularly cultural differences (Valverde-Berrocoso et al., 2020, p. 5153). Additionally, secondary analysis facilitates the integration of multiple data sources, offering a comprehensive understanding of how the affective filter influences language acquisition.

Additionally, cross-sectional, longitudinal, and cross-cultural analyses are essential for the Kuwaiti context and are effectively facilitated through this approach. The primary research design further aids in evaluating and refining existing literature, thereby strengthening theoretical frameworks. This method aligns with language acquisition research, which emphasizes that meta-analytical techniques offer valuable insights into contextual changes and methodological rigor.

Data Sources

This research incorporates a diverse range of primary sources to ensure comprehensive coverage of the subject. Notable peer-reviewed journals include TESOL Quarterly, Language Learning, and the Arab World English Journal. Additionally, documents from the Ministry of Education of Kuwait serve as key sources for statistical data and policy analysis, while UNESCO reports provide valuable comparative data on educational trends.

Priority is given to previous studies from Gulf Cooperation Council (GCC) countries, ensuring contextual relevance. Source selection follows strict criteria related to affective filters in language acquisition, considering relevance, authorship, and publication years. Since education is constantly evolving, emphasis is placed on modern data (Hiver et al., 2021, p. 201) to align the analysis with current conceptions of affective factors in Kuwait's educational context, thereby enhancing the research's credibility and originality.

Data Collection

A structured approach will be used to ensure comprehensive and relevant data collection. Academic databases such as JSTOR, ERIC, and ProQuest will be searched using Boolean search terms, including "affective filter," "Kuwait," "English acquisition," and "gender differences." This approach aligns with Zhang and Wang's recommendations for precision in digital data mining for educational research (Gusenbauer & Haddaway, 2020, p. 181). Additionally, Kuwait University's digital library provides access to unpublished theses and conference proceedings, offering valuable local resources.

Kuwait's official governmental databases, such as the Central Statistical Bureau, serve as key sources for demographic and educational statistics. The data collection process includes systematic documentation of sources, assessing relevance and maintaining complete bibliographic records. This structured approach enhances data reliability and facilitates a more controlled and efficient analysis. In secondary research, rigorous data collection is essential to

ensuring the validity of findings (Hiver et al., 2021, p. 201). This methodology strengthens the study's contribution to future research.

Data Analysis

The data gathered is analyzed using multiple methods to ensure meaningful interpretation. Thematic analysis is employed to identify "recurring patterns and emergent themes across diverse sources" (Hiver et al., 2021, p. 201). This method allows for the comparison and contrast of qualitative results from various micro-studies, revealing deeper trends related to affective filter effects. For instance, Almutairi's (2021) study of 500 Kuwaiti students found that low-anxiety learners performed 25% better in English acquisition, reinforcing the importance of affective factors in language learning. Similarly, Altarah (2021) analyzed 1,000 students, highlighting those female learners demonstrated 20% higher motivation levels, further emphasizing gender-based differences in affective filters.

Quantitative data is subjected to meta-analysis, where findings from multiple studies are statistically analyzed to enhance credibility. The inclusion of Almutairi's and Altarah's findings in this meta-analysis strengthens the understanding of gendered affective factors and their impact on English language acquisition.

A comparative analysis framework is used to examine gender differences in language acquisition, aligning with approaches that differentiate gendered language learning patterns (Hiver et al., 2021, p. 201). The findings from Altarah's study provide empirical support for these gendered patterns, particularly regarding motivation and performance differences in mixed-gender versus gender-segregated learning environments.

Additionally, policies and cultural discourses are examined through critical discourse analysis, providing context for the empirical research findings. This analytical approach is effective as it integrates existing knowledge while generating new insights by connecting different pieces of information. The rigorous analysis ultimately enriches the understanding of affective filter dynamics within Kuwait's educational context.

Results

Findings

The findings from this secondary research analysis provide valuable insights into how the affective filter influences English language learning among Kuwaiti college students. A literature review of major studies from the past five years confirms that affective factors, particularly anxiety and motivation, play a significant role in students' language learning achievement.

A survey of 500 Kuwaiti college students found that low-anxiety learners were 25% more proficient in English than high-anxiety learners after one year (Almutairi, 2021, p. 206). This difference was particularly evident in verbal abilities such as speaking and listening.

Significant gender differences were observed in affective filter levels. A study of 1,000 Kuwaiti students revealed that female students exhibited 20% higher motivation in English classes compared to male students (Altarah, 2021). However, the validity of this finding is questioned by research showing that male students' language anxiety increased by 15% after transitioning

from single gender to coeducational learning environments at the college level (Smith, 2022). This suggests that previous educational experiences influence affective factors in language acquisition.

Moreover, classroom gender composition impacted anxiety levels. In classes where female students made up 70% of the class, male students' anxiety scores were 30% higher than those in gender-balanced classrooms (Alotaibi, 2021). Conversely, in male-dominated classrooms, female students' anxiety levels increased by 25%. These findings emphasize the complex relationship between gender composition, affective variables, and English language learning among Kuwaiti college students.

Interpretation

The results highlight the significant role of the affective filter in English language learning among Kuwaiti college students, as well as the impact of gender on this process. This provides a concrete answer to the first research question: For low-anxiety students, proficiency increases by 25%, confirming the substantial influence of affective factors on language learning (Almutairi, 2021, p. 206; Alotaibi, 2021). These findings align with Krashen's Affective Filter Hypothesis, emphasizing the importance of reducing anxiety in English language classrooms to enhance learning outcomes.

Gender differences observed in the studies contribute to answering the second research question. The findings indicate that female students exhibit 20% higher motivation levels than male students, suggesting they have a greater advantage in language learning. However, a notable concern is the increase in anxiety among male students from 10% to 15% when transitioning from single-gender to mixed-gender classrooms. This outcome underscores the interaction between cultural factors, prior academic experiences, and affective variables in language acquisition.

Additionally, heightened stress levels among gender minority students present another challenge. Male students experience 30% higher anxiety in female-dominated classes, while female students report a 25% increase in stress in male-dominated classrooms. This suggests that affective barriers are not solely individual-specific but are influenced by classroom dynamics and gendered learning environments (Phillips, 2024, p. 74). These results advocate for a more individualized approach to addressing affective barriers, taking classroom gender distribution into account, rather than relying on binary gender models of language acquisition.

Discussion

Implications

The findings have significant implications for education, particularly in English language teaching in Kuwait. The research highlights the critical impact of anxiety on language learning, as evidenced by the 25% higher proficiency gains among low-anxiety students. This underscores the need for low-stress learning environments to facilitate effective language input processing. Teachers should implement strategies that reduce anxiety, such as alerting and defocusing activities, which have been shown to lower language learners' anxiety levels by 30%.

Given the gender-specific differences in affective filters, tailored motivational strategies are necessary. The research indicates that female students exhibit 20% higher motivation than males, while male students experience a 15% increase in anxiety in mixed-gender classrooms (Almutairi, 2021, p. 206). A gradual integration approach that includes gender-sensitive support strategies can help ease this transition. Peer mentoring programs, where senior students help new students adjust to mixed-gender environments, have been shown to reduce transition stress by 40%.

The increased anxiety levels among gender minorities suggest that classroom composition should be carefully considered. These challenges can be mitigated through balanced group work, seat rotations, and culturally relevant learning materials. Research shows that using culturally appropriate content for both genders enhances student engagement and reduces affective filters (Bensalem, 2021, p. 10). Furthermore, locally contextualized materials have been found to increase student participation by 35% across both genders.

Recommendations

The implications drawn from this research have significant consequences for educational policymakers, particularly in addressing affective factors in English language learning. Despite its impact, the affective dimension remains largely underrepresented in the English language curriculum. To address this gap, systematic integration is needed, including mandatory teacher training on recognizing and mitigating affective barriers, with a specific focus on gender-related challenges. Additionally, a national assessment framework should be developed to monitor student anxiety and motivation levels, ensuring continuous improvement in language learning outcomes.

Teachers and curriculum developers must adopt gender-sensitive teaching methods and materials that cater to diverse learning styles. The use of collaborative learning strategies has been shown to reduce anxiety by 28%, particularly in mixed-gender classrooms (Alhashem & Alhouti, 2021, p. 345). A flexible curriculum model that adapts to affective needs and incorporates personalized learning paths could further enhance student engagement and success.

Furthermore, technology-enhanced learning platforms can provide anonymous participation options and allow students to progress independently, which has been found to reduce gender-based anxiety by 22% among male students in female-dominated classrooms. Incorporating reflection activities and emotional intelligence training into regular English language instruction could help create a more inclusive and supportive learning environment, ultimately enhancing student confidence and participation.

Limitations

This study is limited by its reliance on secondary research and its focus on existing literature specific to Kuwait. As a result, certain context-specific variables could not be uniquely controlled. The absence of primary research methods means that complex student interactions and detailed personal experiences may not have been fully captured. Moreover, the focus on studies from recent years may not reveal long-term trends in affective filter effects over extended periods.

Another limitation is the binary gender approach used in most cited studies, which may exclude important insights into gender diversity. Furthermore, since most studies analyzed were conducted in traditional classroom settings, they may underrepresent the role of affective factors in online and blended learning environments, which are becoming increasingly common.

Future research should address these limitations by designing longitudinal studies tailored to the Kuwaiti educational environment. A mixed-methods approach, combining quantitative and qualitative data, would provide a more comprehensive understanding of student experiences. Additionally, examining gender differences alongside other factors, such as academic achievement and prior exposure to English, could offer deeper insights into affective filter characteristics.

Research on innovative learning methods, such as virtual reality language immersion, could further expand the understanding of affective filters in foreign language acquisition. Additionally, investigating the effects of teacher gender and gender roles on student anxiety and motivation would provide valuable insights for teacher training and classroom management strategies.

Conclusion

Summary of Key Findings

This research highlights a significant understanding of the affective filter in English language development among Kuwaiti college students. The study demonstrates the profound impact of anxiety and motivation on language acquisition, as low-anxiety learners showed a 25% increase in proficiency. A key finding was the role of gender differences, with female students exhibiting 20% higher motivation than males in English classes. However, mixed-gender learning environments posed challenges, as male students experienced a 15% rise in language anxiety when transitioning to these settings.

Classroom gender composition also influenced affective factors in ways that negatively affected minority gender groups. Male students in female-dominated classrooms showed a 30% increase in anxiety, while female students in male-dominated classrooms experienced a 25% rise in anxiety levels. These findings underscore the interaction between cultural influences, prior educational experiences, and second language acquisition outcomes.

The results highlight the need for a more context-sensitive approach to English language instruction in Kuwait. They call for a critical re-evaluation of conventional teaching methods, emphasizing the importance of affective factors in developing effective curricula and classroom management strategies.

Educational Implications

Based on this study's findings, there is a strong need for a paradigm shift in English language teaching in Kuwait. The impact of anxiety on language acquisition suggests that teachers should adopt strategies to reduce students' anxiety levels. Incorporating mindfulness techniques into classroom activities, particularly for language learners, can help decrease anxiety levels by up to 30%.

Additionally, the study highlights the importance of tailored support structures to address gender-related differences. For male students transitioning into mixed-gender learning environments, adaptive mechanisms such as moderate turnover techniques and buddy systems have been found to reduce transition-related anxiety by 40%. For female students, building on their intrinsic motivation through targeted motivational strategies can further enhance their learning outcomes.

The findings on classroom composition emphasize the need for a structured approach to group dynamics. To minimize affective barriers, it is recommended to implement balanced group work, rotate seating arrangements, and integrate gender-sensitive and culturally relevant materials. The study reveals that student engagement improved by 35% when contextualized content was used, reinforcing the importance of culturally responsive teaching methods.

Final Thoughts

This study contributes to the understanding of the affective filter hypothesis and its relevance in the Kuwaiti educational system. A deeper analysis of gender, cultural, and affective factors provides a strong foundation for informed changes in English language pedagogy. The findings challenge the traditional normalization approach, emphasizing the need for gender-sensitive strategies in language learning.

The study's findings, particularly regarding increased anxiety among gender minority students and the challenges of transitioning to mixed-gender settings, offer valuable insights for policymakers and educators. For instance, the integration of technology-enhanced learning platforms has been shown to reduce male students' anxiety by 22% in female-dominated classrooms, highlighting a practical solution for improving English language programs.

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Learning Innovation in the 3T Area: The Effectiveness of Moodle-Based Blended Learning on Critical Thinking Skills

Desak Made Anggraeni, Universitas Negeri Surabaya, Indonesia
Binar Kurnia Prahani, Universitas Negeri Surabaya, Indonesia
Suyatno, Universitas Negeri Surabaya, Indonesia
Budi Jatmiko, Universitas Negeri Surabaya, Indonesia

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Abstract
This research aims to evaluate the effectiveness of blended learning MOODLE-based in improving the critical thinking skills (CTS) of prospective teacher students in 3T (Frontier, Outermost, and Disadvantaged) areas. This research uses mixed research methods (mixed methods). The research design used one group pre-test and a post-test design repeated without control classes. The sample in this study was 34 prospective teacher students in semester 1 of the 2023/2024 academic year at universities in Sumba - NTT - Indonesia. Learning blended combines face-to-face meetings with the usage platform e-learning MOODLE as the primary media. Learning design focuses on active interaction, critical discussion, and problem-solving through online assignments and forums. The instruments used in this research consisted of the CTS test and the student response questionnaire. Data analysis techniques use quantitative and qualitative descriptive, paired t-test, N-Gain, and test-t independent. The research results show that learning blended learning MOODLE-based effectiveness in increasing CTS is shown by (a) there is a statistically significant increase in CTS test scores at an alpha (real level) of 5%; (b) the average CTS N-Gain is at least in the medium category (N-Gain≥.30); and (c) the average N-Gain is consistent (not different) in the three classes The research results concluded that learning blended MOODLE-based is effective in increasing the CTS of prospective teacher students in 3T areas. Hopefully, these findings can become a reference for educational institutions developing creative and responsive learning strategies, especially in areas with limited access to education.

Keywords: Learning Innovation, Blended Learning, MOODLE, Critical Thinking Skills

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Introduction

Students and teachers engage in the classroom while learning. This commitment will assist with establishing an informative learning climate among student and students (Pauline et al., 2023). Many variables impact the progress of student' opportunities for growth in the study hall, one of which is the student's capacity to plan imaginative and intelligent picking up utilizing different learning media that are presently being created (Amanda et al., 2023; Shariful et al., 2023). Students should be mechanically proficient to develop connecting with and dynamic opportunities for growth (Amanda et al., 2023). The significance of the student's part in learning is the key motivation behind for what reason being an instructor needs broad preparation start in school. As a forthcoming student, students are by implication requested to expect a more dynamic job in endlessly learning plan.

Understudy student up-and-comers are forthcoming instructors who assume a significant part in guaranteeing their understudy's prosperity. Imminent students in the age Z generation should be resilient people in light of the fact that, as well as having the option to configuration learning and comprehend understudy attributes, they should likewise figure out the progression of science and innovation (Clarence et al., 2024; Sage et al., 2023; Yan, 2023). Accordingly, to adjust to current logical and mechanical changes, understudy students should be prepared in assorted 21st century thinking capacities that are basic today (Elcine et al., 2018; Hatice et al., 2021; Min et al., 2023). The significance of getting ready for a vocation in the growing computerized time is basic. The fast mechanical change has radically modified the work scene. To contend and prevail in present day cutthroat business market, Age Z should be ready with fundamental abilities and extraordinary adaptability. Student in age Z acquiring needs four abilities, one of which is Critical Thinking Skills (CTS) (Miguel et al., 2024; Sage et al., 2022; Ward et al., 2023).

CTS is a really significant ability in the twenty first century. CTS alludes to an individual's ability to think plainly and normally about what they ought to do. Decisive reasoning permits student to grasp the reason why a variable changes and how one variable influences different elements (Duran & Dökme, 2016). Decisive reasoning necessities reality, reflection, examination (Mutakinati et al., 2018), conviction, and activity. Decisive reasoning is characterized as decisive reasoning with an accentuation on independent direction. Decisive reasoning is the capacity to distinguish deals with any consequences regarding issues in a calculated and dependable methodology (Mundilarto & Ismoyo, 2017). At the tertiary level, CTS is a essential for learning. Student benefit fundamentally from CTS since they are change specialists. Student, as change specialists, need to dissect fundamentally in all circumstances to be delicate and receptive to society difficulties and issues.

This differs from the data obtained in the field. The facts on the ground reveal that critical thinking skills remain low in Indonesia. According to a World Economic Forum (WEF) study on the 2016-2017 Global Competitiveness Index (GCI), Indonesia was rated 41st out of 138 nations, after Malaysia and Thailand (Nababan, 2019). The worker's educational level, particularly critical thinking and analytical thinking skills, has an impact on this (Changwong et al., 2018). Several studies, including research by Ploysangwal (2018) in Thailand, Manshaee and colleagues (2014) in Iran, Sarigoz (2012) in Turkey, reveal that students' critical thinking skills are also at a low level. This is consistent with the findings of various studies in Indonesia, which reveal that critical thinking skills are inadequate at all levels of schooling in Indonesia. According to a survey done by Setiawati and Corebima (2017) in Pare-Pare, South Sulawesi. Furthermore, Mahanal and colleagues (2016) and Asyari and

colleagues (2017) discovered that students at universities X and Y lacked critical thinking skills. Aside from that, students continue to struggle with critical thinking, particularly in primary school. Critical thinking skills were still low in three elementary schools in the Buleleng District, according to Wijayanti and colleagues (2015). Aside from that, Budiana (2013) demonstrated that the original critical thinking skills test obtained a score of less than 40% for each component, which was still regarded low.

Based on the data identification results, it was discovered that there has been no extensive research on the island of Sumba on critical thinking, teamwork, communication, and creativity as 21st century skills. Sumba Island is divided into four districts: the Southwest Sumba district, the West Sumba district, the Central Sumba district, and the East Sumba district. All areas on the island of Sumba are classified as 3T (frontier, outermost and disadvantaged). The Indonesian government considers four districts on the island of Sumba as underdeveloped areas: Southwest Sumba district, West Sumba district, Central Sumba district, and East Sumba district. Presidential Regulation Number 63 of 2020 specifies this classification. This district has also been recognized as a special region based on geographical characteristics by Minister of Education, Culture, Research, and Technology Decree No. 160/P/2021. The 3T area is a location with insufficient infrastructure, thus only a few people choose to be shifted there (Hasthoro & Aambarwati, 2016). Districts with less developed territory and society than other regions in the nation are considered to be underdeveloped regions, as defined by Presidential Regulation of the Republic of Indonesia Number 63 of 2020. The evaluation of underdeveloped areas takes into account a number of variables, such as the local economy, human resources, infrastructure, amenities, financial capability, accessibility, and regional features. These standards lead to the inclusion of Southwest Sumba Regency in the 3T area. The educational conditions in the 3T area differ from those in other more developed areas of Indonesia. Communities in the 3T area have a low level of awareness about sending their children to school, educational facilities are very inadequate, and the number of teachers and educational staff is limited and of poor quality (Dudung et al., 2018), all of which have an impact on the quality of student learning outcomes, such as the low level of 21st century skills possessed by students in the area.

Issues in decisive reasoning abilities incorporate the discoveries of the 2022 Program for International Student Assessment (PISA), which exhibit that Indonesian student' CTS actually low (OEDC, 2023). One strategy to further develop student' CTS is to make a learning model that prepares their CTS. The learning model that frequently prepares CTS is Issue Based Learning (PBL) (Akhdinirwanto et al., Amin et al., 2020; 2020; Hidayati et al., 2021; Ismail et al., 2017; Kardoyo et al., 2020; Oderinu et al., 2020; Putu et al., 2018; Suarniati et al., 2019; C.- C. Foo et al., 2021; Suryanti & Nurhuda, 2021). The PBL model backings student in associating figuring out how to genuine issues (Hashim and Samsudin, 2020). Nonetheless, the use of the PBL model demonstrated that there were still impediments. Suryanti and Nurhuda (2021) displayed during picking up utilizing the PBL model, a few student showed inactive.

The extent of student who effectively contribute troublesome answers for their companions is not exactly half; be that as it may, modifying student' propensities from inactive to dynamic takes time. Sajidan and colleagues (2022) found that PBL doesn't permit student to team up with different gatherings, prompting compelling critical thinking. Also, when student talk about issues they are not upheld by proof from examination ends. The disadvantages of carrying out the PBL worldview included student actually experiencing issues making clear answers for the issues they uncovered, and it was challenging for the gathering to distinguish

answers for the issues they communicated. What's more, this study's improvement stage needs a lengthy time (Amin et al., 2020).

In accordance with information from a fundamental investigation of understudy CTS levels directed on understudy student competitors in the material science schooling concentrate on program at Weetebula Catholic College, Southwest Sumba, Indonesia, understudy CTS will in general be low, at 49.50%. The four CTS indicators tested were assessed as follows: analysis indicators (56.22% in the medium category), interpretation indicators (43.78% in the low category), inference indicators (42.70% in the low category), and evaluation indicators (55.32% in the medium category). The findings of the data analysis revealed that the inference indicator had the lowest value of the three major CTS indicators. The data reveal that there are still issues in the sector of student CTS. Students with a low CTS will find it more challenging to identify and solve the challenges they present.

According to the findings, the PBL model's concerns are found in the third stage, which includes driving individual and gathering examinations. In this stage, the student urges student to get the fundamental information, direct examinations, and look for clarifications and arrangements so student can explore on the subjects instructed. The discoveries show that student keep on battling with considering choices while drawing derivations, taking care of issues, and pursuing choices in view of the responses to issues given, frequently alluded to as deduction. This calls for an extreme measure of investment, and procedures are expected to show student how to put together their choices with respect to the answers for the issues that are introduced. The strategy that can be utilized is mind mapping. Mind mapping can help student concentrate on more proficiently and further develop their CTS (Zubaidah et al. 2018). Mind mapping is valuable for arranging, imparting, being more imaginative, critical thinking, centering consideration, coordinating and offering viewpoints, recollecting better, learning all the more rapidly and productively, and preparing to make sense of an entire thought.

Mind mapping helps student how to get determinations from different thoughts, make ideal ends, sum up, and show associations between thoughts. Mind mapping is otherwise called a learning method for critical thinking, idea association, maintenance, narrating, and thought trade (Kernan et al., 2018). Mind mapping empowers student to review, hold however much happy as could be expected, normally group it, and accomplish prompt and direct access (Arini et al., 2017). Mind mapping is a helpful hierarchical reasoning strategy that works with information maintenance in the cerebrum and recovery from outside the mind (Zahro et al., 2018). Thus, it is basic to foster a PBL model that can help student to utilize mind maps.

Amin and colleagues (2020) found that PBL significantly impacts students' CTS and suggests combining it with e-learning or mixed learning. Mixed learning is crucial for students to adapt to rapid advancements in science and innovation. MOODLE, an open-source LMS, is a creative, easy-to-use, and versatile e-learning platform available on Android, making it an ideal choice for students. Student approach gaining materials from anyplace and whenever (Ait et al., 2024; Peter et al., 2024). Subsequently, coordinating LMS MOODLE inside the educational experience might further develop guidance as well as learning exercises.

This study reveals that students struggle with applying the PBL worldview in learning, especially when combined with LMS. To address this, a MOODLE-based MMSB model learning approach was proposed. This approach aims to meet 21st-century students' needs while providing a hypothetical and exact framework. The fourth phase of the MOODLE-

based model focuses on developing inference indicators and mind mapping from research results, enabling students to make conclusions based on findings.

This research aims to evaluate the effectiveness of blended learning MOODLE-based in improving the critical thinking skills of prospective teacher students in 3T (Frontier, Outermost, and Disadvantaged) areas. The findings of this research can become a reference for educational institutions developing creative and responsive learning strategies, especially in areas with limited access to education.

Literature Review

District 3T Area (Outermost, Frontier, and Disadvantaged)

The Indonesian government categorizes 3T areas based on regional boundaries, physical conditions, and special positions. "Frontier and Outermost" areas are defined by physical conditions, while "Frontier and Disadvantaged" areas are categorized based on economic conditions, human resources, development facilities, regional finance, barrier access, and features. Leading and underdeveloped areas have direct boundaries with neighboring countries, while outermost and underprivileged areas are classified differently and have no commonalities in features. The phrase 3T area is frequently used in educational development efforts, such as the equitable distribution of primary and secondary school teachers (Dikdasmen). The 3T area tends to be the government's top priority in pursuing fair development in a variety of ways. The 3T region is an Indonesian territory with less developed physical, social, economic, and cultural characteristics than other regions on a national scale. The 3T zone also serves as a gateway to Indonesia's borders with other countries. The 3T region suffers a number of issues that restrict its people's development and well-being. Some of the major issues affecting 3T areas include (1) inadequate accessibility, (2) low educational quality, (3) bad public health, and (4) poverty and social inequality (Purwanda et al., 2023).

Critical Thinking Skills (CTS)

Critical thinking is a crucial skill for life, work, and overall functioning, initiated and processed by the left brain. It involves evaluating and analyzing information based on experts' opinions. Critical thinking motivates students to find answers and understand, evaluating implicit thoughts and their own thought processes. It is often referred to as high-level process skills, helping students connect knowledge from multiple sources for a deeper understanding. Akhdinirwanto and colleagues (2020) explained that critical thinking skills are one of the essential skills for students to live in the 21st century where the phase of life is entering the era of digital revolution 4.0. and is the most important skill in school and life in the future (Amin et al., 2020; Toheri et al., 2020). In the current era of digital revolution, critical thinking skills are an important aspect in modern education (Elmouhtarim, 2018; Walter & Walter, 2018), important competencies in successful student performance (Hasanpour et al., 2018; Verawati et al., 2019); and the most important real-life skills (Mutakinati et al., 2018). These are essential abilities that students must have in solving problems (Özgenel, 2018; Silviariza et al., 2021) and the process for making the right decisions (Özgenel, 2018) so that what we think is best about the truth we can obtain and do correctly. Critical thinking helps students to absorb knowledge and improve their performance.

CTS are very important to be taught, trained as early as possible and carried out continuously according to students' ability to observe various problems that may occur in learning activities and think about solutions to these problems (Rahmadita et al., 2021). Critical thinking skills consist of cognitive abilities that help students to improve academic achievement related to solving social and scientific problems found in everyday life (Abbasi & Izadpanah, 2018; Halpern, 2005; Sendag & Odabasi, 2009). The benefit of students having CTS is that it helps students to have broad insight, independent assessment which results in interpretation, analysis and evaluation as well as inference (Agbi & Yuangsoi, 2022; Saputro et al., 2020). Students who are active in trying to solve problems related to everyday life are critical students (Elmouhtarim, 2018; Walter & Walter, 2018). Facione (2015) identifies basic and higher-order thinking abilities, with this study examining critical thinking skills like analysis, interpretation, evaluation, and inference, adapted from his suggested indicators. Table 1 shown data regarding indicators and operational definitions of critical thinking skills indicators.

Table 1: Indicator and Operational Definiton of CTS

No.	Indicator of CTS	Operational Definitions
1	Interpretation	Interpretation is also referred to as categorization, deciphering meaning, and clarifying meaning.
2	Analysis	Examining ideas and evaluating arguments are both examples of analysis.
3	Inference	Inference is referred to as looking for evidence, guessing, alternatives, and drawing conclusions.
4	Evaluation	Evaluation is also known as assessing claims and assessing arguments.

Source: Fascione (2015)

MOODLE-Based Mind Mapping Science Blended (MMSB) Learning Model

The results of practical and theoretical investigations into the drawbacks of applying the PBL model to enhance students' CTS were used to develop the MOODLE-based MMSB model in this study. This sort of guidance joins face to face guidance in the classroom with online guidance by means of LMS MOODLE, which students and student can access from anyplace whenever. A few CTS pointers can't be prepared while utilizing the PBL learning model to improve CTS, as indicated by the discoveries of information examination connected with the model. Thusly, the suitable strategy for preparing the leftover low level CTS pointers in unambiguous, the surmising marker is to foster a MOODLE-based MMSB model.

One strategy that may be utilized is mind mapping. Student that utilization mind mapping can further develop their review strategies and foster their decisive abilities to reason (Zubaidah et al. 2018). With mind maps, clients can coordinate data through colors, images, pictures, and profound worth (Polat & Aydın, 2020). According to Kernan and colleagues (2017), mind mapping is likewise depicted as a learning system utilized for thought trade, narrating, memory upgrade, critical thinking, and idea organizing. However much information as could be expected might be learned, coordinated, and put away by student utilizing mind mapping, which additionally takes into consideration regular order and gives fast and simple access (Arini et al., 2017). As per Zahro and colleagues (2018), mind mapping is a strong hierarchical reasoning device that works with the capacity of information in the cerebrum and the recovery of data from sources outside the mind. Thus, a MOODLE-based MMSB model a PBL model that can show student' CTS through mind mapping should be made.

The syntax of the MOODLE-based MMSB model has 6 (six) stages or phases, namely: phase 1 Orientation; phase 2 Organization; phase 3 Investigation; phase 4 Developing Mind Mapping; phase 5 Create and present the work; phase 6 Evaluate. Learning with the MOODLE-based MMSB Model is carried out in a blended manner, namely synchronous (learning by carrying out face-to-face learning activities in class) and asynchronous (learning by accessing material or assignments online on MOODLE).

Methods

Research Design

This type of research is mixed research methods (mixed methods). This research design uses the one group pre-test post-test design (Fraenkel et al, 2012) which involves two classes, namely class A and class B. The one group pre-test post-test design is shown in Table 2.

Table 2: The One Group Pre-test Post-test Design

Kelas	O1	X	O2
A	Pre-test	Treatment	Post-test
B	Pre-test	Treatment	Post-test

Information: O1: Pre-test to measure students' initial CTS
O2: Post-test to measure students' final CTS
X: Learning with the MOODLE-based MMSB learning model
A, B: Class where testing activities are carried out

Sample and Data Collection

This research was conducted from August to October 2023 involving 2 (two) classes in the physics education study program - Weetebula Catholic University, Indonesia. The sampling technique uses a saturated sample technique, namely taking all members of the population to be used as research samples. The number of class A students was 19 students while class B students were 15 students, so the total sample size in this study was 34 students.

Research Instrument

The effectiveness of the MOODLE-based MMSB model is assessed using the CTS Test and student response assessments.

Analyzing of Data

The study uses CTS test results to assess the effectiveness of the MOODLE-based MMSB model. Four CTS indicators are measured using twelve questions, and data analysis is conducted using SPSS 22 and inferential statistics. The N-Gain value is calculated using the formula (Hake, 1998).

$$N - Gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

Information : N-Gain = normalized gain value (normalized gain)
Spost = CTS post-test score
Spre = CTS pre-test value
Smax = maximum CTS value

The data resulting from the N-Gain calculation is then converted into criteria are present in Table 3.

Table 3: N-Gain Criteria

Nilai N-Gain	**Kriteria**
.70 < N-Gain	High
.30 ≤ N-Gain ≤ .70	Moderate
N-Gain < .30	Low

(Source : Hake,1998)

The results of the generated N-Gain were subsequently analyzed through a parametric test with a paired t-test. With the use of SPSS 22, a statistical analysis of the paired t-test was performed. The MOODLE-based MMSB model is said to be effective if 1) there is a statistically significant increase in CTS test scores at an alpha (real level) of 5%; 2) the average CTS N-Gain is at least in the medium category (N-Gain≥.30); 3) the average N-Gain is consistent (not different) in the three classes (Lestari et al., 2021).

Result and Discussion

Students take a CTS test in order to assess the increase in their CTS. During a sixth meeting, tests will be given at the beginning and end of the lecture. The number of tests given was 12 questions which were divided into 4 indicators related to CTS, namely: (1) analysis indicators; (2) interpretation indicators; (3) inference indicators; and (4) evaluation indicators. The average pre-test, post-test and N-Gain CTS scores of students are shown in Table 4.

Table 4: Average Pre-test, Post-test, dan N-Gain CTS

Description	Class A		Class B	
	Pre-test	Post-test	Pre-test	Post-test
Lowest value	13.33	43.33	31.67	51.67
The highest score	40.00	88.33	48.33	88.33
Average value	28.33	67.54	40.78	68.22
Number of Students	19	19	15	15
N-Gain Average	.55		.46	
Category	Moderate		Moderate	

The data in Table 4 shows that the average N-Gain value for class A is .55 (medium category) and class B is .47 (medium category). For average value data N-The gain in class A and class B is shown in Figure 1.

Figure 1: Differences in N-Gain in Class A and Class B

In this study, there were 4 (four) CTS indicators that were trained. The average N-Gain value for each CTS indicator is shown in Table 5.

Tabel 5: Average N-Gain in CTS Indicator

No.	CTS Indicator	Class	N-Gain indicator	Categori
1	Analysis	A	.43	Moderate
		B	.33	Moderate
2	Interpretation	A	.56	Moderate
		B	.50	Moderate
3	Inference	A	.57	Moderate
		B	.50	Moderate
4	Evaluate	A	.54	Moderate
		B	.43	Moderate

The results of the N-Gain value analysis from class A and class B were then continued with normality tests. Normality testing was carried out using the Shapiro-Wilk test for the average N-Gain value of the 2 (two) classes used. Normality test results are shown in Table 6.

Table 6: Normality Test Results

Class	Shapiro-Wilk Test			Conclusion
	Data	Statistic	Sig.	
A	N-Gain	.979	.934	Normal
B	N-Gain	.906	.117	Normal

The N-Gain normality test results in class A and class B showed Sig.>.05, indicating a normally distributed population. A paired t-test was conducted to determine the increase in CTS scores after learning using the MOODLE-based MMSB model, as shown in Table 7.

Table 7: CTS Paired t-Test Results

Class	N	Paired t-test, α = 5%				
		Mean	Std. error mean	T	Df	P
A	19	-	39.208	2.629	-14.915	18
B	15	-	17.335	3.332	-5.202	14

The paired t-test results indicate a difference between pre-test and post-test, indicating an increase in students' CTS scores after learning with the model. The population variance homogeneity test, using the Levene Test, as shown in Table 8.

Table 8: Homogeneity Test Results

Class	Levene's Test		Conclusion
	Data	Sig.	
A - B	N-Gain	.270	Homogen

The results of the analysis of the similarity test of two variances using the Levene Test Sig value.>.05, namely Sig.=.270. So it can be concluded that Ho is accepted, which means that the variance values for class A and class B are the same (homogeneous).

The last test carried out was the independent-t samples test. The purpose of this test is to find out whether the average N-Gain for both classes A and B is different or not. This test was carried out using the SPSS version 22 program. The results of the independent-t samples test are shown in Table 9.

Table 9: Independent-t Samples Test Results

Uji Statistic Test	Data	Sig.	Information
Independent t-Test	N-Gain	.197	Consistent

Based on the results of the independent samples test in Table 9, it was found that the Sig. (2-tailed) =.197 where the Sig value. (2-tailed)>.05. From the results obtained, it is known that Ho is accepted, meaning that the average value of N-Gain CTS for students in both classes is not different (consistent).

Discussion

The MOODLE-based MMSB model introduces students to learning through authentic problems, focusing on decisive critical thinking. It uses the MOODLE Learning Management System to train students in adapting to science and innovation. The model includes five key components: linguistic structure, social framework, response standard, emotionally supportive network, informative effect, and influence. The MOODLE-based MMSB model created should meet the rules of being validity, practicality and effectiveness (Hasyim et al., 2024; Jatmiko et al., 2018; Prayogi et al., 2018; Setiani et al., 2019; Siswanto et al., 2018; Wahyuni et al., 2020).

The effectiveness of the MOODLE-based MMSB model is able to be seen in several techniques, involving the average value of the pre-test, post-test, and N-Gain CTS, the Shapiro-Wilk test, the paired t-test, the Levene test, and the independent-t samples test, as shown in Tables 4, 6, 7, 8, and 9**.** Tables 5 shows that the average N-Gain value for each CTS indicator in the two groups fell below the medium range. Meanwhile, in Table 9 it is shown that the average N-Gain CTS score for students in both classes is not different (consistent). The study found a significant increase in students' CTS test scores after using the MOODLE-based MMBS model. The average N-Gain CTS for both classes was medium, and the average N-Gain remained consistent. This suggests that the MOODLE-based MMSB model effectively trains students' CTS by integrating indicators at each stage. Phase 1 Orientation in education uses theoretical studies like ARCS theory, attention theory, and dual code theory to

support learning activities. ARCS theory relates learning material to students' needs and conditions, while the Curves hypothesis emphasizes consideration, certainty, and satisfaction. The double code hypothesis suggests that both outward and verbal information is better remembered. This stage focuses on decisive reasoning abilities, such as understanding the pointer, using Moodle effectively, and implementing clear proof exercises. The interpretation indicator is the key indicator of CTS achieved.

Phase 2 of the MOODLE-based MMSB model involves the development of students' critical thinking skills through social constructivism and collaborative learning. Students engage in conversation exercises with others, select data, create theories, and make choices to incorporate new experiences into their past knowledge. The Zone of Proximal Development (ZPD) states that students learn best when in their nearest development zone. Mixed learning can further develop students' initial decisive reasoning abilities, helping them tackle issues. The CTS indicators trained in this phase are analytical indicators. Phase 3 involves the investigation phase, focusing on Vygotsky's learning hypothesis, social constructivism, cooperative learning, and mind mapping. MOODLE impacts cooperation and correspondence, while mind mapping aids in critical thinking, recall, and group effort.

The MOODLE-based MMSB model focuses on the development of mind mapping, a concept supported by memory and cognitive learning theories. Students in groups create mind maps from data to solve problems, which are then uploaded to Moodle. This phase helps students learn better and develop their thinking skills, enhancing critical thinking, memory, and presentation. In the create and present work phase, students engage in conversations to create critical thinking arrangements based on mind mapping, with the outcomes introduced as work. The inference indicator evaluates the CTS achieved in this phase. In this phase, the indicator of CTS achieved is the inference indicator. Experimental examinations from related research results, to be specific exploration results which express that decisive critical thinking skills are the cycles and capacities engaged with normal navigation (Latifa et al., 2017); Moodle LMS makes it conceivable to make conversation discussions and submit tasks from anyplace (Ricardo et al., 2020); Psyche planning helps decisive reasoning, recollecting, show abilities, bunch joint effort and critical thinking (Sari et al., 2018).

The evaluate phase in the MOODLE-based MMSB model is supported by ARCS (Attention, Confidence, and Satisfication), retention theory, and feedback theory. It involves students presenting, appreciating, and making conclusions based on input from other groups, with the lecturer providing feedback. The results of the group discussion and conclusions are uploaded to the link in Moodle. Study of research results related to activities in this phase, namely research results which state that Moodle is used as a tool in blended learning which facilitates assignments, online forums and quizzes (Bayyat, 2021); Moodle is used for students to be active in taking exams online at any time (Ricardo et al., 2020). The indicators of CTS achieved in this last phase of activities are evaluation indicators.

Increasing student CTS with the MOODLE-based MMSB model is in accordance with the consequences of exploration directed by Fikriyati and colleagues (2022); Kardoyo and colleagues, (2020); Mundilanto and colleagues, (2017); Prayogi and colleagues, (2018), which expresses that the utilization of a learning model is viable in preparing student' CTS. The mixed learning model affects expanding student' CTS (Phakakat et al., 2020; Srikan et al., 2021). The utilization of brain planning in learning assists student with recognizing significant ideas so student can be prepared to make surmisings from the issues given (Kernan et al., 2017). Increasing student CTS with the MOODLE-based MMSB model is

also supported by the ARCS theory (Attention, Confidence, and Satisfication); dual core theory; cooperative learning; social constructivism theory; ZPD (Zone of Proximal Development), Vygotsky's learning theory; memory theory; cognitive learning theory; retention theory; and feedback theory.

Based on the data that has been obtained, it can be concluded that the MOODLE-based MMSB learning model developed is: valid, practical and effective in training CTS for prospective teacher students. In theory and empirically, the MOODLE-based MMSB model developed is suitable for use as a learning model to train students' CTS.

Implications of Using the MOODLE-Based MMSB Model in Learning

The MOODLE-based MMSB model enhances student critical thinking skills and technology independence. It blends classroom and online learning, promoting critical thinking and asynchronous learning. Students can access material from lecturer explanations, MOODLE links, and videos, promoting flexible study methods.

Conclusion

This research aims to describe the validity, practicality and effectiveness of the MOODLE-based MMSB learning model for training students' CTS. The research results show that the MOODLE-based MBBS model is effective, as indicated by an increase in the CTS score which is statistically significant at the real level of .05, the average N-gain for class A and class B is .55 and .47 respectively in the medium category, the average N-gain is not different in the two classes. Thus, students can train their CTS through science lessons using the MOODLE-based MMSB model.

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Contact email: desakmade.22003@mhs.unesa.ac.id

Evaluating Western Cultural Content in Chinese Middle School English Textbooks Using the Zone of Proximal Development

Peihan Ji, Wenzhou University, China
Yujie Su, Wenzhou University, China
Vivian Ngan-Lin Lei, Macao Polytechnic University, China
Xiaoshu Xu, Wenzhou University, China
Yuqing Dai, Wenzhou University, China

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Abstract
With the increasing communication between China and other parts of the world, cross-cultural education has become increasingly important, necessitating the examination of non-Chinese, particularly Western, cultural elements in English education. Vygotsky's "zone of proximal development" (ZPD) theory emphasizes the critical role of development space in students' growth and supports the idea that the inclusion of Western elements in teaching materials acts as a scaffold for students to learn about Western culture. This paper evaluates the effectiveness of textbook compilation from three perspectives: students' current level, potential development level, and auxiliary support, using ZPD theory. By examining the Western cultural content in Foreign Language Teaching and Research Press (FLTRP) textbooks through a mixed methods approach, including analysis, questionnaires, and interviews, it was found that the assessment of students' current level is relatively lacking, and the scaffolding for auxiliary cultural teaching is minimal and often overlooked. The study suggests enhancing the evaluation of student's current level, emphasizing Western cultural connotations, presenting multicultural contrasts, increasing interest and authenticity, and adding auxiliary supports to better facilitate students' cognitive and psychological development.

Keywords: Zone of Proximal Development, FLTRP, Middle School English Textbooks, Western Culture, Culture Evaluation

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Introduction

In the context of contemporary globalization, fostering cross-cultural communication and enhancing mutual understanding have become paramount imperatives. Recent years have seen China's education system prioritizing the development of students' cross-cultural competence to address the challenges posed by globalization. This has been achieved through comprehensive reforms, including examination modifications, syllabus revisions, and textbook updates (Wu et al., 2024). The English Curriculum Standards for Compulsory Education in Junior High Schools (2022 edition) issued by the Ministry of Education emphasize the cultivation of cultural awareness and outline requirements for cross-cultural cognition, attitude, and behaviour. Scholars generally agree that cross-cultural competence refers to the ability to communicate effectively and appropriately with individuals from diverse cultural backgrounds (Hu, 2013). The absence of direct assessment of cross-cultural communication in entrance examinations has led some teachers to neglect cultural teaching. Although the importance of cultural competence is acknowledged in new curriculum reforms, teachers' cognitive gaps, insufficient skills, and practical challenges hinder the effective development of students' intercultural communication abilities (Li & Li, 2023). A survey by Zhang (2014) revealed that 90 percent of students have never communicated with native English speakers. Additionally, most English teachers have never been abroad. Ning (2018) further corroborates this view, highlighting the influence of social environment and exam-oriented education as significant factors contributing to this outcome.

Schools play a crucial role in implementing intercultural education, with foreign language teaching serving as the most effective and significant means of fostering intercultural competence (Li & Li, 2023). Wang and Li (2017) assert that textbook research is a critical component of foreign language pedagogy, holding substantial importance for the development of the discipline. English textbooks, which incorporate Western cultural elements, serve as essential tools for students to understand the Western world—encompassing various nations and states in Australasia, Western Europe, and North America—and to convey intercultural communicative competence.

Moreover, Vygotsky's “zone of proximal development” (ZPD) theory underscores the pivotal role of teaching in children's development. This theory posits that teaching should not merely train and reinforce existing psychological functions but should also stimulate and develop new ones (Yu, 2004). Within this framework, the inclusion of Western cultural elements in textbooks serves as a scaffold to aid students in their cultural learning and cognitive development, helping them achieve their highest potential.

Therefore, this paper applies the ZPD theory to set assessment criteria for Western cultural elements in English textbooks. Meanwhile, Foreign Language Teaching and Research Press (FLTRP) is a prominent publisher of English textbooks in China, widely incorporating Western cultural elements into its middle school English textbooks. Thus, the research explores whether the presentation and organization of these elements in FLTRP's teaching materials align with students' cognitive abilities and mastery. To draw meaningful conclusions, the study addresses the following research questions:

1) How does the theory of the "zone of proximal development" reflect Western culture in the FLTRP textbooks?
2) Based on the ZPD theory, is the design and organization of Western cultural content in FLTRP junior middle school English textbooks effective?

3) How can the Western cultural content in FLTRP junior high school English textbooks be optimized to better align with the ZPD theory and improve students' learning outcomes?

By analysing the Western cultural content in textbooks and conducting user surveys and interviews, this study aims to provide more targeted and diverse teaching guidance for junior middle school English education in China. Additionally, it seeks to offer substantive suggestions for future textbook compilation and teaching practices.

Literature Review

Zone of Proximal Development

The theoretical research on the “zone of proximal development” (ZPD) originated from Vygotsky's 1935 book, The Intellectual Development of Children in the Teaching Process. In this seminal work, Vygotsky delineated the gap between the actual developmental level of children, characterized by their ability to solve problems independently, and their potential developmental level, defined by their capacity to solve problems under adult guidance or in collaboration with more competent peers. In the late 1970s, Vygotsky's theory was introduced to Western academia, sparking significant scholarly interest and continuous study, which culminated in what has been termed the "Vygotsky research fever." Western scholars' research confirmed the theory's pedagogical value and underscored the importance of mediated learning. For instance, American psychologist Reuven Feuerstein argued that cognitive development results from mediated learning, proposing that mediation enables children to grasp the significance of learning activities and ultimately enhances their cognitive adaptability through internalization.

In China, Vygotsky's ZPD theory is frequently mentioned in educational psychology and child psychology textbooks, though it is often confined to brief introductions. Liang Aimin (as cited in Qi, 2003) articulated the principles of transcendence and dynamics within the context of the ZPD concept and its application in teaching development. According to literature reviews, the ZPD theory has been applied across various educational levels, including ordinary middle schools, higher vocational colleges, and universities, highlighting its broad applicability. However, in terms of teaching content, the focus has predominantly been on knowledge areas such as reading and vocabulary within English teaching. There is a noticeable lack of application in cultivating middle school students' cultural awareness, indicating an imbalance in the distribution of teaching content in English education (Guo, 2018). To date, there is a dearth of applied research on the ZPD theory within China, which starkly contrasts with the extensive research conducted abroad (Guo et al., 2023).

Research on the ZPD has flourished internationally over the past 20 years, integrating extensively with theories of scaffolding, dynamic assessment, and sociocultural theory. However, the majority of these studies focus on teacher instruction and the development of students' basic skills, with limited exploration of the application of ZPD in conjunction with teaching materials. Notable exceptions include the work of Dijana Plut and colleagues, who utilized teaching materials as tools to support cultural learning, thereby transferring these materials from a traditional instructional context to a broader cultural framework. Vygotsky emphasized the centrality of cultural tools in his theory, describing them as the building blocks of development and cultural infrastructure (Plut & Pešić, 2003). Furthermore, Raab Vass and colleagues (2011) demonstrated that textbooks could provide significant material

support for students' knowledge acquisition. Similarly, Infant and colleagues (2021) re-examined the importance of providing dialogue support to learners using teaching materials in real tasks, proposing mediation development based on this theoretical foundation, suggesting that concept-based teaching materials serve as cognitive tools to regulate learners' second language use.

Cultural Research in Middle School English Textbooks

Since the 1960s, cultural teaching has become a prominent topic in foreign language education, driven by the rise and development of sociolinguistics, social psychology, grammar, and cross-cultural communication. Consequently, integrating culture into teaching materials has sparked considerable academic discussion. For example, Hua and Vien (2023) explored how to incorporate culture into English teaching within the context of Vietnamese language instruction, advocating for the inclusion of multicultural content in English textbooks. Nguyen and Cao (2019) conducted a similar study on the cultural content of Vietnamese textbooks, analyzing the materials from cross-cultural and critical perspectives. They found that the textbooks primarily focused on training students to use English for communication with English-speaking countries, neglecting the promotion of cross-cultural learning.

In China, research on cultural content in textbooks, particularly in junior middle school English textbooks remains scarce. Yu (2023) summarized findings from statistical analyses of English textbook research papers published in eight domestic CSSCI journals between 2000 and 2022. On average, only seven articles per year addressed English teaching materials. Moreover, research on English textbooks for basic education constitutes just 17.3% of the total 156 articles, despite this educational stage being crucial for the formation of students' character and values. The content selection, design, and use of textbooks play a pivotal role in student development. Existing studies tend to focus more on ideological and political elements and Chinese cultural content, with fewer investigations into FLTRP's English textbooks. Guo (2018) employed keywords such as “zone of proximal development,” “middle school English teaching materials,” “Western culture,” and “new curriculum standards” in a full-text database search of Chinese journals, yielding limited results. Specifically, there were 333 titles and 1,167 abstracts for “zone of proximal development,” but none for “Western Culture in Middle School English Textbooks,” and only 3 abstracts. Similarly, “zone of proximal development + English Teaching” yielded 61 titles and 242 abstracts, whereas “Western Culture + New Curriculum Standards” had no titles and only 13 abstracts.

Huang Dan and Huang Li (2023) have also emphasized the need for enriched research on cultivating intercultural communicative awareness in junior middle school English teaching. Existing literature on this topic predominantly focuses on senior high schools and universities, with relatively few studies at the junior middle school level. Over the past decade, only 63 relevant studies have been conducted. In higher education, courses on British and American culture and intercultural communication are common, leading to more extensive research. However, in basic education, English instruction often prioritizes language knowledge and test-taking skills, making it challenging for students to systematically learn about domestic and foreign cultures. As a result, studies on cultivating cultural awareness in junior middle school English teaching are limited.

In the realm of basic education, teaching materials are pivotal in integrating students' cultural awareness with their language learning. While theoretical research on the ZPD frequently emphasizes internal theoretical guidance, there is a notable deficiency in practical research. Conversely, textbook research predominantly focuses on practical applications. To address this gap, this study adopts a dual approach, combining “internal theoretical research” with “external practical research.” This methodology aims to provide a comprehensive understanding of the application and impact of the ZPD theory in the context of teaching materials and cultural education.

Methods

In this study, a mixed method was employed, including content analysis, questionnaires, and interviews. Content analysis examined the Western cultural content in FLTRP's New Standard English textbooks to assess alignment with Vygotsky's "zone of proximal development" theory. Questionnaires were administered to 71 middle school students to evaluate their understanding and perceptions of this content. Interviews with four experienced English teachers provided insights into the practical implementation and effectiveness of the textbooks' cultural content. This combination of methods ensured a comprehensive evaluation of the textbooks from both theoretical and practical perspectives.

Sample and Sampling

Convenience sampling was initially employed to select participants for the questionnaire survey, comprising 71 middle school students from Ouhai District, Wenzhou City, who were using Foreign Language Teaching and Research Press (FLTRP) teaching materials. The sample included 30 female and 41 male students, spanning Grades 7 to 9. To enhance the representativeness of the sample, a stratified random sampling method was subsequently applied, ensuring proportional representation across different grades and genders. Purposive sampling was employed for the interviews to ensure that the selected participants had substantial experience with the FLTRP textbooks and could provide informed insights into their use and effectiveness. The interview participants comprised four seasoned English teachers, each with an average of nine years of teaching experience.

Research Instruments

The questionnaire was developed to assess students' understanding and perceptions of Western cultural content in the FLTRP textbooks. It consisted of multiple-choice and open-ended questions designed to evaluate students' grasp of cultural elements and their views on the effectiveness of the textbook's design and organization. To ensure reliability, the questionnaire underwent a pilot test with a small sample of students, and necessary adjustments were made based on the feedback. The validity of the questionnaire was established through expert review by three educational researchers specializing in English language teaching and cultural studies.

The questionnaire was designed to assess students' understanding and perceptions of Western cultural content in the FLTRP textbooks. It comprised single-choice, multiple-choice, and open-ended questions, addressing students' basic information (Q1), content cognition and matching (Q2-Q4), skills improvement and development (Q5), and suggestions for textbook improvement (Q6-Q10). Questions Q2-Q6 were rated on a five-point Likert scale: 5=strongly agree, and 1=strongly disagree. To ensure reliability, the questionnaire underwent a pilot test

with a small sample of students, and necessary adjustments were made based on the feedback. The validity of the questionnaire was established through the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity.

The interview questionnaire consisted of five questions divided into two aspects. According to Chen (2021), teachers using the “zone of proximal development” (ZPD) theory in junior middle school English teaching can facilitate better and faster student development by shifting traditional teaching concepts. Teachers' understanding of teaching materials significantly impacts the effectiveness of teaching activities (Zhou & Liu, 2023). Therefore, the first aspect focused on teachers' understanding of Western culture in the textbooks and their teaching methods (Q1-Q4), while the second aspect solicited teachers' suggestions (Q5).

Data Collection

The classification of Western cultural content in grades 7-9 of FLTRP textbooks was based on both the content analysis of the FLTRP materials and Vygotsky's theoretical framework, which includes the elements of "current level," "developable level," and "auxiliary support." Additionally, the effectiveness of this classification was evaluated in accordance with these elements.

The questionnaire survey was administered to 71 middle school students from Ouhai District, Wenzhou City, who use FLTRP teaching materials. The data collection was conducted using the Wenjuanxing platform, a widely used online survey tool in China. Students were given three weeks to complete the questionnaire. The questionnaire was distributed and completed in a controlled environment, with teachers overseeing the process to ensure that the students understood the questions and responded accurately.

Interviews were conducted with four experienced English teachers. Each interview lasted approximately 30 minutes and was conducted in a quiet, private setting to ensure candid responses. The interviews were recorded and transcribed for analysis.

Data Analysis

The data collected from the questionnaires, interviews, and content analysis were systematically analyzed using a combination of qualitative and quantitative methods. Content analysis was conducted on FLTRP's New Standard English textbooks to evaluate the representation and integration of Western cultural content. This analysis assessed how well the textbooks align with Vygotsky's "zone of proximal development" theory, focusing on the adequacy of cultural content as scaffolding for students' cognitive and cultural development.

The collected questionnaire data were analyzed using descriptive statistics to summarize the students' responses. This quantitative analysis provided insights into the students' comprehension of Western cultural content and their opinions on the textbooks' effectiveness.

The interview transcripts were analyzed using thematic analysis to identify key themes and insights from the teachers' perspectives. This qualitative analysis focused on understanding the practical implementation of the textbooks and gathering professional opinions on their cultural content.

Results

Content Analysis of the Textbooks

An analysis of FLTRP's English textbooks revealed a total of 204 standardized courses, with 95 of these courses containing Western cultural content. The distribution of Western cultural content is as follows: 17 courses in 7A (Book One, Grade Seven), 26 courses in 7B (Book Two, Grade Seven), 21 courses in 8A (Book One, Grade Eight), 15 courses in 8B (Book Two, Grade Eight), 17 courses in 9A (Book One, Grade Nine), and 14 courses in 9B (Book Two, Grade Nine).

According to Vygotsky's "zone of proximal development" (ZPD) theory, the ZPD represents the gap between a child's current level of independent problem-solving and the higher level of potential development achievable through guidance or collaboration (Vygotsky, 1978). In this study, the Western cultural content of grades 7-9 in FLTRP's textbooks was classified and analyzed based on the three elements of the ZPD theory: the current developmental level, the potential developmental level, and the scaffolding required to bridge the gap between the two. The categorization and evaluation of the Western cultural content according to these elements are detailed in Table 1.

Table 1: Specific Categories of Data Statistics

Elements	Details	
Current level	Checklist	Pre-class activities
Developable level	Repeat theme	Expand and improve
Auxiliary support	Illustration	Reminder box

Table 2: The Distribution of Teaching Materials to Students' Current Level

Element	Details	7A	7B	8A	8B	9A	9B
Current level	Check list	0	0	0	0	0	0
	Pre-class activities	1	2	0	1	0	0

Table 2 reveals that the teaching materials lack a systematic assessment of students' pre-existing knowledge. In terms of pre-class instructional activities, such assessments were conducted only on four occasions. In 7A, a map exercise required students to locate different countries on a map prior to the lesson. In 7B, activities included map-related questions, dialogues, and music playback. In 8B, a contextual scenario was created for a hypothetical trip to Los Angeles.

Table 3: The Distribution of Contents of Students' Developable Level

Element	Details	7A	7B	8A	8B	9A	9B
Developable level	Repeat	0	4	2	1	2	1
	Expand and improve	12 10AW, 2exercises	17 10AW, 7exercises	22 11AW, 11exercises	17 8AW, 9exercises	26 10AW, 16exercises	13 6AW, 7exercises

Note: AW stands for data cards "around the world" in the Unit 3 of the textbooks.

Table 3 indicates the presence of recurring themes across the textbooks for each grade. In 7A, concepts such as first name, last name, family name, and given name are introduced across two units. In 7B, the life of Shakespeare is covered in Unit 2, with further exploration of Shakespeare's house in Unit 3's "Around the World" (AW) section. Additionally, Unit 3 covers greetings, body language, and etiquette. Western music culture is introduced in Unit 2 with Vienna, the City of Music, and expanded upon with the Vienna New Year Concert in Unit 3's AW. The review module includes characters from literary works, music introductions from various countries, and ways of greeting in different cultures.

In 8A, an entire unit is dedicated to the Western story of Alice in Wonderland, with expanded knowledge of the story's origins presented in AW. Module 11, Unit 1, discusses Chinese and American gift-giving habits, while Unit 3 introduces Western and Greek gift-giving customs in AW. The unit review covers gift-opening practices in different countries. In 8B, Los Angeles is featured in Unit 1 and the Los Angeles Summer Camp in Unit 2.

Similarly, 9A introduces literary works and characters, covering Shakespeare, The Adventures of Tom Sawyer, The Adventures of Alex the Knight, and Plato's The Republic, reflecting themes also found in 7B and 8A. Module 10 focuses entirely on Australian culture. In 9B, eating habits are explored in Module 4 exercises, with British and American party and dining customs highlighted in Module 6.

Table 4: The Distribution of Provision of Auxiliary Supports for Students

Element	Details	7A	7B	8A	8B	9A	9B
Auxiliary support	Illustration	8 7 AW	5 5AW	9 8 AW	7 7AW	8 8AW	6 6AW
	Reminder box	2 1 underlined	0	0	0	0	0

Results of Student Questionnaires

In this study, 71 questionnaires were distributed to students, and 68 were effectively collected, yielding a response rate of 96%. The questionnaire comprised 10 questions, including students' basic information (Q1), content cognition and matching questions (Q2-Q4), skills improvement and development questions (Q5), and students' suggestions on textbook improvement (Q6-Q10). Questions Q2-Q6 used a five-point Likert scale, where 5=strongly agree, 4=agree, 3=neutral, 2=disagree, and 1=strongly disagree.

To evaluate the reliability and validity of the questionnaire, Cronbach's alpha was calculated, resulting in a coefficient of 0.779 for questions Q2-Q7, indicating satisfactory reliability. Validity was assessed using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity, with KMO at 0.628 and Bartlett's significance at 0.000, confirming the validity of the data.

The distribution of students across grades was relatively even, as shown in Table 4-5:

Table 5: Students' Information

Grades	Seven	Eight	Nine
Proportion (%)	26.79	30.36	42.86

This balanced distribution facilitated the analysis of cognitive differences among students in different grades regarding the textbook content.

The responses to questions about the richness, challenge, and helpfulness of the textbook content are summarized in Table 6:

Table 6: Cognition and Matching of Textbook Content and Students

Questions	Options				
	5	4	3	2	1
Q2: Richness of contents	0	42.41	40.69	16.9	0
Q3: Challenging	0	24.14	60.34	15.52	0
Q4: Helpfulness	8.93	73.21	17.86	0	0

Students generally rated the richness of Western cultural content as moderate. The perceived difficulty of the content varied, reflecting different levels of development among students. However, most students found the content helpful in understanding and accepting Western culture.

The impact of the textbooks on students' cross-cultural communication skills is presented in Table 7:

Table 7: Student Skills Improvement and Development Status

Questions	Options				
	5	4	3	2	1
Q5: Improve the ability of cross-cultural communication	7.14	67.86	23.21	1.79	0

The majority of students acknowledged some improvement in their cross-cultural communication skills, though responses varied, indicating different levels of mastery and absorption. Student suggestions for enhancing the textbook content are shown in Tables 8–9:

Table 8: Students' Suggestions for Textbooks

Question	Options				
	5	4	3	2	1
Q6: Content depth	8.93	62.5	28.57	0	0
Q7: Interest	5.36	73.21	16.07	5.56	0

Table 9: Suggestions for Improving the Cultural Content

Contents	Richer content	Historical/ cultural background	Modern elements	Real-life connection	Deeper analysis
Proportion (%)	98.28	53.45	55.17	86.21	50

The majority of students expressed a desire for richer content and stronger connections to real-life experiences, as well as more historical and modern cultural elements. Students' preferences for the presentation of Western culture in textbooks are summarized in Table 10:

Table 10: Suggestions for the Presentation of Western Culture

Contents	Annotation and analysis	Real examples	Practice activities
Proportion (%)	84.48	94.83	20.69

Most students preferred more analysis and real examples, highlighting the demand for depth and authenticity in the textbooks.

The open-ended responses from students offered a variety of suggestions for enhancing the textbook content, which can be categorized into four main areas: content enrichment, engagement and relevance, depth and complexity, and comparative cultural practices.

Students expressed a desire for updating the textbook content by including comparisons to Chinese culture, incorporating more historical knowledge, and diversifying the representation of Western cultural content. This indicates a need for a broader and more varied cultural representation that encompasses multiple perspectives. Enriching the content in these ways can provide students with a more comprehensive understanding of cultural contexts.

Many students emphasized the importance of making learning tasks more engaging and including more real-life cases. They also suggested incorporating interesting cultural information from daily life. These suggestions highlight the need for content that is not only educational but also relatable and engaging. By integrating real-life examples and making tasks more interactive, the textbooks can better capture students' interest and enhance their learning experience.

Additionally, some students called for the inclusion of appropriately challenging texts for more in-depth introductions and analyses of cultural topics. This reflects a demand for more complex material that can foster a deeper understanding of cultural nuances. Including more advanced texts and thorough analyses can help students develop critical thinking skills and a more nuanced appreciation of cultural differences.

Results of the Teacher Interviews

To ensure the validity of the thematic analysis, a rigorous coding process was employed. First, all interview transcripts were carefully transcribed verbatim. The initial coding involved reading through the transcripts multiple times to identify recurring themes and patterns. Two independent researchers coded the data to enhance reliability, and any discrepancies were resolved through discussion. The codes were then grouped into broader themes that reflected the main findings of the study. To ensure the accuracy and comprehensiveness of the themes, member checking was conducted, where the teachers reviewed the summarized themes and provided feedback. This iterative process helped refine the themes and ensured that they accurately represented the teachers' perspectives.

Thematic analysis of the interview data revealed that most teachers emphasized the importance of incorporating Western cultural content in their lessons. They believe that understanding Western culture is crucial for enhancing students' English proficiency and cross-cultural communication skills. To achieve this, teachers frequently supplement textbook content with additional resources such as pictures, videos, and role-playing activities. These methods help students gain a deeper understanding of the cultural nuances behind the English language, thereby increasing their interest and enthusiasm for learning.

The analysis indicated variability in how Western cultural content is addressed across different grade levels. Seventh-grade teachers often expand on the Western cultural content presented in the "Around the World" (AW) sections, with advanced students encouraged to read related literature after class. In contrast, ninth-grade teachers, facing time constraints and

exam pressures, tend to focus less on Western cultural content, particularly in the AW sections. Sometimes, they even instruct students to study this material independently after class.

Teachers suggested that the curriculum should place greater emphasis on cultural diversity and inclusiveness, encompassing a broader range of Western countries and cultural phenomena. They also recommended incorporating cultural content that is closely related to students' real-life experiences to better engage their interest and enthusiasm.

In summary, the thematic analysis highlights the teachers' recognition of the importance of Western cultural content in the textbooks and their efforts to enhance this content through supplementary materials and varied teaching methods. However, it also points to the need for curricular adjustments to better support diverse cultural education and to accommodate the practical constraints faced by teachers at different grade levels. These insights align with the broader goal of improving the cultural depth and engagement of English language education.

Discussion

The data collection revealed that the representation of Western cultural content is relatively consistent across all grades in the FLTRP English textbooks, with a substantial proportion dedicated to Western culture in junior middle school. However, an analysis of the textbooks indicated a lack of assessments to gauge students' current levels of understanding. For example, the FLTRP textbooks do not include self-test sheets, and pre-class guidance is minimal, appearing only four times throughout the series. Vygotsky's "zone of proximal development" (ZPD) theory emphasizes the importance of understanding the current developmental level of students. Questionnaire statistics show that students' perceptions of the difficulty of Western cultural content vary widely, though most are concentrated at a medium level. This variance likely reflects the differing ZPDs among students. To address this, teachers need to more accurately assess students' learning levels and incorporate targeted pre-class guidance. Textbook writers should also consider integrating more preparatory content, which can serve as both a reinforcement for advanced students and a support for those who struggle.

Promoting students' developmental levels requires effective teaching that goes beyond their existing level of development and actively fosters their potential (Miao, 2021). The textbooks exhibit repeated cultural themes, which aid in gradually deepening students' cultural understanding. For instance, British and American gift customs are introduced in Grade 7 and revisited with Chinese and American gift-giving traditions in Grade 8. This progressive knowledge development helps students gain a more comprehensive understanding of cultural practices. Additionally, within individual units, there are overlaps and expansions of cultural content. For example, Grade 7 covers the distinctions between first names and last names, which are then elaborated upon in subsequent sections. Similar expansions are seen with topics such as Shakespeare's life and Vienna's music culture, where initial introductions are deepened through supplementary content in the “Around the World” (AW) sections and review modules.

Pre-class tasks serve as scaffolding for classroom learning, significantly impacting the effectiveness of cultural education (He, 2023). Some units effectively use pre-class tasks to set the stage for deeper cultural understanding. For example, in Grade 8's “Summer in Los Angeles,” pre-class activities help students prepare for an immersive cultural experience.

Music and dialogue exercises in Grade 7 introduce students to Western music culture, enhancing their appreciation through a comparative lens with Chinese drama. These scaffolded activities activate students' prior knowledge and help teachers identify their ZPDs, enabling more tailored instruction (Lu & Kang, 2008).

Despite these strengths, there are areas for improvement in the design and presentation of Western cultural content. Most cultural information is presented directly, often in the AW sections, which, while helpful for initial understanding, do not always encourage deeper engagement. Interviews with students revealed that many find this approach too straightforward, leading to a lack of challenge and interest. A significant proportion of students noted that much of the textbook content focuses on Chinese culture, with Western cultural content often being less prominent. This suggests a need for more explicit marking of Western cultural content and greater emphasis in classroom instruction.

Some cultural points are integrated into dialogues, emails, and diaries, and are reinforced through exercises like fill-in-the-blank and multiple-choice questions. While these methods help consolidate students' memory of cultural points, many students reported that these exercises were not sufficiently challenging or interesting. The focus on accuracy in answering questions often leads to a neglect of the cultural content itself, reducing the effectiveness of cultural education.

Based on the findings from internal theoretical research and external practical research, the following suggestions are proposed for enhancing the Western cultural content in the textbooks:

First, there is a clear need for more robust assessment mechanisms in the textbooks. Analyzing the development status of junior high school students is conducive to improving their learning efficiency (Chen, 2021). This could include self-assessment links and chapter summary evaluations. Regular tests and consolidation activities should be included to monitor students' progress and reinforce key content. The current textbooks lack such features, which are essential for helping students consolidate their learning and for teachers to gauge their understanding accurately.

Second, the cultural content in the textbooks should be deepened. While the content is broad, it often lacks depth. Textbooks should constantly create new thinking “ZPDs” to promote students' continual intellectual growth, thereby elevating their cognitive development (Zeng, 2011). Incorporating more detailed cultural and historical knowledge, including idiomatic expressions and colloquial language, would enhance students' understanding. For example, the textbooks rarely cover English idioms and legends, such as “Do as the Romans do.” Additionally, the cultural focus is predominantly on British and American contexts. Expanding this to include more diverse cultures would broaden students' cultural horizons.

Third, the presentation of Western culture can be optimized by incorporating more interactive and engaging activities. Ying and Xu (2001) demonstrated that interest and knowledge are fundamental attributes that educational materials should possess. Games, thematic units, and situational role-plays can make learning more interesting and challenging. Including real-life cultural materials and experiences will make the content more relatable and engaging for students (Ying & Xu, 2001).

Fourth, there is a need to increase auxiliary support for Western culture learning. Currently, cultural illustrations are mostly confined to the AW sections, with limited reminders of cultural priorities. Related topics could be linked to multimedia resources, including videos and audio content, which can transform and reorganize students' cognitive structures to facilitate the construction of new knowledge (Duan, 2016). Adding more visual aids, QR codes for video content, and performance activities can significantly enhance students' grasp of Western culture. These supports will make cultural learning more accessible and engaging, helping students to better internalize the content.

By addressing these areas, the FLTRP English textbooks can better support students' cultural learning and development, providing a richer, more engaging educational experience.

Conclusion

This study examines the impact of the “zone of proximal development” (ZPD) theory on FLTRP teaching materials through an analysis of textbook content and investigations involving both students and teachers. The findings reaffirm FLTRP's longstanding significance in Chinese education while also identifying areas for improvement. By establishing a textbook evaluation framework based on ZPD theory, this study aims to provide valuable references for middle school English teachers and textbook researchers, particularly in the context of teaching and designing Western cultural content. This framework is intended to lay a solid foundation for fostering cultural awareness among middle school students.

However, this study has several limitations. First, the classification standards for cultural content may be influenced by personal subjective factors, which can affect the authority and comprehensiveness of the findings. Second, the research sample is limited to students and teachers in the Wenzhou area, restricting the generalizability of the results. Third, as highlighted in the literature review, there are limited studies combining ZPD theory and Western cultural content in teaching materials, resulting in a lack of extensive academic references for this research.

Despite these limitations, the forthcoming publication of a new edition of the FLTRP textbook may address some of the suggestions made in this study and potentially offer additional insights. Future research should aim to verify these findings with different subject groups and under more rigorous research conditions, striving to achieve a coordinated development of teaching materials and student cognition.

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Contact email: jessica212j@outlook.com

Appendices

Appendix A: Questionnaires for Students

An Investigation on the Effectiveness of Western Culture Arrangement in Junior High School Textbooks Based on the Theory of "Zone of Proximal Development"
Dear students,

We are conducting a research on the content of Western culture in FLTRP junior high school textbooks. Please take about 3 minutes to help fill out this questionnaire. This questionnaire is anonymous, all data is only statistical analysis, please fill in according to the real idea, there is no right or wrong. We promise to keep your information strictly confidential.

1. What grade are you in now? [single-choice]*
○Grade Seven
○Grade Eight
○Grade Nine
2. Do you think the current English textbooks are rich enough about Western culture? [single-choice]*

Strongly agree	○5	○4	○3	○2	○1	Strongly disagree

3. Do you think the Western cultural content of textbooks is challenging for you? [single-choice]*

Strongly agree	○5	○4	○3	○2	○1	Strongly disagree

4. Do you think the content about Western culture in the textbook is helpful for you to understand and accept Western culture? [single-choice]*

Strongly agree	○5	○4	○3	○2	○1	Strongly disagree

5. Do you think your cross-cultural communication ability has improved after learning the textbook? [single-choice]*

Strongly agree	○5	○4	○3	○2	○1	Strongly disagree

6. Do you think the Western culture content in the textbook should pay more attention to its historical background and in-depth analysis of social culture? [single-choice]*

Strongly agree	○5	○4	○3	○2	○1	Strongly disagree

7. Do you think the Western cultural content in the textbook helps you develop a deeper interest in English language and culture?[single-choice]*

Strongly agree	○5	○4	○3	○2	○1	Strongly disagree

8. In your opinion, what aspects of Western culture content in English textbooks should be improved or strengthened?[multiple-choice] *
□Make the content more rich and diverse
□Pay more attention to historical and cultural background
□Introduce more modern elements
□Strengthen the connection to real life
□In-depth analysis of cultural phenomena and values
□Other：_____
9. How do you think the content of Western culture in English textbooks should be improved to better help you learn? [multiple-choice] *
□Add more explanations and comments

□Provide more practical examples
□Offer more exercises and activities
□Other：_____
10.Do you have any suggestions or opinions about Western culture in English textbooks? [open-ended questions] *

Appendix B: Contents of Teachers' Interview

1. Will you consciously explain the content of Western culture in class? 2. What is the relationship between your teaching of Western culture and the teaching materials? 3. Is the arrangement of Western cultural content in English books conducive to your teaching of Western cultural content? 4. How do you teach Western culture? Will it incorporate the "zone of proximal development theory"? 5. Do you have any suggestions on the arrangement of Western cultural content in the textbook?

Using Emotional and Multiple Intelligences to Predict Graduate Online Students Connectedness

Loren B. Naffziger, Grand Canyon University, United States

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Abstract
The COVID-19 pandemic accelerated the use of online learning in all areas of academia. Colleges were thrust into converting on-ground classes to online venues, creating a need to examine the needs of the learners differently. What is not known is how different intelligence strengths can influence the students' ability to connect to their online learning environment is fundamental to their success (Bollinger & Merindale, 2004). Carthy and colleagues (2022) noted that the need for student support in online education included the coaching of emotional intelligence (EI) strategies, which the participants in the study reported as having a positive effect on academics. The connection between EI and the theory of multiple intelligences is pronounced, especially in exploring Gardner's definitions (Gardner, 2006) of interpersonal and intrapersonal intelligences, which correspond with the interpersonal skills and self-awareness constructs of EI (see Goleman, 2005). Using the theoretical foundation of the Community of Inquiry (Garrison et al., 2010), the researcher poses the premise that it is not known if, or to what extent, emotional and multiple intelligences predict graduate school students' sense of connectedness in their online learning coursework. A quantitative predictive correlational study involving online graduate school students from a large university is proposed for the study. The use of a regression analysis procedure using the statistical package for the social science (SPSS) software will provide an analysis of the correlation between the major domains of emotional and multiple intelligences as predictors of graduate school students' sense of connectedness in their coursework.

Keywords: Community of Inquiry, Emotional Intelligence, Multiple Intelligences, Online Learning, Quantitative Predictive Correlational Study, Regression Analysis

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Introduction

Bollinger and Merindale (2004) noted that distance learners have a lower retention rate than students in traditional learning environments. One of the factors associated with this phenomenon is student satisfaction. Satisfaction with an online course has been associated with multiple factors including communication and connectedness with peers and the faculty members. Berenson and colleagues (2008) discussed learning as a function of a student's emotional response to the learning environment. It has been noted that student success in an online class is related multiple psychological factors including emotional self-regulation. Mohamed and colleagues (2022) reported there is a correlation between under college students' emotional intelligence (EI) and overall mental health. Additionally, researchers have found a significant correlation between high levels of EI and academic performance (Rai & Khanal, 2017). These studies were focused on EI whereas Andrei (2023) presented a study on the interactions between EI, spiritual intelligence, and education.

Literature Review

Self-care is universally accepted as important for individuals, especially in highly stressful situations including academia. Loi and Pryce (2022) noted that the stress of college coursework coupled with the pressure to achieve can lead to a lack of sleep and life stresses. The combination of all these stresses can lead to academic burnout, which includes the key dimensions of emotional exhaustion, cynicism, and a reduction in efficacy (Maslach & Leiter, 2016). In their study, Loi and Pryce explored the relationships between academic burnout, well-being, EI, and mindful self-care. Their study data indicated there is a relationship between EI and mindful self-care, which highlights the value of both of the variables.

Carthy and colleagues (2022) found that EI coaching to support university students had a positive effect on academic achievement. In a mixed method study, the researchers stated that participants indicated positive results with the coaching and their wellbeing. Other researchers have presented the use of EI as a means for testing and evaluating social and healthcare student selections (Pienimaa et al., 2023). Pienimaa and colleagues noted that previous researchers had presented EI as a tool to assess the potential applicant's ability to be successful in social care and healthcare studies. These studies presented support for the value of EI in supporting and assessing college students.

Online learners can struggle with being connected in an online classroom environment (Zimmerman & Nimon, 2017). The premise that being connected to a community in the online classroom has been supported by researchers. Zhang and Renshaw (2019) postulated that college students who exhibit high levels of agreeableness and extraversion as measured by the College Student Subjective Wellbeing Questionnaire (CSSWQ). The personality traits of agreeableness and extraversion align to the interpersonal intelligence as presented in the work of Howard Gardner (2006). Gardner discussed a ninth intelligence (existential), which aligns to spiritual intelligence research conducted by other scholars (e.g., Amran, 2022; Vancea, 2014).

Amram (2022) presented an argument for the validity of spiritual intelligence as it meets the criteria used to establish other intelligences espoused by Gardner as well as EI. Several spiritual intelligence scales have been developed to address the thinking related to existential

processing of life in spiritual terms. The instruments that have been developed to date show a correlation to EI, which also is connected to the parameters of multiple intelligences (MI).

Conclusion

The proposed study will explore the correlation between graduate school students' levels of EI, MI, and their sense of connectedness as measured by the Online Student Connectedness Survey (OCSS). The EI instrument can also provide an association between spiritual intelligence (King et al., 2012), which can add to the usefulness of this study. The studies noted in the review of the literature were focused on undergraduate school students, which creates the opportunity for the proposed study to help address a gap in the current literature.

Method and Design

The quantitative approach seeks to determine the relationship between two or more variables (Rahman, 2016). Three validated instruments used in previous quantitative research (Armstrong, 2000; Wong & Law, 2002; Zimmerman & Nimon, 2017) will be used to measure the variables in this study. The research design employed for this study is a correlational-predictive design. Asamoah, 2014 asserted that the correlation design is employed not only to discover the relationships between variables but can also help researchers "predict how one variable might predict another" (p. 50). The EI and MI instruments will be used to determine if or to what extent there is a relationship to students' online student connectedness as measured by the OCSS.

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Contact email: Loren.Naffziger@my.gcu.edu

Analysis of the Need for the Development of Research-Based History Learning Models in Higher Education With the TPACK Approach

Asyrul Fikri, University of Riau, Indonesia
Suarman, University of Riau, Indonesia
Isjoni, University of Riau, Indonesia
Sumarno, University of Riau, Indonesia

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Official Conference Proceedings

Abstract
21st century learning requires the use of models that take advantage of technological advances, especially in supporting research and research. The research-based history learning model with the TPACK approach is one of the models that can be used to support history learning. The purpose of this study is to analyze the need for the development of a research-based history learning model with the TPACK approach. The research method used is R&D using only one stage, namely the analysis stage. The participants of this study consisted of 27 lecturers and 107 students. The data collection technique of this study uses observation, interview, and questionnaire dissemination techniques. The data analysis used in this study only uses qualitative data to describe the need to develop a research-based learning model with the TPACK approach in history learning. The results show that the implementation of RBL is very important to support the tridharma of lecturers and local history learning, although the needs analysis shows that the application is not yet clearly visible in the lecture materials and outputs, so it is necessary to develop a more effective and relevant model to the local context. Study program students want to use lecturers' research results as a reference, and with digital support through TPACK, learning can be more dynamic, facilitate the integration of theory with real practice, as well as improve historical thinking skills and enrich student learning experiences.

Keywords: TPACK, Research-Based Learning Model, History Learning

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Introduction

Education is one of the main pillars in building human civilization. In the current era of globalization and technological advancement, education is required to be able to adapt to rapid changes (Sadikin et al., 2023; Tolchah & Mu'ammar, 2019). The Industrial Revolution 4.0 presents new challenges and opportunities for the world of education, including in the context of learning history in higher education (Akrim, 2022; Kayembe & Nel, 2019). Automation and digitalization have become an integral part of daily life, demanding education to adapt to new methods and approaches that are more relevant and effective (Kalimullina et al., 2021; Trends et al., 2020).

One of the problems faced in history education in higher education is the lack of innovation in learning models and methods. Most of the learning is still centered on the conventional lecture method. This results in students becoming passive and not actively involved in the learning process. Students now have extensive access to information from a variety of sources, which is often more interesting and relevant than what is presented in class. In addition, many educators still face difficulties in utilizing technology effectively in history teaching. Educators tend to rely on traditional methods, such as reference books and PowerPoint presentations, without taking advantage of various digital tools and resources that can enhance student interactivity and engagement. The lack of skills and training in educational technology is often an obstacle for educators to innovate and develop more dynamic and engaging teaching methods.

To overcome this problem, it is necessary to develop a learning model that can motivate students to be actively involved in the learning process. Research-based learning (PBR) has emerged as one of the potential solutions that allows students to search, analyze, and integrate information from various sources, so that students not only master the material theoretically, but also develop critical and analytical thinking skills (Budayawati et al., 2019; Rohim et al., 2019; Rosena et al., 2024).

Research-based learning (PBR) is one of the student-centered learning (SCL) models that integrates research in the learning process (Nawawi et al., 2021; Suwito et al., 2019; Wibowo & Suryo, 2019). Therefore, PBR opens opportunities for the development of learning methods, including (Brew & Saunders, 2020; Burgess & Pande, 2005; Wessels et al., 2021): (1) learning renewal by integrating research results, (2) active participation of students in the implementation of research, (3) learning using research instruments, and (4) development of an inclusive research context (students learn procedures and research results to understand the intricacies of synthesis). The research-based learning model provides opportunities and courage for students to actively participate in the learning process (Bergmark, 2022; Suyatman, 2020). High-level learning guides students not only to master the knowledge and understanding of the course, but to be able to reach the highest level of learning, namely creation (Dewi & Primayana, 2019; Maknun, 2020).

The Technological Pedagogical and Content Knowledge (TPACK) approach can be used to strengthen the implementation of PBR. TPACK is a framework that combines knowledge of content, pedagogy, and technology to create more effective and engaging learning (Absari et al., 2020; Malik et al., 2019; Taopan, 2020). With TPACK, educators can design learning experiences that suit the needs of students in the digital era, while utilizing technology as an interactive learning tool (Agustini et al., 2019; Lisa et al., 2021; Sarwa et al., 2020). Previous research has shown that the application of TPACK in learning can increase student

engagement and motivation (Almaiah et al., 2022; Widyasari et al., 2022). By integrating technology in history learning, students can be invited to actively participate in research and collaborative projects (Macgilchrist et al., 2020; Yang & Baldwin, 2020). This not only helps students understand the material more deeply, but also prepares students to face challenges in the increasingly complex and dynamic world of work.

The development of innovative learning models can significantly improve student learning outcomes (Kwangmuang et al., 2021; Malmia et al., 2019; Supena et al., 2021). With the right approach, students not only learn to memorize historical facts, but also understand the context and implications of these historical events. Students are invited to think critically and reflectively, so that they are able to apply the knowledge gained in real life. The implementation of TPACK and PBR in history learning in higher education can also contribute to the development of a curriculum that is more responsive to the times. A curriculum designed with the needs and potential of students in mind can increase the relevance and effectiveness of history education. In addition, this approach can also help build a young generation that is more adaptive, creative, and innovative in facing global challenges.

Research conducted by Kusumawardana (2020) the application of a research-based learning model can improve student interpretation. Zahrawati and Aras (2020) said that Research-Based Learning is effective in improving student learning outcomes and learning interests. Quddus (2020) revealed that the implementation of TPACK can improve student competence. However, based on the above research, no previous researcher has analyzed the development of a research-based history learning model with the TPACK approach. Thus, the development of a research-based history learning model with the TPACK approach requires a comprehensive needs analysis. It is important to ensure that the model developed is truly in accordance with the characteristics and needs of students and the context of education in higher education. Through needs analysis, educators can determine the most effective methods, strategies, and tools to use in learning.

Method

This research uses the ADDIE development (R&D) method. The ADDIE model was chosen because it is in accordance with the situation and conditions of improving the professional competence of lecturers who require continuous evaluation in developing a model. The stages of the ADDIE method used in this study only use one stage, namely analysis. At this stage, an analysis of material concepts, analysis of the needs of lecturers and students, and analysis of learning models that have been used previously are carried out.

The data collection techniques used are observation, interviews, questionnaires, and document analysis. The questionnaire was filled out by lecturers and students with a questionnaire score using a likert scale with a score range of 1 to 5. The questionnaire used has been tested for validity and reliability so that it can be used in research. The results of the validity and reliability test of the questionnaire can be seen in table 1.

Table 1: Questionnaire Validity Test for Lecturers

No Question	r-count	r-table	Information
1	0.668	0.381	Valid
2	0.516	0.381	Valid
3	0.760	0.381	Valid
4	0.677	0.381	Valid
5	0.717	0.381	Valid
6	0.581	0.381	Valid

Table 1 shows that the overall questionnaire for lecturers has a significance value greater than the r-table of 0.381 which concludes that the questionnaire is valid and can be used in research.

Table 2: Questionnaire Validity Test for Students

No Question	r-count	r-table	Information
1	0.802	0.176	Valid
2	0.751	0.176	Valid
3	0.787	0.176	Valid
4	0.864	0.176	Valid
5	0.803	0.176	Valid

Table 2 also shows that the overall questionnaire for students has a greater significance value than the r-table of 0.176 which concludes that the questionnaire is valid and can be used in research.

Table 3: Instrument Reliability Test

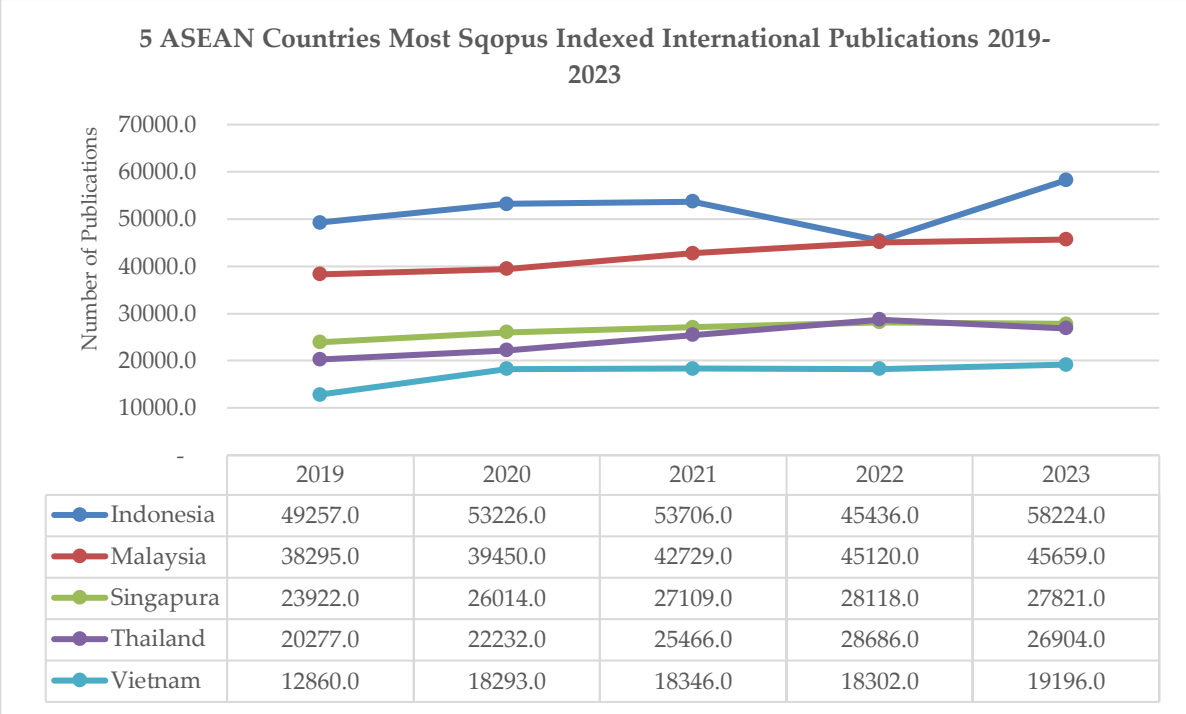
Questionnaire	Cronbach's Alpha	N of Items
Lecturer	0.726	6
Student	0.708	5

Based on table 3, it can be seen that the entire questionnaire has a significance value greater than 0.05, which shows that all the questionnaires of lecturers and students can be used as questionnaires in research.

This study is only one type of data generated in this study, namely qualitative data Qualitative data is generated during the preliminary study and model development. Qualitative data analysis is carried out through direct interpretation based on the results of observations, interviews, and questionnaire distribution.

Result

In general, the research culture in Indonesia universities has undergone development, this is shown by data sourced from SJR (Scimago Journal and Country Rank) from 2019 to 2023 shown in figure 1. Compared to five ASEAN countries, namely Singapore, Malaysia, Thailand and Viet Nam, Indonesia occupies the first position with those published in international journals indexed by Scopus. The achievements of international scientific publications indexed by Scopus come from the Ministry of Education and Culture, Research and Technology, Non-Ministerial Government Institutions, and other research and development institutions.



	2019	2020	2021	2022	2023
Indonesia	49257.0	53226.0	53706.0	45436.0	58224.0
Malaysia	38295.0	39450.0	42729.0	45120.0	45659.0
Singapura	23922.0	26014.0	27109.0	28118.0	27821.0
Thailand	20277.0	22232.0	25466.0	28686.0	26904.0
Vietnam	12860.0	18293.0	18346.0	18302.0	19196.0

Figure 1: 5 ASEAN Countries Most Scopus Indexed International Publications 2019-2023

Although the number of publications has increased, in terms of citations, Indonesia is still below other countries. This shows that the quality of Indonesia's research is still low. The quality of publications can be calculated by the H-index. The H-index is a composite index of 5 (five) indicators, namely the number of documents, the number of documents that are worthy of citation, the number of citations, the number of citations themselves, and the number of citations per document. According to the 2023 Scientific Journal Ranking (SJR), Indonesia is ranked 38th with an H-index of 318. In the Southeast Asian region, Indonesia is still below Singapore (H-index 806), Malaysia (H-index 504), and Thailand (H-index 452).

Table 4: International Journal Citation Information 1996-2023

Country	Documents	Citable documents	Citations	Self-citations	Citations per document	H index
Singapore	432121	393012	12870663	1128547	29.78	806
Malaysia	502815	477046	6857678	1393297	13.64	504
Thailand	305015	288839	4767712	706073	15.63	452
Indonesian	376908	366528	2287188	670472	6.07	318
Vietnam	139043	132344	2021594	309286	14.54	316

The low quality of publications can be caused by internal factors and external factors. Internal factors, among others, the choice of research topics/themes are often not in line with the trend of international research topics/themes, so it is unlikely that Indonesia's research results can be input for international research. Limited research capacity (both researchers and infrastructure) also limits the type of research that can be conducted. Another internal problem that often arises is the violation of scientific ethics that causes the failure of accreditation in national and international publications. In addition, the lack of development of writing culture in higher education is a problem for the research community, especially students. This leads to a lack of ability to comprehensively analyze and interpret research results in national and international publications. From an external perspective, financial

support is also needed to facilitate and provide encouragement for students and lecturers to be able to conduct quality research.

Regarding research activities in higher education, the Higher Education Law has clearly explained, especially in articles 45 and 46. Article 45 reads: 1. Research in Higher Education is directed to develop Science and Technology, as well as improve the welfare of the community and the competitiveness of the nation; 2. Research as referred to in paragraph (1) is carried out by the Academic Community in accordance with scientific autonomy and academic culture; 3. Research as referred to in paragraph (2) is carried out based on competency and competition paths. Article 46 reads: the results of the research are useful for: a. enrichment of Science and Technology and learning; b. improving the quality of higher education and the progress of the nation's civilization; c. increasing the independence, progress, and competitiveness of the nation; d. fulfillment of strategic needs for national development; and the transformation of Indonesia society into a science-based society.

Permenristekdikti No. 44 of 2015 concerning National Standards for Higher Education also strengthens the importance of research activities in higher education. In this Permendikbud, it is explained that even the national standards for higher education consist of 24 standards, namely 8 national standards for education, 8 national standards for research and 8 national standards for service. The details of the 8 research standards are as follows: research result standards; standard of research content; standards of research processes; research assessment standards; research standards; standards of research facilities and infrastructure; research management standards; and research funding and financing standards. The emergence of this separate research standard clearly emphasizes that the formation of research universities has received a special forum in Permenristekdikti No. 44 of 2014. The comparison chart of the number of scientific publications of the five ASEAN countries above is a challenge for universities in Indonesia to increase the number of scientific publications at the international level, especially at the ASEAN level. This also has an impact on the competition of universities in the country to increase the number of scientific publications in reputable international journals and SINTA indexed journals.

From the Scimago Journal and Country Rank (2023) data, the publication of the academic community of the University of Riau in reputable international journals is ranked 32nd below UNIMED (28), UNSRI (23), UNP (16), UNILA (15), USK (11), and USU (9).

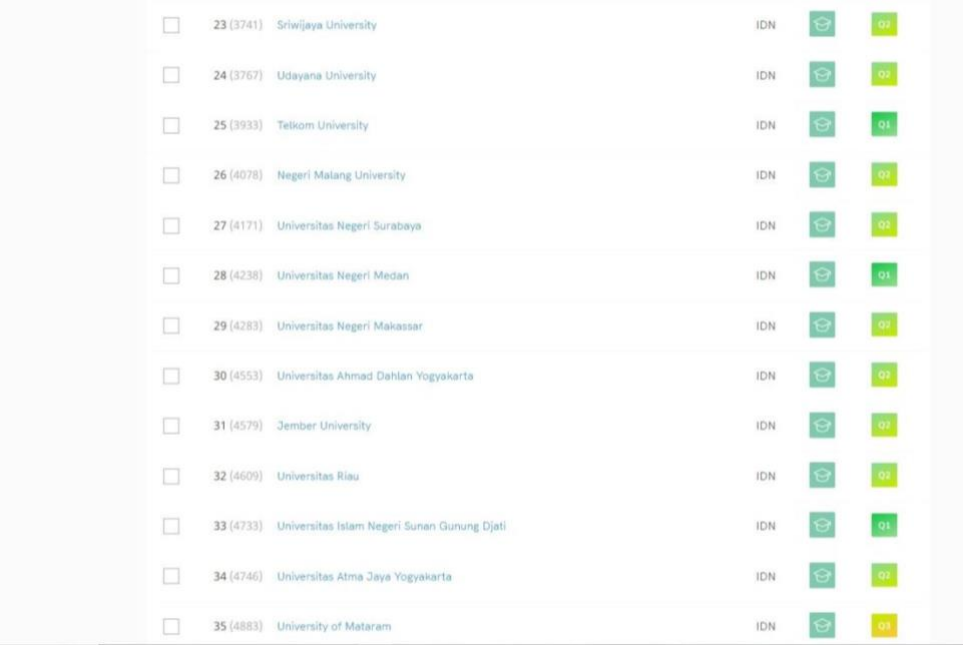


Figure 2: Ranking of the University of Riau in Scopus Publications

As an effort to realize a research university, it can be seen in the formulation of the scientific vision of the History Education Study Program of FKIP University of Riau which is in line with the vision of the faculty and the University of Riau which can be seen in the following figure.

Figure 3: Alignment of Study Program Vision With Faculty Vision and University Vision

In addition, according to Salimi and colleagues (2017) LPTK are required to connect teaching, research and community service. Research-Based Learning (RBL) has the opportunity to be a solution to revitalize and connect teaching, research and service. The integration of research in learning, hereinafter known as Research-Based Learning. Research-Based Learning (PBR/RBL) is based on the philosophy of constructivism which includes 4 (four) aspects, namely: problem-based learning and problems must arise from problems in research developed by lecturer research, learning by developing up-to-date prior knowledge based on the results of cutting-edge research, collecting, analyzing data and testing the correctness of the analysis results, and finally developing reports and publications. Realizing that PBR is very attached to the tridharma task as a lecturer, the application of PBL in courses at the University of Riau is very important.

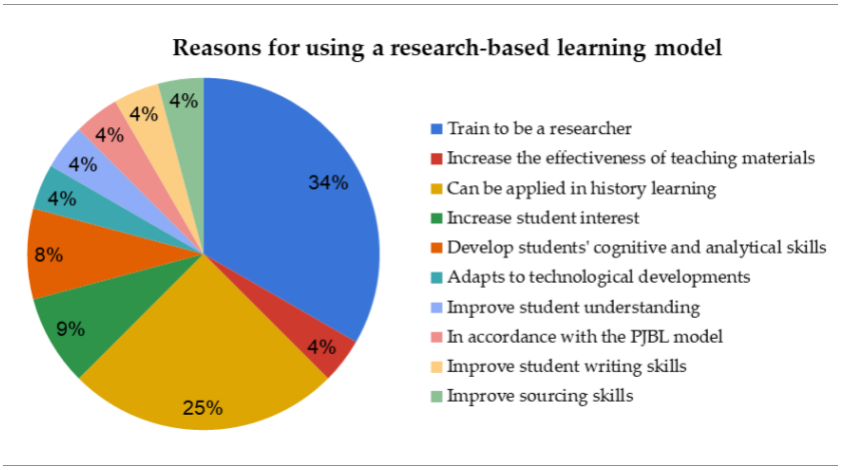


Figure 4: Reasons for the Importance of Using Research-Based Learning Models

This is the reason for the need for the development of a research-based learning model at FKIP University of Riau. Especially in the History Education study program of FKIP University of Riau. The analysis of needs in learning for the needs of lecturers and students so that the desired learning goals are achieved is a consideration to implement the right learning model. Likewise, in local history course lectures, in order for learning objectives to be achieved, better planning is needed. The selection of local history courses is an effort to achieve the vision of the Study Program, namely developing research-based history education and learning by integrating local wisdom, in this case Riau Malay Culture. A needs analysis was also carried out to see the gaps that have existed so far in learning local history courses, especially in terms of historical thinking skills possessed by students in the History Education Study Program, FKIP University of Riau.

Efforts made in identifying better learning needs are carried out by document studies, observations, and interviews. The analysis of the needs of model development was carried out by analyzing lecture equipment documents and direct interviews with lecturers and students regarding their experience so far in the lecture process.

Based on the analysis of lecture document materials for lecturers of the History Education Study Program, FKIP University of Riau, it was found that only 25% of lecturers used their research results as lecture references. Although from the results of the interview, most of the lecturers admitted that they had implemented research-based history learning, but this could not be proven in writing either from the lecture apparatus or the output or student assignments that were the output of the course and were not associated with local wisdom or elements of local history. Furthermore, from the results of the interview, an input and suggestion for model development was obtained, which needs to be considered in the aspects of implementation time and classroom management. The historical research carried out is, of course, one that can be carried out in a short time but can still produce a research study that can be accounted for. Especially research related to local history, which according to most study program lecturers, students' understanding of local history is very low and needs to be improved. For this reason, the use of digital historical sources can be an alternative in implementing the model in lectures, and also the use of digital historical sources supports the concept of Technological, Pedagogical, Content, and Knowledge (TPACK).

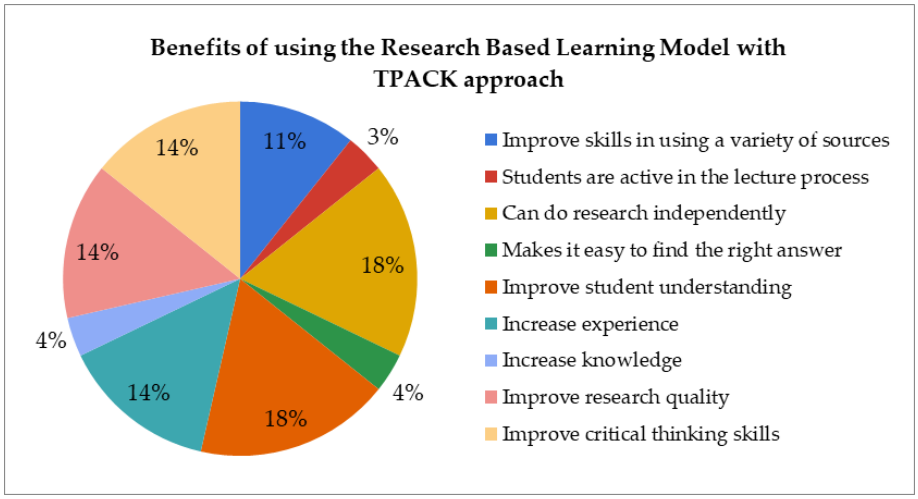


Figure 5: Benefits of Using a Research-Based Learning Model With the TPACK Approach

Furthermore, from the analysis of student needs based on the results of interviews with 15 students of the History Education study program of FKIP University of Riau related to student experience in the lecture process of study program courses, namely 65% said that most of the lecturers of the History Education study program FKIP University of Riau have used a research-based history learning model, as evidenced by giving assignments to students to search for articles on google scholar as a reference in Lecture. He further explained that the lecture experience that students want to get if they use a research-based learning model is that 35% of students want to use the research results of study program lecturers as material references or examples in the lecture process, 15% of students want to use research results or articles published in SINTA indexed journals, and 50% of students want to carry out mini research. The benefits of applying research-based history learning in lectures, according to students, are being able to distinguish historical events from non-history, being able to compose historical events chronologically, and as an exercise for working on a final project/thesis in the field of history (Cohen, 2019; List & Univers, 2021). The students' answers are in line with the concept of historical thinking. However, related to the historical thinking skills of history education students, there needs to be a clear measurement of the level of skills obtained by students.

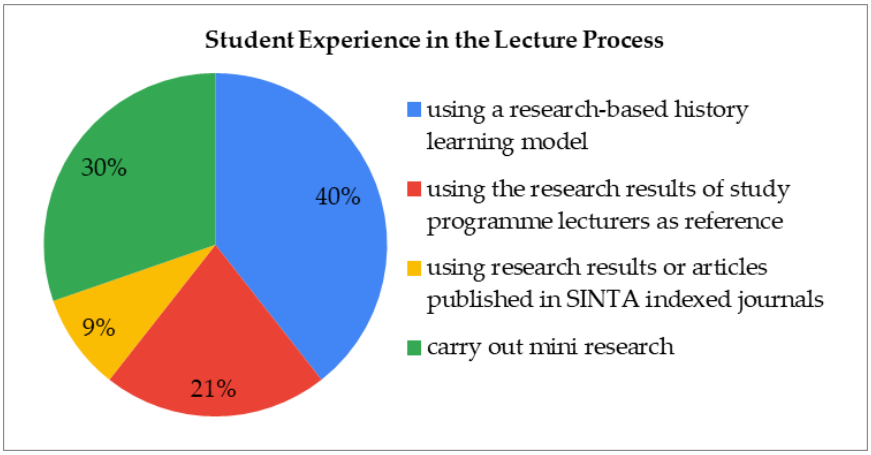


Figure 6: Student Experience in the Learning Process

The data presented in figure 7 highlights the positive reception of active learning methods, such as group discussions, presentations, and case studies, among the students. This trend underscores the need to combine a research-based history learning model using the TPACK

(Technological Pedagogical Content Knowledge) approach. By integrating technology and pedagogy with content knowledge, educators can create dynamic and engaging learning experiences that resonate with students (Mirra, 2019; Pramesworo et al., 2023). Very positive responses to the interactive method showed that students were more engaged and motivated when they were actively involved in the student learning process.

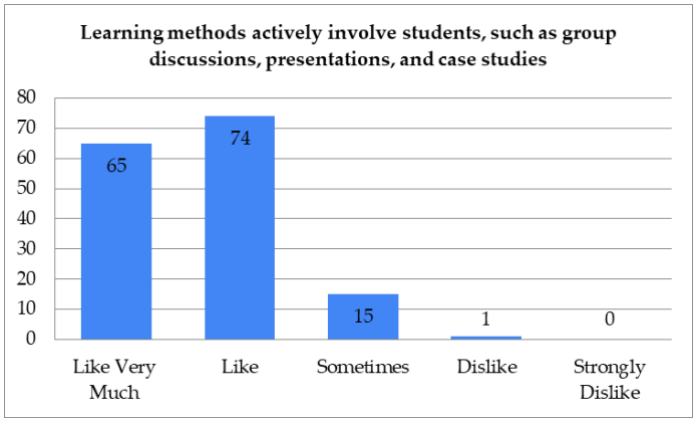


Figure 7: Learning That Actively Engages Students

Figure 8 shows that a large number of students prefer learning methods that incorporate technology, such as video, animation, and digital learning applications. With 72 students liking and 66 students really liking, it's clear that digital aids are very effective in engaging students. This highlights the need for a research-based history learning model using the TPACK (Technological Pedagogical Content Knowledge) approach. By seamlessly integrating technology with pedagogical strategies and historical content, educators can create a more immersive and interactive learning environment (Bekele, 2019). The positive response to technology-based learning underscores its potential to improve historical understanding and knowledge retention (Gyll & Hayes, 2023). Thus, adopting the TPACK approach in history education not only caters to students' preferences, but also equips students with digital literacy skills that are essential for the 21st century.

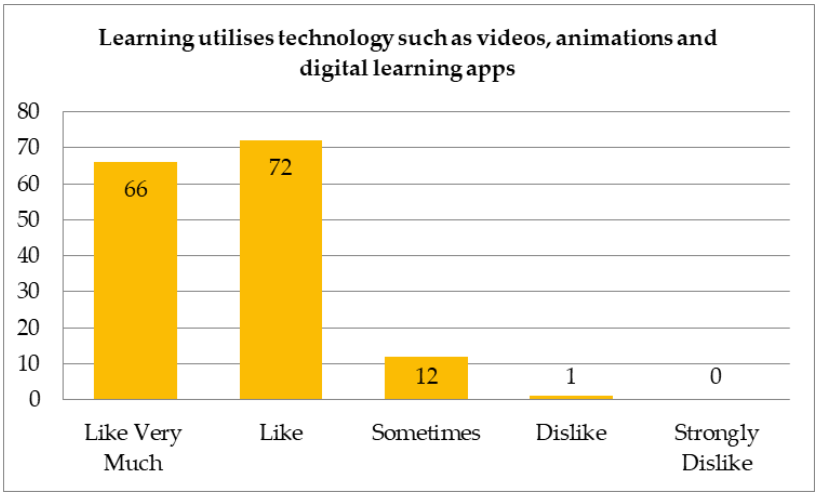


Figure 8: Use of Technology in History Learning

Figure 8 illustrates the strong preference among students to receive constructive and timely feedback from lecturers, with 106 students stating that students "Like" and 47 stating that students "Like" this approach. Such feedback is essential to encourage the academic development and growth of students. This emphasizes the importance of integrating a

research-based history learning model using the TPACK (Technological Pedagogical Content Knowledge) approach. TPACK not only enables seamless integration of technology and pedagogy, but also facilitates personalized and direct feedback through digital platforms (Chaipidech et al., 2021; Shoukat et al., 2024). By using TPACK in history education, lecturers can provide tailored feedback to meet individual learning needs, improve comprehension, and motivate students to engage more deeply with history content (Abu-Hardan et al., 2019; Sebbowa & Ng'ambi, 2020). This approach ensures that feedback is not only timely but also relevant and constructive, ultimately supporting students' academic success and fostering a more effective learning environment.

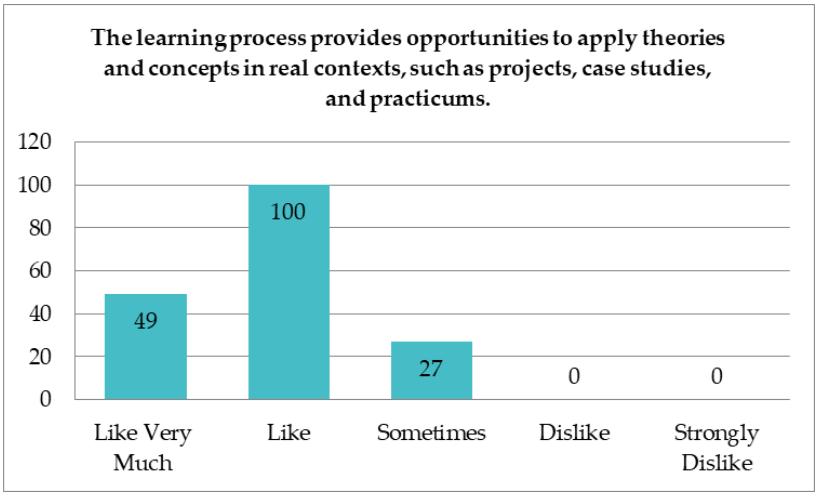


Figure 9: Application of Theory in the Real World

Figure 9 shows a clear preference among students for a learning process that allows students to apply theories and concepts in real-world contexts, with 100 students indicating that students "Like" and 49 students stating that students "Strongly Like" opportunities such as projects, case studies, and practicums. This data underscores the need to apply a research-based history learning model using the TPACK (Technological Pedagogical Content Knowledge) approach. By integrating technology with pedagogical strategies and historical content, educators can create authentic learning experiences that connect academic theory with practical applications (Smith et al., 2020). The TPACK approach facilitates the use of digital tools and resources to design projects and case studies that mirror real-world scenarios, thereby enhancing students' critical thinking and problem-solving skills.

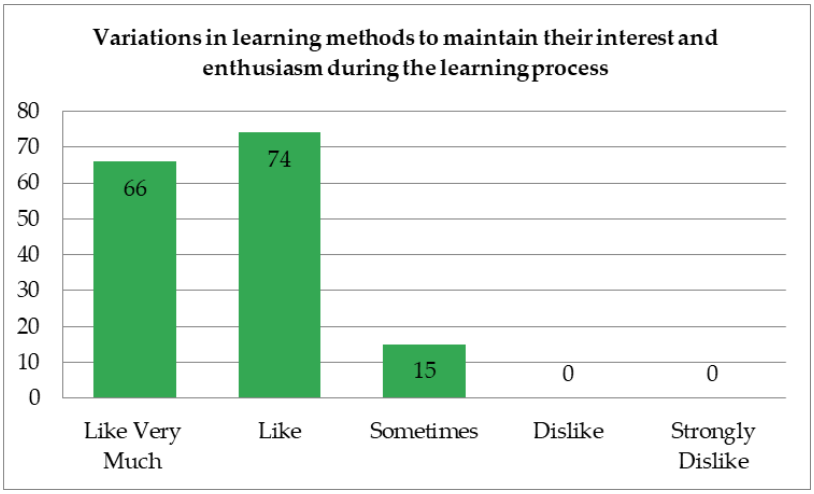


Figure 10: Use of Diverse Learning Models

Figure 10 highlights that most students value variety in learning methods, with 74 students indicating that students "Like" and 66 students stating that students "Like" students "Very Much" with diversity in learning approaches. The enthusiasm for these varied learning methods shows the importance of adopting a research-based history learning model using the TPACK (Technological Pedagogical Content Knowledge) approach. By integrating technology with pedagogical strategies and historical content, educators can offer diverse and engaging learning experiences that suit different learning styles and preferences. The TPACK framework allows teachers to combine multimedia resources, interactive activities, and innovative teaching techniques, thus keeping students' interest and enthusiasm throughout the learning process.

In addition, the basic thing behind the research on the development of this RBL model in the local history course based on the study of literature and the learning situation in this course is the limited or absence of history laboratory infrastructure which causes students to tend to always get material theoretically without real application or real practice. Through the implementation of the RBL model, it is hoped that it will contribute to learning with a new model that prioritizes student-oriented learning methods by carrying out research in learning, so that it is hoped that the limitations of practical experience and the model used so far can be minimized. Therefore, the development of a research-based history learning model to improve historical thinking skills as a prospective history teacher is an effort to achieve the vision of the History Education Study Program of FKIP University of Riau.

Discussion

The development of a research-based history learning model in higher education with the TPACK approach is an important step in improving the quality of student learning and understanding. Research by Kusumawardana (2021) shows that the application of a research-based learning model can improve students' interpretation skills, while Zahrawati and Aras (2020) found that this approach is effective in improving student learning outcomes and interests. Quddus (2019) added that the implementation of TPACK can improve the overall competence of students, thereby supporting the integration of technology in the learning process.

At the University of Riau, the importance of implementing Research-Based Learning (RBL) is emphasized to support the tridharma of lecturers, which includes teaching, research, and community service (Ikhsan et al., 2019). This is in line with the vision of the History Education Study Program which seeks to integrate local wisdom in the curriculum. Although some lecturers at FKIP Universitas Riau have claimed to implement RBL, the needs analysis shows that evidence of such implementation is still not seen in teaching materials and lecture outputs. This signals the need to develop a more effective and relevant RBL model to the local context.

Students in the History Education Study Program, University of Riau, expressed a desire to use the results of lecturers' research as a reference in learning, and realized the benefits of research-based learning in understanding history and preparing for final projects. The TPACK approach, which integrates technology, pedagogy, and knowledge content, is necessary to facilitate more dynamic and engaging learning, enable the integration of theory with real practice, and improve students' historical thinking skills.

The development of research-based learning models in higher education can be done in several ways. First, students can be asked to search for and review scientific articles published in journals as part of their course assignments. This not only encourages student involvement in research, but also improves their ability to assess academic literature and understand how research supports the theory being studied. Second, involving students in mini-research, both individually and in groups, can help them develop research and problem-solving skills. This allows students to experience first-hand the research process, from problem formulation to data analysis, and apply their knowledge in real-world contexts.

Third, lecturers can involve students in the research they conduct, giving students first-hand experience of how research is conducted in the academic world. This participation gives students the opportunity to learn directly from lecturers, while also honing practical skills that they can use in the future. Fourth, the use of lecturers' own research results as a reference in the courses taught can provide concrete examples to students about how research is carried out and applied in their field of study. It also shows students how research conducted at their own university can contribute to their learning. Fifth, integrating the research results of others as a reference in lectures can enrich students' perspectives and show them the relevance and practical application of the theories they are learning. It also helps students to better appreciate the importance of research in the development of knowledge and practice in their field.

This approach not only enriches students' learning experience, but also prepares them for the challenges in the world of work that require research skills and critical thinking skills. By leveraging the TPACK framework, teaching can become more relevant and responsive to technological developments and student needs, allowing them to thrive in an interactive learning environment and support 21st century skills. Overall, the analysis of the need to develop a research-based history learning model with the TPACK approach in higher education emphasizes the importance of creating a learning environment that supports the development of student competencies. The application of this model is expected to minimize the limitations of current practical experience, improve historical thinking skills, and contribute to the achievement of the vision of the study program.

Conclusion

The application of the Research-Based Learning (RBL) model is very important to connect teaching, research, and community service, in accordance with the demands of LPTK At the University of Riau, the importance of RBL is emphasized in supporting the tri dharma of lecturers and local history learning, in line with the vision of the History Education Study Program that integrates local wisdom. The needs analysis at FKIP Universitas Riau shows that although some lecturers claim to have implemented RBL, the evidence is still not seen in the material and lecture output. This indicates the need to develop an RBL model that is effective and relevant to the local context. Study program students want to use the results of lecturers' research as a reference and benefit of research-based learning in understanding history and preparing for final projects. Digital support through TPACK (Technological Pedagogical Content Knowledge) is also needed to facilitate dynamic and engaging learning, which allows the integration of theory with real practice. This effort aims to improve students' historical thinking skills, maximize the use of digital resources, and enrich the student learning experience.

The limitation of this study lies in the lack of evidence that can be seen from the application of the research-based learning model (RBL) in the materials and lecture outcomes at FKIP University of Riau, despite claims from lecturers that RBL has been implemented. This indicates the need for further development of an effective RBL model that is appropriate to the local context. In addition, technological support through the TPACK approach has not been fully utilized, so the integration of theory with real practice has not been optimal. For further research, it is recommended that the development of the RBL model be carried out with a greater focus on the local context and the use of lecturer research results as a learning reference. Research should also pay attention to the maximum use of digital resources to create a more dynamic and interesting learning experience for students. The impact of this research on the world of education and higher education institutions can be in the form of improving the quality of teaching through the integration of teaching, research, and community service. By adopting the TPACK approach, institutions can enrich the curriculum and improve students' historical thinking skills, prepare them for challenges in the world of work, and support the achievement of the tri dharma of higher education.

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Perception of History Education Students on the Use of Virtual Reality Tour 3D Media of the Wings Palace in Pelalawan

Bunari, Riau University of Riau, Indonesia
Muhammad Afrillyan Dwi Syahputra, University of Riau, Indonesia
Ria Rafianti, University of Riau, Indonesia
Chandra Perwira Negara, University of Riau, Indonesia
Asyrul Fikri, University of Riau, Indonesia

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Abstract
This research is based on the results of the development of the Theasys Virtual Reality Tour of Pelalawan Wing Palace software. This research aims to see the extent to which students' perceptions as research objects assess the results of products that have been designed. So that becomes the initial basis for using this product in the community (school or campus). The research method used in this research is descriptive quantitative. The data collection techniques used in this research were questionnaires and interviews. Based on the results of data analysis of students' perceptions of the Virtual Reality Tour of Pelalawan Wing Palace, the five indicators of media product suitability (material, illustrations, media appearance and attractiveness) through a Likert scale questionnaire were at an average score of 5 and 4, which means they were rated as good and Very good. It can be concluded that the product is suitable for dissemination and use in the community (school or campus) as additional teaching material for historical material, especially Riau Malay History material.

Keywords: Theasys, Virtual Tour, Perception

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Introduction

We now live in the Cyber Era filled with social networks, virtual communities, artificial humans, 3D worlds, digital applications, and collaborative games that are able to change the way we see the world. The most important thing in this era is our ability to record, share, and disseminate information. According to Remondino and Campana (2014, p. 113), creative technology has brought new breakthroughs in human behavior and interaction with others and the surrounding environment. With various features on social media, video calls that can be made via smart watches, to virtual reality interactions that feel so alive.

This is the reality of today's life that is highly dependent on digital devices. With the development of the era that continues to change, the education system must adapt. In this modern era, an important issue in the world of Indonesian education is the use of digital learning, especially when the academic community is faced with conditions that encourage education to be carried out online.

Not only that, the use of efficient digital learning materials. With the increase in education through the internet, virtual education systems are increasingly developing, such as virtual reality, virtual stores, and virtual companies where users can access learning through digital devices and the internet. This shows that the world is currently heading towards the Industrial Revolution 4. Society 5. 0 and zero. Almost all community activities have now adopted digital technology and the internet (Ismavida et al., 2022).

The development of Information and Communication Technology has made a significant contribution to humans in various sectors, including in the field of education. With the development of this situation, we can see changes in the way of learning that has undergone many developments, both personal learning methods, learning media, and learning processes (Husnita & Junaidi, 2023). The development of information technology in the world of education now includes the use of Virtual Tour 360 to present historical tourism objects.

In line with technological developments, according to Nunuk Suryani (2016), it is time for history learning to change. Not only recording the sequence of events, but also discussing the values that can be learned from these events. One of them is the values of historical awareness. That way, historical awareness is not limited to tragic memories of the past such as war, defeat, and destruction (Syahputra, 2020). One of the important values is awareness of local history.

Therefore, in an effort to introduce local history through the latest learning media and answer the challenges of education in the era of digitalization 5.0, history learning in schools and on campuses, especially in history learning, must develop. One of them is by using 3D Virtual Reality (VR) Media which is applied to the Istana Sayap site in Pelalawan Regency, Riau Province. By collaborating Learning Media and Local Historical Heritage, it is believed that it can increase the passion for history in schools and universities.

Basically, Virtual Reality 3D (hereinafter abbreviated as VR 3D) is a technology that allows users to interact with a computer-simulated environment in a virtual world that is capable of generating a three- or even four-dimensional atmosphere, making the user feel as if they are directly physically involved in the environment.

In short, the importance of the position of history learning is in shaping students as the young generation who will continue the nation's struggle (Sardiman, 2015, p. 2). However, in fact, the negative paradigm towards history learning still exists. There are still often erroneous interpretations of the implementation and meaning of history learning among the community today. Problems in history lessons from time to time are always related to traditional teaching methods (Suryani, 2013, p. 211). Learning history that only relies on memorization without including character building tends to encourage thoughts that tend to be practical and pragmatic.

However, there are limitations in terms of learning resources and media, especially in Indonesia. Many times, the traditional method of using textbooks and lectures is not fully able to inspire maximum learning interest, especially in history lessons (Adiyono et al., 2023). The reason is because history teachers find it difficult to package local history content so that it can be aligned with the material that has been set in the national curriculum (Fahrizal, 2023).

In line with the main study of this study, namely to see students' perceptions in using the Virtual Tour Istana Sayap application in Pelalawan. Perception occurs when users of the five senses begin to receive stimuli, then arrange and interpret them to understand what they are feeling (Nafendani et al., 2021). Perception is a process in which we organize and interpret patterns of stimuli in the surrounding environment. The main application of online learning is the unstable network connection, the costs are getting higher, learning becomes less effective, and the workload becomes too heavy. An individual's determination to use technology products is greatly influenced by the views they have.

This research is expected to help achieve the objectives of learning history on campus and in schools, so the author tries to see how high the level of perception of students in the History Education study program at Riau University is, as evaluation material for researchers to disseminate this application in the community (schools or campuses).

Research Methods

This research was conducted with a descriptive approach based on quantity. Mardalis (2007) explains that quantitative research is conducted by testing hypotheses or solving problems based on theoretical deduction, with the use of statistical data for measurement. Descriptive quantitative research is a type of research conducted by describing and analyzing a phenomenon objectively.

According to Sugiyono (2012, p. 29), this study applies a descriptive approach with the aim of providing an overview of the object or research results. The definition of descriptive according to Sugiyono is a method that functions to provide an overview or description of the research object based on data or samples that have been collected, without making general conclusions. In this research approach, a quantitative approach is used starting from data collection, data interpretation, to presentation of the results. This approach is also related to research samples that emphasize current issues and actual phenomena with research results in the form of significant data.

The population used in this study was 39 students, namely students from the class of 2024. The sample used was 39 students by distributing a Likert scale observation questionnaire.

Research Result

Products Under Assessment

Virtual reality tours, often referred to as panoramic tours, are simulations of a specific location made up of multiple 360-photographs. In various ways, images, videos, and other multimedia elements can be connected to each other to create a cohesive and engaging display. Here is a the concept of creating a Virtual Tour of the Istana Sayap and the snapshot of the product display that was assessed regarding student perceptions.

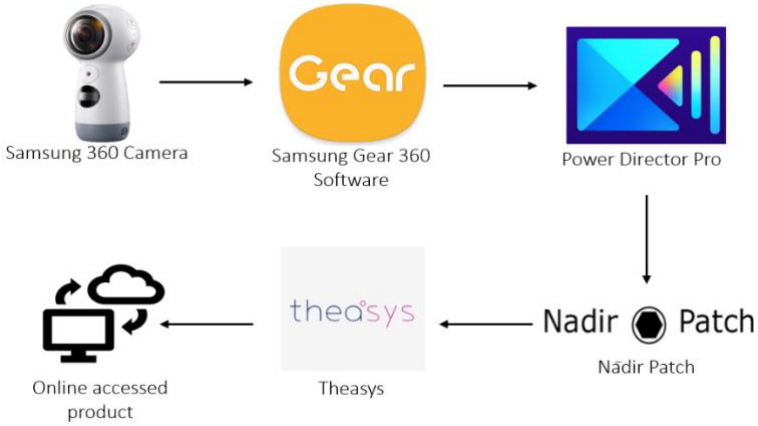

Figure 1: The Concept of Virtual Reality (VR) Tour by Theasys Software

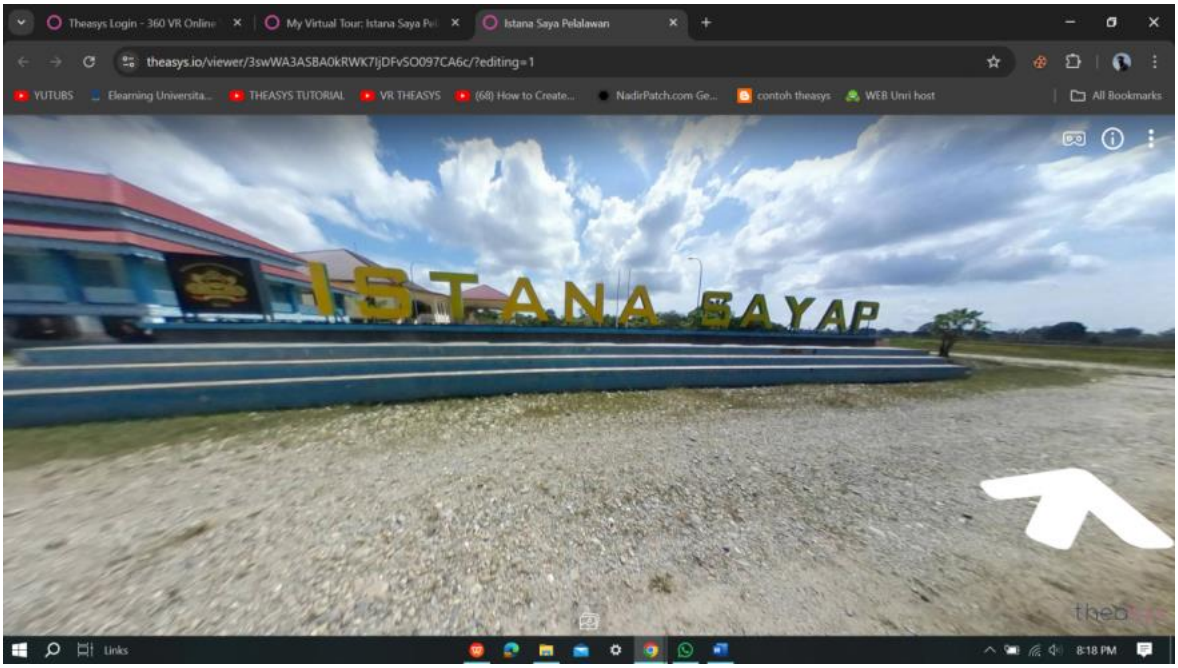

Figure 2: Istana Sayap's Gate on VR Tour

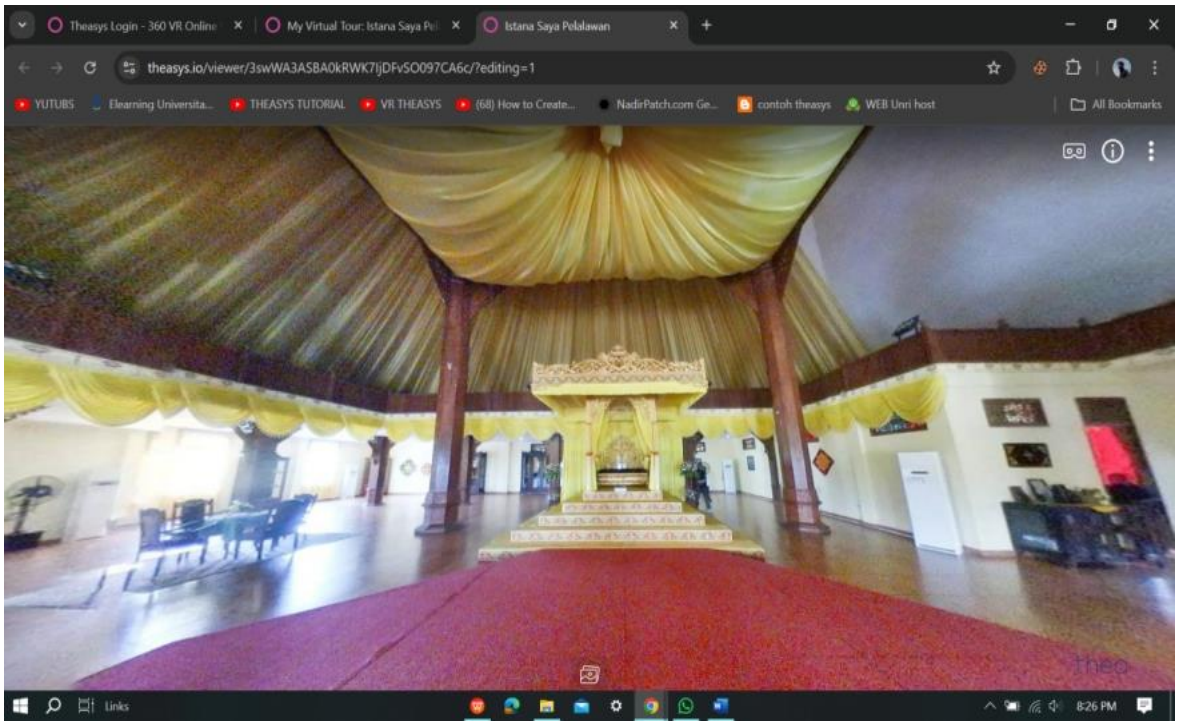

Figure 3: The First Room of the Wing Palace Functions as a Throne

Data Description

In accordance with the established research variables, the description of the research data results explains the perception of students in the History Education study program towards learning through the Istana Sayap Virtual Tour Application media. In this study, researchers will evaluate how students in the History Education Study Program, University of Riau assess this product from the student's perspective. Data were obtained from distributing questionnaires to 39 respondents, then processed and analyzed.

Overview of Student Perception Assessment Results

Perception assessment is seen from the media or product suitability indicators of material, illustrations, media appearance, and attractiveness (Winarno, 2009).

Based on the results of the analysis of student perceptions of learning through the Virtual Tour Application media, Istana Sayap is in the Good category. This is evident from the results of the analysis of the percentage level, 55% answered good, 45% answered very good, and 2% considered it quite good. Based on the results of the analysis, it can be concluded that in general, student perceptions of learning through E-Learning media in History Education Study Program Students are in the Good category. This can be seen in the following table and histogram:

Table 1: Student Perception Assessment Data

No	Aspect Evaluation	Statement	Average	Information
1	**Material**	a. The Virtual Tour of Istana Sayap application used can support the material to be taught.	5	Very good
		b. The Istana Sayap Virtual Tour application is used in accordance with learning objectives.	4	Good
		c. The use of the Istana Saya Virtual Tour Application is in accordance with CPMK	4	Good
2	**Illustration**	a. The Virtual Tour Application Media of Istana Sayap that is used can make it easier for students to understand historical material in online learning.	5	Very good
		b. The Virtual Tour of Istana Sayap application that is used can present videos that are true to the original to support history learning.	5	Very good
3	**Media View**	a. The appearance of the Istana Sayap Virtual Tour Application can attract students' attention and support students' online learning activities.	4	Good
		b. The Istana Saya Virtual Tour application displays attractive colors, images and visuals.	4	Good
4	**Attractiveness**	A. The use of the Istana Sayap Virtual Tour Application can increase students' enthusiasm for learning during online learning.	4	Good
		B. The use of the Istana Sayap Virtual Tour Application can help lecturers deliver history lessons effectively to students in the classroom.	5	Very good
Total number			2470	
Average			4.2	

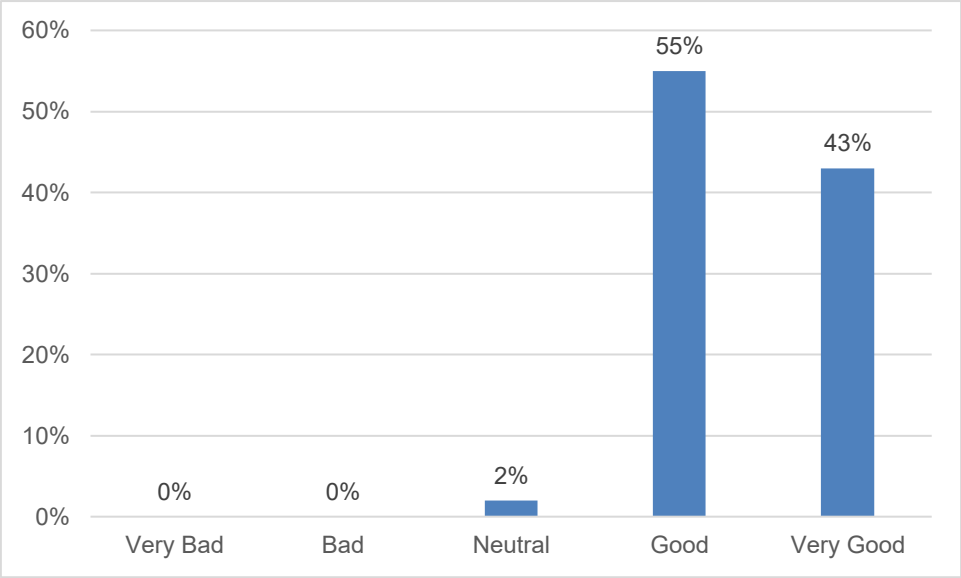

Figure 4: Students Perceptions Percentage

Based on the results of the perception assessment obtained by students, the Istana Sayap application media in Pelalawan received a score of 4.2. This shows that the product developed is included in the good category. Thus, this development media is worthy of being distributed. Then in the presentation of the percentage also shows that there are 55% who answered good, 43% answered very good, and only 2% felt sufficient.

Conclusion

Based on the results of the analysis of student perception data on the Virtual Reality Tour of Istana Sayap Pelalawan, from the five indicators of media product feasibility (material, illustration, media display, and appeal) through a Likert scale questionnaire, the average score is 5 and 4, which means it is considered good and very good. It can be concluded that the product is worthy of being disseminated and utilized in the community (schools or campuses) as additional teaching materials for History material, especially for the Riau Malay History material. In the description of the data from this study, it is explained that each data indicator about student perceptions of learning through E-Learning media consists of 5 indicators, namely: 1) Material, 2) Illustration, 3) Media Display, 4) Appeal.

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Analyzing Gender-Based Perceptions of Corruption and Equity Among Engineering Students: Insights From a Multidisciplinary Data Mining Approach

Gloria Martínez, Instituto Politécnico Nacional, Mexico
Nashielly Yarzabal, Instituto Politécnico Nacional, Mexico
Juan Sabas, Universidad Rosario Castellanos, Mexico

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Official Conference Proceedings

Abstract
In this study, we explored the differing perceptions of equity and corruption values between women and men through data mining analysis. Utilizing an extensive database of surveys, we applied advanced data mining techniques to identify significant patterns and differences in the perception of these values across genders. The results were derived from a survey initially designed as a result of a multidisciplinary and socially complex analysis, targeting engineering students at the National Polytechnic Institute in Mexico. The survey measured perceptions of corruption in educational institutions, businesses, the general public, as well as in public and private educational institutions. It was found that men perceived some of these entities as more corrupt. According to the results, women tend to have a more critical perception of acts of corruption and place a higher value on principles of equity. Additionally, students were asked why they were pursuing their careers, and the majority responded that it was to earn more money. These findings not only provide a deeper understanding of how men and women perceive equity and corruption but also inform the development of educational strategies and public policies. This study underscores the importance of considering gender in the study of social values and highlights its relevance for designing policies that effectively promote equity and combat corruption.

Keywords: Gender, Corruption, Values, Soft Skills

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Introduction

The topic of values is crucial in contemporary integral development, highlighting the importance of their implementation in educational settings to promote societal change and environmental protection (UNESCO, 2023). As part of soft skills development (Moreno et al., 2022), the aim is to foster values to "promote a more inclusive educational environment where learning occurs effectively" (UNESCO, 2024).

Traditionally, it has been thought that women are more sensitive due to greater activity in the right hemisphere of their brains. Recent studies (Jiang Xin, 2019) indicate that gender-related differences exist across the entire brain. Gender expectations, sociocultural influences, and life experiences may contribute to the formation of distinctive patterns. Carol Gilligan's research (1982) has demonstrated that moral reasoning varies by gender, with women placing a higher priority on interpersonal connections and caregiving responsibilities over abstract duty and rights. In other words, women's moral thinking is often shaped by interconnectedness, care, and empathy, while men's moral reasoning tends to be formal, legal, and impartial.

In the context of higher education institutions in Mexico, analyzing perceptions of equity and corruption among engineering students reveals gender differences. The focus on corruption arises from its prevalent status as a countervalue in Mexico (Martínez, 2017). This study targets students at the Instituto Politécnico Nacional (IPN) and applies a data mining approach to examine how men and women perceive these values in various contexts, including educational institutions, companies, and society at large. Results indicate that women tend to be more critical of corruption and place a higher value on equity principles compared to their male counterparts. Within brain functions, "ethical intelligence" is defined as the ability to understand all life and all human beings, a quality of consciousness that leads to either humanization or destruction (Seijo, 2012). Through statistical analysis, this research aims to provide a comprehensive perspective on potential gender differences in perceptions of corruption; its findings will contribute to the design of educational and public policies aimed at promoting equity and combating corruption, taking into account gendered perspectives.

About Corruption and Values

According to the CPI, carried out by Transparency International, Mexico is in position 126 (Transparency International, 2023) among the 180 countries evaluated, sharing the score with El Salvador, Kenya and Togo, all with 31/100 points. The highest CPI scores correspond to Denmark (90/100), Finland (87/100) and New Zealand (85/100). The worst-rated countries are South Sudan (13/100), Syria (13/100), Venezuela (13/100) and Somalia (11/100) with nations such as Bolivia, Kenya, Kyrgyzstan and Pakistan and above Azerbaijan, Gabon, Malawi, Mali and Russia.

Mexico has a lot of resources to be a rich country, the problem of inequity is a crisis of values(González, 2000). The focus on corruption arises from its prevalent status as a countervalue in Mexico (Martínez, 2017). One of the most important in Mexico is honesty.

Methodology

Data Mining

A survey was applied to 965 students by Google Forms. For the analysis of the results, data science (Aguilar, 2023) was employed as a multidisciplinary academic method to extract knowledge from data. Additionally, data mining (Navarro, 2020) was used to identify new relationships between variables and to summarize data sets in a comprehensible and useful manner, which is relevant in social research (Rivero, 2022). This technique allowed the identification of relevant patterns and trends regarding emotional needs, access to tutoring, and the academic challenges faced by students (UNESCO, 2024).

Analysis of Perceptions on Corruption and Equity

To conduct this analysis, survey responses on perceptions of corruption and equity were collected from Communications and Electronics Engineering students at the Instituto Politécnico Nacional. Respondents rated each question on a scale from 1 to 5, where 1 represents a low perception of integrity or morality, and 5 represents a high perception of corruption or moral influence in media, depending on the context of the question.

Dataset Description

The dataset includes perception-based questions covering various areas, such as public and private institutions, the educational system, and specific demographic groups.
The following describes the key columns in the dataset:

Gender: Gender of respondents (Male or Female).
Questions: Each question pertains to the perception of corruption, integrity, or morality in specific institutions and groups, as follows:
118: Overall perceived level of corruption.
119: Public institutions and officials.
120: Private companies.
121: Government schools at primary and secondary levels.
122: Private schools at primary and secondary levels.
123: Public universities.
124: Private universities.
125: General perception of the Instituto Politécnico Nacional (IPN).
126: Perception of ESIME Zacatenco.
127-137: Perceptions of specific groups, such as youth, individuals over 40, the wealthy, the poor, teachers, and the influence of media like television and Facebook.

Initial Analysis Focus Areas

Quantification of Response Counts

The number of responses received for each question was determined and broken down by gender, allowing for an understanding of the distribution of perceptions across demographic groups.

Descriptive Statistics

Descriptive statistics were calculated, including mean, median, standard deviation, minimum and maximum values, and percentiles for each question. These statistics help to observe perception trends and identify potential biases in perceptions between men and women.

Correlation Analysis

A correlation matrix was created among the responses to each question. This matrix identifies significant relationships between perceptions, suggesting, for instance, that respondents who perceive high levels of corruption in public institutions also tend to have similar perceptions of other sectors, such as the educational system and private companies. Pearson's correlation was used in this case, as it is insensitive to scale differences and allows measurement of the linear relationship between two variables.

This analysis provides a comprehensive understanding of how corruption and equity are perceived across different sectors and institutions and suggests patterns of perception among various groups and types of institutions.

Quantification of Response Counts

To analyze and visualize the distribution of responses for each perception question, a frequency count was conducted for each item in the dataset.

The analysis of the twelve questions in the dataset revealed: eighteen questions are related to perceptions of corruption and integrity across public and private institutions and social groups. Two specific questions address perceptions of whether television and Facebook propagate moral values. Subsequently, these frequency counts for responses by question were represented in a bar chart, providing a clear visualization of response distribution across each perception category.

Results and Analysis

Frequency Charts

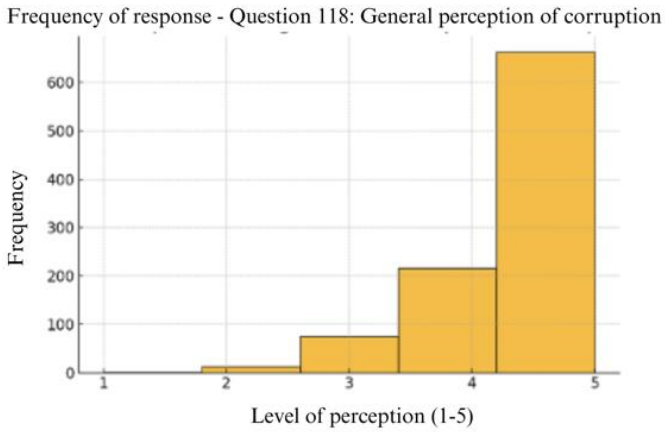

Figure 1: General Perception

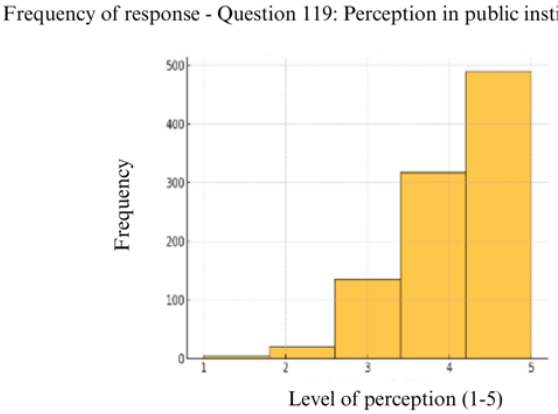

Figure 2: Perception in Public Institutions and Officials

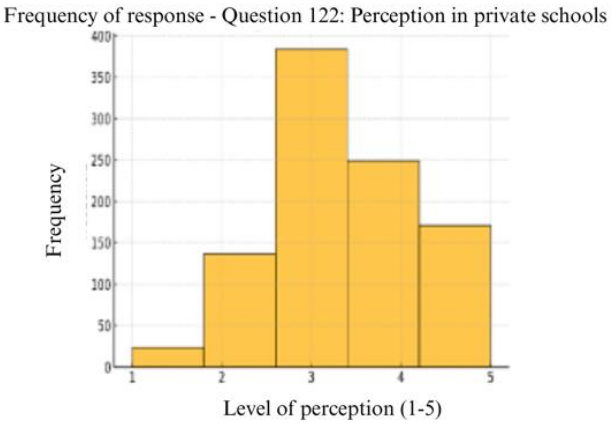

Figure 3: Perception in Private Schools

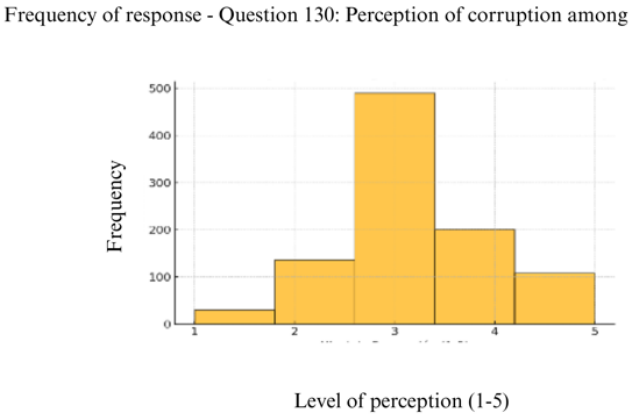

Figure 4: Perception Among Young People

Correlation Analysis

A correlation matrix was generated, shown in Figure 5, highlighting relationships among various aspects evaluated in the survey (correlations were rounded for clarity), correlation matrix among perception questions (question numbers).

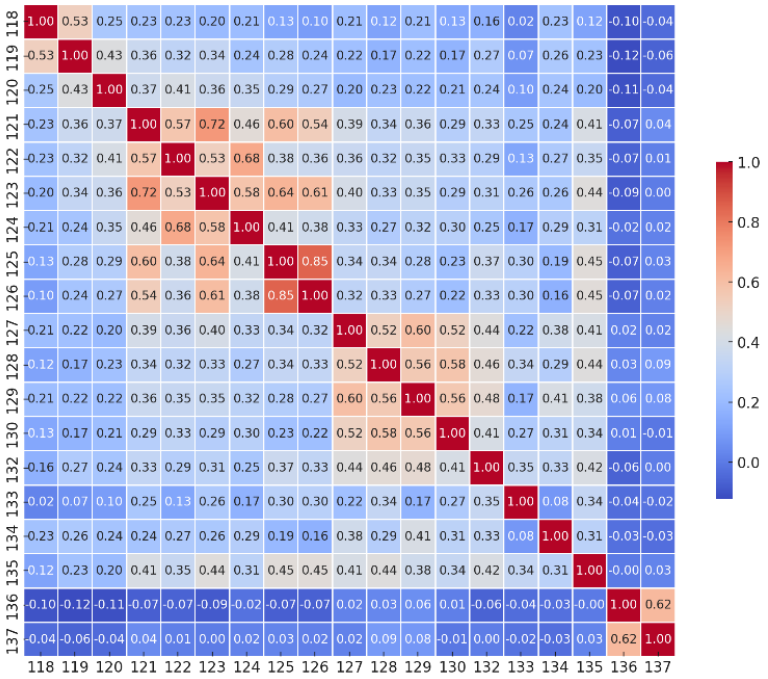

Figure 5: Question Correlation

A descriptive statistical analysis was conducted:

Table 1: Descriptive Statistical Analysis

Question number	Mean	Standard deviation	Percentile distribution
118	Women: 4.62, Men: 4.56	Women: 0.68, Men: 0.70	(25%, 50%, 75%) (4-5),
119	Women: 4.36, Men: 4.30	Women: 0.81, Men: 0.82	Most are grouped in 75%
120	Women: 3.91, Men: 3.84	Women: 0.93, Men: 0.90	Close to 4
121	Women: 3.27, Men: 3.34	Women: 1.01, Men: 1.05	Mixed options
122	Women: 3.45, Men: 3.41	Women: 0.95, Men: 1.04	Critical perceptions
123	Women: 3.25, Men: 3.16	Women: 1.07, Men: 1.10	Dispersion
125	Women: 2.72, Men: 2.73	Women: 1.07, Men: 1.13	Low and médium levels
126	Women: 2.59, Men: 2.54	Women: 1.06, Men: 1.13	Varied and dispersed
127	Women: 3.63, Men: 3.55	Women: 0.92, Men: 0.93	Madium levels
128	Women: 3.03, Men: 3.07	Women: 0.79, Men: 0.92	Medium levels
129	Women: 3.41, Men: 3.51	Women: 0.87, Men: 0.94	Mostly in levels 3 and 4
130	Women: 3.15, Men: 3.26	Women: 0.88, Men: 0.95	Mostly in levels 3 and 4

132	Women: 2.99, Men: 3.07	Women: 0.91, Men: 1.00	Diversity
133	Women: 2.47, Men: 2.59	Women: 1.02, Men: 1.13	Low and médium levels
134	Women: 3.93, Men: 3.92	Women: 0.96, Men: 0.95	Medium and high levels (3-5)
135	Women: 2.79, Men: 2.79	Women: 0.86, Men: 0.92	Medium levels
136	Women: 2.74, Men: 2.70	Women: 1.11, Men: 1.14	Low levels (2-3)
137	Women: 2.59, Men: 2.48	Women: 1.11, Men: 1.13	Low levels (2-3)

It was asked why they were studying their degree:

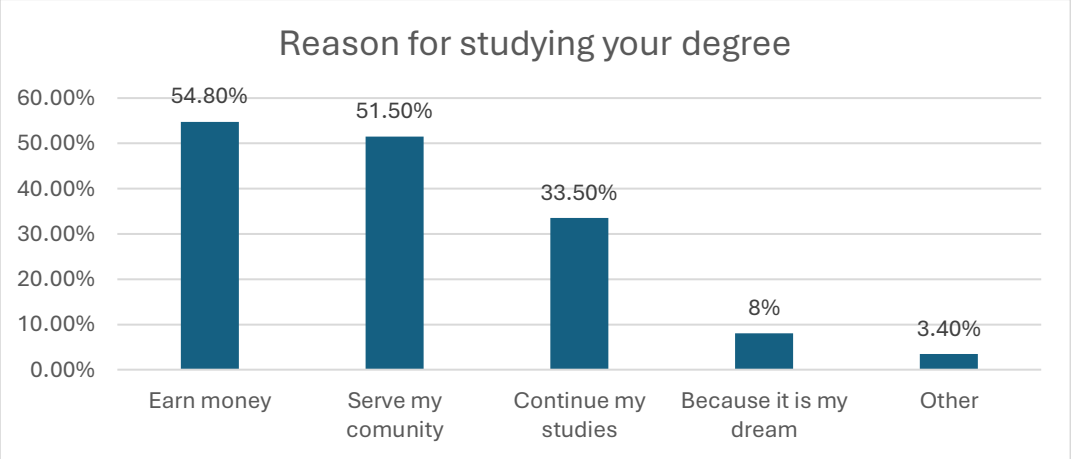

Figure 6: Degree Reason Chart

Results and Analysis

- General perception of corruption (Question 118): The perception is consistent and high across both genders, with a slight tendency for women to be more critical.
- Perception of public institutions and officials (Question 119): The perception is high and consistent, with a slight tendency for women to be more critical.
- Perception of private companies (Question 120): Women tend to view private companies more critically than men, who show greater variability in their responses.
- Perception of public schools (Question 121): Both genders perceive corruption in public education, with diversity in responses.
- Perception of private schools (Question 122): The perception of corruption in private schools is consistent and critical.
- Perception of public universities (Question 123): The perception is somewhat diverse, although women appear to be slightly more critical.
- Perception of the IPN in general (Question 125): Both genders perceive the IPN similarly (on average), with dispersed perceptions.
- Perception of ESIME Zacatenco (Question 126): Perceptions of ESIME Zacatenco show diversity, with women being slightly more critical.
- Perception of the general population (Question 127): The perception is moderate and similar across genders, with little variability.

- Perception of women (Question 128): The perception of women is moderate, with less variability in female responses.
- Perception of men (Question 129): Both genders view the integrity of men similarly, slightly lower than that of women, with moderate consensus in both distributions.
- Perception of youth (Question 130): The perception of youth is fairly uniform, with both genders showing similar views; it is moderate.
- Perception of people over 40 years (Question 132): Men tend to view individuals over 40 as slightly more integral than women.
- Perception of the poor (Question 133): The perception is low in both genders, with more diverse opinions among men.
- Perception of the rich (Question 134): The perception is similar across both genders, with somewhat dispersed opinions. It is higher than the perception of corruption among the poor.
- Perception of teachers (Question 135): The perception of teachers is low and similar across genders.
- Perception of television as a propagator of moral values (Question 136): Television is seen as a medium with low moral influence, with no significant differences between genders.
- Perception of Facebook as a propagator of moral values (Question 137): Facebook is seen as a medium with low moral influence, with a slightly more negative perception among women.

General Interpretation of the Correlation Matrix

Results With High Positive Correlation (close to +1).

- Public institutions and public schools (e.g., Questions 119 and 121): These questions tend to have positively correlated responses, suggesting that those who perceive high levels of corruption in public institutions also perceive corruption in public schools.
- Private companies and private universities (Questions 120 and 124): A positive correlation between these responses suggests that those who perceive corruption in private companies tend to also perceive high levels of corruption in private educational institutions.
- Moral values in television and Facebook (Questions 136 and 137): This high correlation suggests that respondents who believe that television propagates moral values tend to hold the same view about Facebook, reflecting a general perception of the moral influence of media.

Moderate Positive Correlation (between +0.4 and +0.7).

- Perception of corruption in general and in public institutions (Questions 118 and 119): There is a moderate positive correlation, indicating that those who perceive high levels of corruption in general tend to also perceive corruption in public institutions.
- Perception of youth and the poor (Questions 130 and 133): The moderate correlation between these perceptions suggests that those who hold a moderate or negative view of the integrity of youth tend to have a similar perception of the poor.
- Perception of the rich and teachers (Questions 134 and 135): Although the correlation is more moderate, those who view the rich with greater integrity tend to view teachers similarly.

Low or Negative Correlation (near 0 or negative).

- General corruption and moral values on facebook (Questions 118 and 137): The low correlation suggests that the general perception of corruption is not significantly related to the opinion on whether Facebook propagates moral values.
- Perception of the poor and the rich (Questions 133 and 134): The low correlation suggests that perceptions of these two groups are evaluated differently, with no clear relationship in opinions about their integrity.
- Perception of people over 40 and youth (Questions 132 and 130): The low correlation between these questions reflects that perceptions of integrity in these groups do not necessarily align, which could be due to stereotypes or differences in personal experiences.

The main reason why they are studying the degree in Communications and Electronics Engineering is because they want to make money (54.5%), followed by serving their community (51.5%).

Conclusion

The perception of corruption and moral values in various sectors and institutions in Mexico shows a critical consistency between genders, with a general tendency for women to be slightly more critical. It is perceived that men are more corrupt than women, and that the rich are more corrupt than the poor, as well as private schools and institutions being slightly more corrupt than public ones. The perceptions of corruption in both public and private institutions are correlated, suggesting a generalized distrust of organizations. Furthermore, there is a shared perception of the low moral influence of media such as television and Facebook. The evaluation of perceptions across different social groups, such as youth and the poor, suggests common stereotypes, while the lack of evaluation between others, such as the poor and the rich, indicates differentiated assessments of integrity. It is important to note that the IPN is a public institution aimed at children of workers from lower socioeconomic backgrounds, condition that may influence perceptions. The main reason why they are studying their Engineering degree is because they want to make money.

The study reflects a critical and complex view of integrity in Mexican society. Ideally, the absence of corruption should be perceived, though around 2.5 (halfway) or less is statistically moderate, and the results are generally not good. It is recommended that efforts be made to reduce the perception of corruption.

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Contact email: gjmartinezb@ipn.mx

Tolerance for Uncertainty as a Mediation Role in the Relationship Between Professional Identity and Career Choice Among Early Childhood Student Teachers in China

Jie Pan, University of Malaya, Malaysia
Mohammad Ismath Ramzy Mohammad Ismail, University of Malaya, Malaysia

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Abstract
In recent years, Education policies have focused on developing early childhood education (ECE) by establishing a stable, high-quality teacher workforce in China. The career choices of pre-service teachers (ECE PSTs) directly impact their career paths, well-being, and the future of early childhood education in China. However, many ECE PSTs face significant obstacles in career decision-making due to labor market uncertainties, leading to low commitment and early resignation. Understanding the factors influencing their decisions is crucial to reducing future regret. While professional identity (PI) is critical in career decisions, its impact may be weakened by external and personal reasons. There is still relatively little research on the outcomes of tolerance of uncertainty (TU) and the career choice aspects of its PSTs. This study examines whether TU mediates the relationship between PI and career choice. Using a causal relationship analysis, this study surveyed 385 ECE students. A convenience sampling method was employed, and statistical techniques, including mediation analysis and structural equation modeling (SEM) using Smart-PLS 4.0, were applied to validate the model and assess the relationships. The findings show that PI dimensions (Professional Values, Efficiency, Willingness, Volition) significantly influence career choice through the mediation of TU (Preference, Tolerance, Aversion). Specifically, higher PI enhances TU, increasing the likelihood of choosing a teaching career. These results expand the theoretical understanding of career development and provide practical guidance for higher education institutions. Emphasizing the cultivation of PI and coping with career uncertainties can improve decision-making confidence and increase career commitment among ECE pre-service teachers.

Keywords: Professional Identity, Career Choice, Ambiguity Tolerance

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Introduction

For most student teachers, the goal is clear: to become impactful educators and find fulfillment in their work. However, the path to a teaching career is fraught with uncertainties, including evolving educational policies, school resources, and job market fluctuations (Scherer et al., 2020). Despite academic success and internship experience, many student teachers face challenges securing stable teaching positions (Huu Nghia & Tai, 2019).

In China, early childhood education (ECE) career development faces notable challenges. Higher education institutions have expanded ECE enrollment to meet demand (Hong et al., 2023), but many pre-service teachers are reluctant to work in kindergartens, leading to a gap between career expectations and choices (Liu & Boyd, 2020). Yu and colleagues (2023) found 63% of 1,018 surveyed pre-service teachers uncertain about pursuing teaching, reflecting ambivalence toward ECE careers. Additionally, the Free Teacher Education (FTE) program struggles to ensure long-term teaching commitments, with 19% of participants planning to leave teaching after fulfilling obligations and 35% uncertain about continuing (Li qiong et al., 2022).

Uncertainty in the labor market exacerbates these challenges. Demographic shifts, including a population decline since 2022, have decreased the preschool-age population, creating a projected 33% surplus in educational resources (Zuo & Yao, 2024). Simultaneously, policies expanding childcare for children under three years old (Wang et al., 2024), add further unpredictability to the employment outlook.

Despite these challenges, some individuals pursue teaching out of passion and a sense of purpose. However, the high turnover rate among preschool teachers in China, driven by low salaries, high workloads, and limited recognition, often leads to regret in career choices (Liu & Xie, 2021). These career decisions not only affect individual teachers but also the broader stability of the education sector (Williams III et al., 2022). Understanding the factors influencing these choices is crucial.

Professional identity plays a significant role in outcomes such as academic achievement and career development across fields (McCall et al., 2020; Tomlinson & Jackson, 2021; Zou et al., 2024). While research on ECE pre-service teachers has examined professional identity, mental health, and career development, the link between professional identity and career outcomes remains underexplored. There is a need for model-based research on the interplay among professional identity, tolerance for ambiguity, and career choice.

This study empirically evaluates a framework linking professional identity, tolerance for career ambiguity, and career intention, with a focus on the mediating role of ambiguity tolerance in navigating uncertainties. It aims to uncover the mechanisms connecting professional identity and career choice, contributing to the theoretical understanding of student teachers' career decisions.

By examining uncertainty tolerance as a mediating variable, this study provides valuable insights for teacher education programs. The theoretical foundations of professional identity, career uncertainty tolerance, and career choice are reviewed, followed by the research design, findings, and conclusions.

Literature Review

Professional Identity

Professional identity is an individual's sense of identification and belonging to a particular profession, which is unstable and dynamic. It is an integrative process in which an individual attempts to find a balance between personal traits and professional demands (the professional demands, values, and standards set by Initial Teacher Education [ITE] institutions and school) (Pillen et al., 2013).

The positive impact of professional identity on students' academic and career success is widely recognized. Developing a strong professional identity serves as a critical link between higher education and future employment, shaping students' sense of confidence and familiarity with their chosen career paths (Tomlinson & Jackson, 2021). Wolniak and Engberg (2019) emphasize that high-quality college experiences, including the cultivation of professional identity, significantly affect students' early career outcomes, particularly in selecting jobs related to their fields of study. Weiß and colleagues (2023) found that teachers' identification with their professional identity throughout different career stages is closely tied to their career decisions. A strong sense of professional identity equips teachers to better navigate career challenges, such as adapting to diverse student needs, employing effective teaching strategies, and committing to lifelong learning (Hammerness, 2005). In contrast, teachers with weaker professional identities, especially pre-service teachers, are more susceptible to emotional exhaustion, depersonalization, and a reduced sense of professional efficacy, which are key indicators of burnout (Lu et al., 2019; Sun et al., 2022). This heightened burnout risk, in turn, increases the likelihood of teacher turnover (Hong, 2010). Additionally, Sun and colleagues (2022) found a significant positive correlation between professional identity and job satisfaction. Professional identity fosters job satisfaction through psychological empowerment and deeper engagement, ultimately reinforcing teachers' commitment to their career choices. Therefore, understanding students' professional identity is crucial for comprehending their career-related behaviors and psychology and for developing intervention measures.

Research on professional identity has established a comprehensive theoretical framework, emphasizing factors influencing student teachers' professional identity, including personal characteristics (e.g., values, beliefs, skills), emotions (e.g., anxiety, frustration, achievement), internships, and social support (e.g., teacher training, mentorship, teacher-student interactions) (Castillo Nuñez et al., 2019; Timoštšuk & Ugaste, 2010). Using Lave and Wenger's communities of practice framework, studies highlight how novices evolve into core members through legitimate peripheral participation, shaping their professional identity (Pennington & Richards, 2016; Williams & Ritter, 2010). Zembylas (2018), applying Butler's concept of self-identity, offers an ethical and political lens to understand how teachers construct professional identities within social and cultural norms.

Some studies have investigated the impact of professional identity on teachers, such as workplace well-being, job burnout, and job satisfaction, academic performance, career decisions, planning, work engagement, and turnover intentions (Lin et al., 2022; Lu et al., 2022; Wu et al., 2024). Professional identity significantly influences academic performance, career preparedness, planning, self-efficacy, engagement, and job satisfaction while reducing turnover intentions across various fields, including nursing, higher education, civil engineering, and the hotel industry (McCall et al., 2020; Tomlinson & Jackson, 2021; Wang

et al., 2020; Zou et al., 2024). It shapes career decisions through socio-cultural and personal factors and fosters alignment between personal and professional identities. However, its impact on early childhood teacher candidates remains underexplored, requiring further research.

Tolerance of Uncertainty

Tolerance of uncertainty, or ambiguity tolerance, refers to the ability to navigate ambiguous situations, including those that are unfamiliar, complex, or conflicting (Epishin & Bogacheva, 2020). It is considered crucial for addressing novel, complex problems without straightforward solutions. Psychological responses to uncertainty vary, ranging from acceptance (e.g., seeking information, embracing ambiguity) to avoidance (e.g., distraction, helplessness) (McLain et al., 2015).

Cross-disciplinary research highlights factors influencing ambiguity tolerance, such as personality traits (e.g., extroversion, preference for structure), training, and support systems. Studies suggest it predicts career decision-making processes and outcomes. For example, Endres and colleagues (2009) linked ambiguity tolerance to enhanced self-efficacy in complex tasks, while Xu and Tracey (2014) found it significantly impacts career indecision among college students. Storme and colleagues (2019) reported that preference for ambiguous information reduces decision-making difficulties, whereas aversion exacerbates them. Similarly, Xu (2020) noted that ambiguity aversion negatively affects career decisions, particularly among individuals prone to anxiety. Borracci and colleagues (2021) identified a connection between tolerance for ambiguity and university major selection in medical students.

Despite these insights, empirical studies on ambiguity tolerance in career decision-making are limited (Arbona et al., 2021). Notably, research on ECE PSTs and related career variables remains a gap in the literature.

TU as a Mediator

In VUCA era (Volatility, Uncertainty, Complexity, Ambiguity), career development has become increasingly unpredictable, rendering traditional static career matching methods outdated. The Chaos Theory of Careers (CTC) highlights that career development is inherently uncertain and complex, with unpredictable factors significantly influencing decision-making (Pryor & Bright, 2014). CTC emphasizes embracing uncertainty and fostering adaptability to better handle career changes and complexities. It suggests that individuals should develop self-awareness while accepting external uncertainties, remaining flexible and open to new opportunities. Studies also demonstrate the effectiveness of short-term CTC-based interventions in boosting career confidence and reducing irrational career-related thoughts (Davey et al., 2005; Schlesinger & Daley, 2016). This study explores the relationship between professional identity (PI) and career choice, focusing on the mediating role of tolerance for ambiguity (TU).

Kwok (2018) notes that self-uncertainty can weaken perceptions of academic and professional identity, while self-certainty alone does not significantly influence decision-making. Research indicates that combining self-certainty with world certainty motivates goal-directed actions, such as dedicating more time to study or engaging in career planning (Smith et al., 2014).

Connections between PI and TU have been identified in previous research. Reischl and Hirsch (1988) that a clear professional identity reduces stress during transitions by enhancing ambiguity tolerance. A strong sense of identity improves coping effectiveness in ambiguous situations. Garrison and colleagues (2017) found that career identity indirectly enhances life satisfaction among Korean college students by increasing tolerance for uncertainty, mediated by emotional factors.

Despite these findings, empirical research on the mechanisms linking PI and career choice, particularly among pre-service teachers, remains limited. This study hypothesizes that tolerance for career uncertainty mediates the relationship between professional identity and the willingness to pursue teaching careers among ECE pre-service teachers in China.

The Present Study

The present study focusing on student early childhood education teachers at Chinese Universities about their prior decision process of becoming a teacher. We propose hypotheses and a research model based on career chaos theory and previous empirical studies. Based on the above elaboration, a research model of the relationship between professional identity and career decision of becoming a preschool teacher through career decision-making tolerance ambiguity was developed.

We expected the following hypothesis: H1 H2 H3 H4, as shown in Fig.1 Conceptual model.

- H1: Professional identity positively influences the decision to become a preschool teacher.
- H2: Professional identity positively influences the career decision-making ambiguity tolerance
- H3: Tolerance for uncertainty positively influences the decision to become a preschool teacher.
- H4: Professional identity indirectly influences the decision to become a preschool teacher through tolerance for uncertainty.

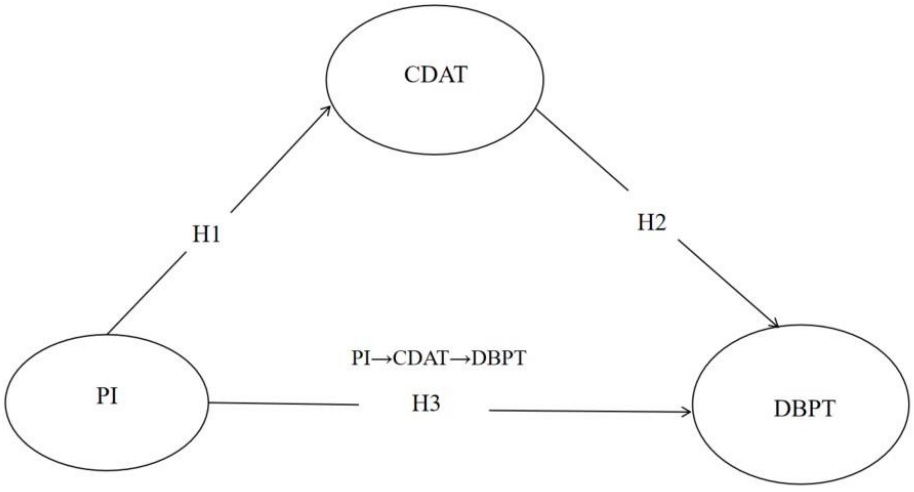


Figure 1: Conceptual Model

Method

Participants and Procedures

To ensure a statistically representative sample, we used *Calculator.net* to calculate the required sample size based on population size, confidence level, and margin of error. The final calculated sample size was 385. Due to limited funding and time constraints, a convenience sampling method was employed.

In the fall of 2024, a four-week survey was conducted using the Wenjuanxing platform (https://www.wjx.cn/). A total of 552 university students from 25 normal universities offering a four-year Bachelor of Education in Early Childhood Education (BEd ECE) program participated voluntarily and anonymously. Participants included first- to fourth-year students, as well as graduate students. The survey collected demographic information (gender, grade level, major, family economic status) and data on professional identity (PI), career decision-making ambiguity tolerance (CDAT), and career choice (DBPT).

To encourage participation, each respondent who completed the survey received a 3 RMB reward. Of the 552 distributed questionnaires, 446 were returned. After excluding 61 questionnaires due to incomplete responses or failed validity checks, 385 valid responses were retained, resulting in an 86.3% valid response rate. Anonymity and confidentiality were strictly ensured throughout the process.

Table 1: Demographic Profile of Sample

Demographic Profile	***Description***	***N***	***%***
Gender	Female	357	92%
	Male	28	8%
Age	18-20	144	37%
	21-23	188	49%
	24-26	53	14%
Study stage	First Year	73	19%
	Second Year	89	23%
	Third Year	124	32%
	Fourth Year	99	26%
Type of Teacher Candidates	Service-bound Teacher Candidates	55	14%
	Self-funded Teacher Candidates	330	86%
Parents' Economic Social status	Low-income Households	39	10%
	Middle-income Households	290	75%
	High-income Households	9	2%

Research Instruments

The following scales were used in this study. We assessed the comprehensibility of the items through discussions with five student teachers, resolving any discrepancies until consensus

was reached. Some wording was slightly adjusted and modified to ensure clarity. All the measurement constructs were measured on a 5-point-likert-type scale, from “does not describe me at all” to “describes me well”.

Professional Identification Scale for pre-service teachers (Wang et al., 2010) was adopted to assess pre-service teachers' professional identity. The Cronbach's alpha for the entire scale was 0.783. Previous studies have demonstrated that this scale has strong reliability and validity, making it a widely accepted tool for evaluating professional identity among pre-service teachers (Chen et al., 2016; Zhang et al., 2021). The scale consists of 12 items divided into four dimensions: professional values, professional efficacy, professional commitment, and professional volition. Participants rated each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In the present study, higher scores on the scale indicated stronger professional identity among pre-service teachers.

Career Decision Ambiguity Tolerance (CDAT) scale consists of 18 items designed to assess individuals' evaluations and responses to the career decision-making process (Xu & Tracey, 2015). The Cronbach's alpha for the entire scale is 0.83. The CDAT scale is divided into three dimensions: preference (e.g., "I am open to careers I have never heard of or thought of before"), tolerance (e.g., "I do not mind changing my career in the future if necessary"), and aversion (e.g., "People's different or sometimes contradictory perspectives about a career make me uncomfortable"). Each construct contains six items. The CDAT uses a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 18 to 126, with higher scores indicating a greater tolerance for ambiguity in career decision-making.

Decision to Become a Teacher Scale consists of six items (e.g., "How carefully have you thought about becoming a preschool teacher?") (Watt & Richardson, 2007). Cronbach's alpha for the entire scale is 0.88. It uses a five-point rating scale, with higher scores indicating a stronger intention to pursue a teaching career.

Data Analyses and Results

Structural Equation Modelling Techniques

This study includes two second-order constructs: professional identity and career decision ambiguity tolerance. Professional identity consists of four first-order constructs: (1) Career Intention and Expectation, (2) Work Volition, (3) Career Value, and (4) Career Self-Efficacy. Similarly, career decision ambiguity tolerance comprises three first-order constructs: (1) Preference, (2) Tolerance, and (3) Avoidance. The path model is relatively complex as evidenced in many constructs per model and indicators per construct, moreover, the goal is to predict and explain a key target construct and/or to identify its relevant antecedent constructs. Therefore, this study employs structural equation modeling (SEM) techniques for quantitative analysis. Moreover, the researcher used SPSS.29 to analyze the data, according to the histogram of the three variables we found that none of the variables followed a normal distribution. PLS-SEM does not require data to be normally distributed, making it a suitable analysis tool for small samples and non-normally distributed data (Hair et al., 2017). The Partial Least Squares (PLS) method is used to examine theoretical relationships based on the outer model (measurement model) and the inner model (structural model), focusing on maximizing the explained variance of latent variables and interpreting the causal relationships between them. PLS-SEM is particularly suitable for developing new models or

for theories that are still in the developmental stage (Hair et al., 2019). We used Smart-PLS 4 to test the research hypotheses in this study. Smart PLS is a popular software that implements the Partial Least Squares Structural Equation Modeling (PLS-SEM) method, allowing researchers to perform functions such as the "PLS-SEM Algorithm," "Bootstrapping," and "PLS predict."

Collinearity Test

During the data cleaning and preprocessing process, we handled outliers (including missing data) by removing the outliers. We deleted the records of participants who did not provide informed consent, as well as those who did not respond carefully (including participants who gave the same answer to all items or had missing values in some sections). After removing invalid responses, to further avoid the risk of high collinearity in the results, we also calculated the variance inflation factor (VIF). The results show that all VIF < 3 (Professional Identity=1.642, Career Decision Ambiguity Tolerance=1.664), indicating low correlations between the independent variables. There is no serious collinearity in the model, and the model is relatively robust (O'brien, 2007).

Table 2: Collinearity Diagnostics

	Tolerance	VIF
PI	.611	1.642
CDAT	.619	1.664

a. Dependent variable：Decision to be a Preschool Teacher

Measurement Model Analysis

We conducted confirmatory factor analysis (CFA) on the existing scales to evaluate their psychometric properties, including reliability, validity, and the appropriateness of the hypothesized structure. The measurement model evaluation includes calculating factor loadings, Cronbach's α, composite reliability (CR), and average variance extracted (AVE) (Hair Jr et al., 2017). Table 2 shows that all factor loadings meet the recommended standard range, with values above 0.7. The AVE values also meet the recommended threshold, all exceeding 0.5. The lowest composite reliability value is 0.843, thus all CR values are within the recommended levels (Fornell & Larcker, 1981; Hair Jr et al., 2017). Table 3 presents the general reliability and validity statistics for all measurement constructs, as well as the average score of the latent variables (mean=3.670). All latent variables are measured with more than three items.

Table 3: Measurement Model

Scale item	*Mean Score*	*Factor Loading*	*Cronbach α*	*AVE*	*CR*
Professional Identity	3.435		.767	.590	.852
PI-1	3.38	0.852			
PI-2	4.35	0.871			
PI-3	3.41	0.862			
PI-4	3.35	0.840			
PI-5	3.38	0.845			
PI-6	3.46	0.855			
PI-7	3.33	0.846			
PI-8	3.37	0.836			
PI-9	3.42	0.852			
PI-10	3.53	0.839			
PI-11	3.59	0.852			
PI-12	3.64	0.837			
Career Decision-making Ambiguity Tolerance	3.482		.724	.642	.843
CDAT-1	3.52	0.773			
CDAT-2	3.54	0.826			
CDAT-3	3.57	0.826			
CDAT-4	3.56	0.834			
CDAT-5	3.57	0.807			
CDAT-6	3.64	0.824			
CDAT-7	3.34	0.825			
CDAT-8	4.42	0.841			
CDAT-9	3.41	0.818			
CDAT-10	3.44	0.818			
CDAT-11	3.45	0.815			
CDAT-12	4.25	0.798			
CDAT-13	3.50	0.792			
CDAT-14	3.43	0.813			
CDAT-15	3.39	0.794			
CDAT-16	3.52	0.813			
CDAT-17	3.49	0.808			
CDAT-18	3.49	0.800			
Decision to Become a Preschool Teacher	3.559		.856	.582	.893
DBPT-1	3.57	0.729			
DBPT-2	3.52	0.765			
DBPT-3	3.56	0.745			
DBPT-4	3.20	0.774			
DBPT-5	4.12	0.783			
DBPT-6	3.03	0.781			

Heterotrait-Monotrait Ratio (HTMT) value was used to assess discriminate validity, HTMT is a more modern and widely accepted method for assessing discriminant validity. HTMT values below 0.90 (and in some cases, below 0.85) indicate that the constructs have good discriminant validity (Franke & Sarstedt, 2019). The calculation results show that all HTMT

values for the constructs were below 0.90, as shown in Table 4, satisfying the threshold value.

Table 4: Discriminate Validity

	CDAT	DBPT	PI
Career Decision Ambiguity Tolerance (CDAT)			
Decision to be a preschool teacher (DBPT)	0.705		
Professional identity (PI)	0.693	0.808	

Demographic Analysis and Correlational Analysis

We adopted SPSS 29.0 to analysis the spearman coefficient, the correlational coefficient of latent variables and dimensions between each other is shown as following Table 5.

Table 5: Correlations of the Study Variables (N=385)

	1	2	3	4	5	6	7	8	9	10
PI-1	1.000									
CIE-2	.665**	1.000								
CVo-3	.755**	.356**	1.000							
CVa-4	.674**	.316**	.412**	1.000						
CSE-5	.749**	.472**	.471**	.446**	1.000					
CDAT-6	.519**	.418**	.455**	.365**	.452**	1.000				
Preference-7	.509**	.495**	.386**	.407**	.486**	.716**	1.000			
Tolerance-8	.440**	.325**	.399**	.267**	.381**	.782**	.424**	1.000		
Aversion-9	-.409**	-.256**	-.378**	-.351**	-.372**	-.724**	-.334**	-.394**	1.000	
DBPT-10	.609**	.481**	.526**	.531**	.592**	.516**	.641**	.453**	-.311**	1.000

Notes. *p < 0.005, **p < 0.01.

Structural Model Analysis

After evaluating the reliability and validity of the measurement model, we tested the research hypotheses proposed in this study. To test the hypotheses, we used the PLS-SEM algorithm to obtain path coefficients (β), f-squared values, and their statistical significance. In addition to the paths tested in the structural model, the explanatory power of the proposed model is also a key indicator, which can be assessed using the R^2 value. As shown in Table 4, all hypotheses are supported. According to the critical values of explanatory power measured by R^2 as proposed by Ozili (2023), all R^2 values indicate acceptable levels ($0.100 \leqslant R^2 \leqslant 0.500$). In addition, we adopted the blindfolding method to calculate the Q^2 values of the latent variables. As seen in Fig 2, the results show that the Q^2 values of the latent variables are all greater than 0, indicating that the model has a certain predictive ability for these latent variables (Chin et al., 2020).

Table 6: Hypothesis Testing

Hypotheses	***β***	***t- Statistics***	***Decision***	***f2***
H1: PI→CDAT	.629	18.20**	Supported	0.653
H2: PI→DBPT	.498	9.54**	Supported	0.338
H3: CDAT→DBPT	.326	6.04**	Supported	0.145

Notes. *p < 0.005, **p < 0.01.

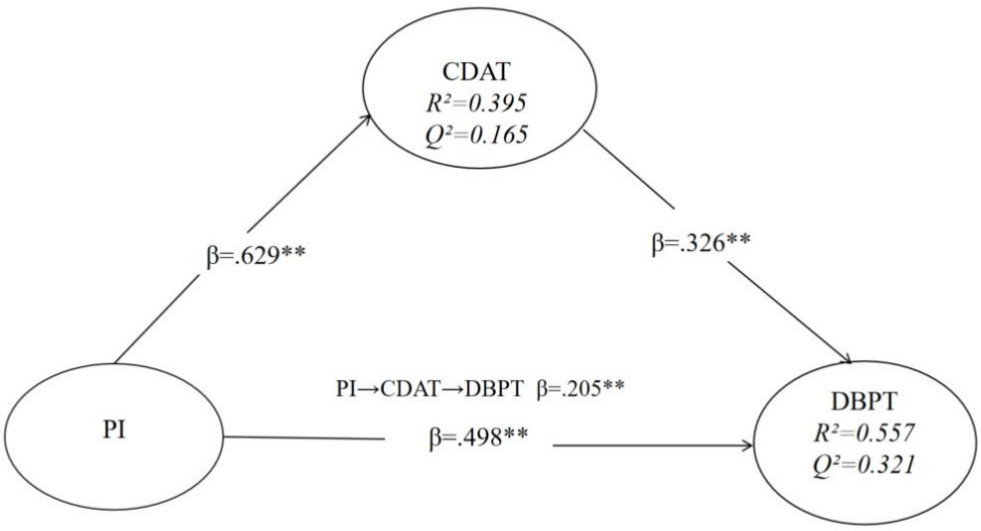
In addition, the indirect effects of career decision-making ambiguity tolerance were calculated by running Bootstrapping with 5000 iterations. The results are shown in Table 5. According to the Bootstrap method proposed by Preacher and Hayes (2004), mediation effects can be determined by calculating the confidence interval of the indirect effect: if the confidence interval does not include zero, the indirect effect is significant, indicating the presence of mediation.

Our results indicate that career decision-making tolerance of ambiguity partially mediated the relationship between professional identity and career choice of becoming preschool teacher (β=0.205, p< 0.01, BCa CI: [0.141–0.270]).

Table 7: Mediating Effects of Career Decision-Making Ambiguity Tolerance

Hypothesis	***β***	***Standard Deviation***	***t-Statistics***	***Decision***
PI→CDAT→DBPT	.205	0.033	6.17**	Supported

Notes. *p < 0.005, **p < 0.01.



Notes. *p < 0.05, **p < 0.01.

Figure 2: Structural Model

Discussion

The Impact of Professional Identity on Career Decision Ambiguity Tolerance (Hypothesis 1)

The results confirm that professional identity predicts tolerance for career decision ambiguity, aligning with prior research (Li et al., 2022). A strong professional identity reduces uncertainties about oneself and future career paths, fostering acceptance of ambiguity and adaptability to complex environments. This acceptance minimizes anxiety and stress, enhancing emotional stability, life satisfaction, and a positive outlook (Garrison et al., 2017). In contrast, underdeveloped professional identity can lead to self-doubt and anxiety, hindering career growth and reducing openness to ambiguity (Chavez Rojas et al., 2023). Internalized self-doubt may be perceived as failure, limiting innovation and adaptability (Pavlova, 2018). Conversely, individuals with a strong professional identity view uncertainty as an opportunity for growth, addressing challenges proactively.

In summary, professional identity enhances pre-service teachers' tolerance for career uncertainties, fostering adaptability and resilience. As a core element of self-agency, it helps individuals maintain inner harmony while navigating uncertain career paths, encouraging growth and development.

The Impact of Professional Identity on Career Decision (Hypothesis 2)

The findings confirm that professional identity (PI) significantly predicts the desire to pursue teaching (DBPT) among ECE PSTs in China. A strong professional identity enhances pre-service teachers' sense of belonging and commitment to the teaching profession, motivating them to pursue this path with greater resolve.

This aligns with previous research showing that work volition predicts career adaptability and mediates the relationship between perceived social status and adaptability (Autin et al., 2017; Su et al., 2023; Zhao et al., 2022). For pre-service teachers, a strong professional identity fosters autonomy, community, and purpose, strengthening their commitment and adaptability to handle the challenges and uncertainties of the education field.

The Impact of Tolerance Ambiguity on Career Decision (Hypothesis 3)

Tolerance for ambiguity was found to positively predict ECE PSTs' decision to pursue a career as kindergarten teachers. This supports the role of ambiguity tolerance in shaping career choices, as it influences how individuals process uncertainty and make decisions (Hirsh et al., 2012). Intolerance of ambiguity is linked to anxiety and excessive future worry (Carleton, 2012)，while fostering ambiguity tolerance can reduce anxiety and improve decision-making efficacy, confidence, and adaptability (Lee & Jung, 2021).

This finding aligns with research showing that higher ambiguity tolerance enhances adaptability through organizational support and proactive career management (Zhou, 2023). Viewing uncertainty as an opportunity for growth promotes adaptability, and traits like openness and agreeableness may underlie this tolerance. Individuals high in openness often embrace challenges and exhibit curiosity, making them well-suited for complex fields like early childhood education (Fayn et al., 2019). This study integrates themes of personality

traits, career adaptability, and the interplay between organizational and personal career strategies in career decision-making.

The Indirect Effects of Career Decision-Making Ambiguity Tolerance on Career Choice (Hypothesis 4)

The results confirm that career decision-making ambiguity tolerance (CDAT) partially mediates the relationship between professional identity and career choice. As noted by Smith and colleagues (2014), even with a strong professional identity, students must tolerate external uncertainties to remain adaptable in the face of change. This tolerance enables them to balance self-determination with unpredictability, increasing their ability to navigate complex career paths and achieve their goals.

Career paths are often probabilistic and unpredictable, and individuals with higher ambiguity tolerance are better equipped to process uncertain information and take proactive actions. Tolerance for ambiguity buffers negative reactions to uncertainty, reducing avoidance behaviors and fostering adaptability, contrasting with a rigid focus on control (Porfeli & Savickas, 2012).

Implications and Recommendations

Professional identity acts as a self-regulatory mechanism, enhancing tolerance for uncertainty and promoting positive emotional experiences. While unpredictability in professional environments challenges these mechanisms, student-teachers adapt by creating career plans, refining teaching skills, and gaining internship experience, fostering proactive agency (Cai et al., 2022). This study addresses a gap by examining how professional identity supports pre-service teachers in managing career uncertainty through self-regulation.

The findings align with the Chaos Theory of Career (CTC) indicated by Pryor and Bright (2003), which emphasizes that adaptability is more critical than fixed career choices in navigating complexity, change, and chance. Professional identity not only guides career development but also fosters flexibility and proactivity in uncertain environments, enhancing adaptability and satisfaction. This underscores the need for career services in teacher education programs to prioritize adaptability over traditional person-job fit models (Xu, 2021).

Since tolerance for ambiguity is a flexible psychological trait influenced by environmental factors (Furnham & Marks, 2013), integrating cognitive behavioral therapy (CBT) into teacher education can help address uncertainty-related anxiety and improve ambiguity tolerance (Reis-Dennis et al., 2021). CBT not only reduces stress but also supports professional development and retention in teaching (Lazarus et al., 2020).

Additionally, career guidance should address the dual nature of ambiguity tolerance, helping students balance courage and curiosity with effective decision-making to avoid overconfidence or indecision (Reis-Dennis et al., 2021). Practical strategies include: incorporating group discussions and case-sharing in career training, encouraging reflective and critical thinking through problem-based learning (PBL) using incomplete or ambiguous data, introducing “gray cases” and multi-option exam questions to train decision-making under uncertainty (Borracci et al., 2021; Lazarus et al., 2024). These approaches cultivate

adaptability, confidence, and composure, equipping students to tackle future professional challenges effectively.

Limitations and Future Directions

This study employed a cross-sectional design, limiting the ability to explore causal relationships between variables. Professional identity, a dynamic and evolving process, develops gradually over time, particularly in early childhood education (Keary et al., 2020). Longitudinal studies within Initial Teacher Education (ITE) are needed to examine the mechanisms underlying the development of professional identity and its impact on teaching commitment.

Additionally, this study focused on pre-service early childhood teachers, which may limit the generalizability of findings to other groups. Different professions attract individuals with varying levels of ambiguity tolerance, and the structured nature of early childhood education may influence how these results apply to less stable professional environments.

Finally, pre-service teachers who choose early childhood education may prefer a stable, structured work environment, seeking to avoid the stress associated with high uncertainty (Borracci et al., 2021). While the findings highlight the positive impact of tolerance for ambiguity on career decisions, the potential bidirectional relationship remains unexplored. Future research could investigate whether career choices or decision maturity also shape individuals' tolerance for ambiguity, offering further insights into this dynamic relationship.

Conclusions

To conclude, this study supports the existing literature by showcasing professional identity as a predictor to facilitate student teachers choose to pursue a teaching position in early childhood education field via career decision-making tolerance ambiguity (Huang et al., 2022). The findings of this study highlight the significance of professional identity in the career development of pre-service teachers (Pérez de Albéniz-Garrote & Medina Gómez, 2020). While the concept of professional identity spans multiple social sciences—including education, philosophy, and psychology—its importance in the formative stages of teacher development is undeniable. During Initial Teacher Education (ITE), various approaches can support identity formation, and shifting these approaches can enhance ITE’s impact on identity construction. Therefore, teacher education programs can strengthen pre-service teachers’ confidence in managing uncertain professional situations by developing coping strategies and adaptability (Thorpe et al., 2020). On a broader level, these efforts may also contribute significantly to teacher retention in the field.

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Contact email: ismathramzy@um.edu.my

Nurturing Early Childhood's Character in Indonesia

Siti Aisyah, Universitas Terbuka, Indonesia
Nina Mariani Noor, Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Indonesia

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Abstract
The cornerstone of children's future lies in character and religious education, a principle deeply emphasized in Indonesia, particularly during early childhood development. Within the Ahmadiyah community, education serves as a vital tool to ensure its continuity. This study examines how the Indonesian Ahmadi women in fostering character and religious education among their children. Using qualitative methods including observation, in-depth interviews, and focused group discussions with mothers from Kuningan and Yogyakarta, this research investigates the community's strategies in nurturing their children's character and spirituality. Findings reveal the crucial roles Ahmadi women play in shaping their children's character, imparting values spanning religious, humanitarian, and civic spheres, such as honesty, discipline, accountability, politeness, compassion, and religious devotion. To overcome challenges in education, these women employ diverse strategies and rely on support from spouses, families, and the community. The Ahmadiyah community serves as the primary supporter, offering guidance and necessary resources to facilitate these efforts.

Keywords: Early Childhood, Ahmadiyah, Women, Character Education, Religious Education

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Introduction

In the context of Indonesia, character education and religious education are very basic education for children. Character and religious education strengthen children's foundation for their future. Through Presidential Regulation No. 87/2017, the Indonesian government aims to cultivate the cultural, qualitative, and character aspects of the Indonesian people, thereby enhancing their religious character.

It is very clear that the family has a major contribution in shaping a quality Muslim personality. Mothers, as parents, referred to in Islam as a child's first madrasah, have a very large role and influence in supporting the education of their children and shaping their character and instilling religious values. A mother's experience and education, both formal and informal, determine the success of a family in educating their children. If the mother as the first madrasah in the family can carry out her function, then the family is able to carry out the function of education and welfare. The success of the family in carrying out this function can be seen by the generation that is formed having a strong and good character. If the family fails to carry out its educational function, the resulting generation will also be a failed generation (Suradi et al., 2021).

This study stipulates the strategies conducted by Ahmadi women in giving character and religious education to their early childhood. The Ahmadiyah resembles a community development entity that integrates three distinct facets: the spiritual realm, the social or moral sphere, and the economic domain (Burhani, 2014). The Ahmadiyah, as a spiritual and mystical movement, provides a sense of religious devotion and inner serenity to those who faithfully adhere to its principles (Burhani, 2014).

The Ahmadiyah community, as a Muslim minority faith group, have been compelled to organize in order to safeguard their beliefs and to discover innovative and efficient methods to ensure the well-being of their members and promote the growth and continuity of their community (Balzani, 2020, p. 24). The Ahmadis can be described as a multifaceted modern Islamic sect, exhibiting traits of religious conservatism while also displaying elements of social progressiveness in certain aspects. They advocate for women's education and endorse women taking on specific leadership roles. They campaign for peace through its slogan ‘love for all, hatred for none’ (Balzani, 2020, p. 30). Furthermore, the strength and endurance of Jemaat Ahmadiyah Indonesia stem from their commitment to the principles of loving all and hating none, which safeguard their survival amidst challenges and stress (Sulistyati, 2015). Moreover, a sense of persecution has captured their imaginations and become the driving force behind their beliefs and lifestyles --- negotiated through the acquisition of formal education and culture wherever they find themselves (Gosh, 2006).

Ahmadi women in Indonesia play as active agent in facing hostilities and persecution to their communities (Noor, 2018; Trianita, 2009). They also play an active role in advocating themselves and their groups from intolerance and persecution they face (Inasshabihah, 2020). Furthermore, Ahmadi women have significant role in educating their children in the middle of challenges that their community experience as minority group. This paper aims to explore the roles and strategies of Ahmadi women in imparting character and spirituality for their early children in the mid of circumstances of their community.

Method

The method used in this study included qualitative research with a descriptive design. This research involved Ahmadi women as mothers located in Kuningan West Java and Yogyakarta. Qualitative data collection with observation, in depth interviews and Focused Group Discussions were conducted with women who have early children.

In this study, we employ Bandura's "social learning theory" to delve deeper into the role and impact of mothers on character education and the instillation of religious values. Social learning theory, a cornerstone of behaviorism, underscores the cognitive dimensions of thought, comprehension, and assessment. According to Albert Bandura's social cognitive theory, learning is influenced by social, cognitive, and personal factors. Cognitive aspects involve students' outlooks on success, while social aspects encompass their observation of parental behavior. Bandura, a key proponent of social cognitive theory, posits that students can mentally process and adapt their experiences during learning. He formulated a reciprocal model comprising behavior, personal cognition, and environment, emphasizing their interplay in the learning process. Environmental stimuli shape behavior, behavior influences the environment, and personal cognitive factors impact behavior (Bandura, 1971).

Character Education for Early Childhood

Character education encompasses teachings related to religion, ethics, manners, morals, and values, aimed at nurturing individuals with positive character traits. Through character education, these positive values are imparted, internalized, and reflected through tangible actions. The Indonesian government, as outlined in Presidential Regulation No. 87/2017, is dedicated to fostering religious character to cultivate a populace rich in culture, quality, and character. Hence, the government mandates a Character Education Strengthening Movement to be executed across all educational institutions, formal, informal, and non-formal alike. The values embedded within this religious character span religious, humanitarian, and citizenship aspects. This educational endeavor is a continuous effort, requiring the involvement of all stakeholders, including families, communities, and schools (Muslim, 2020).

Victorynie and colleagues, in their research conducted at Al-Hilal Islamic Elementary School Bekasi, observed that character education necessitates collaboration and proactive involvement from both schools and parents to cultivate Islamic religious values in children. They noted that a robust groundwork laid by families, reinforced by the Islamic Education curriculum in schools, plays a pivotal role in shaping students' Islamic character (Victorynie et al., 2020).

Aningsih et al., in their investigation into character education implementation in elementary schools, underscored the necessity of character education within the learning process of elementary school children. They identified a broad spectrum of character traits commonly integrated into elementary school education, encompassing religious values, discipline, leadership, responsibility, cooperation, tolerance, cleanliness, tidiness, perseverance, politeness, courage, confidence, thriftiness, honesty, independence, justice, nationalism, acceptance of diversity, creativity, and appreciation of achievement. The researchers also outlined various strategies employed in elementary schools to instill these character traits, including setting examples, habitual reinforcement, shaping the school's atmosphere, incorporating character education into all academic subjects, and integrating it into extracurricular activities (Aningsih et al., 2022).

Character education within the family dynamic involves active participation from all family members, including fathers, mothers, and children. The effectiveness of character education in the family is influenced by various factors, with one crucial determinant being the communication strategy employed by parents. A qualitative study conducted in Medan, focusing on three Muslim families, revealed that an open communication approach, coupled with the sequential stages of understanding morals, cultivating affection for morals, and subsequently practicing morals, proved successful in nurturing religious character in children. Moreover, leading by example and providing parental supervision were highlighted as reinforcing factors that facilitate the cultivation of character traits in adolescents (Aulia & Hasibuan, 2019). Furthermore, parents utilize advice, modeling, and habitual reinforcement as key strategies in strengthening religious character in their children, as highlighted in research by Salafuddin and colleagues (2020).

Whereas Muslims in Bandung and neighboring regions prioritize certain ideal character traits in their children, aiming for them to be honest, disciplined, responsible, polite, confident, hardworking, tolerant, creative, innovative, caring, productive, and religious. These traits are considered essential pillars for Muslim children as they navigate through the challenges posed by the fourth industrial revolution and the concept of society 5.0 (Ramdani et al., 2020).

Anggraini (2021) underscores the pivotal influence of the family in molding children's character, encompassing their actions and modes of communication. Furthermore, schools play a crucial role in character development, with teachers assuming significant responsibility, as emphasized by Sudaryanti (Harun et al., 2020). Educators have noted a beneficial correlation between collaborative endeavors and challenging behaviors, as well as between a child's proficiency in receptive language and their prosocial skills. To foster character development effectively, there is a recommendation to concentrate on improving the professionalism of collaboration between parents and preschools (Cohen & Anders, 2020).

In the context of Malay culture in Malay-Muslim families, they use a Malay culture-based character education model. The virtues and exemplary values of Malay culture are used as a model and applied through intervention and habituation of characters from their Malay culture. Challenges in the digital era require parental involvement in guiding their children (Kurniawan & Miftah, 2021). Discussing on character education based on multicultural and local wisdom, there are four dimensions come up. The deity dimension is solely characterized by indicators of belief, worship, and ethical values. The self dimension encompasses indicators such as honesty, responsibility, and independence. The fellow human dimension includes four indicators: rights and obligations, adherence to the law, appreciation for others' work, and politeness towards everyone. Similarly, the environmental dimension comprises four indicators: national spirit, love for the country, communicativeness, and environmental care (Harun et al., 2020). In Malay-Muslim families, character education is often rooted in Malay culture, leveraging its virtues and exemplary values as a foundation. These cultural values are imparted through interventions and habitual practices within the family structure. Given the challenges posed by the digital era, parental involvement becomes crucial in guiding their children through these cultural teachings (Kurniawan & Miftah, 2021).

Parents' expectations significantly shape the family's perspective on religious character. Through effective parenting practices, including modeling behaviors, explaining actions, setting achievable yet high standards, and involving children in decision-making processes, parents can instill a wide array of character values in their children. These values encompass

traits such as honesty, religiosity, democratic principles, effective communication, discipline, diligence, responsibility, humility, independence, and empathy. Moreover, children who come from nurturing and cohesive families often exhibit fewer emotional disturbances and tend to be more self-reliant compared to children from single-parent households. This underscores the importance of familial support and cohesion in fostering religious character among children (Sukiyani & Zamroni, 2014).

Parents wield considerable influence in instilling character education in their children. Their role encompasses various aspects such as leading by example, providing opportunities for practice, delegating responsibilities, offering guidance and supervision, and steering children towards making wise choices in their interactions. However, there exist obstacles hindering parents from effectively fulfilling this role in character education, including both internal and external barriers, as highlighted by researchers Puspytasari (2022) and Utomo and Alawiyah (2022).

For parents to effectively influence their child's character development and prepare them to become well-rounded individuals and responsible citizens, they require adequate skills in child education. This necessitates continuous learning and the integration of Islamic and global values into their parenting approach (Sokip et al., 2019). To fulfill their role in instilling Islamic values within the family's religious framework, parents must commit to ongoing education to enhance their understanding and dedicate time to nurture these values within their children (Rohita & Maulida, 2018).

To foster character development in children, creating a nurturing and encouraging environment is paramount. The family, being the primary setting where children first interact, holds significant influence over their character education. Every member of the family, including parents and siblings, contributes to shaping the child's character. By integrating character education within the family dynamics, children are provided with a foundation for a positive outlook on life (Harun et al., 2020; Utomo & Alawiyah, 2022). Widayati (2013) noted that molding good character in early childhood is particularly feasible due to children's heightened ability to absorb knowledge and their ongoing mental development (Widayati, 2013).

Transitioning to the concept of the mother as the child's initial madrasa (school), Munirah (2019) highlights the ongoing challenge surrounding the ideal role of women in education, primarily due to their limited awareness of the importance of early childhood education (Munirah, 2019). However, research conducted in Muslim minority regions reveals three distinct roles that mothers can undertake to preserve their children's Islamic values: non-formal religious education, informal religious upbringing within the family sphere, and formal religious education within public and private schools. In minority areas, homemakers emerge as crucial pillars in safeguarding the Islamic values of their children (Dasopang & Lubis, 2021).

By virtue of her innate abilities, a woman possesses the unique privilege of conceiving, giving birth, and breastfeeding, which inherently fosters a deep bond with her children. This closeness positions a woman, particularly a mother, as the spiritual cornerstone in shaping her children's character, thereby cultivating a generation of excellence. As educators and early influencers of character, women hold a distinct and invaluable role, rendering their position within the family even more significant compared to men (Lestari, 2016). The maternal presence in nurturing, affectionately caring for, and guiding children is of paramount

importance as it profoundly impacts the development of their character. Moreover, mothers must fulfill three essential factors—physical well-being, mental stability, and continuous learning and knowledge acquisition—to effectively fulfill their pivotal role within the family (Aziza, 2020).

While education in Muslim minority groups, such as in Jamaah Tablighi community, there are five major Islamic character building in family: being good to parents, having a sense of shame for violating Sharia, behaving in accordance with Islamic law, being on time, and having good character (Engkizar et al., 2021). In doing study among American muslims, mothers' discussions about core Islamic values and warm, supportive parenting fostered their children's religious identification. their children's religious identification, which in turn is associated with their positive character traits, including helping others, valuing diversity, speak up for justice or stand up for what they believe in (Cheah et al., 2021).

Within Muslim minority communities like the Jamaah Tablighi community, family-based education prioritizes five key Islamic character traits: showing kindness and respect to parents, maintaining a sense of shame regarding actions that contravene Sharia (Islamic law), adhering to Islamic principles in behavior, punctuality, and exhibiting good character (Engkizar et al., 2021). In studies conducted among American Muslims, it was found that mothers' discussions regarding fundamental Islamic values coupled with warm and supportive parenting practices significantly contributed to their children's religious identification. This religious identification, in turn, correlated with positive character attributes in their children, such as altruism, appreciation for diversity, and advocacy for justice or standing up for their beliefs (Cheah et al., 2021).

Spiritual Education in Ahmadiyah

The Ahmadiyah Muslim community, considered a minority group in Indonesia, adheres steadfastly to their religious principles, which emphasize teachings of peace and love, exemplified by their motto "love for all, hatred for none." In the face of discrimination and persecution, Ahmadis typically respond in a passive and defensive manner, aligning with their religious doctrine that prohibits retaliation against those who harm them (Rizkita & Hidayat, 2023).

As a transnational organization under one leadership, Ahmadiyah community have their Khalifah who become resource person where the members consult to. Ahmadis usually listen to instruction and suggestions from their Khalifah related to their daily lives including education. The Ahmadis are connected spiritually with the Khalifah in their daily lives. Every week, on Jumat prayer, they are suggested to listen to and watch Khalifah’s khutbah (speech) that directly broadcasted through YouTube channel. Moreover, they will also listen to what The Khalifah suggests and commands.

In the Ahmadiyah community, religious education occurs both within families, where parents individually impart teachings, and in a dedicated institution known as the "Pre Madrasah." The curriculum not only covers subjects such as the Qur'an, hadith, ethics, and jurisprudence but also includes the history of Ahmadiyah (Azkar, 2019). Mothers play a crucial role in this process, as they are guided by the organization regarding which educational materials to provide for their children.

Ahmadis are encouraged to have their formal education as high as they can, both for men and women. For women, they are suggested at least having diploma education (Noor, 2018). The community support their pupils to have continuous education by giving funding aid for those who have difficulties in financing their study through scholarship.

Ahmadiyah Indonesia operates a formal educational institution at the senior high school level, known as SMA Plus Al Wahid in Tasikmalaya, West Java. This institution serves as a platform for cultivating Ahmadiyah values and teachings among adolescents. Character education is integrated into the curriculum through four main sources: the cultural heritage of the Indonesian nation, the foundational principles of Pancasila (the state ideology), the demands of the 21st century, and the organizational motto "Love For All Hatred For None." The slogan "Love for all, hatred for none" is employed to reinforce the national identity of their youth and foster collaboration with surrounding communities (Sanusi et al., 2022). Additionally, SMA Plus Al Wahid emphasizes special character values derived from the organizational motto of the Ahmadiyah Congregation, namely: religious devotion, social skills, and a compassionate outlook towards humanity (Sanusi et al., 2022).

Tolerance education for children within Ahmadiyah families is accomplished by nurturing attitudes that embody the ethos of “Love for All and Hatred for None,” actively engaging in dialogue, and establishing social connections. In the practical implementation of religious tolerance among young children in Ahmadiyah families in Manislor, efforts include promoting tolerance, fostering self-identity development, and addressing the fundamental needs of children (Wartini & Shulhan, 2017).

Multiple Roles of Ahmadi Women in Children’s Character Education

Women frequently assume the primary role of parents or caregivers for young children, playing a crucial part in supplying the essential love, attention, and care vital for their growth and character development. Through regular interactions, women have the opportunity to impart fundamental values like kindness, empathy, cooperation, and responsibility to children. Here, we will explore the diverse responsibilities of Ahmadi women in shaping the character of their young offspring.

Overall, Ahmadi women play a vital and multifaceted role in shaping the character and moral development of their early children, laying the foundation for their future growth and contributions within the community.

Based on our interviews and focus group discussions (FGDs) with informants, it emerged that mothers serve as the primary caregivers for their children, regardless of whether they are full-time homemakers or also hold jobs outside the household. They shoulder the responsibility of caring for their children, often receiving assistance from other family members such as husbands, grandparents, or close relatives.

During early childhood, the mother plays a pivotal role in fulfilling not only the physical needs but also the spiritual needs of her child, such as providing love and attention. With children spending a significant portion of their day in the company of their mothers, from waking up to going to sleep, mothers greatly influence the caregiving and parenting patterns that shape children's character development. Even when mothers are employed outside the home, childcare is often entrusted to other female family members, such as grandmothers. Through their nurturing and guidance, women, as mothers, have the profound ability to mold

the character of their children. One informant highlighted how her role as a mother influences her decision-making, carefully selecting foods and toys for her children. Another expressed awareness of the impact her parenting style will have on her children's character development.

Women also act as powerful behavioral role models for children, as children tend to mimic the actions of the adults in their environment. Consequently, the positive behaviors exhibited by women in their interactions with others, conflict resolution, and displays of empathy can significantly impact children's character development from a young age. Informants in this study indicated that leading by example is more effective in influencing children's behavior than simply instructing them verbally without demonstrating the behavior themselves. Mothers reported that they frequently encourage their children to engage in certain actions rather than merely instructing them to do so.

One participant said:

> During prayer time, when the maghrib call to prayer is heard, I will invite my young child to join the prayer. Although he still does not understand the recitation. I also invite him to recite the Koran, memorizing short letters.

Another informant shared that she occasionally struggles to capture her children's attention when she simply verbally instructs them to perform certain tasks without modeling the behavior herself. To address this challenge, she actively demonstrates the activities she wishes her child to engage in. For instance, she consistently takes her children to the mosque for prayers and encourages their participation in weekly pengajian (religious gatherings). Her hope is that by instilling a habit of engaging in these religious activities from a young age, her children will grow up to be devout and pious individuals.

Some of the ways mothers shape the character of early childhood above, namely by giving examples and children imitating. Giving direct examples by giving children the opportunity to observe and then giving rewards if children can do it, according to social learning theory will make children learn directly from their examples and observations (Bandura, 1971). In addition to being informative, this method will also increase the capabilities of the child.

As members of the Ahmadiyah community, Ahmadi women partake in various religious activities on a daily, weekly, monthly, and annual basis. These activities include daily recitation of the Qur'an, tuning in to watch and listen to the Jum'at prayer delivered by their Khalifah every Friday via YouTube, and attending the annual Jalsah Salanah gathering. In all of these endeavors, Ahmadi women actively involve and encourage their young children to participate. Through these shared experiences, they aim to instill in their children a deep understanding of what it means to be an Ahmadi and to embody the values and character traits integral to their faith.

Based on the findings from our focus group discussions (FGDs) and interviews, Ahmadi women prioritize several key character traits when educating their children, including honesty, discipline, responsibility, courtesy, compassion, and religious devotion. Specifically focusing on the importance of honesty, nearly all mothers emphasized its significance in their children's upbringing. One mother shared a personal anecdote highlighting the challenges she faced in instilling honesty in her child. As a working mother, she found herself with limited time to spend with her child, leading to decreased supervision. Consequently, her child

developed an addiction to playing video games, to the extent of resorting to stealing money to afford game rentals. To address this issue, the mother emphasized the importance of honesty to her son, urging him to be truthful in all his actions.

In addition to emphasizing honesty, mothers in this study also prioritize cultivating the character of discipline in their children. Furthermore, they focus on instilling traits such as responsibility, courtesy, compassion, and religious devotion. According to the findings of our research, women shape their children's character through various methods, including setting examples and establishing habitual practices.

During early childhood, imitation is a predominant characteristic, making home-based education reliant on setting examples through positive attitudes and behaviors, introducing beneficial habits, and supplementing them with guidance. This approach aligns with Amini's perspective that fostering positive character in children necessitates communication utilizing the language of character (Amini, 2008). Therefore, it's imperative for parents to engage in discussions with their children regarding acceptable and unacceptable behaviors, elucidating the reasons behind them, rather than solely relying on verbal instructions for character education.

An example highlighted by one of the informants is the nurturing of a caring attitude. A mother shared that she frequently involves her child in acts of kindness, such as providing assistance to those in need. By actively engaging her child in these sharing activities and demonstrating compassion through her own actions, she aims to instill in her child the value of caring for others. Her aspiration is that her child will internalize these experiences and grow up to be a compassionate individual who willingly shares with others.

Another mother, whose child has special needs, specifically autism, shared her approach to nurturing a caring character in her child. Since her child rarely leaves the house, she actively involves a neighbor's child of a similar age to play with her child. Through this interaction, the mother teaches her child the importance of sharing toys and food with their friend. She believes that firsthand experience is crucial for her child to develop a caring character, emphasizing the value of sharing through practical engagement with others.

Another effective method for shaping children's character from an early age is through habituation. Character education necessitates the establishment of positive habits, such as being honest, respectful, and diligent, while instilling a sense of shame towards dishonesty, laziness, and neglecting the environment. It's important to recognize that character development in children is a gradual process that requires consistent and deliberate training to attain the desired traits and resilience.

Challenges of Early Childhood Character Education Today

Typically, married couples with young children are in their prime working years, leading to increased activity outside the home for both fathers and mothers. This current era is commonly referred to as the age of disruption, characterized by the rapid advancement of the internet, which has fundamentally transformed various aspects of daily life. Children are now introduced to the internet at a young age, belonging to a generation known as digital natives, who are immersed in the digital world. Digital natives are children raised in an environment saturated with and reliant on computers, video games, digital music players, smartphones, video cameras, and other modern technological devices and tools (Prensky, 2001).

During early childhood, a significant amount of time is often spent with gadgets, whether for entertainment or play. The advancement of information technology has its advantages, as it facilitates parents in accessing knowledge and educational resources to aid in their children's upbringing. Additionally, children benefit from alternative games and learning opportunities provided by these devices. However, gadgets can also serve as distractions in the process of instilling character traits in children.

Mothers participating in this study acknowledged the unavoidable necessity of mobile phones in today's society, recognizing that their children cannot be shielded from them. Some mothers even likened mobile phones to demons, attributing them to disrupting the process of character education for their children. They humorously referred to mobile phones as "the sprawl demon," deriving the name from their shape.

To address this challenge, some mothers employ a reward system with their children. For instance, if their children exhibit positive behaviors like tidying up their toys after playing or memorizing short letters, they are rewarded with time to play with gadgets. Additionally, mothers implement a "screen time" policy, which involves setting limits on the amount of time their children spend using screens.

Family and Community Support for Early Childhood Character Education

Within the household or family setting, a natural educational process unfolds, serving as an effective means to instill and actualize specific values or teachings. This process serves as a foundational framework for education in formal institutions like schools and contributes to the formation of individuals. The household or family performs various functions, including socio-economic, recreational, reproductive, and educational functions. It is expected that households or families provide children with a nurturing environment where their physical and emotional needs can be met.

The family serves as the primary informal educational institution for a child, where they undergo growth, development, and learning. Within the family environment, children receive their initial introduction to education. Through the educational experiences provided within the family, children acquire habits, skills, various attitudes, and a diverse range of knowledge. Additionally, it is within the family that children first receive character education, which lays the foundation for their future character development.

As highlighted earlier, women, particularly mothers, hold a pivotal role in molding children's character. However, to effectively educate their children, mothers require support. Findings from interviews conducted in this study reveal several types of support deemed essential by mothers. This support encompasses assistance from husbands, grandparents, and the broader environment.

The husband plays a crucial role as the first partner needed by a mother in shaping their children's character. While mothers who opt to be housewives typically exert a more dominant influence on their children, husbands also contribute to the process of character education within the home. The presence of the father's role is significant for fostering children's character development.

One informant revealed that her husband works out of town and only returns home once a week or every two weeks. In his absence, the mother diligently applies her methods to shape

the children's character. However, upon the husband's return, he tends to fulfill all the children's wishes, undoing the progress made by the mother. Mrs. A stresses the importance of establishing a common ground and agreement between both parents in educating their children.

The second support crucial for a woman in educating her children comes from the extended family, particularly from grandparents. In Indonesian culture, the prevalence of "sandwich families" is notable, wherein three generations reside under one roof, comprising children, parents, and grandparents.

The approach to character education between mothers and fathers, as well as grandparents, naturally varies. Mothers typically emphasize the significance of character education for their children, often employing strict methods involving concepts of reward and punishment, as well as assigning tasks and instilling habits. In contrast, grandparents tend to adopt a more lenient approach with their grandchildren. This discrepancy in approaches presents a challenge in shaping children's character. Therefore, support from grandparents is crucial, necessitating cooperation and consistency in educating children.

The final support for women in educating their children comes from the community, the Ahmadiyah community. In the preparation and nurturing of the next generation within the Ahmadiyah community, guidance and necessary materials are consistently provided. The community facilitates this through its organizational structure, particularly through the Tarbiyat division, which is responsible for providing, organizing, and overseeing activities related to religious education. Ahmadi women are equipped with knowledge and support from the community to aid them in their role as educators.

Furthermore, the Ahmadiyah community also has a special program known as the Waqf-e-Now program, wherein parents declare their intention to dedicate their children for the sake of religion through the Ahmadiyah organization. This program begins preparing the younger generation from the time they are in their mother's womb. A mother with three children participating in the Waqf-e-Now program expressed gratitude for her children's involvement. Through this program, she and her husband receive regular training, guidance, and assistance on raising, nurturing, and educating their children, as well as on how to be exemplary parents and what materials to provide to their children to instill and prepare them to be devout Ahmadis. Additionally, the Ahmadiyah community offers support by providing scholarships when necessary to facilitate their children's education, both at school and university level.The main body of text. Refer to the following Style Checklist for formatting.

Conclusions

In conclusion, nurturing and instilling character education in early childhood has consistently been a paramount responsibility for Ahmadi women in Indonesia, necessitating their adoption of multiple roles. Despite facing challenges of intolerance and discrimination within their community, Ahmadi women persistently impart the essential traits required for their children's future. They are supported in this endeavor by their spouses, extended families, and the broader Ahmadiyah community. Through their collective efforts, Ahmadi women strive to ensure the holistic development and character formation of their children, contributing positively to their community and society at large.

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Individuals' Motivations for Selecting a Liberal Arts Major: Evidence From a Transnational University in China

Shan He, Ningxia University, China

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Abstract
In the Chinese context, there is a tendency to divide college majors into two broad categories: STEM—or those with direct vocational implications in their titles, such as Engineering and Computer Science—and Liberal Arts, which are seen as being less directly linked to a certain job position, such as disciplines in the Arts, Humanities and many of the Social Sciences. In this paper, the rationales for individuals to have selected a liberal arts major at a transnational university are unraveled. This study strives to capture the mental journey of these young adults before their embarkation on their educational experiences, namely how they mapped their anticipated future blueprints into immediate major choices within limited time period. Semi-structured, in-depth interviews were conducted with students and graduates who enrolled in two non-applied, non-vocational first-degree programs: International Relations and Communications, at a transnational campus. Empirical data collection and analysis suggest that: (1) Students' major decisions are often intertwined with their choice of university, particularly regarding the characteristics of Sino-foreign institutions; (2) The majority of students were excluded from their initially desired majors due to their scores on the College Entrance Examination (Gaokao); (3) Some students exhibited a rational understanding of their strengths, preferences, and career plans, while others acknowledged making decisions without sufficient information; (4) A small group of students is intrinsically motivated by the liberal arts, and possesses unique perceptions and expectations that align with the principles of a liberal arts education.

Keywords: Liberal Arts, College Major, Transnational University

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Introduction

Since the expansion of higher education in China, an increasing number of Chinese students have been admitted to colleges and universities, providing broader access to tertiary education for the general population (Li & Xing, 2010). Notably, the choice of a college major has become a crucial decision for many individuals, as it significantly impacts their future career paths and personal development. In the Chinese context, there is a tendency to divide college majors into two broad categories: STEM—or those with direct vocational implications in their titles, such as Engineering and Computer Science—and Liberal Arts, which are seen as being less directly linked to a certain job position, such as disciplines in the Arts, Humanities and many of the Social Sciences. While liberal arts majors are popular among students seeking a well-rounded and interdisciplinary education, they also encounter complex issues influenced by employment concerns, a perceived lack of practicality, and social and cultural pressures (Zhang et al., 2024).

Recent decades have witnessed a growing interest in liberal arts education in China, particularly within transnational higher education settings (Postiglione, 2016). TNHE institutions often position themselves as incubators of critical thinking, creativity, and global competencies, attracting numerous students searching for alternative pathways to traditional education (Montgomery, 2016). However, little is known about the motivations that drive these students to pursue liberal arts majors over more vocationally oriented programs. This study aims to fill this gap by examining the motivations of individuals who select a liberal arts major at a transnational university in China. It sheds light on the factors influencing their decisions, and explores the implications for the development of higher education in the broader context of global educational trends and societal transformations.

Literature Review

Concepts and Terminology

Diverse interpretations have been made of the concept of "liberal arts", and it lacks a consistently applied definition. In Chinese literature, terms such as "liberal arts education" (literally translated as profound and elegant education) and "general education" (common knowledge education) refer to various manifestations of holistic or whole-person education, and can be used interchangeably (Jiang, 2014). Some Chinese universities have established liberal arts colleges or programs, which further complicates the meaning of this concept in China and potentially beyond. To avoid misunderstandings, the study reported in this paper adheres to the use of "liberal arts" to primarily denote the non-applied, non-vocational disciplines of study that do not lead to a specific job position, such as those in the Arts, Humanities, and many of the Social Sciences. This paper also discusses liberal arts as a general educational philosophy that "*empowers individuals, liberates the mind from ignorance, and cultivates social responsibility*" (AAC&U, 2002, p. 25). As mentioned, this philosophy is adopted by many universities in offering their respective curricula and educational experiences, which are expected to be accessible to all students.

Contemporary LA Practices in China

From the 1950s onward, the Soviet model was adopted as an effective means of promoting the development of a socialist economy. The liberal arts were inevitably neglected due to social changes and practical demands of the time. Before the early 1990s, "specialization"

was a characteristic of the Chinese undergraduate curriculum, resulting in scarce connections among different institutions and disciplines (Wang & Li, 2001). While the positive influence of the Soviet model on education is acknowledged, Li (2001, p. 112) argues that the omission of the humanities and social sciences has led to the emergence of individuals who are "*lopsidedly-developed*". This consequence was gradually recognized and addressed in Chinese education policy, especially after the 1990s, when efforts were made to revive the philosophy of liberal education with Chinese characteristics, culminating in the adoption of Suzhi Education (Pang et al., 2020). The backdrop to China's Suzhi Education was the country's reform and opening-up period, during which policymakers acknowledged that the strength of the nation had to depend on the quality of its people.

Moreover, Wang (2004) asserts that with the rapid expansion of higher education, today's college students are in need of an education that not only imparts specialized knowledge, but also fosters their social responsibility, critical thinking, and creativity. In other words, Chinese students are expected to acquire both knowledge and skills, while simultaneously developing into responsible citizens with a range of comprehensive qualities, such as independent thinking and sound judgment. As some universities have implemented a liberal arts curriculum as part of their culturally-oriented quality education, others have introduced "common courses" that are available to all students within the university (Li & Cao, 2024). These practices reflect the belief that undergraduate students should receive a well-rounded education alongside their professional studies.

Major Decisions and Choices

As the knowledge-based economy diversifies, the decision regarding a major and career is likely to become increasingly difficult. Factors such as job availability, income potential, gender suitability, and personal passion significantly affect students' choices of majors (Kuhail et al., 2022). While college majors yield varying economic outcomes, these differences do not diminish the overall value of a university education (Atuahene, 2021). In countries like the United States, the top three factors influencing a college student's choice of an academic major are personal interest, parental guidance, and potential income (Stock & Stock, 2019). In fact, many incoming college freshmen remain undecided about their majors, and their decisions to change majors stem from various reasons, including the challenges associated with their initial majors, the influence of their college instructors, and parental expectations (Jaradat, 2017). It is important to note that intrinsic motivations and internal extrinsic motivations are positively correlated with college students' satisfaction and sense of belonging, and vice versa (Soria & Stebleton, 2013). Furthermore, Soria and Stebleton (2013) conducted a conceptual examination of students' motivations for selecting their majors through the lens of self-determination theory, which differentiates between intrinsic motivation and various extrinsic sources of motivation, leading to different outcomes. For Chinese students, however, the impact of social values and family is often profound, making the choice of a college major a careful balance of risks, costs, benefits, values, and social conditions (Zhao, 2022).

Methodology

Research Context

The Gaokao, or the National College Entrance Examination, plays a crucial role in determining the universities and majors that Chinese students can pursue. Outstanding results

open doors to prestigious institutions regardless of a student's socio-economic background. University A, one of the leading branch campuses in China, is a first-tier institution established in 2004 through a partnership between a Chinese entity and a British university. It claims to offer all courses in English or other foreign languages and follows a curriculum framework identical to that of the host university (Lu, 2018). Although University A is transitioning towards a liberal arts program, its curriculum still places a stronger emphasis on Business and Engineering, with a comparatively minor focus on Humanities and Social Sciences, which bridges those two faculties.

Research Design

The purpose of this research is to uncover the underlying motivations behind students' choices, and to capture the mental journey of these young adults before they embark on their educational experiences. Therefore, an interpretivist paradigm is deemed the most appropriate and effective approach for providing a detailed and nuanced understanding of the topic under investigation. The author used qualitative research methods to gather data suitable for in-depth analysis embedded within a case study.

Data Collection and Analysis

This study employed purposive sampling to recruit participants who were well-suited to address the core research question. The participants included senior undergraduate students, recent graduates with a liberal arts degree, and faculty members who teach liberal arts courses at University A. This study involved individuals from two majors in the Faculty of Humanities and Social Sciences at University A. The first major allows students to explore topics such as international relations, global history, and political science (hereafter abbreviated as IR). The second major focuses on communication, culture, languages, and emerging forms of media (hereafter abbreviated as CC). Additionally, individuals who self-identified as "special" or "unusual", such as those who transferred from other majors back to liberal arts, were particularly encouraged to participate and share their experiences.

A deeper analysis of the data commenced once all semi-structured interviews were completed. The author acted as both the interviewer and the transcriber, effectively managing the extensive data generated from the case study. All interviews were transcribed verbatim to maintain their authenticity in relation to the originals. Given the nature and purpose of this study, an inductive approach was utilized to develop the analytical framework from the data. After managing and preparing the transcripts, coding was carried out to identify sections of the text that corresponded to relevant categories and subcategories pertinent to the research (Creswell, 2014). Then, a grounded thematic approach to analysis was used to identify the underlying patterns and themes that "*capture something important*" across the data related to the research questions (Braun & Clarke, 2006, p. 10). To ensure the quality of the research, the author emphasized a rigorous methodology and careful interpretation of the findings. Ethical considerations were also taken into account at different stages, including the preparation for conducting the study, accessing research samples, data collection, data analysis, and post-processing of data.

Findings

"Choosing" the University

1. Restriction of Gaokao Score

When asked about their reasons for attending University A, several participants recounted their challenging experiences with the Gaokao admission system. After completing the Gaokao, students intending to enroll in domestic tertiary education must fill out an application form, indicating their preferred institutions and majors. Those who achieve higher scores have a greater chance of being admitted to their desired institutions and fields of study. However, one student expressed the opinion that University A was usually not the first choice for Chinese students:

> "*If you ask this question to most students at [University A], their responses would likely be, 'I failed the Gaokao exam'. Many of them aspired to go to a prestigious 985 university, but their scores only qualified them for an average 985 or a reputable 211 university. So they came here to explore the possibility of pursuing postgraduate studies abroad.*" (Yu, F, Year 3)

"Project 985" and "Project 211" are initiatives implemented by the Ministry of Education to enhance the quality of higher education in China. Launched in 1998, Project 985 aims to establish first-class, high-level universities that rank among the world's best and can support China's modernization efforts. Project 211, initiated in 1995, focuses on strengthening key disciplines which were essential for China's socio-economic development in the twenty-first century (Lin & Wang, 2022). Chinese students predominantly favor the universities selected by the government for these projects. Those who aspire to excel and leverage their high scores for admission to prestigious universities may perceive the admission standards of University A as low and, therefore, choose not to apply:

> "*I think it largely depends on your Gaokao score. You should then consider the universities that correspond with it. At that time, the entry score for [University A] was slightly higher than the minimum cut-off for Tier 1.*" (Ann, F, working)

However, for those whose performance was unexpectedly unsatisfactory, it was necessary to prepare a "fallback" option that would lead them to an alternative destination. For instance, another student, Jin (F, Year 4), recalled that she was initially unable to gain admission to her target institution, which was both a Project 985 and 211 university. Yet she was reluctant to attend other Chinese universities because they did not appear as reputable in her eyes.

2. The Important Others

To explore other possibilities, students like Jin, who suffered a setback, sought support from the experiences and advice of those around them:

> "*Other people mentioned that [University A] had a positive atmosphere and was generally pretty good, which influenced my decision. It took me no more than three days to familiarize myself with the university and make my choice.*" (Jin, F, Year 4)

Since University A has a shorter history than most traditional Chinese universities, students typically have limited knowledge about it before their enrollment. Although Jin felt disappointed about missing her preferred university, the recommendations from others convinced her that University A would be a worthwhile investment for the next four years.

Similarly, "other people" played a crucial role for a few participants:

> "*A friend of my father said [University A] was not bad. He also has a student who went there.*" (Xuan, F, working)

> "*It was primarily because one of my relatives has a son who studies at [University A]. He felt it was pretty good. The feedback was positive.*" (Tao, M, Year 3)

As University A is not widely recognized, it is possible that Xuan and Tao overlooked it and did not include it in their initial list of choices. However, their decision-making process was inadvertently influenced by "critical incidents" and "important others", such as friends and relatives, who ultimately altered their educational and even career paths to a considerable extent. These "incidental others" are common in the lives of participants and can sometimes provide a substantial source of rationality.

3. Special Institutional Advantages

University A may be viewed as a last resort by some "unfortunate" students. However, many others perceived its advantages, particularly when compared to other non-985 and non-211 universities, as distinctive qualities. Respondents primarily identified these qualities as English-medium instruction and opportunities for studying abroad. These advantages are often assessed based on publicly available information and are linked to individuals' personal values and aspirations:

> "*While skimming through the application guidebook, I noticed that the university emphasizes English, which I found quite appealing. I have a strong interest in languages.*" (Yan, F, working)

Instead of choosing a major, Yan initially contemplated studying the English language, seeing it as an important ability and an area of interest for her university education. Given her limited understanding of University A, she believed that pursuing a foreign education would at least improve her English language proficiency, a skill she considered essential for her future.

In addition, as University A was very internationalized, Yan's parents were attracted to it, believing that the atmosphere—where one could "experience the British educational environment"—was a key advantage. Similarly, Xiao described herself as someone who "could have attended several prestigious Chinese universities" but chose to enroll at University A on a scholarship. She shared her positive impression, which stood in contrast to those of many other participants:

> "*I like [University A] because its atmosphere is distinct from that of other typical Chinese universities. There is a greater sense of freedom, which I truly value. English is also one of my strengths.*" (Xiao, F, Year 4)

Having achieved a significantly higher Gaokao score above the Tier 1 cut-off, Xiao could have selected a university that many would consider "better" and made a more conventional decision. However, she stated that she had "deliberately disregarded other options". Evidently, performing well on Gaokao granted Xiao the autonomy to determine how she wishes to navigate her journey. By opting not to join the crowded, conformist majority, she pursued distinctiveness, which could serve as a compelling advantage but also presented a potentially high-risk strategy.

"Choosing" the Liberal Arts Major

1. Allocation of Admission System

Unlike the most popular majors at University A, such as Finance and Business, International Relations (IR) and Communication and Culture (CC) are less sought after, with relatively lower average entry scores. Many participants admitted that their enrollment in IR was "an accident" and that they were "reallocated" to this field by the Gaokao admission system. Others remembered their initial choices, which were entirely different from IR or CC:

> "*The most realistic reason was that I did not achieve a high enough score. At first, I chose Business because I was interested in the subject. However, I was assigned to [CC] due to my insufficient score.*" (Ting, F, Year 3)

Many participants intended to study Business—a degree regarded as more "useful" in their own eyes or those of their parents. However, after competing with other students, they were unable to pursue their preferred major due to their scores. The tendency of these individuals, along with many other Chinese students, to prioritize vocational paths stems from historical and cultural influences. Following China's reform and opening-up in the late 1970s, the population was confronted with new risks, uncertainties, and the necessity of self-responsibility, moving away from the expectation of permanent, lifelong employment that had previously prevailed (Liu, 2023). Consequently, the generation of these students' parents often exhibits heightened sensitivity to risks. As a result, professional fields such as business, medical science, and engineering are considered as more favorable career paths due to their stability and potential for higher financial returns:

> "*I think [IR] does not have the reputation that Computer Science and Business have among Chinese parents. Chinese parents seem to think that choosing [IR] is sort of like choosing Philosophy… or you know, something abstract that you can never get a job.*" (Gary, M, professor in IR)

As a professor, Gary observed that in China, the utilitarian perspective—viewing university education primarily as preparation for the job market—remains dominant. Students' parents, who tend to be conservative and risk-averse, are actively involved and can become influential decision-makers in their children's selection of majors.

2. Ignorance of Major

Unlike those who were "obsessed" with hard disciplines, a few participants claimed that they did not give much thought to their chosen majors. Xiao (F, Year 4), a top performer who chose University A, admitted that she "did not think much" after Gaokao about what she wanted to study or her future plans. Another participant, Min, mentioned that she could not

recall the majors she had selected back then, but ultimately found herself studying IR. She speculated that her initial choice was not IR, but acknowledged that she had no clear ideas about majors at that time.

As Min enrolled in IR unwittingly, some other students, despite being aware of their preferences, had only a superficial understanding of what they were about to study. For instance, Ting (F, Year 3) believed it was a coincidence that she studied CC, stating that she "did not know anything about this major before". Similarly, Qing (F, Year 4) described herself as "quite naïve… did not think too much… [and had] not expected the course content [of CC] to be like this". Another student evaluated the major solely based on her subjective impression:

> "*I picked up the pamphlet of [University A] and skimmed through it to see if I liked the title of the major. I did not analyze the introduction below the major in detail, nor did I fully understand its meaning. However, I felt that the Business major had a distinctly international appeal.*" (Yan, F, working)

Yan admitted that a glimpse of the Business major's name led her to associate it with "international trade and aspects like that", which she found very appealing. However, she did not explore her thoughts any further.

Fortunately, there were still a few participants who believed that studying IR or CC aligned with their academic strengths and capabilities, thereby improving their competitiveness. Thus, it was regarded as a relatively rational choice:

> "*During high school, I developed a strong interest in interdisciplinary subjects that encompassed politics and history, which ultimately influenced my decision to major in fields such as [IR].*" (Qing, F, Year 4)

Qing was then enrolled in CC, and convinced herself that "there might be another way out", indicating her uncertainty about whether CC was truly the right choice. Yet she found it "acceptable", suggesting that she was potentially capable of pursuing a career in this field afterwards. More importantly, she was candid about her primary goal, which was to study at University A rather than to choose a specific major.

3. An Unusual Decision

A small number of participants transferred from more popular majors to IR and CC. Of particular interest are the decisions made by two female students, Xiao and Yu, who switched from Finance to IR and CC respectively after one year of study. Xiao described Finance as "very boring", stating that the student group was "homogeneous and not very interesting". She felt there were "too many straight-A students", which led to fierce competition characterized by "numerous certificates to prepare for" and "ceaseless internships". A more significant factor influencing her decision to change was her observation that "the majority of students in Finance had similar development paths and engaged in similar activities". Xiao transferred to IR from Finance, hoping her university education would be "exploratory", "humanistic", and one that could "bring passion to life":

> "*Students in [IR] were more active. My Finance classmates behaved like high school students in class; their responses were often similar. But in [IR], everyone was eager*

> *to share their ideas, which were quite diverse. For example, one female student expressed that her dream was to become a shepherdess.*" (Xiao, F, Year 4)

Xiao appreciated the open-minded perspectives and attitudes of IR students, and she was more inclined to engage with those who embraced a variety of lifestyles. She was, however, not the only student who enjoyed meeting people with diverse interests, hobbies, and ideas. Yu, a student who transferred from Finance to CC, considered herself "a very communicative person" with "a colorful life." Yu described her choice of veering to CC as very sensible because "everyone was very capable in the Finance major", which, once again, fostered intense competition. Therefore, she opted to leverage her personal strengths, such as communication skills and creativity, as her "professional advantage" by directly studying CC. In her view, graduates in Finance, and possibly in Business, are in oversupply in the Chinese labor market:

> "The *Finance major is highly popular in China, with many universities offering related programs. Although the demand for graduates in this field is limited, the number of students pursuing this major is virtually limitless.*" (Yu, F, Year 4)

Furthermore, after changing her major to IR, Xiao wondered whether she possessed the same capacity to study a more applied subject. To address her concerns, she independently enrolled in an online course on financial management and completed the exams for the Finance major at University A to reassure herself of her abilities. She then demonstrated that she was more than capable of passing these exams. This experience strongly boosted her confidence in her learning skills, and she asserted that much of the content in Finance "can be learned on your own". This realization provided her with a sense of relief as she pursued a liberal arts discipline.

Another male student, Ran, initially enrolled in the Computer Science major but later switched to IR on his own initiative. His motivation for making this unconventional decision derived from his critical understanding of the role of a university, which he associated with a liberal arts education:

> "*I was profoundly influenced by the idea that at university, we should prioritize developing a way of thinking and fostering a habit of lifelong learning over solely acquiring specific skills. Therefore, the choice of major is not of utmost importance; what holds greater significance is the cultivation of values. So I chose [IR], which is a rather 'vague' discipline.*" (Ran, M, working)

Discussion

Based on the findings, it can be inferred that individuals' motivations for pursuing a liberal arts major are primarily influenced by socio-economic factors. Sino-foreign universities typically charge much higher tuition fees than domestic institutions. This disparity implies that the socio-economic status of the interviewees could provide a social foundation for their pursuit of a liberal arts major and personal fulfillment. Indeed, the possession of social and cultural capital plays a crucial role in the admission processes of European and American liberal arts colleges, which tend to favor applicants from advantaged backgrounds (Lewis, 2016). In China, Hu and Wu (2017, p. 190) found that:

> *those with greater endowment of cultural capital are more likely to come from socioeconomically advantaged families, and, at the same time, demonstrate a stronger propensity to major in liberal arts fields rather than science, technology, engineering and mathematics (STEM) fields*.

At University A, the few exceptions who transferred from STEM or business to liberal arts all came from privileged family backgrounds and exhibited decent cultural capital through their understanding of a "proper" university education. Thus, they were empowered to take on the risks associated with choosing a major that contradicts the utilitarian perspective on employability and higher education.

Secondly, the curricula of liberal arts education have been implemented in various regional contexts, each characterized by distinct academic traditions, structures, and cultures. This illustrates how the practice and interpretation of this educational philosophy can vary based on differing contextual needs, beliefs, and values (Kirby & Van der Wende, 2016). A persistent identification of liberal arts education can be its distinction from education aimed at professional purposes (The Yale Report, 1828). A "professional" education prepares students for specific roles demanded by the labor market, while a "liberal" education equips students with fundamental knowledge and skills applicable in various life situations. In this regard, President Xi (2024) also continues to advocate for a well-rounded education and the development of an education system that fosters "*a new generation of young people who possess comprehensive moral, intellectual, physical, and aesthetic grounding, along with a strong work ethic*". Thus, universities and society should collaborate to create a more balanced and healthy educational environment by promoting a broader definition of success that encompasses not only academic achievements but also personal growth, creativity, and social responsibility. Sino-foreign joint ventures could positively influence other Chinese universities by nurturing well-rounded individuals and contributing to societal progress.

In recent years, University A has welcomed a growing number of students with exceptional Gaokao scores, particularly in business-related majors, which consistently have the highest admission requirements. Some students have chosen to pursue majors deemed the "strongest", believing that choosing a major with the highest Gaokao score would maximize the utility of their scores. Participants who previously followed the high school Liberal Arts track were ineligible to select pure STEM majors; however, they were given the opportunity to study business-related fields once they achieved the required admission score. Many perceive these fields as more applied, specific, and lucrative compared to "pure" Arts, Humanities, and Social Sciences. Nevertheless, driven by this score-oriented mindset, many students may later find themselves uncertain about which major to pursue or may have simply followed their parents' advice. Besides, as the university selection mechanism has changed in some provinces of China—where students must choose specific disciplines rather than purely universities—the decision-making process has become increasingly complex. Therefore, there is an urgent need for activities that assist high school students in making informed educational and career plans. Initiatives such as school visits and lectures can help them prepare for their futures well in advance.

Conclusion

This study analyzed the motivations of individuals pursuing a liberal arts major at a transnational university in China. Empirical data collection and analysis suggest that: (1) Students' major decisions are often intertwined with their choice of university, particularly

regarding the characteristics of Sino-foreign institutions; (2) The majority of students were excluded from their initially desired majors because of their scores on the College Entrance Examination (Gaokao); (3) Some students exhibited a rational understanding of their strengths, preferences, and career plans, while others acknowledged making decisions without sufficient information; (4) A small group of students is intrinsically motivated by the liberal arts, and possesses unique perceptions and expectations that align with the principles of a liberal arts education. In summary, despite the encouraging trend of rising admission scores at University A, there are many unusual, intricate, and potentially unpredictable factors influencing students' decision-making processes. These complexities are likely to remain hidden without engaging with students in a way that facilitates thorough exploration.

Due to its qualitative sampling and processing techniques, this research is neither generalizable nor statistically representative. The applicability of data is limited to other universities offering liberal arts majors and to individuals enrolled in different liberal arts programs. However, the findings could be enhanced by incorporating quantitative data collection and analysis, which would enable the investigation of correlations among different demographic variables, such as gender, family background, and personal experiences. Another limitation is that practical issues related to curriculum design were not fully addressed, and were not the primary focus of this study. The selected humanities and social science disciplines from the two cases are temporarily referred to as "liberal arts", but if a deeper pedagogical perspective is employed, the content, format, and organization of the courses may offer a better understanding of their characteristics.

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Do You Re(meme)ber: Reconstructing Memes as a Summary for Recall and Comprehension in Mapua University

Marian Ingrid A. Sauco, Mapua University, Philippines
Marvin B. De Leon, Mapua University, Philippines

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Abstract
The education crisis in the Philippines is a problem that millions of Filipinos face. Despite being a country where students spend the most hours in school, the Philippines is less productive than other countries (Philippine Business for Education, 2023). The K-12 system was employed in the Philippines to improve quality education and enhance students' academic skills and competency (Almerino et al., 2020). With the prevailing challenges in the Philippine education system, the study seeks to improve quality education by exploring the potential use of memes in education. This study explored memes to improve recall and comprehension in Chemistry through a mixed-method approach. The study used Molina's (2020) guidelines to deconstruct the learning material and memes. Through deconstruction, the study was able to identify three ways to create memes for education: (1) panel layout, (2) conditional layout, and (3) map layout. The study also used a content analysis for the responses and a survey to measure the effectiveness of memes. The results showed that memes are an effective means to recall, comprehend, and summarize a lesson. The memes created for the study is most effective in terms of comprehension, while some students think that memes are an effective way to recall and provide an educational summary. Future scholars may consider changing the study's methodology to explore other geographical contexts and apply the study in other disciplines to have a more cohesive understanding of memes in education.

Keywords: Internet Memes, Educational Memes, Comprehension, Recall, Chemistry

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Introduction

The rise of social media has changed the way people interact and communicate. Education is also changing as people find new communication methods through social media. Recent news claims that TikTok, a popular short-form video application, is also gaining attention for transforming how students learn.

Despite controversies surrounding TikTok, it is found that 69% of users have shared that TikTok has helped with their homework (Langreo, 2022). Several studies similarly found that using TikTok promotes student motivation and engagement (Adnan, 2021; Escamilla-Fajardo et al., 2021; Khlaif & Salfa, 2021; Yélamos-Guerra, 2022). The way people learn has transformed as technology and social media have introduced new means of communication. Aside from TikTok, memes are among the latest means of communication that emerged with technology and social media. Most viral memes are in image and text format, often containing the reality of a person's experience (Milosavljević, 2020).

Today, memes are often associated with the younger generation, which includes Generation Z and Millenials (Harshavardhan, 2019). Young college students are involved with using memes to express their opinions and views on sociopolitical issues (Harshavardhan, 2019). Moreover, memes' humorous and light-hearted nature makes them appealing to many youths today (Harshavardhan, 2019). One local study found that Filipino students who were taught internet memes about mathematics and were given the chance to create memes based on their understanding of the lesson had positive results (Godinez, 2023). In another local study, it found that memes have the potential to be used in classrooms to promote humor and creativity. They expounded that memes could be used to represent and communicate people's experiences using a form of media (Valenzuela et al., 2022).

With all of these in mind, it is evident that there is a vast potential for memes to be applied in education. However, existing studies are still limited and could be developed, especially in various cultural and geographical contexts. This study aimed to contribute helpful knowledge on the development of memes as an educational tool that could potentially improve quality education in the Philippines.

The study sought to create memes that can summarize complex concepts such as science and math, as these are the subjects that many Filipino students struggle with. According to Rogayan and colleagues (2021), Filipino STEM students have trouble with the level of difficulty of STEM courses. In addition, many SHS students from the Philippines choose a different SHS strand due to the grade requirements to qualify as a STEM student and the negative perceptions towards taking STEM (Andrada & Marasigan, 2020). The STEM strand usually includes technical and scientific courses that many Filipino students struggle with. The Philippines also had the lowest scores in math and science among 58 countries that participated in the Trends in International Mathematics and Science Study (TIMSS). Moreover, it was also found that only 16% of Filipinos can understand math, while only 23% can understand and explain scientific phenomena (Chi, 2023).

In particular, the study focused on creating memes related to chemistry lessons, precisely Le Chatelier's principle and the steps in solving using the ICE table method. While there have been a few studies about memes in the context of education in the Philippines, none of them has yet used memes as an educational tool to explain a concept from a lesson. The present

study intends to localize memes as an educational tool to teach scientific lessons. As such, the research questions that guided the study are as follows:

1. What are the processes for memes to be used as a summary for promoting recall and comprehension in chemistry?
2. What are the visual design elements needed in an educational meme that can summarize scientific concepts and can promote recall and comprehension?
3. How effective are memes in terms of improving recall and comprehension of students?

Methodology

A. Conceptual Framework

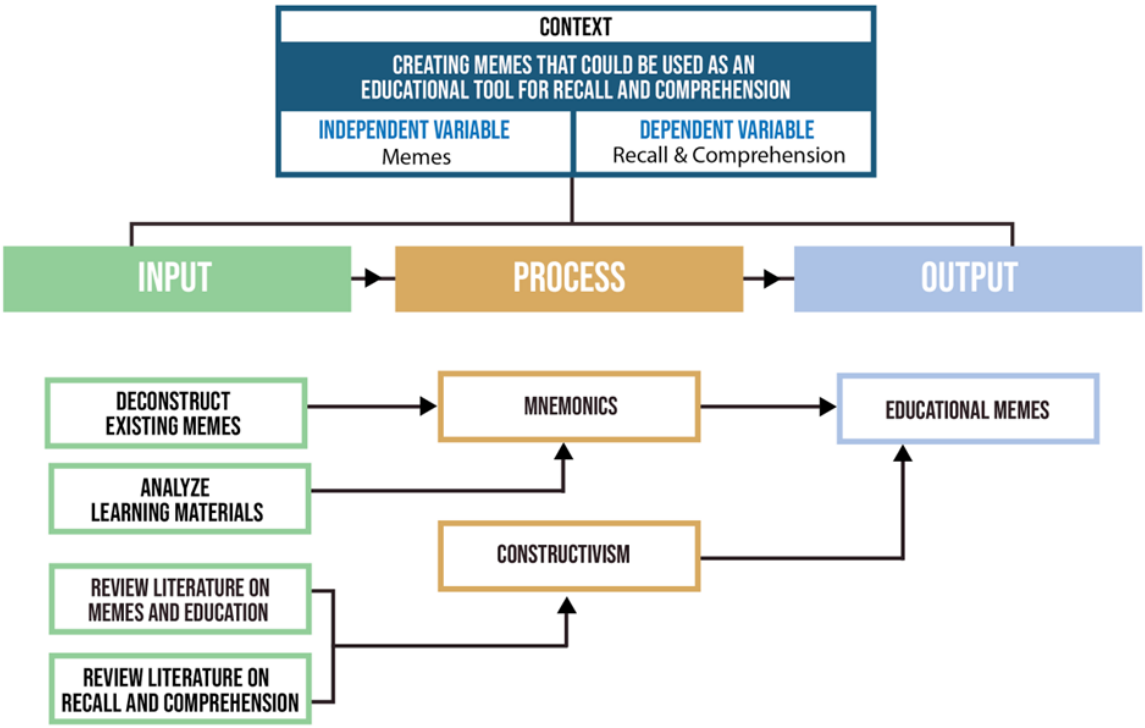

Figure 1: Conceptual Framework Using Context-Input-Process-Output Model (CIPO) Framework

Using the Context-Input-Process-Output model (CIPO) framework, this section discusses the conceptual guidelines to accomplish the study's objectives. As mentioned earlier, the objectives of the study are (1) to determine the processes for memes to be used as a summary for promoting recall and comprehension, (2) to identify the visual design elements needed in an educational meme that can summarize scientific concepts that can promote recall and comprehension, and (3) to measure the effectiveness of memes in terms of improving recall and comprehension.

For the first objective, the inputted data needed are literature about memes, education, recall, and comprehension, all analyzed using constructivist learning theory. Understanding existing literature helped determine how memes may be used as an educational tool for recall and comprehension. Apart from this, the study also inputted meme samples and creations guided

by mnemonics and the six characteristics that make an internet meme by *Molina (2020)* in the process.

Deconstructing viral memes on the Internet satisfies the study's second objective, determining the elements needed to make a meme that can summarize complex concepts. The researcher utilized the identified meaning of a meme to help create an educational meme, which is the intended output of the study. The last input in the conceptual framework is the learning materials provided by the science teacher partnered in this study. The learning materials provided are the uniformed PowerPoint presentation by the Mapua SHS science department for course outcome 5, which covers the lesson on Le Chatelier's principles and the steps in solving using the ICE table method.

The last objective of the study is satisfied through the instruments to be used—a mixed-method survey. The qualitative part of the survey asks the respondents for an open-ended response about the memes they have encountered. In contrast, the quantitative part of the survey is a validated Likert scale that deals with knowing the effectiveness of the memes deployed.

B. Data Collection Procedure

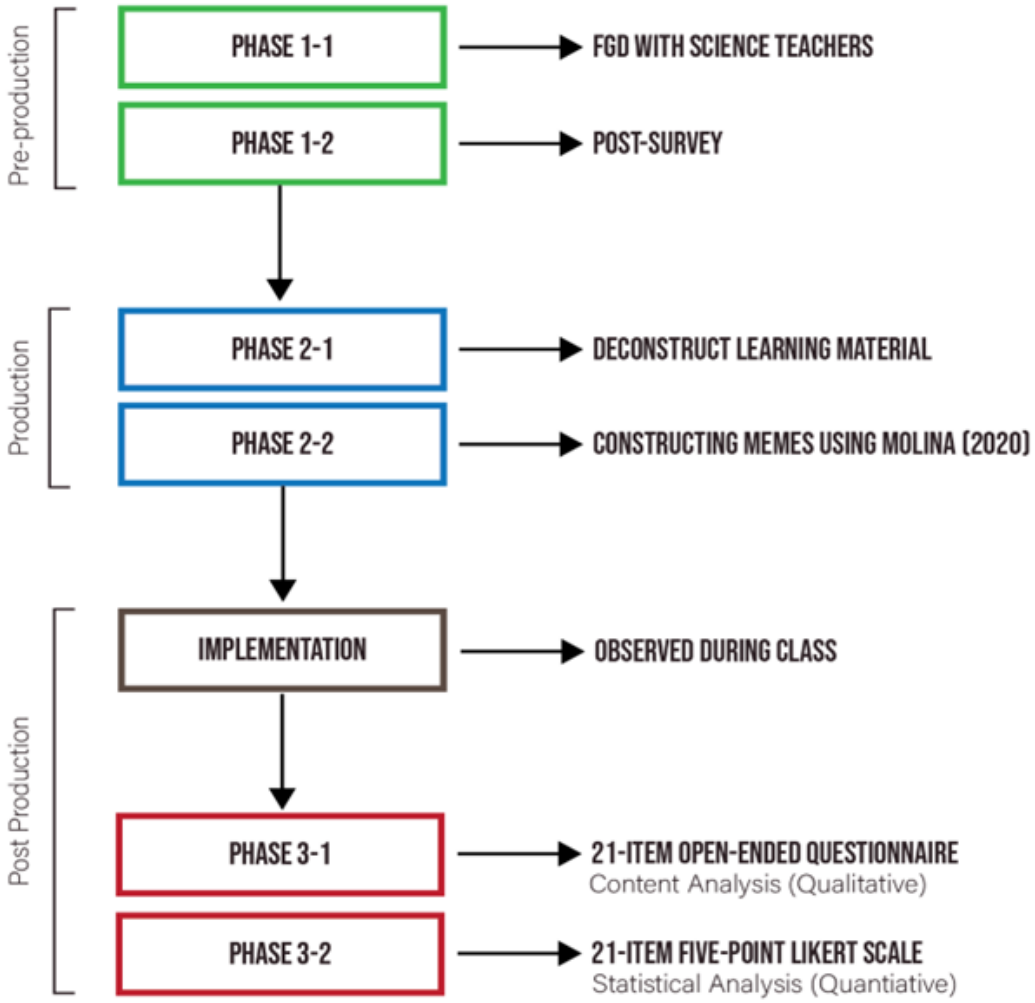

Figure 2: Data Collection Procedure

The pre-production phase includes **Phase 1-1**, which refers to the FGD with the science teachers, and **Phase 1-2,** which refers to the qualitative post-survey form that seeks to understand why students struggle with learning chemistry.

The production phase includes Phases **2-1**, deconstructing the learning material using mnemonics. **Phase 2-2** refers to constructing memes based on the definition of simplified lessons. Memes contain memorable aspects such as photos and words that could call an experience, information, feeling, or response (Maryme, 2020). Mnemonics guided the study in formulating memes and figuring out the elements needed to translate a complex lesson into a memorable meme that students could recall. For further validation, the study used the guidelines by **Molina (2020),** wherein she established the prevailing characteristics found in internet memes. In addition, the lens of constructivism was used as a theory in analyzing the results of the study.

Table 1: Molina (2020) Characteristics of an Internet Meme

Characteristics of an internet meme	**Definition** *(Molina, 2020)*
Visual Format	Memes can be in images and videos. For image memes, its communicative value increases when it is accompanied with a text that relates to the image.
Intertextual Nature	A meme's visual format does not create meaning. However, the intertextuality of a meme refers to the expression from the combination of the image and text of the meme. A meme can be understood through the combination of both components (i.e., image and text)
Cultural Component	Memes also consider its original conceptualization as a cultural artifact that creates symbolic resources within a culture. A meme can be understood, depending on its assigned culture.
Stance	This refers to the social role of the meme. This can either be positive or negative.
Virality	For a content to be considered as a meme, it must be shared through the internet. The virality of a meme refers to its shareability that allows memes to evolve through time. It also refers to the imitative qualities that makes a meme easily shareable and relatable.
Imitation	Memes start as a concept that becomes transmitted with slight modifications from each person. Internet memes have imitative qualities but vary in its means of propagation and replicability.

After the production phase, the first part of the post-production phase is the *implementation***,** which is the time that the researcher observed during the class where the memes were deployed to all the Grade 11 students. Phases 3-1 and 3-2 refer to the online survey collected after eight days since the memes were shown to the students. *Phase 3-1* refers to the 21-item

open-ended questionnaire wherein the responses collected were analyzed using a content analysis. *Phase 3-2* refers to the 21-item five-point Likert scale wherein the gathered responses from this were statistically analyzed.

Results

Research Question 1:

The following steps may be referenced in implementing memes in education: (1) Collect and Assess, (2) Deconstruct learning material, (3) Construct memes, (4) Implement memes, and (5) Analyze and Interpret

Research Question 2:

Overall, all of the memes were able to promote recall. The students could recognize the lessons from Le Chatelier's principle and the steps in solving using the ICE table method. For the elements, the students could primarily recall the memes used in each of the seven memes. In addition, most of the students recalled graphics and color in each of the memes. In terms of file format, adding moving graphics such as GIFs could catch students' attention and interest, making them recall the lesson and elements better. Finally, most students could comprehend Le Chatelier's principles as they could accurately explain the concept based on their understanding of the memes. Many students could still enumerate the steps for solving using the ICE table method. However, some students expressed that there are too many elements in the seventh meme, making it quite challenging for some students to understand.

Research Question 3:

Table 2: Results of Overall Effectiveness of Memes as Recall, Comprehension, and Summary

Overall Effectiveness of Memes			
Effectiveness	**Mean**	**SD**	
Recall	**3.88**	**0.81**	**Effective**
Comprehension	**3.89**	**0.80**	**Effective**
Summary	**3.88**	**0.80**	**Effective**

Legend: 1.00-1.80 (Very Ineffective), 1.81-2.60 (Ineffective), 2.61-3.40 (Neutral), 3.41-4.20 (Effective), 4.21-5.00 (Very Effective)

Discussion

The memes are the most effective regarding comprehension (M=3.89, SD=0.90). Most respondents also think that the memes are effective for recalling (M=3.88, SD=0.81) and providing an educational summary (M=3.88, SD=0.80). Meme 3 is the most effective out of all the memes (M=3.99, SD=0.86). The respondents agree that the meme helped improve their understanding (M=4.00, SD=0.89) and recall (M=3.99, SD=0.91) of the concept, "Change in concentration of a reactant or product when removed". They think this meme is a compelling topic summary (M=3.99, SD=0.86). In addition, Meme 2 is the most effective for recall (M=4.03, SD=0.91) and summarization (M=4.01, SD=0.91), while Meme 3 is the most effective for improving comprehension (M=4.00, SD=0.89). The possible reason meme 3 is effective could be external factors. In class observation, many students were still distracted

when meme 1 was introduced because some were late in class, some were eating their food, and some were using their phones. However, as the class progressed, memes 2 and 3 sustained better engagement as the teacher could grab the student's attention when they saw the trade offer meme. While memes 4 to 6 also used the trade offer meme, it is possible that memes 2 and 3 were more effective as it was the first of the series of trade offer memes introduced. It is possible that the student's attention became less focused when the other memes were shown.

On the other hand, meme 7 was the least effective (M=3.47, SD=1.02). However, it is still effective for the students in helping them recall (M=3.47, SD=1.05), summarize (M=3.46, SD=1.09), and understand the steps in solving the ICE table method (M=3.47, SD=1.09). The possible reason meme 7 is the least effective among the memes is due to sensory overload. Many of the responses in the content analysis raised the fact that they did not recall anything from the meme due to it having too many visual cues. While Meme 7 summarized the topic through a map layout design, it still did not meet the recall and comprehension of students as it had too many visual cues that became distracting and counterproductive. Despite this, meme 7 and the other memes are effective, which could imply that memes in learning stimulate assimilation and accommodation according to constructivism. Assimilation refers to modifying new information to fit into what the mind already knows, while accommodation refers to the external realities to arrive at a better understanding. According to Ghaour (2016), when the students' beliefs are unmatched by what is being presented, the student is drawn to resolve the conflict through assimilation and accommodation. Relating these to the memes, it is possible that the students were drawn to resolve the conflict they saw with what the memes represented. They tried to fit or adapt what they knew to what was shown in the meme, allowing them to recall and comprehend. How the memes were used could create a mismatch between what the students usually consume and what they consume. Since memes are more commonly used in social media for entertainment, the students were likely surprised that they saw them in their class, which could grab their attention and draw them to resolve what is being shown in the meme. Moreover, it is worth noting that many of the students elucidated how their teachers do not use memes in any of their subjects or lessons. Hence, they were surprised and more interested when they saw the meme.

Conclusion

In conclusion, using FGD was useful in gathering the insights and experiences of science teachers. The FGD allowed the researcher to identify chemistry as the science subject most Grade 11 students struggle with. Furthermore, deconstructing the learning material and memes through constructivism and mnemonics helps identify the ways memes can be created as a summary for promoting recall and comprehension. Through mnemonics, the study was able to simplify the definition of the topics through word association. In deconstructing the learning material, the researcher identified two types of topics: concept- and process-based. Furthermore, the study was able to identify three ways to create memes as a summary: (1) panel layout, (2) conditional layout, and (3) map layout design. In translating the learning material into a meme, the researcher also deconstructed the definitions through mnemonics. Using the guidelines of Molina (2020), the study concluded that the characteristics found in memes and supporting them with visual design elements help promote recall and comprehension among Gen Z students. With this, using memes in education benefited students and teachers as the memes made learning easier for students.

Creating open-ended questions in the survey provided useful insights about how effective the memes are for the students. Using a content analysis provided feedback that addressed the need of the student to learn the concept effectively. Furthermore, the content analysis identified the main visual elements needed to create an effective meme for recall and comprehension: visual format, layout, and graphics. GIFs in memes are more effective than static images. Among the three ways of creating meme layouts, which are (1) panel, (2) conditional, and (3) map, the conditional layout design had the greatest effect in improving recall and comprehension. Meanwhile, the map layout meme was the least effective due to sensory overload caused by the numerous visual cues present in the meme. In terms of graphics, the study concluded that using viral and timely memes as the main character yielded better recall and comprehension. Consequently, humor in memes was favorable to Gen Zs. Using the Five-point Likert Scale in the online survey provided a feasible way of measuring the effectiveness of the memes in education. It is also worth considering that even though the memes are effective, the study's results are still limited as it elucidated that the memes in the study are not highly effective, which could indicate improvement.

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Cultivating Intuition for Mathematical Modelling in an Interdisciplinary STEM Lesson: A Case Study in Singapore

Lim Kim Yong, National University of Singapore, Singapore
Ng Mei Ting, National University of Singapore, Singapore

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Abstract
This study presents the rationale and execution of an interdisciplinary STEM lesson on mathematical modelling for secondary and pre-tertiary students in Singapore. Instead of directly introducing differential equations, which are typically employed in such models, an alternative computational thinking approach is utilized. The lesson employs relatable contexts such as a zombie apocalypse to foster understanding of concepts in infectious diseases. A key objective is the acquiring of the mathematical reasoning behind the susceptible-infected-recovered (SIR) model for infectious disease spread. In addition, this approach is also accessible to students unacquainted with calculus, without compromising the rigor and accuracy of the model. Aligned with Singapore's strategic focus on educational technology in the education system, the lesson supports students in developing foundational data competencies and computational thinking skills with the use of spreadsheet software. These readily available digital tools facilitate the automation of calculations and modelling of disease spread. Predicted outcomes by the model can be compared with real-world data e.g. COVID-19 infection numbers. This enables students to see how mathematics and biology intersect, fostering a better appreciation of the interdisciplinary nature of real-world problems.

Keywords: Mathematical Modelling, Epidemic Modelling, STEM, Lesson Design

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Introduction

In Singapore's Mathematics curriculum framework, mathematical modelling is regarded as a process of translating real-world problems into mathematical terms in order to find potential solutions for it (Ministry of Education, 2020). A real-world problem is first simplified and represented by a mathematical model. The model can then be solved to obtain a solution which would be interpreted in the real-world context (Ang, 2001). The model then undergoes iterations of refinement to reflect the real-world problem more accurately (Figure 1).

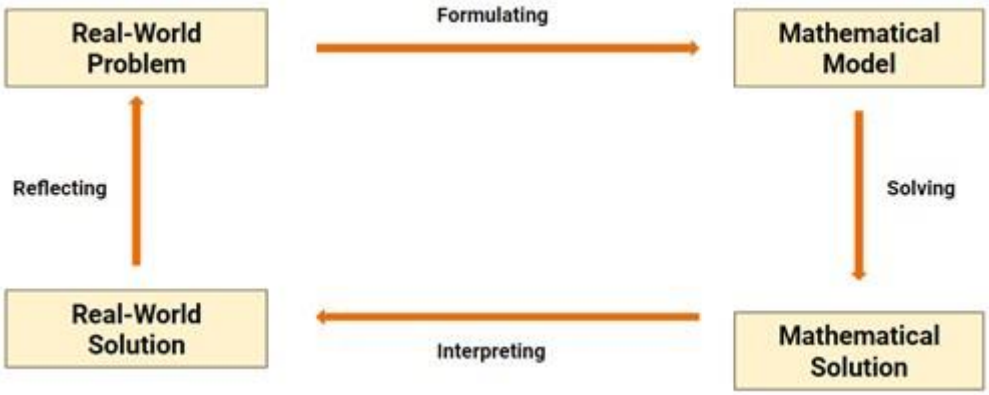

Figure 1: A Simplified View of the Mathematical Modelling Process

Mathematical modelling process has widespread relevance in many real-world applications, including in the study of infectious diseases. Through mathematical reasoning, epidemic models are constructed and become invaluable tools used to predict the spread of diseases and support governments in making informed public health interventions.

Many epidemic models are traditionally driven by a system of ordinary differential equations to estimate epidemiological parameters, such as the transmission rate and reproduction number. Epidemic models, which are often based on various assumptions, can be classified into stochastic or deterministic models. Two common examples of the latter include the Susceptible-Infected-Recovered (SIR) model and Susceptible-Exposed-Infected-Recovered (SEIR) model (Frontiers in Public Health, 2020).

In teaching mathematical modelling, Lofgren et al. (2016) highlighted that making mathematical modelling concepts accessible to allow students to build an intuitive understanding and appreciation for the subject remains a key challenge. Additionally, the conventional use of differential equations in these models can be daunting for students with little or no prior exposure to calculus. In Singapore, introductory courses on coupled differential equations are only formally introduced in the third or fourth year of undergraduate studies.

In the aftermath of COVID-19 pandemic, there were noticeable shifts in Singapore's national curriculum. As part of Singapore Edtech Masterplan 2030, Singapore has pushed for more integration of technology into educational practices. Students are encouraged to develop digital literacy and technology skills. In addition, a new examinable topic on infectious diseases was introduced in the Biology Syllabus (2023) meant for 16 year-olds.

Given the stated challenges in teaching epidemic models and the recent shifts in Singapore's national curriculum, we were motivated to design an interdisciplinary lesson on modelling an epidemic using the Susceptible-Infected-Recovered (SIR) model. Instead of directly introducing differential equations, students are to build the model from scratch using spreadsheet software such as Microsoft Excel. Through this process, we hope to help students grasp the mathematical reasoning behind a basic epidemic model while fostering basic data competencies in the use of spreadsheet software.

Susceptible-Infected-Recovered (SIR) Model

Susceptible-Infected-Recovered (SIR) model is one of the most foundational models in epidemic modelling. It divides a population of N individuals into three categories:

- **S**usceptible (S) – number of individuals who are vulnerable to a disease
- **I**nfectious (I) – number of individuals who are infected and can spread the disease
- **R**ecovered (R) – number of individuals who have recovered and acquired immunity, or died

The model assumes that the population remains constant and is homogenously well-mixed. All individuals in the population are susceptible at time t = 0 (Day 0), and immunity is conferred after a single infection. The relationship between the above categories can be summarised by a system of differential equations:

- **S(t)** - number of individuals who are vulnerable to a disease at time t
- **I(t)** - number of individuals who are infected and can spread the disease at time t
- **R(t)** - number of individuals who have recovered and acquired immunity, or died at time t

$$\frac{dS}{dt} = -\beta\frac{I}{N}S$$
$$\frac{dI}{dt} = \beta\frac{I}{N}S - \Upsilon I$$
$$\frac{dR}{dt} = \Upsilon I$$

β and ϒ are the transmission rate and recovery rate respectively. The former is influenced by two factors: the number of contacts per unit time (π) and the probability of infection upon contact (p). The transmission rate captures the average rate at which a susceptible individual will be infected upon contact with an infected.

The "Modelling an Epidemic" Lesson Design

The "Modelling an Epidemic" lesson was designed to be two-hours long for secondary and pre-tertiary students with little or no prior exposure in Calculus. This lesson was offered as a workshop package to local and international schools under the Science Demonstration Laboratory in the National University of Singapore as part of local educational outreach efforts.

For implementation of lesson, access to a laptop with spreadsheet software, such as Microsoft Excel or Google Sheets, is required. If access to computers is limited, students can work in pairs or small groups.

1. Lesson Introduction

As a brief introductory segment, the etymology of common epidemiological terms – specifically "outbreak", "epidemic" and "pandemic" – is introduced to students in relation to their definitions and scale of impact using real world news articles.

2. A Simple Model: Susceptible – Infected

A study by Lofgren et al. (2016) highlighted the potential of using zombie epidemic as an effective teaching tool for modelling infectious diseases as students may already have an intuitive sense of how the disease spread or can gain familiarity over a film. In her study, she incorporated zombie epidemics into a workshop for a group of public health professionals. A three-category "SZR" model was employed, where the population is divided into susceptible (S), zombie (Z), or removed (R) groups before building up to more complicated models. The models use difference-equations to represent the relationships between the categories. These equations were then written into Python and R codes and provided to students as part of the hands-on implementation segment.

Drawing inspiration from popular media such as the 2016 Korean horror film "Train to Busan" (Yeon, S., 2016) and the study by Lofgren et al (2016), a fictitious scenario 1 was posed to the students (Figure 2).

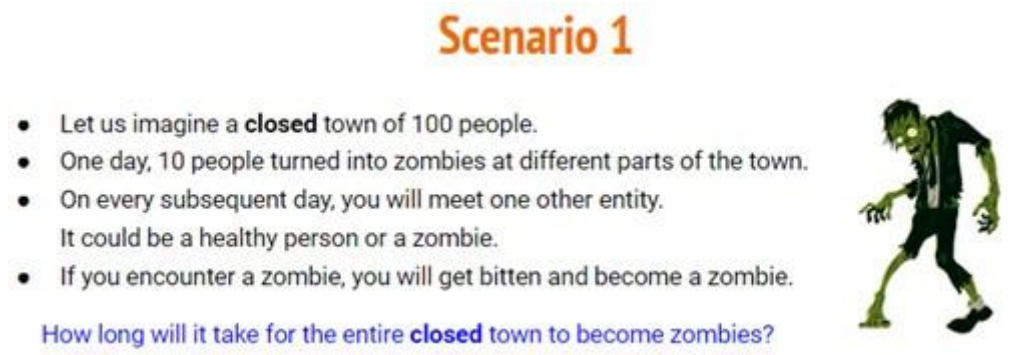

Figure 2: A Simple Zombie Scenario Was Posed

Instead of diving into and discussing a three-category "SZR" model as a start, a simpler Susceptible-Infected (SI) model was adopted as we found that it is easier to consider fewer categories of entities in teaching spreadsheet skills in the later segment of the lesson. In the SI model, students could naturally identify and describe the two primary entities that would exist: the susceptible (S) are healthy individuals who are yet to be bitten and infected but who can be, and the infected (I) are zombies who can bite others and spread the infection.

After understanding the problem, students were guided to simplify the problem by exploring possible model assumptions. A series of carefully framed questions, designed with deliberate word choices, were posed to guide students through the inquiry process (Table 1). These questions were helpful in facilitating them to reason and construct appropriate model assumptions.

Table 1: Some Examples of the Carefully Framed Questions Posed to Students

Examples of Questions	**Assumption**
Let us imagine a **closed** town of 100 individuals and 10 individuals turned into zombies. What does "closed" suggest to us about the population?	A constant population size.
If a susceptible meets a zombie, they will **definitely** be bitten and become a zombie. What does this suggest to us about the chances of being infected once we meet a zombie?	Chance of getting infected by a zombie upon contact is 1.

To support students in grasping the mathematical reasoning behind SI model, students were tasked to determine the number of days required for the entire town to become zombies through a pen-and-paper exercise. In the SI model, the pen-and-paper-exercise consists of five columns (Figure 3). The unit for time t is 'Day'.

- Day – day of infection
- S(t) - number of healthy people who can be bitten and thus infected at time t
- I(t) - total number of zombies who can bite others and spread the disease by time t
- I_new(t) – a helper variable created to track the number of newly formed zombies at time t
- Total – total number of entities in the closed town

Students explore how the ratio of zombies to the total population affects the chances of a healthy person meeting a zombie each day, in turn affecting the number of newly formed zombies.

Day	S	I_new	I	Total
1	100 - 10 = 90	0	10	90 + 10 = 100
2	90 - 9 = 81	$\frac{10}{100} \times 90 = 9$	10 + 9 = 19	81 + 19 = 100

Figure 3: Students Complete the Pen-and-Paper Exercise Manually

The pen-and-paper exercise serves as a scaffolding technique to help students work through the mathematical reasoning behind the SI model by internalising how the categories change every subsequent day using simple mathematical terms (Figure 4). Instructors could guide students through working the first 3 days and leave computations for the rest of the days to the students.

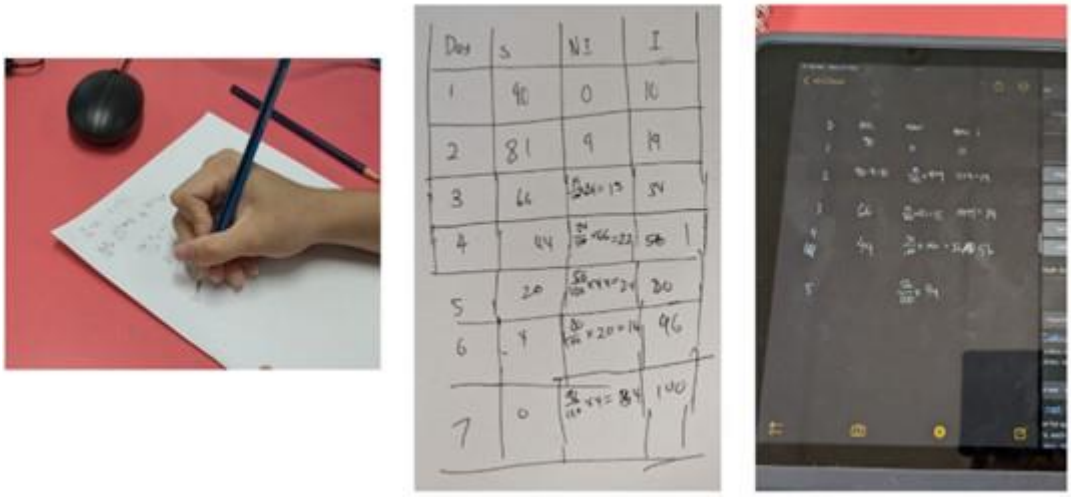

Figure 4: Some Examples of Students' Pen-and-Paper Exercise

After scenario 1, instructors can adjust the context such as exploring different population sizes or possibilities of a healthy person escaping from a zombie upon contact. The latter would influence the probability of infection upon contact with a zombie, in turn affecting transmission rate. Students are encouraged to explore how the change in context may affect the spread of disease. This is when a spreadsheet tool can feature as a more efficient apparatus to solve the problem. In Singapore, the majority of secondary and pre-tertiary students are not formally equipped with programming knowledge as computing is not a mandatory subject in the curriculum. Instead of introducing programming tools like Python or R (Lofgren et al., 2016), which presents an additional steep learning curve, students learn to appreciate the use of accessible spreadsheet tools like Microsoft Excel in building a model from scratch and implement recursions.

Microsoft Excel is introduced to handle tedious computations and model the pen-and-paper exercise. Two parameters are introduced for cell-referencing – 'N' which represents the population size and "b" which represents how likely a susceptible would get infected upon meeting a zombie. In Scenario 1, if a susceptible encounters a zombie, he will definitely get bitten and become a zombie as seen on Figure 2, hence "b" is given the value 1 (Figure 5). During this transition, students learn to input data into cells, use arithmetic operators (+, -, *, /) and automate calculations by cell-referencing ($).

	A	B	C	D	E	F	G	H
1	**Day**	**S**	**I_new**	**I**	**Total**		**Population Size (N)**	100
2	1	90	0	10	100		**b**	1
3	2	=D2/$H$1*B2*$H$2			100			
4	3							

Figure 5: Students Model the Pen-and-Paper Exercise on Spreadsheet Software

Students also explore basic data visualisation by plotting simple charts (Figure 6) to visualise and interpret the infection curve. Using a spreadsheet, students can imagine different contexts and evaluate how it affects the spread of disease in real-time.

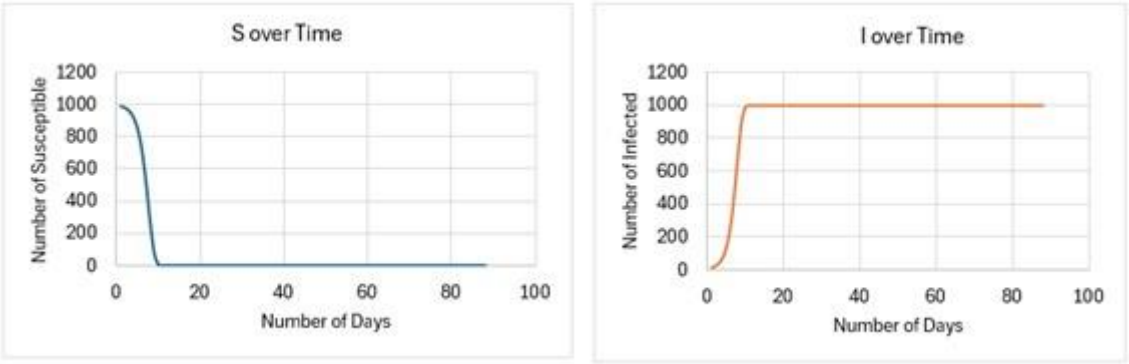

Figure 6: Examples of Simple Solid-Line Scatterplots Plotted to Visualise the Categories

3. A More Realistic Model: Susceptible – Infected – Recovered

After introducing the fictional scenario and SI model, the lesson transitions to a real-world problem with COVID-19 pandemic as a case study, reflecting a more realistic model with the inclusion of a third category – the recovered. The recovered (R) represents the number of people who has recovered or acquired immunity or died from the disease. With students having already gained a foundational understanding of navigating Microsoft Excel, this transition becomes less daunting and more intuitive as students extend their knowledge from the SI model.

The Susceptible-Infected-Recovered (SIR) model introduces a new parameter, k, representing the recovery rate, which depends on the number of days required for recovery. On average, if an infected takes ten days to recover from the disease, the recovery rate (k) would be 0.10. Instead of presenting the parameter through formal definition, we found that the provision of scenarios that allow students to visualise and internalise what the parameter represents helps them foster a deeper understanding of the problem. With this model, students iterate the modelling process by updating and contextualising the assumptions for SIR model, incorporating "Recovered" category and "R_new" helper variable into their spreadsheet, and revise their Excel formulas based on the mathematical reasoning behind how an infected (I) would transition to being recovered (R).

Lastly, the lesson concludes with discussing the significance of basic reproduction number (R_o). Students are encouraged to visualise the three categories and investigate how different public health interventions, such as enforcement of mask-wearing and lockdowns, may affect the peak of infection. By adjusting the values of "b" and "k", thereby changing the basic reproduction number, students are encouraged to discuss and share their insights on how interventions such as mask-wearing and lockdowns affect the disease dynamic (Figure 7).

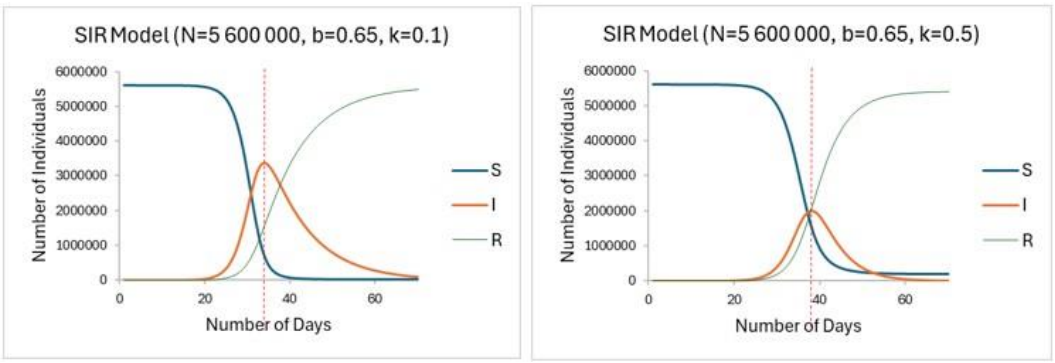

Figure 7: Examples of How the SIR Curves Change With Different Parameter Values of k

Students are also encouraged to compare their model with real world data from trusted government sources. For instance, students could discuss the implications of the infection peak exceeding the number of intensive care unit (ICU) beds available in their country's healthcare system. A mini discussion helps them to appreciate the significance of "flattening the curve", which is a common buzz phrase during the COVID-19 pandemic.

Data Collection and Outcomes

In 2024, 39 secondary 3 (Grade 9 equivalent) students and 20 pre-tertiary (Grade 11 equivalent) students attended the "Modelling an Epidemic" lesson on two separate occasions. Both groups of students are of mixed abilities and learnt to use Microsoft Excel.

A. Pre-Post Quiz Performance

Four learning outcomes were designed to evaluate if the students could grasp the etymology of common epidemiological terms and demonstrate some level of mathematical reasoning. To evaluate the effectiveness of the lesson in achieving these learning outcomes, a pre- and post-quiz was implemented. 37 Grade 9 and 20 Grade 11 responses were collected.

Learning Outcome 1: Distinguish the terms (i) outbreak, (ii) epidemic and (iii) pandemic

2 items were designed for students to identify if the real-world scenario posed should be categorised as an outbreak, epidemic, or pandemic. For both groups, the percentage of students getting a full score of 2 improved post-quiz (Figure 8).

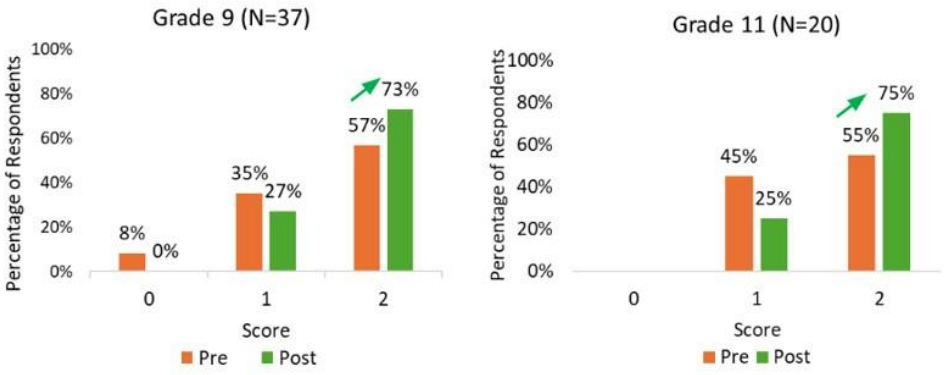

Figure 8: Positive Improvement Observed for Learning Outcome 1

Learning Outcome 2: Identify some assumptions of SI/SIR Model

When we transitioned from SI to SIR model, students were expected to be able to identify the foundational assumptions applicable to SIR model. For both groups, the percentage of students able to identify the assumptions of SIR model accurately improved post-quiz (Figure 9).

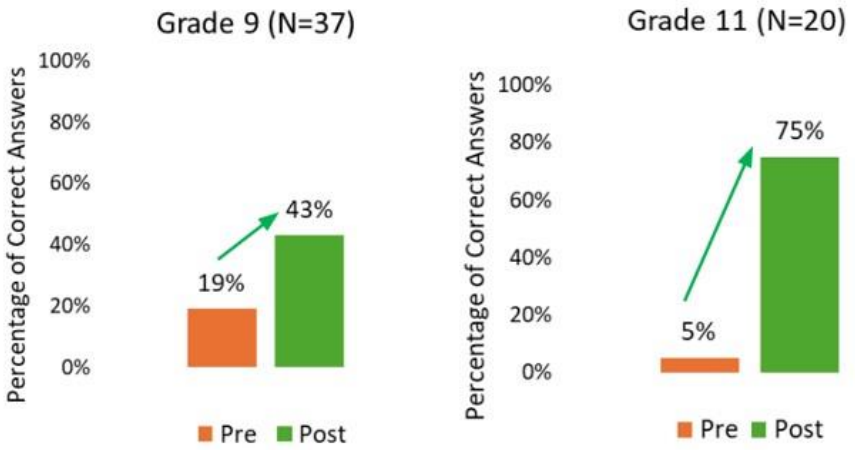

Figure 9: Positive Improvement Observed for Learning Outcome 2

Learning Outcome 3: Recognise and represent the relationships of categories by finding a mathematical expression for the nth day

With all variables defined on day 1, students were required to express the newly infected individuals on the next day (i.e. day 2) using a mathematical expression. Students were expected to be able to represent the relationships of SIR categories using a mathematical expression. For both groups, the percentage of students expressing a correct mathematical equation improved for post-quiz (Figure 10).

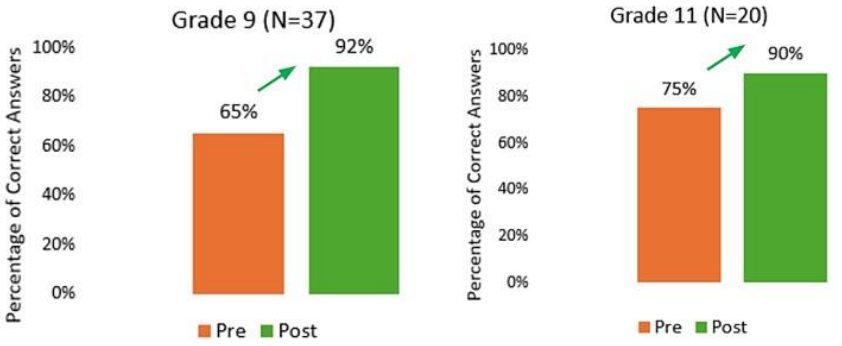

Figure 10: Positive Improvement Observed for Learning Outcome 3

Learning Outcome 4: Describe how parameters of SIR model would be affected based on real world interventions

Given a few real-world interventions, students were expected to predict how the parameters of SIR model ('b' and 'k') would be affected. For pre-quiz, no Grade 11 students were able to attempt the question correctly. After the lesson, 50% of the students attained a score of at least 2 out of 3 (Figure 11).

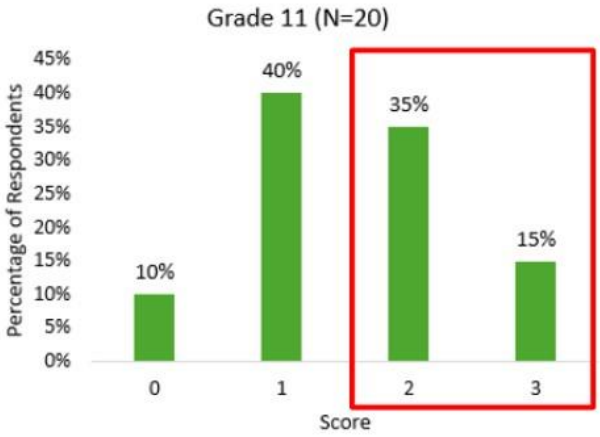

Figure 11: Positive Improvement Observed for Learning Outcome 4

B. Feedback on General Learning Experience

To understand the general learning experience of the students, a feedback form was designed and distributed via Googles Forms after the post-quiz was implemented. The attempt is optional. 19 Grade 9 and 20 Grade 11 responses were collected.

Pertaining to the clarity of the package, 98% of the students found the lesson well-organised and 95% of the students found the theoretical concepts presented in a clear manner. On the efficacy of the pen-and-paper exercise, 92% of the students found it helpful in understanding the mathematical reasoning behind the zombie model (Figure 12).

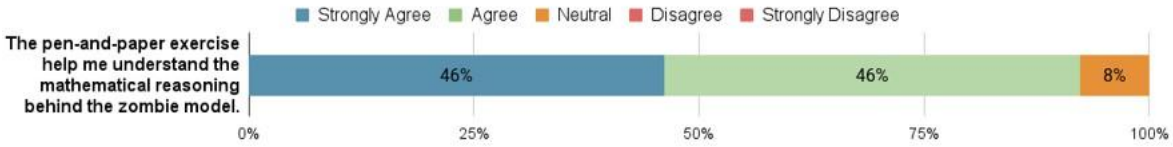

Figure 12: Students Could Understand the Mathematical Reasoning Behind the Zombie Model

On the usefulness of spreadsheet activities, 94% of the students found them helpful in understanding the theoretical concepts (Figure 13) and seeing relevance to the real world (Figure 14).

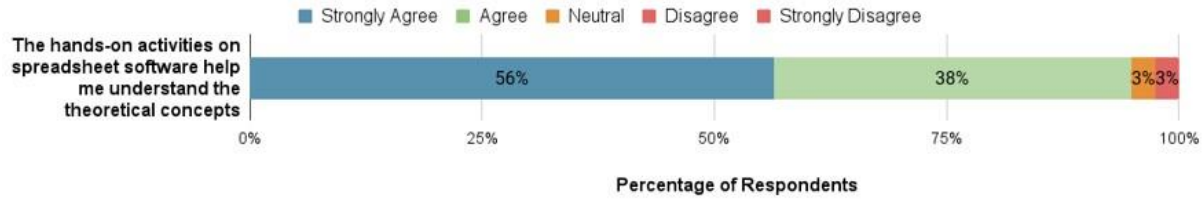

Figure 13: Students Could Understand the Theoretical Concepts

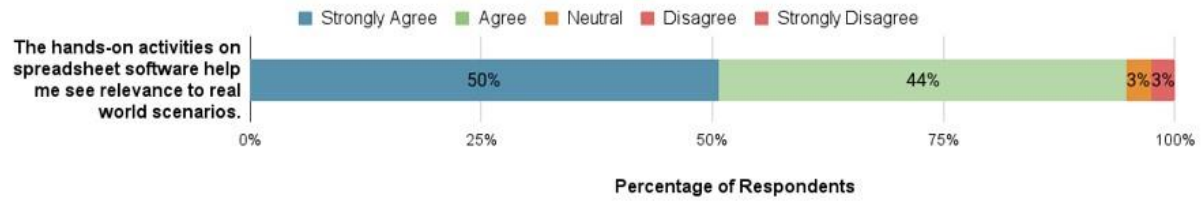

Figure 14: Students Could See Relevance to Real World Scenarios

Overall, in terms of general learning experience, 94% of the students felt engaged in the lesson and were satisfied with the learning experience (Figure 15).

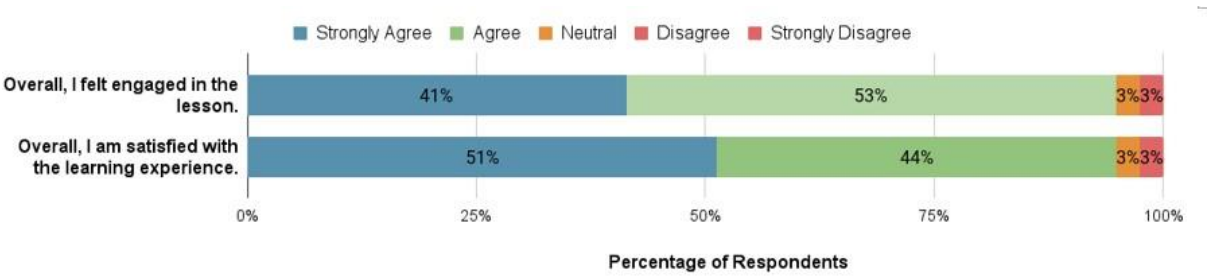

Figure 15: Students Have Positive Feedback on Their General Learning Experience

Lastly, the percentage of students confident in using spreadsheet software to perform basic mathematical calculations increased from 41% to 92% (Figure 16).

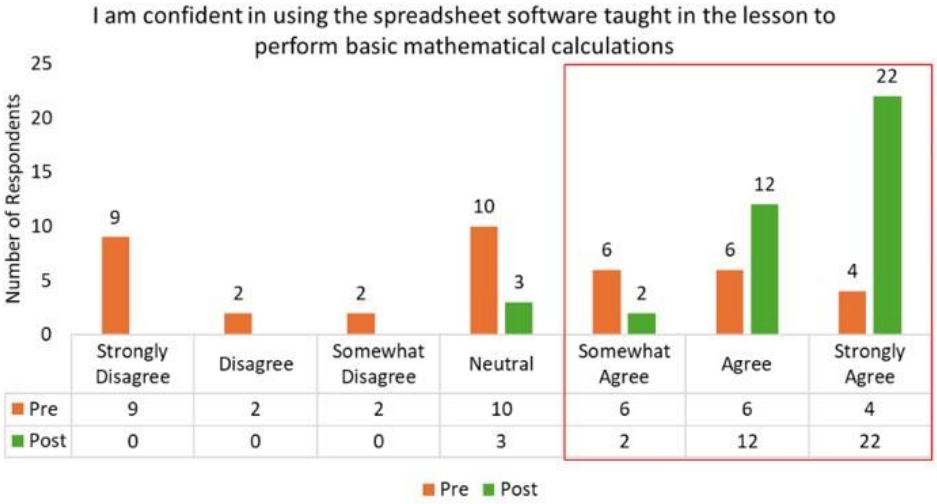

Figure 16: Students Gained Confidence in Using Spreadsheet Software to Perform Basic Mathematical Calculations

Conclusion: Summary & Future Work

The lesson design demonstrated the process of introducing mathematical modelling in a more accessible and intuitive manner for students, in the context of epidemiology. To ensure proper scaffolding towards the Susceptible-Infected-Recovered (SIR) model, a simpler Susceptible-Infected (SI) model was first explored. Instead of diving into differential equations, we introduced parameters that matter and attempt to model the ground situation. We realised that it is helpful to introduce helper variables such as “I_new” and “R_new” to help students work through the mathematical reasoning behind the models.

Despite using a storyline without direct introduction of differential equations, the mathematical reasoning attained eventually maps back to coupled differential equations for SIR model (Figure 17).

$$\frac{dS}{dt} = \frac{-\beta SI}{N} \qquad \frac{dI}{dt} = \frac{\beta SI}{N} - kI \qquad \frac{dR}{dt} = kI$$

C3 =D2/$J$1*B2*$J$2

	A	B	C	D	E	F	G	H	I	J
1	Day	S	I_new	I	R_new	R	Total		Population Size (N)	100
2	1	90	0	10	0	0	100		b	1
3	2	81	9	18	1	1	100			
4	3	66	15	31	2	3	100		Number of days required for recovery	10
5	4	46	20	48	3	6	100		Recovery rate, k	0.1

Figure 17: The Spreadsheet Formula Map Back to the Coupled Differential Equations for SIR Model

There is potential of using the same lesson design and narrative to introduce students to other epidemic models, such as the Susceptible-Exposed-Infected-Recovered (SEIR) by incorporating a scenario where a susceptible may be bitten but have a latent period before he turns into a zombie. This allows for a further extension of knowledge.

Given the interdisciplinary nature of this lesson, there is an initiative to adapt the lesson design into an e-learning package on Singapore Student Learning Space (SLS) (2024). This space acts as a national online learning platform that allows students to access curriculum-aligned resources, engaging lessons, and collaborative tools. With the lesson incorporated into this space, this will allow teachers to access and implement it as a teaching resource, while students can use it for self-directed learning.

Once the lesson package is made available, steps can be taken to collect feedback from a broader range of schools to evaluate its effectiveness as a lesson package. This feedback will be instrumental in refining the lesson design, ensuring that the concepts are more accessible and engaging for students. Also, it allows us to assess how can we promote transfer of learning through mathematical modelling.

Acknowledgements

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Contact emails: scilky@nus.edu.sg
ngmt@nus.edu.sg

Development of Augmented Reality on Mathematics for Grade 2 Students at Zigong Vocational and Technical School in China

Lai Yuhong, Rajamangala University of Technology Thanyaburi, Thailand
Mathuros Panmuang, Rajamangala University of Technology Thanyaburi, Thailand

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Abstract
This study explored the effectiveness of Augmented Reality (AR) technology in enhancing mathematics education, focusing on four topics: Geometry, Analytic Geometry and Functions, Calculus, and Algebra. The objectives were to develop AR-based learning materials, evaluate their impact on student achievement, and assess student satisfaction. The study involved the creation of interactive AR applications with 3D models and dynamic simulations to simplify abstract mathematical concepts. Research instruments included a 50-item pre-test and post-test, an AR media quality evaluation form, and a satisfaction questionnaire, validated by nine experts in content, media, and measurement. The AR applications were tested on 30 students, and their learning outcomes were analyzed using paired-sample t-tests. Results showed a statistically significant improvement in student performance, with mean scores increasing from 24.43 in the pre-test to 33.33 in the post-test ($p < .001$). The satisfaction survey revealed that the overall approval was at a "Very good" level (mean = 4.49, S.D. = 0.51), with students particularly appreciating the clarity, interactivity, and user-friendly design of the AR materials. The applications effectively improved spatial reasoning, comprehension of mathematical relationships, and problem-solving skills. This study concludes that AR significantly enhances learning outcomes and student engagement, addressing challenges in traditional teaching methods. These findings support the broader integration of AR into mathematics education to improve comprehension, motivation, and academic performance. Future research should focus on expanding AR applications across diverse educational levels and subjects.

Keywords: Learning Achievement, AR, Augmented Reality, Mathematics, 3D Model

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Introduction

The 21st century marks a transformative era in education, driven by the rapid evolution of digital technology and innovative teaching tools (Li & Zhou, 2023). Despite these advancements, traditional methods of teaching mathematics still present significant challenges. Many students struggle with abstract concepts, such as geometry and algebra, due to the limitations of conventional teaching tools that rely heavily on static images and textual explanations. This often results in low engagement, reduced motivation, and gaps in conceptual understanding, particularly for complex topics requiring spatial reasoning. The lack of interactivity and real-world application further exacerbates these challenges, leaving educators seeking alternative approaches to enhance learning outcomes.

In response to these challenges, augmented reality (AR) has emerged as a promising educational technology, offering immersive and interactive experiences that bridge the gap between theoretical concepts and practical understanding (Ren et al., 2023). AR enables students to visualize mathematical problems in three dimensions, making abstract concepts tangible and easier to comprehend. Furthermore, AR integrates seamlessly with diverse learning platforms, including smartphone applications and traditional print materials, thus enhancing accessibility and reducing costs (Wang, 2021). By incorporating 3D models and interactive simulations through tools such as 3ds Max, Unity 3D, and Vuforia, AR fosters a dynamic learning environment where students can actively engage with mathematical content and develop problem-solving skills in an intuitive manner (Liang, 2023).

Recognizing the potential of AR to transform mathematics education, this study focuses on addressing the challenges faced by students at Zigong Vocational and Technical School in China. The integration of AR technology into the mathematics curriculum is intended to not only improve students' engagement and comprehension but also to provide a more personalized and innovative learning experience. This research aims to explore the effectiveness of AR by comparing students' performance through pre-test and post-test evaluations and analyzing their satisfaction with this technology. By tackling the limitations of traditional teaching methods and leveraging the advantages of AR, this study seeks to contribute to the development of more effective and engaging educational practices, particularly in mathematics.

Literature Review

Augmented Reality (AR) in Education

Augmented Reality (AR) has become a pivotal tool in modern education, offering immersive and interactive learning experiences that bridge the gap between theoretical concepts and practical understanding. By overlaying digital information onto the real world, AR enhances student engagement and facilitates deeper comprehension across various subjects. Recent studies have demonstrated that AR can significantly improve learning outcomes by providing contextualized and experiential learning opportunities. For instance, a systematic review by Tene and colleagues (2024) synthesized current knowledge on integrating immersive technologies, including AR, in STEM education, highlighting their positive impact on student performance and engagement.

In China, the adoption of AR in educational settings has been gaining momentum. Li and Zhou (2023) explored the deep integration of information technology and regional teaching

in high school mathematics, emphasizing the role of AR in innovating teaching methods and enhancing student understanding. Similarly, Ren and colleagues (2023) investigated experiential teaching modes based on AR resources in solid geometry, finding that AR facilitated intuitive learning and improved spatial reasoning skills among students.

Internationally, the application of AR in education has been extensively studied. A study by Bacca and colleagues (2014) conducted a systematic review of AR trends in education, identifying its benefits in increasing motivation and facilitating learning. Additionally, Akçayır and colleagues (2016) examined AR in education, discussing current technologies and potential educational benefits.

AR in Mathematics Education

The integration of AR into mathematics education has shown promising results in addressing challenges associated with abstract concepts and student engagement. AR enables the visualization of complex mathematical ideas, making them more accessible and comprehensible. In China, Liang (2023) explored the application of AR technology in primary school teaching scenarios, demonstrating how AR can innovate classroom teaching models and empower smart classrooms.

Globally, AR has been utilized to enhance mathematics instruction. For example, a study by Dunleavy and colleagues (2009) investigated the impact of AR on student engagement and learning outcomes in mathematics, finding that AR activities increased student motivation and understanding of mathematical concepts. Similarly, Cai and colleagues (2019) examined the effects of AR-based learning environments on students' mathematical performance, reporting significant improvements in problem-solving skills and conceptual understanding.

Learning Outcomes and Student Achievement

The implementation of AR in educational contexts has been associated with improved learning outcomes and student achievement. AR provides interactive and engaging learning experiences that cater to diverse learning styles, thereby enhancing knowledge retention and application. In China, Wang (2021) conducted research on the design, development, and application of middle school mathematics teaching resources based on AR, highlighting its effectiveness in improving student performance and satisfaction.

International studies have also reported positive impacts of AR on learning outcomes. For instance, a study by Garzón and Acevedo (2019) conducted a meta-analysis of the impact of AR on students' learning gains, concluding that AR has a significant positive effect on learning outcomes across various educational levels and subjects. Additionally, Radu (2014) reviewed the effects of AR on learning performance, noting that AR applications can lead to increased motivation, improved spatial abilities, and enhanced collaboration among students.

In summary, both Chinese and international research underscore the potential of AR to transform education by enhancing engagement, facilitating understanding of complex concepts, and improving overall learning outcomes. The integration of AR into mathematics education offers promising avenues for addressing traditional learning challenges and fostering a more interactive and effective learning environment.

Methodology

Development of AR Content

The study involved the development of Augmented Reality (AR) content specifically designed to enhance learning in four key mathematical areas: Geometry, Analytic Geometry and Functions, Calculus, and Algebra. Each topic was carefully developed to include 3D models, interactive visualizations, and simulations aimed at improving students' comprehension of abstract mathematical concepts.

Development of Research Instruments

Three primary research instruments were developed for this study.

(1) Pre-test and Post-test Assessment
A 50-item test was designed to measure students' knowledge and learning outcomes before and after using AR. The test items were aligned with the mathematical concepts covered by the AR content.

(2) Evaluation of AR Media Quality
A structured evaluation form was developed to assess the quality of the AR content, including its usability, alignment with learning objectives, and effectiveness in promoting engagement and understanding.

(3) Satisfaction Survey
A questionnaire was designed to gauge students' satisfaction after using the AR-based learning materials. The questionnaire employed a 5-point Likert scale to measure various aspects of user experience.

To ensure the validity and reliability of these research instruments, they were reviewed and evaluated by a panel of nine experts comprising, Content Experts (3), to verify the accuracy and relevance of the AR content to the curriculum. Media Experts (3), to assess the technical quality and usability of the AR applications. Measurement and Evaluation Experts (3), to evaluate the appropriateness and clarity of the test items and survey questions.

The experts assessed the instruments based on their alignment with the learning objectives and their capacity to measure the intended outcomes. Revisions were made based on expert feedback before implementing the instruments in the study.

Data Collection

The study was conducted with a sample group of 30 students from Zigong Vocational and Technical School. The AR content was implemented as part of their mathematics curriculum. The data collection process involved the following steps:

(1) Pre-test Administration
Students completed a pre-test to assess their initial knowledge and understanding of the mathematical topics before using the AR-based content.

(2) Implementation of AR Content
Students engaged with the AR materials over a specified period, during which they explored and interacted with the AR applications for the four topics.

(3) Post-test Administration
After completing the AR-based lessons, students took a post-test identical to the pre-test.

(4) Satisfaction Survey
Students completed a satisfaction questionnaire to provide feedback on their experience with the AR materials.

Data Analysis

The data collected from the pre-test and post-test assessments were analyzed using a paired-sample t-test to compare the mean scores and determine the effectiveness of the AR-based learning materials in improving students' academic performance. Additionally, descriptive statistics (mean and standard deviation) were used to analyze students' responses to the satisfaction survey, providing insights into their perceptions and experiences with the AR technology.

Result

Development of AR Technology

The developed AR applications provided interactive and engaging content for four key mathematical topics: Geometry, Analytic Geometry and Functions, Calculus, and Algebra. Each topic featured dynamic 3D models and interactive simulations tailored to enhance student comprehension. The AR interfaces were designed to be user-friendly, offering clear navigation menus and intuitive controls for effective learning experiences. These applications demonstrated the capability of AR to transform abstract mathematical concepts into tangible learning materials, fostering deeper understanding and engagement. As shown in Figure 1:

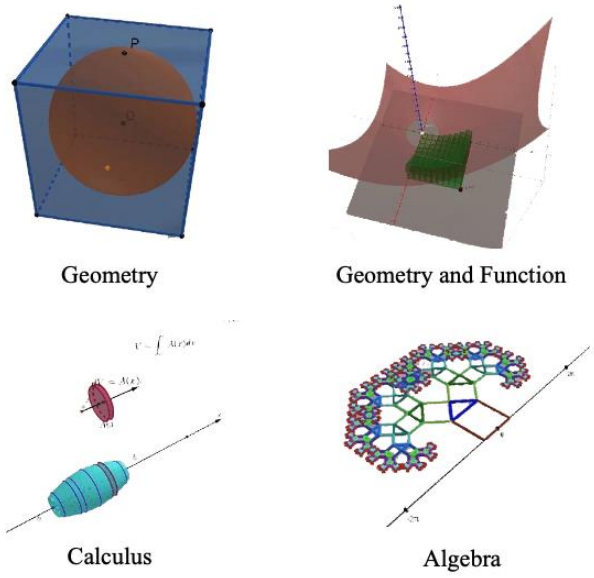

Figure 1: Example of AR Program

Comparative Analysis of Academic Performance

The effectiveness of AR in enhancing student achievement was evaluated by comparing pre-test and post-test results. The findings are summarized in Table 1:

Table 1: Comparison of Academic Performance Before and After Using AR

Test	n	Mean	S.D.	t-test	Sig. (2-tailed)
Pre-test	30	24.43	7.77	10.106	0.000**
Post-test	30	33.33	6.44		

**Statistical Significance at the .001 Level

The analysis revealed a statistically significant improvement in academic performance after students engaged with the AR materials ($p < 0.01$). The mean score increased from 24.43 in the pre-test to 33.33 in the post-test, with a t-test value of 10.106. This indicates that the use of AR technology substantially enhanced students' understanding and mastery of mathematical concepts.

Student Satisfaction With AR Learning

Student satisfaction was assessed using a structured questionnaire. Table 2 presents the results:

Table 2: Results of Analysis of Learner Satisfaction After Using AR

Statement	Mean	S.D.	Result Interpretation
1. The content of this course meets the purpose of AR learning	4.43	.50	Good
2. In line with the AR mathematics teaching theme content, the content is clear and correct.	4.56	.50	Very good
3. Use the language teaching correctly, use the appropriate language description.	4.40	.49	Good
4. The content structure is comprehensive, the original knowledge and the new knowledge link.	4.50	.50	Good
5. Difficulty teaching reasonable students can understand	4.20	.54	Good
6. Curriculum flexibility can meet the differences of students	4.33	.57	Good
7. AR teaching is easy to understand, and the graphic fonts are appropriate.	4.66	.47	Very good
8. The AR program is clear in use and simple in content expression.	4.80	.40	Very good
9. The teaching sound is appropriate.	4.53	.57	Very good
10. Course controls are easy to use and clearly described.	4.56	.50	Very good
11. The interaction with the students is reasonable and comfortable.	4.33	.54	Good
12. The graphics look and comfortable to use.	4.63	.49	Very good

The overall mean satisfaction score was 4.49 (S.D. = 0.51), interpreted as “Very good.” Students highly appreciated the clarity, usability, and aesthetic design of the AR materials. Specific aspects such as content alignment with learning objectives and ease of understanding received particularly high scores.

Discussion

The findings of this study highlight the effectiveness of Augmented Reality (AR) technology in enhancing students' learning outcomes and satisfaction in mathematics education. The results demonstrate a statistically significant improvement in students' academic performance after using AR-based learning materials ($p<.001$). This aligns with prior research that emphasizes the potential of AR to simplify abstract mathematical concepts and promote deeper understanding through interactive and immersive experiences (Ren et al., 2023).

Academic Performance Improvement

The significant increase in post-test scores indicates that AR effectively facilitates students’ comprehension of complex mathematical topics, such as geometry, analytic geometry, calculus, and algebra. Previous studies have shown similar outcomes, where AR-enabled visualization and interaction improve problem-solving skills and conceptual understanding (Cai et al., 2019). Moreover, AR’s ability to provide real-time feedback and adaptive learning paths likely contributed to the observed improvements, as suggested by Wang (2021), who reported AR's effectiveness in tailoring learning to individual needs.

Student Satisfaction

The high level of satisfaction reported by students underscores the usability and engaging nature of AR materials. Key elements, such as clear content structure, interactive 3D models, and aesthetic graphics, were particularly well-received. This supports findings by Liang (2023), who noted that AR fosters positive attitudes toward learning by making abstract concepts more tangible and relatable. Additionally, the flexibility of AR to accommodate diverse learning styles likely enhanced student engagement, as observed in other studies (Garzón & Acevedo, 2019).

Alignment With Global Research

These results are consistent with global findings that emphasize the transformative potential of AR in education. For example, a meta-analysis by Garzón and Acevedo (2019) concluded that AR significantly enhances learning outcomes across various disciplines, particularly STEM fields. Similarly, research in South Korea highlighted the role of AR in reducing math anxiety by creating a non-threatening and interactive learning environment (Kim & Song, 2019).

Implications and Challenges

The findings suggest that integrating AR into mathematics curricula can address common challenges associated with traditional teaching methods, such as limited engagement and difficulty in understanding abstract concepts. However, implementing AR on a larger scale may require addressing challenges such as high development costs, the need for teacher training, and ensuring technological compatibility (Liang, 2023). Future studies could explore

strategies for overcoming these barriers to maximize the potential of AR in diverse educational contexts.

Conclusion

This study evaluated the effectiveness of Augmented Reality (AR) technology in enhancing mathematics education, focusing on four topics: Geometry, Analytic Geometry and Functions, Calculus, and Algebra. The developed AR applications featured interactive 3D models, dynamic visualizations, and user-friendly interfaces designed to make abstract concepts more accessible. Results indicated a statistically significant improvement in students' academic performance, with average scores increasing from 24.43 in the pre-test to 33.33 in the post-test ($p<.001$). Additionally, the student satisfaction survey revealed a high overall score of 4.22 (S.D.=0.51), with users particularly appreciating the clarity, interactivity, and aesthetic quality of the AR materials. Geometry applications improved spatial reasoning, while analytic geometry tools helped students better understand mathematical relationships. Calculus topics, including limits and derivatives, were simplified through interactive simulations, and algebra lessons enhanced problem-solving skills. The study concludes that AR is an effective tool for improving learning outcomes and engagement in mathematics, offering a promising solution to the challenges of traditional teaching methods. These findings support the integration of AR into educational practices to enhance comprehension, engagement, and overall student achievement.

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Contact emails: yuhong_l@mail.rmutt.ac.th
mathuros_p@rmutt.ac.th

A Conceptual Framework for Self-Regulated Learning and Assessment in Pre-service Teacher Education

Apichaya Khwankaew, King Mongkut's Institute of Technology Ladkrabang, Thailand
Jirarat Sitthiworachart, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
Learning Analytics (LA) is a growing trend used to understand how students manage their learning with self-regulation to achieve learning objectives by combining their aptitude with classroom engagement. These involve collecting, analyzing, and reporting student data to optimize learning processes and achievement. By leveraging student data, LA empowers higher education to enhance teaching effectiveness, personalize learning experiences, and address educational challenges. This study investigates the role of LA in supporting Self-Regulated Learning (SRL) among undergraduate pre-service teachers. By analyzing online trace data, we aimed to identify indicators of effective SRL strategies and develop a conceptual framework for assessing SRL. Our systematic review of literature from 2013 to 2023 examined existing research on LA and SRL in higher education. Results indicate that LA can provide valuable insights into students' learning behaviors, enabling the identification of distinct learner profiles. By prioritizing educational measurements aligned with specific SRL stages, we propose to enhance teaching and learning practices for pre-service teachers.

Keywords: Self-Regulated Learning, Learning Analytics, Systematic Literature Review

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Introduction

Education highlights the need for innovative strategies to equip pre-service teachers with the necessary skills to foster effective learning environments. Self-regulated learning (SRL) is a critical competency in this attempt, enabling individuals to take charge of their educational processes by setting goals, monitoring progress, and reflecting on outcomes (Winne, 2005; Zimmerman, 2002). For pre-service teachers, mastery of SRL is vital for their academic success, as well as modeling and instilling these practices in their future learners. (Michalsky & Schechter, 2013). Learning analytics (LA) has emerged as a transformative tool in higher education, offering insights into student behaviors and learning patterns through the analysis of digital trace data (Clark & Tuffley, 2024). By leveraging these insights, educators can better understand how pre-service teachers engage with learning tasks, identify SRL strategies, and tailor interventions to support their development (Leitner et al., 2017). Recent studies have emphasized the potential of LA to reveal patterns in planning, monitoring, and reflection as the key components of SRL to enable targeted support for learners (Kleimola et al., 2024).

LA examines the temporal aspects of learning and offers valuable insights into constructs. It presents unique possibilities for connecting theory and practice. Researchers can identify strategies for effective SRL by analyzing how pre-service teachers engage with online learning platforms, submit assignments, and participate in discussions. However, there are challenges in implementing LA effectively. These include the need for frameworks that solve LA findings into actionable interventions, such as personalized feedback or adaptive learning resources efforts to align LA with the phase of SRL (Saint et al., 2020).

This study explores the role of LA in enhancing SRL among pre-service teachers to examining the indicators as the strategies in engagement and self-regulation, it seeks to develop a conceptual framework for assessing and fostering SRL in pre-service teachers. The findings aim to inform strategies for embedding SRL principles into pre-service teachers' preparation, ultimately contributing to the professional growth of educators and the success of their future students.

Self-Regulated Learning in Pre-service Teacher

Self-regulation is a crucial self-directed process that enables learners to transform their mental strengths into concrete academic performance with effort. Self-regulation includes thoughts, feelings, and individual actions, all aimed at reaching significant goals, which empowers students to take charge of their own (Winne, 2005; Zimmerman, 2002). The structure of self-regulatory processes can be comprehended through three cyclical phases. The forethought phase involves the task analysis and beliefs that occur before learning. The performance phase consists of the processes during the implementation, while the self-reflection phase encompasses the processes that occur after learning (Zimmerman, 2000; Zimmerman, 2002).

Another perspective, in self-regulated learning processes, learner efforts to monitor and control individual aspects of learning throughout four phases: defining tasks, setting goals and plans, using strategies and tactics, and making adaptations (Matcha et al., 2020; Winne, 2005). *Defining task***,** the initial phase involves learners understanding the task directions and available resources. *Goals and plans,* setting clear goals and engaging in thoughtful strategic planning to achieve the lesson is essential. *Studying tactics,* learners enact various strategies to

process and transform information, which they should be able to recall during class. *Adaptations,* the final phase involves long-term changes of learners based on the results of their efforts.

In context of examining the literature and related works on Winne-Hadwin, comparing it with Zimmerman's model to identify indicators (strategies) and approaches for evaluating pre-service teachers. This investigation aims to study effective strategies to encourage their development. Additionally, we explore the application of LA to analyze the behavior of pre-service teachers. To continue on this point, we focus on the following three research question:

1. What are the models on Self-Regulated Learning in Pre-Service Teachers?
2. What are the Learning Analytics trends on Self-Regulated Learning in Pre-Service Teachers?
3. What are the indicators (Strategies) of Self-Regulated Learning in Pre-Service Teachers?

Methodology

We used the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology, which was proposed by (Page et al., 2021) to conduct this systematic review. To investigate the findings, we searched related articles from these databases: Science Direct, Google Scholar, JSTOR, IEEE Xplore, ACM, and Springer, which are recognized as significant reliable sources of publications in various areas, including, educational technology.

Identification of Search Terms

Based on the literature and our expertise, we did not include articles that mentioned other SRL model except Zimmerman and Winne-Hadwin that related with LA and pre-service teacher. Moreover, we also excluded the terms In-Service Teacher or Post-Service Teacher, since they have already learned and gained experience in real classrooms. In contrast to pre-service teachers, who have limited experience. Most of the online searches made use of Boolean operators. To accommodate the databases 'search options, some operators needed to be modified. The general method for locating relevant articles is as follows: ("Self-Regulated Learning" OR "Self-Regulation") AND Assessment AND "Learning Analytics" AND "Conceptual Framework" AND Indicator AND ("Pre-Service Teacher" OR "Preservice Teacher").

The Screening Process

PRISMA procedures are identification, screening, and inclusion. Following three main steps to make the selection – see Figure 1. The screening process involved three procedures: First, remove the duplicated articles. Second, read the titles, keywords, and abstracts to remove the articles according to the inclusion and exclusion criterion - see Table 1. Third, read the full texts to remove the articles that do not conform to inclusion criteria. Data were extracted from the articles that match the criteria. All selected articles were imported into Zotero, which authorized the removal of duplicate entries, filtering the results, and exporting the information to a spreadsheet.

Table 1: Inclusion Exclusion Criterion

Inclusion Criteria (IC)	Exclusion Criteria (EC)
published between January 2013 and December 2023	published before January 2013 and after December 2023
from peer-reviewed journals	from conference proceedings, book chapter, posters
write in English	write in other languages
focus on Pre-Service Teacher	focus on In-Service and Post-Service Teacher
full-text available	not accessible

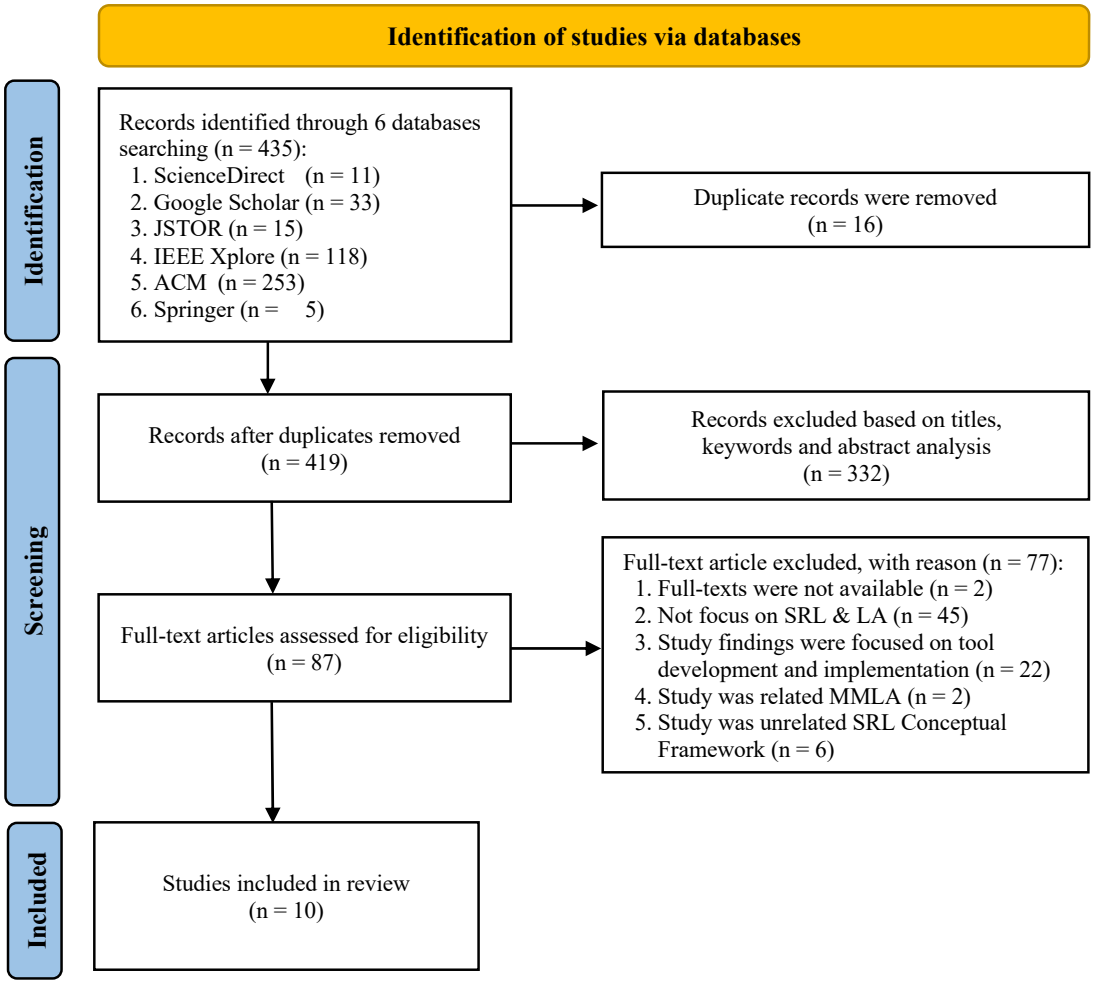

Figure 1: PRISMA Process

Results and Discussion

There were ten included articles. They closely related LA supporting on SRL in pre-service teachers. To address the first question: *What are the models on Self-Regulated Learning in Pre-Service Teachers?* this systematic review attempted to answer. There are five articles were investigated on SRL. Two main articles focused on Winne-Hadwin's SRL model. Saint et al., (2020) mentioned that the Process Mining (PM) algorithm is influenced by Winne-Hadwin and emphasizes conditional probabilities with SRL processes. The process consists of three phases: planning, engagement, and evaluation with reflection. Various evaluation methods, such as active agile, summative approaches, active cohesion, and semi-engagement, have revealed that more successful students consistently engage in more SRL behaviors than their less successful students. The four phases outlined by Winne-Hadwin are: Task

Definition, Goal Setting and Planning, Enactment of Tactics and Strategies, and Adaptation. Various evaluation methods are used, including grading criteria, students' workloads, goals set by students, group progress on tasks, levels of engagement, time spent, and the writing habits of individual students. These methods reflect the impact on both learning and teaching (Matcha et al., 2020).

Lu & Yu (2019) applied Zimmerman's model, which consists of three phases: mForethought, mPerformance, and mReflection. This model has been used in LA to analyze online data, enhancing semantic understanding and metacognitive self-monitoring. LA measures factors such as learning strategies, time and resource management, self-monitoring, and self-confidence. The findings are presented as self-regulation profiles to identify students' strengths and weaknesses, helping in the improvement of learning habits (Liz-Dominguez et al., 2022). Additionally, concerns have been raised about the lack of regulation, particularly related to task avoidance, anxiety, and boredom (Sointu et al., 2022).

Winne-Hadwin and Zimmerman's studies highlight effective indicators and processes for tracking SRL in the classroom through LA data. However, the crucial distinction lies in Winne-Hadwin's adaptation, which plays a necessary role in establishing the application of knowledge for future classroom teaching. It may necessary to present LA as a report of indicators (strategies) to understand the learners and how they affect SRL.

To address the second question: *What are the Learning Analytics trends on Self-Regulated Learning in Pre-Service Teachers?* this systematic review attempted to answer. The studies were categorized into two main types of data for LA. The first type is self-reported data collected through questionnaires, which gather information about learning events (Gewerc et al., 2016; Merikko et al., 2022; Tempelaar et al., 2017). This data provides weakly contextual data that suffers loss and bias due to defects of human memory. On the other hand, the second type is system-reported data, which includes several timestamped traces of learners' activities (Knobbout & Van Der Stappen, 2020; Moreno-Marcos et al., 2020; Tempelaar et al., 2017). This data reflects learners' behaviors and other influencing strategies that may affect SRL.

To address the third question: *What are the indicators (Strategies) of Self-Regulated Learning in Pre-Service Teachers?* – see Table 2. Thirteen specific indicators (strategies) significantly influence SRL.

Table 2: Indicators (Strategies) Self-Regulated Learning

Indicators (Strategies)	Number of studies
Goal setting: (Beatriz Ortega-Ruipérez & Almudena Castellanos-Sánchez, 2023; Huang & Lajoie, 2021; Liz-Dominguez et al., 2022; Saint et al., 2020)	4
Motivational Factors & Orientation: (Gewerc et al., 2016; Liz-Dominguez et al., 2022; Matcha et al., 2020; Sointu et al., 2022)	4
Strategic Planning: (Liz-Dominguez et al., 2022; Saint et al., 2020; Tempelaar et al., 2017)	3
Time Management: (Liz-Dominguez et al., 2022; Matcha et al., 2020; Sointu et al., 2022)	3
Social context: (Gewerc et al., 2016; Liz-Dominguez et al., 2022; Matcha et al., 2020)	3
Self-monitoring: (Huang & Lajoie, 2021; Liz-Dominguez et al., 2022)	2
Reflection: (Huang & Lajoie, 2021; Saint et al., 2020)	2
Transfer: (Huang & Lajoie, 2021; Liz-Dominguez et al., 2022)	2
Choosing informational sources: (Beatriz Ortega-Ruipérez & Almudena Castellanos-Sánchez, 2023; Matcha et al., 2020)	2
Working on a task: (Matcha et al., 2020; Saint et al., 2020)	2
Self-evaluation: (Liz-Dominguez et al., 2022; Saint et al., 2020)	2
Instructional cue: (Liz-Dominguez et al., 2022; Matcha et al., 2020)	2
Acquired (tactic & strategies): (Liz-Dominguez et al., 2022; Matcha et al., 2020)	2

Goal setting is regarded as one of the most important indicators (strategies) influencing SRL. Goals created by students and teachers are defined as specific goals relevant to the task of achieving learning. Another is *motivational factors and orientation*, which reflects establishing and pursuing learning goals to consider the value of tasks. *Strategic planning* also tends to have an impact on SRL, by predicting personal course goal achievements. *Time management* refers to a student's ability to effectively manage and allocate their time, directly impacting their achievement As well as *social context* described involves learners seeking help and information from others.

Moreover, several studies demonstrate that *self-monitoring, reflection, transfer, choosing informational sources, working on a task, self-evaluation, instructional cue, and acquired (tactic & strategies)* are proven to be prominent in affecting SRL. Additionally, some studies suggest more indicators (strategies). They were identified as one of the indicators (strategies) that affect to SRL as follows: task analysis, search, using tools to create and assess task solutions, applying appropriate strategy change, domain knowledge, beliefs, disposition & style, knowledge of study tactic and strategies, primitive, keeping, environmental structuring, rehearsing and memorizing, self-, effort, anxiety.

Conclusion

This systematic literature review has critically reviewed papers related to LA support SRL to enhance pre-service teacher. By reviewing the most recent studies from January 2013 to December 2023, to identify indicators of effective SRL strategies and a conceptual framework for assessing SRL. We proposed some implications related research based on these findings. The framework is based on Winne-Hadwin's model, which emphasizes *Adaptation*, and several indicators (strategies) have been validated in various areas for SRL. Additionally, LA serves as a guideline for us in designing and choosing appropriate algorithms to evaluate and report on student improvement. Moreover, we discovered that the number and quality of studies have been increasing. At the same time, the scope of research

on the framework, measurement, and LA method has been expanding to understand a more particular model of SRL. More research will be required in the future. Although we explored the most well-known scholarly databases for keywords related to LA support SRL for pre-service teachers, some biases may exist in the searching and screening. Exploring additional journals and databases is consequential, as they may contain helpful, relevant studies that could enhance this study. However, the findings from the studies contribute significantly to our understanding of SRL, particularly regarding the indicators (strategies) that support pre-service teacher education.

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Contact email: 66036092@kmitl.ac.th

Development of a Recognizing Digital Skills Model to Promote Community Business Learning and Creative Tourism in the Mekong Riverside Area, Nakhon Phanom Municipality, Thailand

Suwisa Jarutkamolpong, Nakhon Phanom University, Thailand
Kantapop Buathong, Nakhon Phanom University, Thailand
Parama Khangmuang, Khon Kaen University, Thailand
Athirhat NunKuntee, Nakhon Phanom University, Thailand
Kanlaya Mikhama, Nakhon Phanom University, Thailand

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Abstract
Digital literacy and skills development have become essential for life and work in the 21st century. UNESCO's Learning City concept emphasizes creating environments conducive to lifelong learning for all in a community, this study recognizes the importance of digital skills development as a key future skill that needs to be promoted immediately and continuously to enhance the competitiveness and sustainable development of communities in the digital age. The objectives are as follows: 1) Development of a recognizing digital skills Model, 2) evaluate the appropriateness of the developed model, and 3) Investigate the outcomes of recognizing digital skills Model for community business entrepreneurs and creative tourism in the Muang Nakhon Phanom area along the Mekong River. The research methodology consisted of 3 phases: 1) model synthesis through document analysis, 2) model appropriateness assessment by 9 experts, and 3) model application to develop digital skills. The target group consisted of 258 small entrepreneurs from 8 communities in the Mekong River Area, Nakhon Phanom Municipality, selected by purposive sampling. The research instruments were a document synthesis form, a model appropriateness form, and a digital skills assessment form. Data were analyzed using mean and standard deviation. The results found that the digital skills perception model consisted of 4 components: 1) environmental inputs 2) sensory inputs, 3) specialized experience for interpretation, and 4) construing sensory information. Experts assessed the developed model as highly appropriate, and the post-learning digital skills assessment found that 80.58% of the participants scored from basic to advanced levels.

Keywords: Recognizing Digital Skills, Community Business Learning, Creative Tourism, Mekong Riverside Area, Educational Model Development

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Introduction

Digital skills entail an understanding of digital technology that fosters lifelong learning, including the creation of a learning society with information technology. They are essential skills in the 21st century, pivotal to knowledge creation. Digital skills involve the application, design, and creation utilizing the capabilities of information technology to manage data through developed software programs. (Pratolo & Solikhati, 2021). Digital skills encompass explaining access, interpretation, and the design of various forms of content via the Internet. This includes the ability to communicate, utilize data to collaborate, and foster creativity through digital technology (Pegrum et al., 2018). Digital literacy is not just about processing and using information; it's about a person's ability to read and understand content, as well as write or create new knowledge. Digital expertise is divided into three levels: Level 1 refers to knowing the skills, concepts, approaches, and attitudes; Level 2 refers to using professional applications; and Level 3 refers to the ability to transform digital space, develop, and create new things. This can be termed innovation, which can arise from creative individuals. The learning process and the development of digital skills for effective communication with the current target group are crucial. This includes utilizing digital skills to enhance the livelihood of community businesses and reach the target audience through digital platforms, thereby maximizing their benefits. Community business is a concept that emphasizes enabling community members to actively participate in laying the foundation for local economic development. This is achieved through collective participation in groups to create employment opportunities and generate additional income. Beyond its impact on economic development, community businesses also foster the growth of resilient communities by promoting cooperation and shared ownership. By pooling resources and leveraging communal wisdom, these enterprises create added value, thereby enhancing the local economy and laying the groundwork for improved quality of life and well-being at both the familial and community levels. The success, progress, stability, and sustainability of both the business and the community hinge on the strength of this foundation. (Nithichaianan & Chidchob, 2022).

The development of creative tourism is greatly influenced by its alignment with the unique context of a given area, which is crucial for fostering sustainable growth. To achieve this, it is imperative to adhere to correct and appropriate guidelines. This involves a comprehensive analysis of both the internal and external environments related to tourism within communities, highlighting both positive and negative aspects. Internally, attention should be given to identifying strengths (Strengths) and weaknesses (Weaknesses) of the community across various dimensions. These include Structure and policy (S1): Organizational structure, work systems, and internal controls. Service and products (S2): Offerings such as services, business programs, tourism activities, and facilities. Personnel (M1): Management of personnel, including coordination officers, operators, tour guides, and staff. Money (M2): Financial and accounting aspects. Materials and equipment (M3): Resources such as office supplies, technology, and equipment. Externally, it is important to assess opportunities (Opportunities) and threats (Threats), which encompass Customers or service recipients (Customer: C), referring to tourists. Political factors (Political: P), including laws and government policies. Economic and environmental conditions (Economic and Environment: E), such as the economy and supporting agencies, as well as commercial competitors, business partners, and alliances. Social conditions (Social: S), encompassing social situations encountered. Technological factors (Technological: T), focusing on systematic technology.

This comprehensive analysis serves as a guideline for creating creative tourism formats that are in harmony with the area's context, facilitating correct and sustainable development. In summary, this approach yields a creative tourism model comprising four key components: 1) creative communities, 2) creative tourist attractions, 3) creative entrepreneurs, and 4) creative tourists (Juliratchaneekron et al., 2022).

Recognition style, which refers to an individual's distinctive pattern of perceiving, processing, and retaining information, plays a significant role in determining how learners interact with and adapt to new knowledge. According to Luo et al. (2023), recognition style can be categorized into dimensions such as holistic or analytical perception, continuous or discontinuous processing, and visual or verbal memory. These unique cognitive patterns influence the efficiency of learning and problem-solving processes. Tailoring educational interventions to align with recognition styles can stimulate cognitive development, leading to better learning outcomes and more effective problem-solving.

In the context of community businesses and creative tourism in Nakhon Phanom, recognition style can guide the design of learning tools that accommodate diverse cognitive preferences among local learners. Yamamoto et al. (2023) emphasize that recognizing individual differences in sensory modalities such as visual, auditory, or kinesthetic preferences can significantly enhance learning efficiency, particularly in digital environments. This highlights the importance of a personalized approach to skill development to meet the diverse needs of learners in a community setting.

The Mekong Riverside region, with its rich cultural heritage and natural resources, offers a unique opportunity to integrate local knowledge and digital skills into community business development. By fostering recognition skills tailored to the local context, this research aims to develop a Recognizing Digital Skills Model that aligns with the recognition styles of community members. This model will support effective learning, enhance creativity, and promote sustainable development in community businesses and creative tourism.

Given the aforementioned reasons, the researcher aims to develop a learning model aligned with the context and approach necessary for promotion. As such, there is a need to investigate concrete guidelines for fostering digital skills to enhance understanding of community businesses, including creative tourism, particularly in the Nakhon Phanom city area. This region has a policy aimed at advancing community tourism to uplift the grassroots economy. Therefore, the goal is to develop a model for recognizing digital skills that can facilitate learning about community businesses and creative tourism in the Mekong River region of Nakhon Phanom Municipality. The intention is to create new knowledge that can harness the potential of citizens towards a digital society. This involves devising a digital skills recognition model with clear components, steps, and application guidelines. These guidelines will not only benefit other areas or contexts but also ensure efficiency in implementation.

Research Objectives

1. Develop a model for recognizing digital skills to facilitate learning about community businesses and creative tourism in the Nakhon Phanom Municipality area along the Mekong River.
2. Evaluate the suitability and effectiveness of the digital skills recognition model in promoting learning about community businesses and creative tourism in the Nakhon Phanom Municipality area along the Mekong River.

3. Investigate the outcomes of digital skill development for community business entrepreneurs and creative tourism in the Muang Nakhon Phanom area along the Mekong River.

Literature Review

Recognition Style

Recognition style in the learning context refers to an individual's unique pattern of perceiving, processing, and retaining new information, which influences learning efficiency and problem-solving abilities. This pattern can be categorized into several dimensions, such as holistic or analytical perception, continuous or discontinuous processing, and visual or verbal memory (Luo et al., 2023). It encompasses the distinctive characteristics of each individual in information perception and processing, including preferences or aptitudes for receiving information through various sensory modalities. These preferences affect cognitive patterns and methods of managing new information, all of which impact learning efficiency and problem-solving capabilities (Yamamoto et al., 2023). In essence, individual recognition styles differ in processing information from various sensory inputs. This process can be enhanced by stimulating cognitive processes tailored to each individual's style, thereby promoting the efficiency of new learning acquisition.

Digital Skills

Digital skills refer to a set of abilities in using digital devices, applications, communication tools, and networks to access, manage, evaluate, create, and communicate information and knowledge. These skills are categorized into three levels:

1. Basic Skills: Fundamental digital technology usage skills, such as using computers, smartphones, and browsing the internet.
2. Intermediate Skills: Enhanced ability to use digital technologies efficiently, including the use of more complex software and applications.
3. Advanced Skills: Skills related to advanced technology use, such as programming, application development, and big data analysis.

It is emphasized that Digital skills are not limited to technical skills alone but also include abilities in critical thinking, problem-solving, communication, and collaboration in digital contexts. This encompasses understanding cybersecurity, digital ethics, and digital media literacy (UNESCO, 2018) In alignment with new and future lifestyles, Digital skills can be described as the ability to use digital technology efficiently and creatively. This includes computational thinking skills, problem-solving, analytical thinking, and creating innovations in digital contexts. These skills are not only related to technology use but also include the ability to evaluate, analyze, and synthesize digital information, as well as critically participate in digital environments (van Laar et al., 2017).

Community Business

Community business refers to an organizational model that integrates business operational concepts with community development, aiming to create a balance between commercial activities and the achievement of social objectives. It utilizes business management principles as a tool to drive social goals (Haugh, 2007). Notably, community businesses do not prioritize maximizing profits like conventional business organizations; instead, their primary

objective is to generate benefits for the community. A key characteristic of community businesses is the process of community participation, which plays a crucial role in both ownership and management. This feature distinguishes them from typical business organizations that often have ownership structures in the form of individuals or capital groups. This process results in local-level impacts, focusing on creating outcomes in both social and economic dimensions within the organization's operational area.

Furthermore, community businesses emphasize financial sustainability, requiring the community to be financially self-reliant through business activities. Hibbert, Shier, and (Teasdale, 2022) conclude that community business is a crucial mechanism for developing grassroots economies and enhancing community capacity. It harmoniously combines the concepts of social entrepreneurship with community development.

Creative Tourism

Creative tourism refers to a form of tourism where tourists and hosts jointly create value through meaningful shared experiences. This type of tourism provides tourists with opportunities to develop their creative potential through active participation, as defined by (UNESCO, 2013). The active involvement of tourists means they are not mere spectators but co-creators of their travel experiences. A notable feature of the Creative Tourism process could be described as tourism that provides opportunities for tourists to develop creative skills through participation in activities, experiential learning, or engagement in activities that are characteristic of that specific area (Wurzburger et al., 2009).

Material and Method

Research Methodology

This research follows a research and development model (R&D). The process involves collecting qualitative and quantitative research data and is divided into three steps: 1. Synthesizing the model, 2. Developing the model and assessing its appropriateness, and 3. Conducting a trial of the model

Target Sample

The target group includes entrepreneurs from 8 communities, totaling 258 people, selected through purposive sampling. The qualifications are defined as entrepreneurs who voluntarily participate in the project. These are shops in community business groups in 8 communities along the tourism route along the Mekong River in the Nakhon Phanom city area.

Research Instrumentations and Validation Assessment

1. Recordings and document analysis forms were employed for the recording and analyzing documents in relation to principles, theories, and relevant research studies.
2. The appropriateness assessment form for the model was developed by the researcher as a 5-level rating scale questionnaire consisting of 13 items. The Index of Item-Objective Congruence (IOC) was calculated at a level of 0.90.
3. The digital skills assessment form was developed by the researcher using a scoring rubric. The holistic scoring rubrics consider the quality level of performance in an overall manner, divided into 5 levels of achievable skills: Absent skills, Elementary

skills, Essential skills, Operational skills and Expert-level skills. The assessment consists of 20 items. The Index of Item-Objective Congruence (IOC) was calculated at a level of 0.88.

Data Collection

1. The synthesis of the recognizing digital skills Model to promote community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality employed a data synthesis method through analytical description and interpretative summarization of data. This process focused on relevant theoretical principles, categorized into the following aspects: perception models, digital skills development, community business, and creative tourism. The study involved reviewing both domestic and international research, creating synthesis summary tables, and providing descriptive interpretations. The data collection period spanned from April to June 2023.
2. The assessment of the appropriateness of the recognizing digital skills Model for promoting community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality was conducted through a data collection process. The researcher distributed the assessment materials via electronic mail, which included a letter requesting expert participation and the appropriateness assessment form. A total of nine experts responded and returned their evaluations via electronic mail. The data collection period for the assessment commenced in July 2023.
3. The digital skills assessment was conducted through data collection from a target group of 258 participants. The researcher carried out individual digital skills evaluations following the participants' engagement in four capacity development learning units. This process took place from September 2023 to February 2024. Participants were selected using purposive sampling. The digital skills assessment results were summarized in April 2024.

Data Analysis

1. The record form was categorized into the following aspects: perception models, digital skills development, community business, and creative tourism. Data were recorded in summary tables as frequency values. The analysis method employed descriptive interpretation and summary.
2. The assessment of the appropriateness of the recognizing digital skills Model for promoting community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality, Utilized descriptive statistics for data analysis, including mean and standard deviation. Qualitative data analysis was conducted through interpretative summarization of the assessment form data and additional recommendations.
3. The digital skills assessment employed an analysis method that compiled individual scores and calculated the overall mean score. The passing criterion was set at 80% of the total score.

Research Summary

The research findings, summarized according to the research objectives, are as follows:

1. Results of the synthesis of the recognizing digital skills Model to promote community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality. The data were synthesized based on key issues and summarized as illustrated in Table 1.

Table 1: Results of the Synthesis of the Recognizing Digital Skills Model to Promote Community Business Learning and Creative Tourism in the Mekong Riverside Area of Nakhon Phanom Municipality

Recognizing Components: Moven & Minor (1998), Chanpanpakdeewong (2016), Paoram (2017), Mukda (2018), Nuambang (2019), Rungruengthanapon & Pooldee (2018), Dechporn (2020)		**Digital Skills Process:** Jadtaniom (2022), Thongeiam (2021), Choeicharoen (2021), Chanayapol (2019)	**Digital Skills Knowledge** Activities of recognizing digital skills Model
Sensation	1) Environmental inputs	1) Review of prior knowledge	**Popular Platforms** Examples of digital footprint and sales, featuring popular community businesses and programs with high reach
	2) Sensory input	2) Identifying important elements	**Essential Digital Skills for Community Entrepreneurs** Popular and renowned entrepreneurs. The leaders share their experiences, categorized by business type. This reflects real success stories from entrepreneurs.
Interpretation	3) Specialized experience for interpretation	3) Recognition of Critical Elements	**Guidelines for Using Popular Platforms to Increase Accessibility** Digital Practice Expand accessible areas from regularly used programs, increase pinning, and create content linked from previously used programs. Add key elements for accessibility in digital spaces
	4) Construing sensory information	4) Content creation and data integration	**Summary of Essential Data for Digital System Input** Input digital data based on templates from each platform Utilize case studies from successful entrepreneurs linked through the same platform to increase interaction

The digital literacy perception model for promoting community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality consists of 4 perception components: 1) environmental inputs 2) sensory inputs, 3) specialized experience for interpretation, and 4) construing sensory information.

The digital literacy perception model is presented in alignment with Experiential Learning Cycles theory (David Kolb), summarized as an overview of the digital literacy perception model as shown in Figure 1.

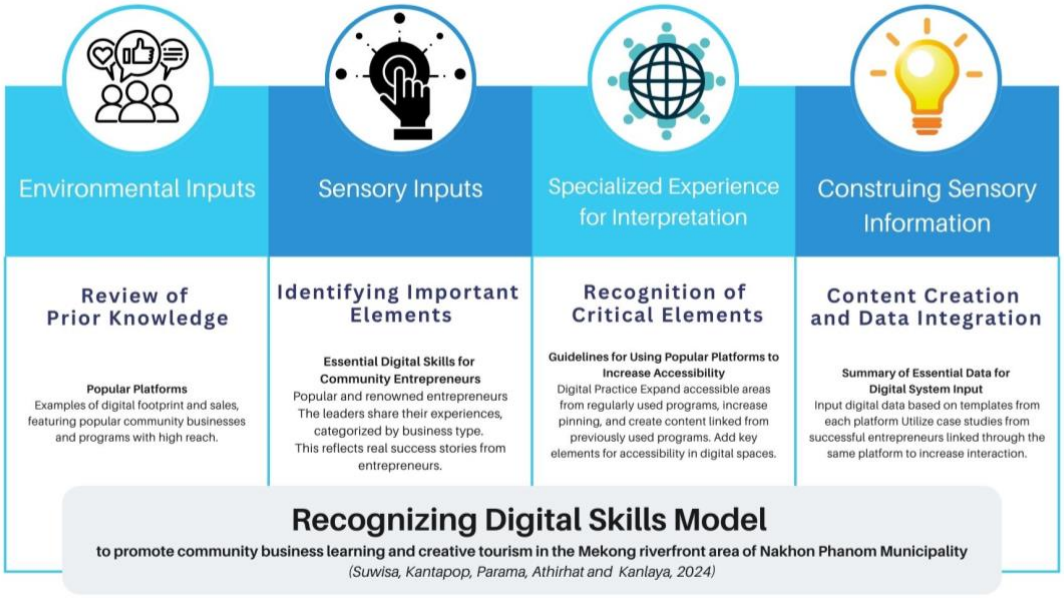

Figure 1: Recognizing Digital Skills Model to Promote Community Business Learning and Creative Tourism in the Mekong Riverfront Area of Nakhon Phanom Municipality

2. The results of the appropriateness evaluation of the Recognizing Digital Skills Model to promote community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality, as assessed by 9 experts, found that the overall appropriateness was at a high level. The results are shown in Table 2.

Table 2: Results of the Appropriateness Evaluation of the Recognizing Digital Skills Model to Promote Community Business Learning and Creative Tourism in the Mekong Riverside Area of Nakhon Phanom Municipality

Evaluation Items for Components/ Processes of Digital Recognition	$\bar{x}$	S.D.	Results
1. Environmental inputs			
-Review of prior knowledge	4.44	0.68	High level
- Popular Platforms Examples of digital footprint and sales, featuring popular community businesses and programs with high reach	4.33	0.67	High level
Summary of Component 1	***4.39***	***0.68***	High level
2. Sensory input			
- Identifying important elements	4.78	0.78	Highest level
- **Essential Digital Skills for Community Entrepreneurs** Popular and renowned entrepreneurs who are group leaders share their experiences, categorized by business type. This reflects real success stories from entrepreneurs who have effectively utilized digital spaces for their businesses	4.67	0.67	Highest level
Summary of Component 2	**4.73**	**0.73**	Highest level
3. Employing specialized experiential learning in interpretation			
- Selective perception of critical elements	4.33	0.67	High level
- **Guidelines for Using Popular Platforms to Increase Accessibility** Digital Practice Expand accessible areas from regularly used programs, increase pinning, and create content linked from previously used programs. Add key elements for accessibility in digital spaces	4.67	0.47	Highest level
Summary of Component 3	**4.50**	**0.57**	Highest level
4. Construing sensory information			
-Content creation and data integration	**4.67**	**0.67**	Highest level
-Summary of Essential Data for Digital System Input Input digital data based on templates from each platform Utilize case studies from successful entrepreneurs linked through the same platform to increase interaction	**4.44**	**0.53**	High level
Summary of Component 4	**4.55**	**0.60**	Highest level
Total Average of All Components	**4.54**	**0.65**	Highest level

From Table 2, the results of the appropriateness evaluation of the Recognizing Digital Skills Model to promote community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality show that the overall expert assessment was at the highest level ($\bar{x}$=4.54, S.D.=0.65). When considering individual components, it was found that Component 2, Sensory input, was rated by experts as the most appropriate.

3. The results of digital skills development for community business entrepreneurs and creative tourism in the Mekong riverside area of Nakhon Phanom City are shown in Table 3.

Table 3: The Number of People Evaluated After Participating in the Digital Skills Workshop for Community Business and Tourism, Totaling 258 Participants

Topic	Absent skills	Elementary skills	Essential skills	Operational skills	Expert-level skills
Capability to describe fundamental comprehension of the unique characteristics of the specified programs					
Facebook for community business	0	25	167	64	2
TikTok for advertising	0	89	149	20	0
Line for real-time customer communication	1	20	164	71	2
Instagram to increase customer reach	0	17	189	50	2
Capability to convey experiential knowledge exchange regarding the special features of programs					
Facebook Marketplace	8	41	171	34	4
Live video streaming through the TikTok application	9	65	170	14	0
Line Offial Chatbot	11	24	158	63	2
Instagram Media: Engaging audiences with visual content	10	25	190	33	0
Capability to integrate product information into sales-enhancing programs					
Google Map	0	4	210	40	4
Foodpanda	4	30	190	34	0
LineMan	6	24	187	41	0
Wongnai	39	80	110	29	0
Capability to establish digital data security for one's own business					
Facebook	9	50	168	23	8
Tiktok	5	31	179	43	0
Line	8	57	146	45	2
Instagram	27	60	128	43	0
Google Map	0	7	190	49	12
Foodpanda	13	59	154	32	0
LineMan	6	60	152	38	2
Wongnai	9	69	141	35	4
Percentage of total (N=256)	**3.19**	**16.22**	**64.21**	**15.52**	**0.85**
	19.42%		**80.58 %**		

From Table 3, it is found that out of 258 project participants who were evaluated, 64.21% demonstrated Essential skills, 15.52% showed Operational skills in practical use, and 0.85% exhibited Expert-level skills. In total, 80.58% of all project participants met or exceeded the set criteria of Essential skills and above. The remaining participants were categorized as having Elementary skills or Absent skills.

Discussion

The synthesis results of the recognizing digital skills model to promote community business learning and creative tourism in the mekong riverside area of nakhon phanom Municipality revealed that it consists of 4 components as follows: 1) environmental inputs 2) sensory inputs, 3) specialized experience for interpretation, and 4) construing sensory information. Xiong & Zhang (2024) conducted a study titled "Enhancing tourist loyalty through location-based service apps: Exploring the roles of digital literacy, perceived ease of use, perceived autonomy, virtual-content congruency, and tourist engagement." The study concludes that contemporary tourists increasingly rely on applications when making travel decisions in specific areas. The authors highlight the significance of digital literacy, emphasizing the importance of user-friendly interfaces and intuitive design. The findings further confirm the positive impact of extending app functionalities that are easily controllable and contribute to user satisfaction. This aligns with creating environments that influence the target audience's perception, emphasizing the importance of utilizing digital spaces to communicate with tourists. It extends to understanding the concepts and methods of experience-driven outcomes that impact sales, serving as a motivation for enhancing digital awareness in a tangible manner. This approach leverages the recognition of desirable outcomes as a foundation for fostering meaningful digital perception. Our results add to those of Deschênes (2024) Collaborative technologies as a social binder Our additional analysis support the idea that employees' technical skills associated with the use of digital technologies contribute to social proximity in the workplace, because these skills facilitate the use of the technologies that keep employees connected with their work environment. This result is particularly important, as it adds to the still-fragmentary knowledge of the effects of using collaborative technologies in a hybrid work context.

The results of this study revealed four key components of digital skill acquisition: environmental inputs, sensory inputs, specific experiences for interpretation, and interpretation of sensory data. These components form a coherent framework that facilitates digital skill development through perceptual processes. The results of this study are consistent with Gibson (2019) ecological approach to perception and learning, which emphasizes the role of the environment in skill acquisition.

The first component, environmental inputs, serve as a foundational component for digital skill acquisition. The results of this study are consistent with research by Wang & Chen (2021) who showed how carefully designed digital environments can enhance learning outcomes by providing appropriate stimuli and feedback mechanisms. The environmental context creates what Henderson et al. (2022) call “digital learning environments,” interactive opportunities that guide users toward skill development in a natural way.

Regarding sensory inputs, the results of this study are consistent with recent sensory research by Martinez-Rodriguez et al. (2023) who showed how multiple sensory channels contribute to digital skill development. The multimodal nature of digital skill acquisition, involving

visual, auditory, and kinesthetic information. It appears to enhance the learning path and improve skill retention.

The third component, the specialized experience for interpretation, builds on Koehler & Thompson (2020) work on the development of expertise in digital environments. Their longitudinal study showed that structured digital task exposure gradually builds interpretive frameworks, allowing learners to recognize patterns and develop more complex digital skills over time.

Finally, the interpretation of the cognitive data component is consistent with the cognitive processing theory proposed by Lee & Park, (2022) who found that active interpretation of digital experiences leads to stronger skill development than passive exposure. This finding suggests that metacognitive awareness plays a key role in transforming digital experiences into concrete skills, with the interactions between these four components creating what Kumar et al. (2023) describe as a "cognitive learning cycle" in digital skills development. This cycle facilitates the recognition and learning of skills through repeated learning, interpretation, and integration of digital experiences. This finding is particularly important because it demonstrates that cognitive processes can be used to enhance digital skills development by coordinating with learning processes and integrating them with other subject areas for further development of desired skills.

2. The assessment of the suitability of the recognizing digital skills model to promote community business learning and creative tourism in the Mekong riverside area of Nakhon Phanom Municipality demonstrated a high level of overall appropriateness. In examining individual components, the results of the evaluation of the suitability of the digital skills awareness model to promote community business learning and creative tourism in the Mekong River area, Nakhon Phanom Municipality, showed a high level of overall suitability, especially the second component, which focuses on essential digital skills through the experiences of successful entrepreneurs, which was highly evaluated by experts.

This issue may be due to the explanation starting from tangible success leading to motivation for self-development, which is consistent with the research of Thompson & Liu (2022) who found that learning through success models affects the inspiration and development of digital skills in community entrepreneurs. Communicating through examples close to reality and through concepts that can be applied to one's own work will enhance awareness and facilitate learning more easily.

The results of the research are also consistent with Kolb (1984) experiential learning theory, which emphasizes the importance of direct experience. Having tangible experiences helps create personal stories to share (a greater emotional connection to the context) as well as a broader perspective on the complexity of impacts within the community. In addition, Wang & Chen (2023) studied and found that learning through direct experiences in a digital context increases the confidence and ability to apply technology to small entrepreneurs. To understand the key components and facilitate positive change.

Rodriguez et al. (2024) conducted a 'phenomenological study of intensive experiential learning for university faculty professional development' and concluded that the experiential learning cycle led to the creation of case studies as an additional way to reach students in the interdisciplinary area of agricultural and natural resource systems. This is consistent with the

research of Henderson & Park (2023) who showed that the cyclical learning model can be applied to digital skills development in a variety of contexts.

In addition, Kumar et al. (2023) found that learning through real-world experiences in a digital context developed problem-solving and creativity skills, which are important skills for entrepreneurs in the digital age. In many ways, this demonstrates the cyclical nature of experiential learning, where learners (in this case faculty) have ongoing experiences as they apply and test new knowledge (teaching others) and then provide the learning experience to their own students.

The significant development of digital skills among participants, exceeding the specified threshold of more than 80% after the implementation of the four-component model, is consistent with several research studies on the development of integrated digital literacy that leads to higher levels of targeted digital skills. In line with the research of Viktoriia et al. (2024) studying on the topic of "Improvement of higher education: how to bridge the digital divide during the transformation?", it was concluded that the issue of promoting digital skills is that the creation of a digital ecosystem involves the development of a single digital environment to support the effective interaction of participants. This system covers regulations, standards, information infrastructure, personnel and data security. It also includes the development of a data protection system within the electronic information system and the suppression of cybercrime. In addition, it requires the development of Internet resources and service characteristics to deploy high-speed broadband communication channels and create a wireless access network to electronic databases. In addition, it creates a mobile-oriented environment for users, allowing users to access electronic information through various devices. Therefore, for the above reasons, it can be explained that the development of higher digital skills can be attributed to external factors or the communication of awareness through a stimulating and motivating environment, in line with Bahri et al., 2024. Therefore, for the above reasons, it can be explained that the development of advanced digital skills can occur from external factors or communication to create awareness through a stimulating and motivating environment, Therefore, for the above reasons, it can be explained that the development of advanced digital skills can occur from external factors or communication to create awareness through a stimulating and motivating environment, which is consistent with the research study of Bahri et al. (2024) who studied the relationship between students' perception of learning media, digital literacy skills, and self-regulated learning and learning outcomes of students in rural areas. It can be concluded that students' perception of learning media, digital literacy skills, and self-regulated learning support and have a moderate relationship with intellectual learning outcomes at the same time. The results of the study found that students' perception of learning media directly and significantly affect students' intellectual learning outcomes. The contribution of students' perception of learning media to intellectual learning outcomes, including digital literacy, directly and significantly affects intellectual learning outcomes, both at the individual and concurrent levels. In addition, it was found that digital literacy contributed to students' intellectual learning outcomes more than the contribution of students' perception of learning media and self-regulated learning. Therefore, from the issue of the format that can promote digital awareness, it is directly affected by understanding what will affect oneself, resulting in intrinsic motivation. Using examples that are consistent with what is needed can be used to design activities in learning other subjects effectively.

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A Comparison of Online Learning Engagement Across Cultural Backgrounds: A Study of Students at Two International Campuses Sharing the Same Curriculum

Suzanne Mary Caliph, Monash University, Australia
Chooi Yeng Lee, Monash University, Malaysia

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Abstract
The impact of cultural background on pharmacy students' engagement with online learning activities during remote learning and in the post-pandemic era remains unclear. In this study, we explored whether cultural differences affected students' engagement with online activities designed for active learning and skill development. We conducted a retrospective analysis of learning management system (LMS) engagement data for second-year pharmacy students at Monash University's Malaysia (MA) and Australia (Parkville PA) campuses. The study examined the LMS data from 2,810 students enrolled across eight semesters. The results from various student cohorts and different online learning activities such as readings, video clips, workshop scenarios, self-test quizzes, and preparatory materials were statistically compared using SigmaPlot® software. In the first year of pandemic remote learning, students at the PA campus showed significantly lower engagement with online resources compared to students at the MA campus. In PA however, international students indicated they were more engaged and satisfied with remote online learning resources than local students. The cultural emphasis on academic achievement, adherence to societal norms, and fulfilling responsibilities as signs of respect and commitment are likely to contribute to higher motivation and engagement with learning resources among these students. Online resources with multimodal approach that combine readings with pictures, videos and self-test quizzes enhance engagement in both campuses, compared with pre-recorded lectures or workbooks alone. Educational institutions should use multimodal online resources and tailor engagement strategies to align with students' cultural values and circumstances to enhance engagement.

Keywords: Cultural Differences, Online Learning, Pharmacy

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Introduction

Cultural factors such as interdependence, independence, self-reliance and attitudes towards technology can significantly impact how students perceive and engage with online learning (Katzman & Stanton, 2020). Additionally, the online learning environment, including access to educators, student connectedness, technology and online resources plays an important role in student engagement (Vo & Ho, 2024). Students who had reliable internet access, quiet study spaces, and supportive teachers were more likely to stay engaged. Self-regulated learning (SRL) is thought to be crucial in remote online learning, helping students take control of their education through goal setting, self-monitoring, and self-reflection. SRL promotes effective time management and adaptability to the online environment, leading to better academic outcomes and increased engagement in remote learning contexts (Broadbent & Poon, 2015).

Understanding the factors that influence student engagement with learning activities and resources is essential for designing effective learning environments that address diverse student needs and enhance academic outcomes. The shift to online education during the COVID-19 pandemic highlighted the importance of adaptable and student-centred teaching strategies, yet the long-term impact of this transition on student engagement remains unclear. As blended learning models become the new norm in the post-pandemic era, it is crucial to assess whether online learning engagement has evolved and how it compares across international contexts. This study explores student engagement with online learning activities between 2020 and 2023, focusing on two international campuses in Australia and Malaysia. Findings from this study can inform future pedagogical approaches, ensuring they remain effective, inclusive, and responsive to changing learning preferences (Martin & Bolliger, 2018). The comparison across campuses offers insights into cultural and contextual factors influencing student interaction with online resources (Sato et al., 2022), contributing to a global understanding of effective blended learning design.

Method

We conducted a retrospective analysis of learning management system (LMS) Moodle engagement data for second-year pharmacy students at Monash University's Malaysia (MA) and Australia Parkville (PA) campuses. The study examined the LMS data from 2,810 students enrolled across eight semesters from 2020-2023. The results from various student cohorts and different online learning activities such as readings, video clips, workshop scenarios, self-test quizzes, and preparatory materials were statistically compared using SigmaPlot® software.

Results and Discussions

In the first year of remote online learning, we found that ‘Discovery book’ engagement was significantly lower in PA campus compared with MA campus in both teaching semesters (Figure 1). Discovery book contains readings, video clips and self-test quizzes related to pathophysiology and pharmacotherapeutic and non-pharmacological (including lifestyle) management options of dermatological conditions, pain and wound care in semester 1 and cardiovascular diseases (e.g. hypertension, dyslipidaemia) in semester 2. Similarly, MA students’ engagement with lecture recordings (Figure 2) was significantly higher in the first year of remote online learning. These findings indicated that Malaysian students adapted to and accepted remote online learning quicker than their Australian counterparts. This may

reflect different cultural and educational expectations, as Malaysian students might place greater value on reviewing readings and recorded content for theoretical understanding and flexible learning opportunities. In contrast, Australian students may prioritise in-person engagement and face-to-face interactions as central to their learning experience. These variations could stem from differing educational practices, with Malaysian systems often emphasising structured, resource-based learning, while Australian education systems encourage interactive and discussion-based approaches. Understanding these cultural and pedagogical distinctions is essential for designing inclusive and effective learning strategies in international and blended learning contexts (Markey et al., 2023). Nevertheless, no differences in engagement with online discovery book were observed in subsequent years, suggesting that the shift to online learning during the pandemic has become normalised, and students now accept and expect online resources to be an integral part of their learning experience.

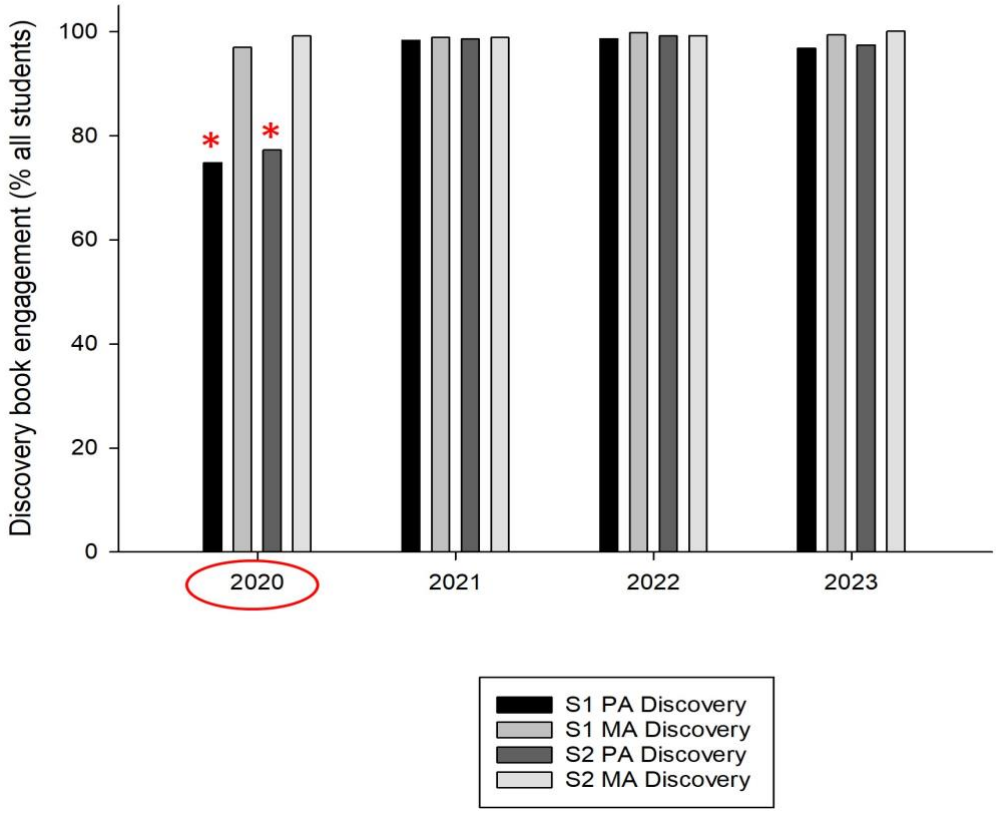

Figure 1: Pharmacy Students (Pa=Australia Campus, Ma=Malaysia Campus) Engagement With Online Discovery Books. Asterisk (*) indicates P<0.05

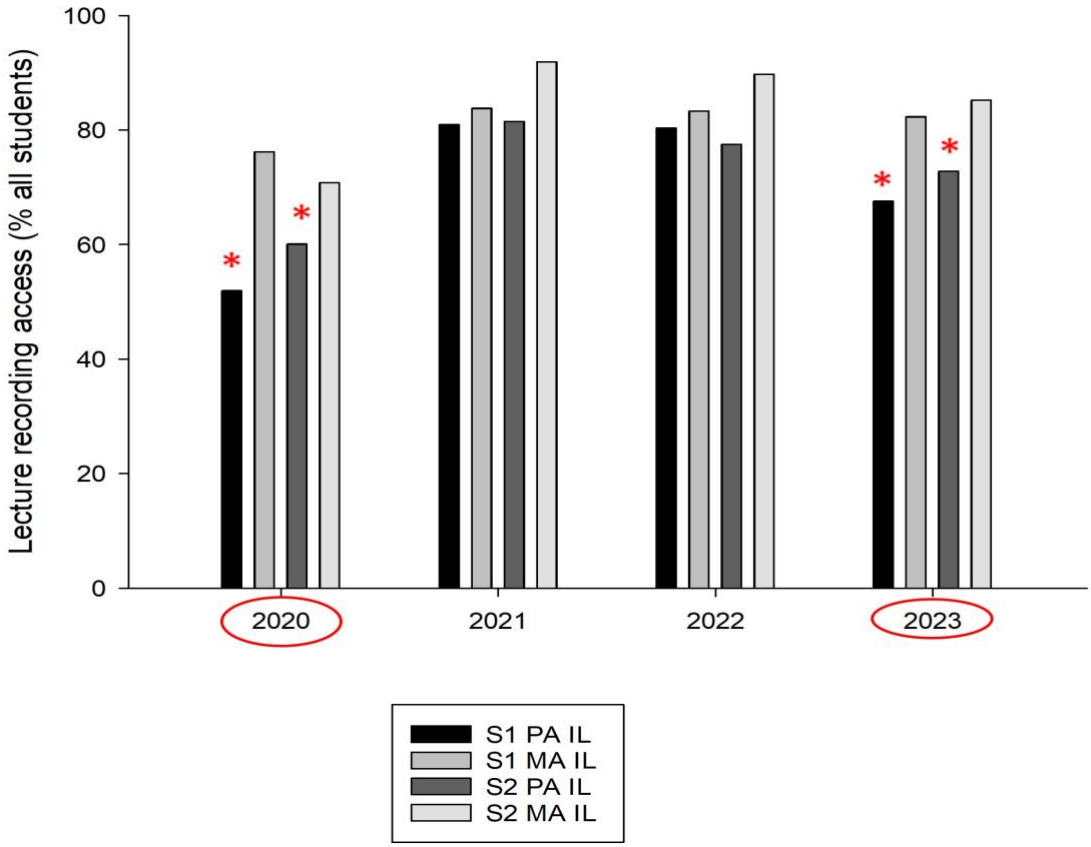

Figure 2: Pharmacy Students (Pa=Australia Campus, Ma=Malaysia Campus) Engagement With Interactive Lecture Recordings. Asterisk (*) indicates P< 0.05

Interestingly, following the resumption of on-campus classes in 2023, review of lecture recordings declined among students in the PA campus (Figure 2) but that remained consistent in the MA campus. This observation highlights potential differences in learning preferences between the two campuses. PA students may favour interactive learning environments, reflecting a preference for collaborative and experiential learning that aligns with Western educational paradigms. On the contrary, MA students may continue to value recorded content for its flexibility and utility in reinforcing theoretical concepts. This attitude aligns with educational practices common in Asian contexts that emphasise resource-based and self-paced study, further emphasising the role of cultural and systemic factors in shaping learning behaviour. Understanding these dynamics is critical for tailoring educational resources and support to meet the diverse needs of international student cohorts.

Between 2021 and 2023, we found that a higher percentage of students from both campuses engaged with discovery books that integrated text, images, animations, videos and quizzes, compared with traditional recorded lectures. The multimodal approach to presenting SRL materials leverages diverse learning modalities - visual, auditory and kinaesthetic, stimulates greater engagement, and enhances comprehension by catering to individual learning preferences. By combining interactive elements with accessible formats, discovery books can make complex concepts more digestible, fostering deeper engagement, understanding and retention. Additionally, integrating multimedia elements has been shown to improve cognitive load management and facilitate meaningful learning by bridging abstract concepts with tangible visuals (Mayer, 2009). Nevertheless, the effectiveness of such resources

compared to recorded lectures may depend on contextual factors, including the subject matter and students' prior familiarity with online learning tools. While recorded lectures are beneficial for revisiting detailed content, discovery books provide a more interactive and flexible learning experience, potentially addressing the varying needs of a diverse student cohort. Future research could explore how integrating these multimodal resources across disciplines impacts long-term learning outcomes and student satisfaction.

As part of the online learning module, self-test quizzes with instant feedback were embedded in discovery books to foster SRL and develop pharmacy professional skills such as problem-solving, critical thinking, and decision-making. The present study found that a significantly higher proportion of MA students engaged with online quizzes during the first year of the pandemic compared to PA students (Figure 3). While quiz usage increased across both campuses in subsequent years, MA students consistently demonstrated higher engagement. This suggests that MA students are more proactive in utilising available resources and valuing the flexibility to review materials at their own pace.

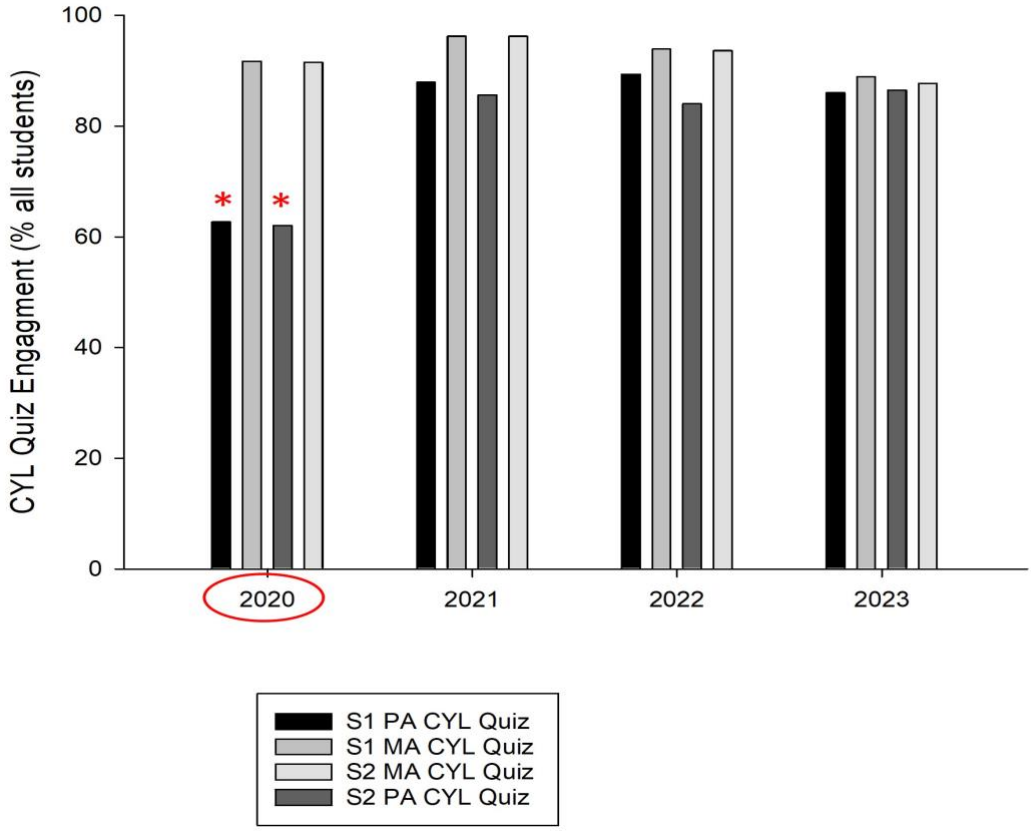

Figure 3: Pharmacy Students (Pa=Australia Campus, Ma=Malaysia Campus) Engagement With Check Your Learning (Cyl), Self-Test Quizzes. Asterisk (*) indicates P<0.05

Self-test quizzes with feedback are particularly beneficial as they provide immediate reinforcement of learning, help identify strengths and weaknesses and enable students to adjust their study strategies effectively. By promoting active recall, metacognitive skills, and personalised learning, such quizzes enhance knowledge retention and academic performance (Nicol & Macfarlane-Dick, 2006). In many Asian cultures where education is highly emphasised, students often strive to excel academically, which may explain MA students'

greater engagement with self-assessment tools (Van der Linden et al., 2021). These findings highlight the value of culturally adaptive learning resources to support diverse learner needs.

Online learning workshop books are provided for students to complete preparatory tasks before attending the small group problem- and scenario-based learning workshops (4-5 students per team), conducted virtually via zoom videoconferencing facility during the pandemic in 2020 and 2021, and in-person when on campus classes resumed in 2022 and 2023. Each pre-workshop book typically contains a clinical case scenario with patient information including current medication list, medical conditions, pathology results and lifestyle considerations for students to identify and solve medication-related problems, e.g. side effects, interactions, contraindications, and adherence issues. During workshops, students worked with team members to solve these problems and propose an individualised care plan including pharmacological and non-pharmacological management options, e.g. smoking cessation, healthy eating, exercise, etc. We found that online workshop workbooks with knowledge-based questions and quizzes engaged more students (>90%) compared with those without (<70%) for both PA and MA cohorts. This indicates the need for assessment-related components to be incorporated in online learning resources to foster students' accountability for effective participation in team tasks.

Conclusion

The findings of our study highlight the importance of tailoring educational strategies to meet the diverse needs of both local and international students in online learning environments. Enhancing engagement may require integrating more interactive elements such as live discussions, collaborative projects, and peer-to-peer learning opportunities as these approaches can foster a sense of connection and active participation, addressing potential preferences for in-person engagement. In contrast, the preference for recorded lectures and asynchronous learning formats among many Asian international students underscores the value of flexibility and accessibility in course design. These students may benefit from didactic components, such as structured content delivery, which can be reviewed multiple times at their own pace to reinforce understanding and mastery of theoretical knowledge. Institutions should prioritise the development of blended learning models that offer both synchronous and asynchronous online learning and in-person classroom options to support the diverse learning needs of their student populations.

The main limitation of the study is the lack of qualitative data which can be referred to explain observations of the Moodle engagement data. Qualitative data include students' comments of their learning experience, e.g. the specific teaching and learning activity or approach which has worked well for them or needs improvement and the reason for change, as well as learning obstacles and expectations throughout the entire study period. These data may provide insights on the distinctive differences between PA and MA students in terms of their engagement on specific online learning activities, during the pandemic and post-pandemic. The information, will subsequently, guide educators in the design of student-centred learning content, taking into account factors such as cultural differences. This limitation is an area of future studies.

Future research should explore how cultural and contextual factors influence engagement with various learning tools and formats. Longitudinal studies could assess the impact of tailored strategies on academic performance, satisfaction, and retention rates across diverse cohorts. Research could also evaluate the role of emerging technologies, such as artificial

intelligence-driven adaptive learning platforms and feedback systems, in enhancing personalised learning experiences for global student populations.

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Contact email: cy.lee.082016@gmail.com

Exploring Authentic English Learning Tasks in the EFL Classroom With KIVA

Michael Johnson, Hamamatsu University School of Medicine, Japan

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Abstract
This study set out to explore the efficacy of authentic online instructional materials and tasks in promoting engagement, critical thinking, and international awareness in a small sample of Japanese EFL learners majoring in medical science. The study measured student impressions of, and attitudes towards, tasks related to providing microcredit loans to borrowers in developing countries through the English-medium website of the non-profit organization KIVA. In a modularized CLIL (Content and Language Integrated Learning) unit, students assessed pools of potential borrowers and extended loans on four occasions. Data related to these tasks were collected using an instrument comprised of ten semantic differential scale items and open-ended items. Results of the sematic differential scale items indicated that students were positively oriented towards these materials and tasks, with participants endorsing their global orientation and meaningful content, as well as their overall importance, positive value, and appeal to interest. The open-ended items further supported positive attitudes towards these materials and tasks, with students finding them an interesting, practical, and novel way to learn about the world while helping others. Open-ended item results also indicated that the process of learning about the situations of people in developing countries while extending loans fostered feelings of personal growth in terms of an appreciation of the hardships faced by people in developing countries, and a newfound desire to be involved in helping others in the future. These results suggest that real-world online philanthropic tasks can offer students rich meaningful educational experiences that transcend the traditional foreign language classroom.

Keywords: Authentic Learning, Authentic Online Instructional Materials, CLIL, Microcredit, English as a Foreign Language

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Introduction

With advances in information and communications technologies, language teachers have been presented with an opportunity to orient learning tasks in a direction which enables learners to interact with the world and connect with others in target language communities in authentic and meaningful ways. Central to this opportunity is the ubiquitous and ever-developing corpus of target language authentic materials being continually produced and readily available online. Increasingly, over the past two decades, these new technologies and materials have been innovatively adapted and applied to expand the classroom beyond their traditional boundaries (Herrington et al., 2010; Warschauer, 2002). The result of this communications technology-embraced reimagination of the classroom is the real opportunity for learners to interact with target language communities in authentic and meaningful ways. Rather than being tied to textbook or teacher-presented simulations or scenarios of target language interaction, learning tasks can be offered which require the learner to be immersed in authentic interaction in target language contexts (albeit online). This approached has been expanding in language education where, in addition to language development, it has been demonstrated to promote higher level cognitive skills particularly in terms of inductive learning (Wurdinger & Carlson, 2010). Additionally, learning in authentic contexts reflects how knowledge is actually used and promotes active and collaborative learning (Herrington et al., 2010).

While there is a seemingly endless number of authentic materials and tasks available online for adoption into the language learning classroom, one area that has proven effective in a wide variety of educational settings is microfinance. Microfinance gained wide attention when Muhammad Yunus won the 2006 Nobel Peace Prize for his work with Grameen Bank in Bangladesh where he pioneered the concept of microcredit loans in providing small loans to impoverished women who would otherwise not qualify for traditional bank loans. The practice of helping people in developing countries through the provision of microcredit loans has grown in popularity in recent years, and is now being carried out online though a number of international NGOs who connect borrowers and loan providers around the world.

The provision of microcredit loans as an authentic learning task in experiential learning has found broad application in a number of educational contexts. Due to the inherent nature of extending microcredit loans to individuals in developing countries, microfinance has become particularly appealing in authentic learning approaches in business education. Through extending loans internationally learners can connect business knowledge theory with practice while also learning about real world socio-economic conditions and practices around the world (Coelhoso & Griffin, 2015; Dick et al., 2021; Grotrian-Ryan et al., 2016; Humphrey, 2008; Reed et al., 2012). For some students, these experiences can be transformative in terms of their personal ongoing approaches to business and philanthropy (Fitzpatrick, 2015).

Microfinance has also been demonstrated to bring a range of benefits to other areas of education. In a study of algebra and world literature students, microcredit loans were shown to be effective in encouraging interdisciplinary analysis while promoting awareness of developing countries, community engagement, subject matter awareness, and collaboration (Staats et al., 2013). Similarly, in computing classes, microfinance has been shown to be an effective way to teach interdisciplinary topics and social responsibility whilst showing how people live and work in other countries around the world (Cannoy, 2015). In foreign language education, students of Spanish working within the microcredit process as volunteer translators showed improvements in motivation and cultural and linguistic competence due to

the opportunity to actually interact with Spanish speakers in facilitating the loan application process (Faszer-McMahon, 2013).

While there has been little specific research into the benefits of microfinance in English as a second or foreign language instruction, Kaduce (2019) has outlined the potential benefits of microcredit loans in the English learning classroom particularly in terms of promoting engagement beyond the classroom and providing authentic learning experiences for students. Drawing on the conditions for authentic learning outlined by Herrington at al. (2010), Kaduce suggests that microcredit has particular utility in making language learning relevant, improving language knowledge and skills, and motivating learners beyond traditional classroom-based approaches. The study described in this paper set out to explore the benefits identified above through administering and evaluating a unit of microcredit instruction with English as a Foreign Language (EFL) learners, with an evaluative focus on their attitudes towards authentic learning and self-reported benefits associated with the experience.

The microfinance NGO KIVA was chosen for this study due to its broad proven utility in authentic and experiential learning approaches (Cannoy, 2015; Coelhoso & Griffin, 2015; Grotrian-Ryan et al., 2016; Humphrey, 2008; Staats et al., 2013). The website offers a portal to thousands of microcredit applicants from around the world, providing applicants' profiles and socioeconomic data for their respective countries. As authentic instructional materials, KIVA provides a rich amount of language for students to read through and discuss, as well as sociological, economic, psychological, and philanthropic considerations that require nuanced and critical consideration.

In order to guide this exploration of EFL students' attitudes towards, and self-perceived benefits from, authentic learning through the provision microcredit loans through KIVA, the following research questions have been devised:

RQ 1: What are EFL students' attitudes towards providing microcredit loans as a language learning task?

RQ 2: What self-perceived benefits are associated with microcredit tasks in the EFL classroom?

Methods

Class Procedure

A microfinance/microcredit instructional unit was created to introduce students to the KIVA platform and offer the opportunity to actually take part in the provision of microcredit loans to borrowers in developing countries. This was designed to be a Content and Language Integrated Learning (CLIL) modular unit due to this instructional design's flexibility and ability to be inserted into a regular course as an independent unit which students could focus on and draw engagement and motivation from (Baetens Beardsmore, 2002; Baetens Beardsmore & Kohls, 1988).

The instructional unit was comprised of four ninety-minute sessions, the first of which began with a short lecture on the history of microfinance, and an orientation to the KIVA online platform. In each of the four sessions, students were divided into small groups and provided with ten profiles of KIVA loan applicants. Students were then required to read the ten profiles with their groups members, and complete an information table recording the applicants' names, countries, national average income, loan purpose, loan amount, and other important

considerations for each individual applicant gleaned from their provided profiles. The groups were then asked to rate the borrowers according to need from most to least needy. The groups then came together for a whole class discussion where each groups discussed and advocated for their choices based on the reasons arrived at within their groups. Following a whole class discussion, a single agreed upon borrower was provided a KIVA loan of $25 within the class. In subsequent classes students monitored the status of outstanding loans, using these experiences as an additional factor in informing subsequent loan decisions. Over the four class sessions of the unit, a total four loans were given on the KIVA website.

Instruments and Analysis

Data were collected with a questionnaire comprised of two parts. The first section was comprised of ten semantic differential scale items. Each of these items was constructed with adjectives of opposite meaning at the opposite ends of a seven-point scale. This approach was chosen due to its utility in quickly and efficiently collecting attitudinal data (Dornyei, 2002). The second section of the questionnaire was comprised of four open-ended questions. The purpose of these questions was to add deeper more descriptive insights into students' attitudes towards the materials and task used in the unit. The semantic differential scales were recorded and analyzed using SPSS v.24 to derive descriptive statistics. The open-ended items were analyzed using two-step content analysis involving initial grouping of responses into general themes, and a further recursive round of classifying into more refined thematic areas (Saldana, 2009).

Participants

A total twenty-three (n=23) medical science students participated in this study. The participants were all first-year Japanese university students with upper-intermediate to advanced English skills. The microcredit unit in which students participated was part of a general study skills class that included international understanding and English language study as a broad general component of the course.

Results

Results of the semantic differential scale items and open-ended survey questions indicated that students had positive attitudes towards the authentic English instructional materials and learning tasks examined in this study, and derived a number of self-perceived benefits from the experience.

All ten of the sematic differential scale items used in this study were positively endorsed (see Table 1). Most strongly endorsed were scales asking about the value students placed on the materials and task (not valuable / valuable m=2.69) and the degree of global orientation (local/global m=2.69). The second most strongly endorsed scale was that measuring students attitudes towards the meaningfulness of the authentic instructional materials and tasks, with the results indicating students strongly found these to be meaningful (m=2.6). The third most strongly endorsed scales were those measuring the degree of value (not valuable / valuable m=2.49) and relative positive orientation (negative / positive m=2.49) of the materials and tasks. The scale with the weakest endorsement was that measuring the degree of difficulty. With a response slightly skewing in the "easy" direction (difficult/easy m=1.13), this indicates while the students did not find the task particularly difficult, they did not find it particularly easy either.

Table 1: KIVA in the Classroom: Semantic Differential Scale Results

Variable	N	m*	sd
boring / interesting	23	2.39	.78
unimportant / important	23	2.47	.79
not valuable / valuable	23	2.69	.47
not helpful / helpful	23	2.21	1.0
negative / positive	23	2.47	.79
passive learning / active learning	23	2.13	1.1
local / global	23	2.69	.55
old / new	23	2.13	.96
difficult / easy	23	1.13	1.63
meaningless / meaningful	23	2.6	.65

(*7-point scale: -3 to +3)

Results of the first open-ended item provided an overall general indication of students' attitudes towards using KIVA (see Table 2). All responses to this first item, "How do you feel about being introduced to KIVA in this class?", were positive. The most frequent responses categories to this item were "it appealed to my interests" (n=11); "it provided an opportunity to help others (n=7); "non-specific positive" (such as it was great, it was good etc.) (n=7); "it provided an opportunity to learn about other countries/people" (n=6); "it was a new / novel experience" (n=6).

Table 2: Open-Ended Item 1 Results

Thematic category	*N*
(1) appealed to interest	11
(2) opportunity to help others	7
(2) nonspecific positive (good, great etc.)	7
(3) opportunity to learn about other countries/people	6
(3) new experience / novelty	6
(4) KIVA/MCL system appeal	4
(5) positively challenging	2
(6) real, practical	1

The second open-ended item in the questionnaire was "How did you feel about giving loans through KIVA in this class?" This item was specifically focused on students' experience of giving microcredit loans to people in developing countries on the KIVA online platform. The responses to this question also were all positive (see Table 3). The most frequent thematic categories included: experienced the opportunity to help others (n=10); experienced personal growth (n=7); felt global reach/connectivity (n=6); positive opportunity to problem solve with classmates (n=3); and, gained insight into situations around the world (n=3).

The third open-ended item was "What did you like best about the KIVA activity? As this was a positively-oriented item, understandably all responses were positive (see Table 4). The most frequent responses to this item were: the opportunity for discussion (n = 8), learning about others' lives around the world (n=8); helping others (n=7); and the process of choosing loans with classmates (n=4).

Table 3: Open-Ended Item 2 Results

Thematic category	*N*
(1) opportunity to help others (n = 10)	10
(2) experienced personal growth (n = 7)	7
(3) felt global reach/connectivity (n =6)	6
(4) opportunity to solve problems with classmates (n = 3)	3
(4) gained insight into situations around the world (n = 3)	3
(5) positive challenge (n = 2)	2
(5) motivated by task (n = 2)	2
(5) nature of task (n = 2)	2

Table 4: Open-Ended Item 3 Results

Thematic category	*N*
(1) opportunity for discussion (n = 8)	8
(2) learning about others' lives around the world (n = 8	8
(3) helping others (n = 7)	7
(4) process of choosing loans (n = 4)	4
(5) sense of appreciation (n = 1)	1
(5) opportunity to present (n = 1)	1
(5) medical themes (n = 1)	1

Discussion

This study set out to examine the utility of microcredit online lending tasks as an authentic learning approach for students learning English as a Foreign Language in Japanese higher education. To evaluate this objective, students' attitudes were assessed following a unit of instruction focused on learning about microcredit and microfinance and actually providing loans to borrowers around the world. These tasks required students to interact with English language medium websites providing them with an authentic immersive experience in the online philanthropic community using the target language of English.

The results of this study indicated that students had positive attitudes towards the microcredit materials and tasks presented. The results of the sematic differential scale items indicated that students strongly thought the experience was valuable, meaningful and expanded their global perspectives. They also found the materials positive, interesting and important while promoting active learning. More detailed information on the students' attitudinal orientation towards the microcredit unit was detailed in the results of the open-ended items. These results endorsed the notion that students found the materials interesting and relevant, but also further indicated that students saw these materials as a new opportunity to help others, to learn about other countries, and positively challenge themselves in an authentic learning environment. These positive results reflect other educational studies where students developed positive attitudinal orientations towards authentic learning though the microcredit loan experiences (Cannoy, 2015; Dick et al., 2021; Grotrian-Ryan et al., 2016).

A second objective of this inquiry was to identify what self-perceived benefits students associated with the microcredit tasks undertaken in this study. Results of the opened-ended items indicated that students particularly found the discussion opportunities afforded by the KIVA tasks and materials beneficial. They also indicated that they found value in learning about the lives of others, and helping people, in various countries around the world. Some students further identified the transformational nature of the experience as beneficial in that it taught them to appreciate their present situation more, and better understand the need to help

others in the future. The benefits identified here are similar to the academic, personal and civil dimension observed by Grotrian-Ryan et al., (2016) in their study of business majors using KIVA in service learning programs. The academic benefits identified by students including problem solving, and discussion and debating while trying to agree on loan recipients, reflect the findings of Coelhoso and Griffin (2015) where provision of KIVA loans promoted higher level thinking and decision-making, and encouraged students to explore alternative viewpoints and test their own critical reasoning. The potential transformational value of extending microcredit loans in the classroom was also observed by Fitzpatrick (2015) and Staats at al., (2013), where these educational experiences changed learners' perspectives and inspired them to carry the lessons learned into their ongoing lives.

The CLIL KIVA microfinance unit design utilized in this study demonstrated flexibility in delivering an experiential learning experience that delivered on a number of levels. Importantly, the results reflect many of the key principles of authentic language learning laid out by Herrington at al. (2010) in which they explain that authentic learning must (among other things): have real world relevance, be complex and allow for a diversity of outcomes, require students to develop their own approach to problem-solving, encourage different perspectives, provide opportunities for collaboration and reflection, promote normative values, encourage communication and motivate learners. According to Warschauer (2002), when using technology in the language classroom the goal of instruction should be not only language development, but development of the person. The multiple areas in which authentic language learning through the provision of microcredit loans through a platform such as KIVA benefited students in this exploratory study suggests it has a great deal of potential not only for meaningful language education, but for the development of the student as a person.

Conclusion

The purpose of this paper was to explore the value of microcredit online lending tasks as an authentic learning approach for learning English as a foreign language. The results indicated that students positively endorsed these materials and tasks, particularly using language authentically in real-world online target language communities. Participants also expressed satisfaction with the opportunity to work collaboratively with their peers in learning about the situations of people in developing countries around the world. This experience appeared to have had transformational value as students expressed a deeper appreciation for their own situation as well as gaining a philanthropic orientation towards helping people in the future. While these benefits strongly indicate a number of potential benefits for students engaged in microcredit tasks in the EFL classroom, the exploratory nature of this study and small sample size suggest that broader in-depth inquiry is necessary to gain a deeper understanding of the full impact these microcredit authentic materials and tasks have on the teaching and learning of English as a foreign language. As the broader education field increasingly embraces authentic learning opportunities presented in the virtual world, moving forward language teachers too must strive to find ways to leverage these opportunities to expand the classroom and provide our students with opportunities to connect with target language communities in authentic and meaningful ways.

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Transforming Teaching and Learning at the Royal University of Bhutan Through Targeted Needs Assessment

Gembo Tshering, Royal University of Bhutan, Bhutan

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Abstract
To ensure ongoing relevance and effectiveness, teaching and learning in higher education institutions must undergo regular reviews and targeted interventions. This study undertook a comprehensive needs assessment to guide the development of targeted professional development (PD) programs in teaching, learning, and assessment in the nine colleges of the Royal University of Bhutan. Employing a convergent parallel mixed-methods design, data were collected from 318 faculty members through a mixed-methods survey questionnaire. This instrument integrated established tools, including the Approaches to Classroom Assessment Inventory Version 3, Teaching Competencies Scale, and Revised Approaches to Teaching Inventory, ensuring a robust evaluation of faculty needs. Typically, needs assessment studies use one of these instruments, resulting in a partial understanding of the needs. The findings revealed a significant and pressing demand for PD initiatives focusing on student-centered teaching strategies, innovative assessment approaches, using assessment data to inform instructional activities, providing qualitative feedback, and understanding 21st-century learners. Furthermore, the study uncovered considerable variation in professional development needs across the different colleges, underscoring the necessity for customized and tailored PD programs to each institution's unique contexts and challenges, highlighting the critical importance of continuous, need-based professional development initiatives. The study also discusses the implications of these findings for designing and implementing effective PD programs, offering insightful and practical recommendations for institutional leaders and policymakers. Drawing upon a framework built from this study, PD initiatives at the Royal University of Bhutan are now being implemented and funded by EUFSTIAT, a project funded by the Erasmus Plus Programme.

Keywords: Professional Development, Assessment Techniques, Royal University of Bhutan, Classroom Assessment Inventory

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Introduction

Context and Importance of Professional Development

In the current educational landscape, characterized by rapid technological advancements and shifting pedagogical paradigms, professional development (PD) is crucial for educators (Darling-Hammond et al., 2017; Jacob et al., 2015). PD programs help faculty members stay updated with the latest teaching methodologies, learning technologies, and assessment strategies, ultimately leading to improved educational outcomes (Bergmark, 2020; Sims & Flecher-Wood, 2020). Despite the availability of general PD programs, there is a growing recognition of the need for tailored PD that addresses specific institutional and disciplinary needs (Kohan et al., 2023; Steinert, 2016; van Dijk, 2023).

Purpose of Needs Assessment

The primary purpose of this study was to conduct a needs assessment across nine colleges, using existing tools from the literature, to identify the specific gaps in teaching, learning, and assessment. The outcomes of this assessment are intended to guide the development of customized PD programs that directly address the identified needs, ensuring that faculty members receive the support necessary to enhance their instructional practices and student engagement.

Research Gap

While the literature well-documents the importance of PD (Darling-Hammond et al., 2017; Jacob et al., 2015), there is a paucity of research on needs assessments that focus specifically on teaching, learning, and evaluation across multiple institutions (Kohan et al., 2023; Steinert, 2016; van Dijk, 2023). This study seeks to fill this gap by providing empirical data on faculty needs across nine distinct colleges, contributing to the broader understanding of how PD programs can be better designed and implemented.

Literature Review

Theoretical Framework

This study is grounded in the theory of andragogy, as articulated by Knowles and colleagues (2015), whose seminal work has been cited over 27,000 times. The theory outlines six fundamental principles, emphasizing that as adults mature, they become increasingly independent and self-directed, taking charge of their learning decisions. Adults leverage their extensive life experiences to comprehend new concepts and skills more effectively, making these experiences a crucial asset in learning. They are incredibly motivated to learn when the content directly relates to their personal or professional lives, addressing immediate needs or challenges. With a problem-centered orientation, adults focus on acquiring practical skills that can be immediately applied rather than purely theoretical knowledge.

Additionally, adults are primarily driven by internal motivators, such as the desire for self-improvement and personal growth. For educators, applying andragogy in teaching requires fostering active participation, utilizing learners' experiences, and ensuring the content's relevance and immediate applicability. In this context, needs assessment is essential for identifying these specific learning needs and ensuring that professional development (PD)

programs are relevant and effective (Behar-Hosenstein et al., 2014; Malicka et al., 2017). This study aligns with pedagogical principles by focusing on teaching, learning, and assessment, promoting PD tailored to faculty members' unique needs.

Previous Studies

Research has consistently shown that effective PD programs are essential for improving teaching, learning, and assessment practices of the faculties of higher education institutions and enhancing student learning outcomes. For instance, a study by Darling-Hammond and colleagues (2017) found that effective PD programs are ongoing, focused on specific content areas, and aligned with educators' needs. Similarly, Desimone (2009) and Malicka and colleagues (2017) highlight the importance of PD, which is directly linked to instructional practices and student learning. Despite these findings, many PD programs still need to be more generic and connected to the actual needs of faculty, underscoring the importance of conducting needs assessments (Othayman et al., 2022).

Challenges and Criticisms

Despite the recognized importance of needs assessments, several challenges exist in their implementation (Othayman et al., 2022). One significant challenge is ensuring that the data collected is accurate and reflective of the actual needs of the faculty (Othayman et al., 2022). This requires using validated instruments and careful data analysis (Bastos et al., 2014). Additionally, there is often a disconnect between the findings of needs assessments and the actual implementation of PD programs, with some institutions failing to translate identified needs into actionable PD initiatives because of the disconnect (Parry-Jones & Soulsby, 2002). Parry-Jones and Soulsby (2002) state that the disconnect arises due to an unclear concept of needs and a need for a straightforward assessment framework. This study used three different data collection tools to determine the needs of the Royal University of Bhutan faculty members to counter the risk, as cited by Parry-Jones and Soulsby (2002).

Methodology

Research Design

The needs assessment used a convergent parallel mixed-methods approach (Creswell, 2021). The data were collected using mixed-methods survey questionnaires (Creswell & Hirose, 2019), providing a comprehensive understanding of faculty needs. The study utilized existing validated instruments to ensure reliability and validity in data collection.

Data Collection

Data were collected from 318 faculty members across nine colleges. The survey instruments included sections on teaching practices, learning strategies, and assessment beliefs. These surveys were administered in person, ensuring broad participation. The questionnaire also contained qualitative survey items intended to enable the participants to write their perspectives, which were not included in the quantitative survey items.

The study used the Approaches to Classroom Assessment Inventory Version 3 (ACAI V3) (CART, 2019). The ACAI-V3 instrument is divided into three parts, with the current study focusing on Part C, which addresses assessment beliefs (CART, 2019). Part C is structured

into four primary dimensions: assessment purpose, assessment process, assessment fairness, and assessment theory. Each dimension comprises three specific priority areas. The purpose of assessment encompasses the assessment of learning, assessment for learning, and assessment as learning. The assessment process involves designing, using/scoring, and communicating assessments. Assessment fairness covers standards, equity, and differentiation in assessment practices. Assessment theory pertains to consistency, contextualization, and balance within the theoretical framework of assessment. In addition to the four primary dimensions, Part C incorporates an additional dimension labeled "assessment beliefs."

Specific questionnaire items are developed for each priority area, culminating in 32 items within Part C (CART, 2019). The distribution of items is as follows: assessment of learning, assessment for learning, and assessment as learning each has two questions; design, use/scoring, and communication each has two questions; standards, equity, and differentiation each has two questions; and consistency, contextualization, and balance each has two questions. The "assessment beliefs" dimension is more extensively covered, with eight dedicated questions. Each has seven levels: strongly agree, agree, disagree, strongly disagree, and do not know.

The surveys were distributed through a direct, in-person approach, ensuring thorough engagement with the participants. A dedicated team of researchers visited each of the nine colleges to administer the paper-and-pencil questionnaires. Before distributing the surveys, the researchers conducted a brief orientation session to inform participants about the survey's purpose, objectives, and significance. This session was essential for clarifying any questions and securing informed participation. Participants were provided consent forms after this briefing, which they were asked to review and complete. After collecting the consent forms, the researchers distributed the survey questionnaires to the faculty members. This method allowed for immediate clarification of doubts and ensured a high response rate. Participation was robust, with all faculty members, except those on long-term study leave, participating in the survey. This hands-on approach facilitated a comprehensive data collection process, minimizing the potential for non-response bias and enhancing the reliability of the findings. The response rate was 52%.

Sample

Data were collected using a census approach, ensuring comprehensive participation across the faculty. An initial invitation letter was sent to all faculty members, encouraging their involvement in the survey. Faculty members on campus during the survey administration participated directly in the study. For those off-campus at the time, arrangements were made to facilitate their participation upon their return. Paper-and-pencil questionnaires were left at their respective colleges, allowing these faculty members to complete the survey at their convenience. This method ensured that the study captured a diverse sample, representing faculty from various disciplines, including the humanities, social sciences, and STEM fields, thereby enhancing the generalizability of the findings across different academic areas.

The survey was conducted across nine colleges affiliated with the Royal University of Bhutan, covering a range of academic disciplines. The participating institutions were Paro College of Education (46 respondents), Gedu College of Business Studies (37), College of Science and Technology (35), Samtse College of Education (31), Jigme Namgyel College of Engineering (44), Sherubtse College (33), Gyalpozhing College of Information Technology

(14), College of Language and Cultural Studies (32), and the College of Natural Resources (45). In total, 317 out of 610 faculty members participated in the survey. The diverse fields, including education, business, engineering, information technology, and natural resources, provided a comprehensive overview of the university's academic environment. Table 1 shows the demographic variables of the participants.

Table 1: Demographic Variables

Demographic variables	Frequency %
Gender	
Male	71.8
Female	28.2
Age	
Below 25	4.8
25-29	17.4
30-39	29.7
40-49	27.4
50-59	19.7
Above 60	1.00
Academic Degree	
Bachelor	20.5
Master	63.5
PhD	16.5
Others	4.4
Pfofessional Degree	
Do not have	39.1
Bed (Primary)	1.9
BEd (Secondary)	4.1
PGCE	44.5
MEd	10.4
Teaching Experience	
One Year or Less	9.7
Two Years	7.1
Three Years	6.5
Four years	2.6
Five years	3.2
More than five years	71.0

Data Analysis

Data collected using the Approaches to Classroom Inventory Assessment Version Three (ACAI-V3) were analyzed to compare and synthesize insights into faculty members' beliefs about assessment.

Alignment of Constructs.

The study aimed to determine whether significant differences exist among the faculty members of the nine colleges' beliefs about assessments. The following steps were undertaken in SPSS version 29 to analyze the data:

- The dataset consisted of responses from 317 participants across nine colleges. Each participant's responses to the 32 items were coded on a scale of 1 to 6, with do not coded 7, with higher scores indicating stronger agreement.
- The 'Do not Know' response option was treated as missing data after it was confirmed to be missing completely at random (MCAR), as indicated by Little's MCAR test, $\chi^2(2244)=2326.520$, $p=.110$.

Factor Analysis.

Factor analysis was conducted to identify the underlying structure of the 32 items designed to measure assessment beliefs across multiple dimensions. The goal was to reduce the data into a smaller set of factors that explain the observed correlations among the variables.

Tests for homogeneity of variance were conducted to assess the consistency of variance across different dimensions. A p-value greater than 0.05 typically indicates homogeneity. In this analysis, only three dimensions showed p-values below 0.05, as detailed in Table 2.

Table 2: Dimensions With Levene Statistics Showing P-Values Below 0.05

Dimension	Based on Mean	Levene Statistics	df1	df2	p-value
Assessment Fairness	Based on Mean	3.046	8	8	.003
Assessment Theory	Based on Mean	2.372	8	8	.017
Assessment Purppse	Based on Mean	2.611	8	8	.009

The Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted to assess the normality of the factors across the nine colleges. Generally, a p-value greater than 0.05 suggests that the data do not significantly deviate from normality. In this analysis, most colleges exhibited p-values greater than 0.05, indicating normality. However, the following dimensions and colleges showed significant deviations from normality, as detailed in Table 3.

Table 3: Kolmogrov-Smirno and Shapiro-Wilk Tests

Dimension	College	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistics	df	p	Statistics	df	p
Assessment Process	Sherubtse College	.254	20	.001	.873	20	.013
Assessment Fairness	College of Language and Cultural Studies	.268	19	<.001	.813	19	.002
Assessment Theory	College of Science and Technology	.313	15	<.001	.869	15	.033
	Sherubtse College	.206	20	.026	.874	20	.014
Assessment Purpose	Samtse College of Education	.212	11	.180	.799	11	.009

The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.79, indicating that the sample was suitable for factor analysis. Bartlett's Test of Sphericity was significant ($\chi^2(496)=1828.17$, $p<.001$), confirming that the correlations among variables were sufficient for the analysis.

Principal Component Analysis was employed to extract factors from the 32 items. An initial analysis was run to obtain eigenvalues for each factor in the data. Nine factors had

eigenvalues greater than one and explained 64.23% of the variance. Based on the scree plot, nine factors were retained for further analysis.

Nine components were extracted based on their eigenvalues (greater than 1), explaining 64.218% of the variance. The initial unrotated solution showed that the first component had an eigenvalue of 6.720, accounting for 20.999% of the variance. The second component had an eigenvalue of 3.803, explaining an additional 11.884% of the variance, with the first two components cumulatively explaining 32.883%. Subsequent components explained progressively less variance, with the ninth component accounting for 3.215%, resulting in a cumulative variance of 64.218% across the nine components.

A Varimax rotation was applied to improve the factor structure's interpretability. After rotation, the variance explained by the first component was reduced to 11.999%, and the second component explained 11.177% of the variance. The rotated solution redistributed the variance evenly across the components, resulting in a more apparent factor structure. The first nine components collectively explained 64.218% of the total variance after rotation, with the variance contributions of the components now more balanced.

The principal component analysis (PCA) was conducted to explore the underlying factor structure of the 32 items related to faculty's assessment beliefs. The analysis employed Varimax rotation to enhance the interpretability of the components. The results of the rotated component matrix are presented in Table 4.

Table 4: Rotated Factor Loadings

Item	Component								
	1	2	3	4	5	6	7	8	9
1	.783			.227					
2	.717			.199		-.181		.228	.180
3	.697	.174			.135		.183		.156
4	.647			.181		-.117	.185	.111	
5	.567	.515			-.122	.198			.114
6	.551	.420			.263	.191	.118		
7	.546							.346	.502
8	.488	.186		.317					
9		.836						.100	
10	.124	.675			.141		.152		
11	-.116	.669	.172	.176		.210		.340	
12	.137	.642	.174	.149	.251				.150
13		.532		.522				.249	.137
14		.482	.188	.202	.163	.239	.217	-.138	-.356
15			.826			.173			
16		.135	.776		-.249			.205	
17			.717			.108	.107	-.218	.212
18	.230			.711				.122	
19	.326	.126		.548			.166	-.174	.364
20	.270	.188	.214	.547	.110	-.136			
21	.249	.175	-.242	.469	-.258	.386			
22		.139			.839	.150			-.123
23		.388	.126		.614	-.146	-.118	.165	.353
24	.251	.180	-.234		.595		.385		
25		.182	.236			.794			
26	-.207	.135	.528	-.127		.576		.257	.103
27	-.150		.195	.202	.290	.494		.185	.403
28			.116				.833		.126

Table 4 (cont.)

29	.230		.333	-.136	.633	.217	
30	.223	.140	.167	.115	.178	.670	-.186
31	.194	.289	.261			.607	.217
32	.103	.239			.235	-.112	.662

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 11 iterations.

Nine distinct components were identified through the analysis. Upon close examination of the ACAI V3 items and its literature, Component 1 is identified as Assessment Purpose, Component 2 as Assessment Process, Component 3 as Assessment Fairness, Component 4 as Assessment Theory 1, Component 5 as Assessment Theory 2, Component 6 as Negative Perceptions of Assessment, Component 7 as Time and Overuse of Assessment, Component 8 as Motivation and Positive Impact of Assessment, and Component 9 as Assessment as an Enjoyable Experience. However, it is essential to note that these actual dimensions, as revealed through exploratory analysis, differ from the expected dimensions reported in the ACAI V3 model. Table 5 shows the items and components.

Table 5: Components and Items

Components	Item No.	Items
Assessment Purpose	1	The primary purpose of classroom assessment is to assign a grade or level to student work.
	2	Classroom assessment should be used to determine if students have met programme standards.
	3	Feedback from classroom assessments improve student learning.
	4	By using assessment, teachers can track the progress of students.
	5	Students should use assessments to evaluate their own work.
	6	Students are able to provide accurate and useful feedback to each other.
	7	Teachers have the skills and knowledge to construct good assessments.
	8	For good classroom assessment, teachers need extensive knowledge of the curriculum.
Assessment Process	9	Classroom assessment involves judging a student's performance in relation to a set of goals/standards/criteria.
	10	Classroom assessment is integral to developing lesson plans and implementing curriculum.
	11	Classroom assessment should be used to provide evidence of student progress for administrative purposes.
	12	Classroom assessment is useful when reporting a student's achievement/progress to parents and caregivers.
	13	An important component of classroom assessment is students taking largescale tests (e.g., provincial assessment, EQAO).
	14	Provincial assessments (e.g., EQAO) are a meaningful form of assessment.
Assessment Fairness	15	All classroom assessments should be adapted to suit the learning needs of identified students (e.g., English language learners).
	16	Students with exceptionalities should be provided with different classroom assessment than other students.
	17	For good assessment, teachers need to know how their students learn.

Table 5 (cont.)

Assessment Theory 1	18	Classroom assessment helps teachers identify the particular learning needs of any student.
	19	Classroom assessment results provide reliable information.
	20	Classroom assessment involves teachers making judgements about how well a student is learning in relation to other students.
	21	Classroom assessment results is a good indicator of the quality of a school.
Assessment Theory 2	22	Assessment results reflect the quality of teaching.
	23	Assessment is an imprecise process.
	24	Observing students is a valid form of assessment.
Negative Perceptions of Assessment	25	Classroom assessment is of little use to teachers on a day-to-day basis.
	26	Classroom assessment interrupts students' learning.
	27	Assessment is a stressful activity for students.
Time and Overuse of Assessment	28	Assessment takes time away from teaching.
	29	Teachers use too many assessments.
Motivation and Positive Impact of Assessment	30	Assessment is a positive force for improving the social climate in a class.
	31	Classroom assessments motivate students to do their best.
Assessment as an Enjoyable Experience	32	Assessment is an engaging and enjoyable experience for students.

Comparison of Expected and Actual Factors.

This study explored the underlying dimensions of assessment-related beliefs and practices among educators. It compared theoretically expected factor groupings with those from our data analysis. Table 6 summarizes these comparisons, highlighting both alignments and discrepancies between the anticipated and actual factors.

Table 6: Expected Factors and Actual Factors

Expected Factor (Item)	Actual Factor (Item)	Comments
Assessment Purpose (1-6)	Assessment Purpose (1-8)	The inclusion of items 7 and 8 suggests that the actual data supports a broader conceptualization of assessment purpose than initially theorized. These additional items may also relate to how assessment is perceived in terms of its goals or intentions, leading to their inclusion in this factor.
Assessment Process (7-12)	Assessment Process (9-14)	This shift indicates that items 7 and 8, expected to belong here, aligned better with the Assessment Purpose factor. Items 13 and 14, which were not initially expected in this group, seem to align more with the practical aspects of the assessment process in the data.
Assessment Fairness (15-18)	Assessment Fairness (15-17)	This divergence suggests that fairness is perceived differently in practice, with items 17 and 18 potentially relating more closely to other factors such as Assessment Theory.
Assessment Theory (19-24)	Assessment Theory (18-21)	The split indicates that the theory-related items may involve distinct theoretical constructs. For instance, items 18 through 21 might relate to foundational theories, while 22 through 24 could pertain to specific applications or implications of those theories.

Table 6 (cont.)

	Assessment Theory (22-24)	This separation from the earlier grouping within Assessment Theory suggests that these items may represent a distinct aspect of theoretical understanding, potentially related to specific applications of assessment theory.
Assessment Beliefs (25-32)		The actual factors reveal a more nuanced understanding of assessment beliefs, suggesting that participants differentiate between negative, positive, and motivational aspects of assessment. The final item (32) stands out as its own factor, likely due to its distinct focus on the enjoyment aspect of assessments.
	Negative perceptions of assessment (25-27)	The actual factors reveal a more nuanced understanding of assessment beliefs, suggesting that participants differentiate between negative, positive, and motivational aspects of assessment.
	Time and overuse of assessments (28-29)	The grouping of these items indicates concerns specifically related to the time-consuming nature and potential overuse of assessments, a focus not as distinct in the original expected factor.
	Motivation and Positive Impact of Assessment (30-31)	This factor highlights positive beliefs regarding assessment's role in motivation and social climate, expanding the expected beliefs factor into a more positive dimension.
	Assessment as an enjoyable experience (32)	The final item stands out as its own factor, likely due to its distinct focus on the enjoyment aspect of assessments, which was not originally anticipated as a separate construct.

The factor analysis revealed insightful deviations from the expected structure of the assessment items. Initially, it was assumed that the items would align with predefined factors based on theoretical assumptions drawn from existing literature. However, the data suggested a different configuration, indicating the need to reevaluate how these factors are conceptualized across cultures. Barnes and colleagues (2017) state that teachers' conceptions of assessment differ across contexts, reflecting teachers' internalization of their cultural priorities and practices.

One of the key findings was related to the Assessment Purpose factor. While items 1 through 6 were expected to align with this factor, the analysis showed that items 7 and 8 also clustered under this category. This suggests that participants perceive the purpose of assessment in a broader context than initially theorized. These additional items may reflect a more comprehensive understanding of assessment goals, highlighting the importance of considering practical perceptions when defining the purpose of assessments.

The Assessment Process factor also revealed an unexpected configuration. Initially, items 7 through 12 were anticipated to belong to this factor. However, the analysis showed that items 7 and 8 aligned more with the Assessment Purpose than the Assessment Process. In contrast, items 13 and 14, not expected to be part of this factor, emerged as critical components of the Assessment Process. This finding indicates that participants may view the assessment process more practically, emphasizing aspects not initially considered in the theoretical framework.

Another interesting result was observed in the Assessment Fairness factor. The expectation was that items 15 through 18 would align with this factor. However, only items 15 and 16 matched this expectation, while items 17 and 18 were found to relate more closely to other

factors, such as Assessment Theory. This suggests that fairness is perceived more specifically by participants, reflecting distinct aspects of fairness that were not captured by the initial grouping.

The analysis of the Assessment Theory factor revealed a more complex structure than initially anticipated. The expected grouping included items 19 through 24, but the factor analysis split these into two groups. Items 18 through 21 appeared to relate to foundational theoretical constructs, while items 22 through 24 pertain to specific applications or implications of these theories. This split highlights the nuanced understanding of assessment theory among participants and suggests that different theoretical aspects are perceived as separate entities.

Lastly, the factor analysis of Assessment Beliefs uncovered a more detailed structure within this category. Although it was expected to encompass items 25 through 32, the analysis revealed distinct sub-factors. These included negative perceptions of assessment, concerns about time and overuse, and positive beliefs regarding assessment's motivational impact and social benefits. Interestingly, item 32 emerged as its factor, likely due to its focus on the enjoyment aspect of assessment, which was not anticipated in the initial theoretical model.

Overall, the factor analysis results suggest that the participants' perceptions of assessment are more complex and varied than the original theoretical model proposed. The emergence of new factors and the realignment of items within existing factors indicate a need for further exploration and refinement of these constructs in both theory and practice. This revised understanding could lead to more targeted and effective approaches to assessment in educational settings.

Composite scores for each dimension were calculated by averaging the items that load onto each factor, representing the participant's level of agreement or belief about each factor.

Reliability Analysis.

Cronbach's Alpha was calculated to assess the internal consistency of the items within each identified factor. Cronbach's Alpha is a measure of reliability that indicates how well the items within a factor are correlated and whether they consistently measure the same underlying construct. Table 7 shows the reliability analysis.

Table 7: Reliability Analysis

Expected Factor (Item)		Actual Factor (Item)		Note
Factor	Cronbach's Alpha	Factor	Cronbach's Alpha	
Assessment Purpose (1-6)	0.563	Assessment Purpose (1-8)	.651	The Cronbach's Alpha for the actual factor (1-8) is higher than expected (1-6), indicating improved internal consistency when additional items are included. This suggests that items 7 and 8, which were initially not included in the expected factor, contribute positively to the coherence of the assessment purpose factor.
Assessment Process (7-12)	.675	Assessment Process (9-14)	.688	The Cronbach's Alpha for the actual factor (9-14) is slightly higher than the expected factor (7-12), reflecting better internal consistency. This may be due to the inclusion of items 9-14, which align well with the practical aspects of the assessment process, leading to a more reliable factor.

Table 7 (cont.)

Assessment Fairness (13-18)	.589	Assessment Fairness (15-17)	.472	The actual Cronbach's Alpha for Assessment Fairness (15-17) is lower than the expected factor (13-18). This decrease suggests that the items 15-17 may not fully capture the intended concept of fairness as effectively as originally anticipated. Items 13 and 14, which were not included in the actual factor, might have contributed to the higher reliability observed in the expected factor.
Assessment Theory (19-24)	.699	Assessment Theory (18-21)	.756	The actual Cronbach's Alpha for Assessment Theory (18-21) is higher than the expected factor (19-24), indicating better internal consistency with this subset of items. This suggests that items 18-21 are particularly effective at capturing the theoretical aspects of assessment. However, items 22-24, which were not included in this factor, have a lower Cronbach's Alpha (0.461) in a separate factor, indicating a weaker reliability in capturing theory-related constructs.
		Assessment Theory (22-24)	.461	The lower Cronbach's Alpha for this group of items suggests that items 22-24 may be less reliable in measuring the theoretical constructs compared to items 18-21. This might indicate that these items pertain to different aspects of assessment theory that require separate consideration.
Assessment Beliefs (25-32)	.647			The Cronbach's Alpha for the expected factor (25-32) is 0.647, but specific sub-factors show varying reliability. This suggests that the overall reliability of assessment beliefs is acceptable, but further analysis of individual sub-factors is necessary.
		Negative perceptions of assessment (25-27)	.604	The Cronbach's Alpha for this sub-factor indicates moderate reliability in measuring negative perceptions of assessment. This suggests some consistency in responses regarding negative views but also highlights areas for potential improvement.
		Time and overuse of assessments (28-29)	.705	The higher Cronbach's Alpha for this sub-factor indicates good reliability in capturing views on time and overuse of assessments. This suggests a strong internal consistency among items related to this issue.
		Motivation and Positive Impact of Assessment (30-31)	.653	The reliability of this sub-factor is satisfactory, indicating that the items effectively measure motivation and the positive impact of assessment. However, there is room for improvement compared to the higher reliability observed in other sub-factors.
		Assessment as an enjoyable experience (32)		The Cronbach's Alpha for this single item is not provided, suggesting that its reliability should be evaluated in the context of overall assessment beliefs or potentially through further validation methods

Descriptive Analysis.

Table 8 presents the descriptive statistics for the composite scores of the identified factors, summarizing the mean, standard deviation (S.D), standard error (S.E), skewness, and kurtosis for each factor.

Table 8: Descriptive Statistics

Dimension	N	Mean (S.D)	Skewness (S.E)	Kurtosis (S.E)
Assessment Process	195	4.39 (.69)	-.344 (.174)	-.013 (.346)
Assessment Fairness	290	4.80 (.82)	-.591 (.143)	-.136 (.285)
Assessment Theory	300	4.59 (.79)	-.898 (.141)	1.967 (.281)
Assessment Purpose	289	4.68 (.56)	-.364 (.143)	1.120 (.286)
Assessment Theory 2	276	4.11 (.79)	-.427 (.147)	.605 (.292)
Negative Perspective about Assessment	296	3.10 (.99)	.083 (.142)	-.157 (.282)
Time and Overuse of Assessment	291	3.53 (1.22)	-.086 (.143)	-.634 (.285)
Motivation and Positive Impact	291	4.36 (.90)	-.483 (.143)	.196 (.285)

The descriptive statistics for the factors reveal varying levels of agreement among participants. Skewness values range from -0.898 to 0.083, and kurtosis values range from -0.157 to 1.967, indicating that the distributions are mostly within acceptable limits for normality (skewness: ±2, kurtosis: ±2). The mean scores suggest that participants generally leaned toward agreement across most factors, with the highest mean observed for "Assessment Fairness" and the lowest for “Negative Perceptions of Assessment.”

The ANOVA Analysis.

The ANOVA analysis in Table 9 evaluates the variability in several factors across different groups, particularly nine colleges. This statistical method examines how group means differ on various assessment factors, highlighting the differences in perceptions or experiences related to these factors. The table provides a comprehensive overview of the variability both between groups and within each group, offering insights into how these factors are perceived differently across the participating colleges. The following sections interpret the results for each factor, focusing on the significance of the differences observed.

Table 9: The ANOVA Analysis

Dimension	Group	Sum of Squares	df	Mean Square	F	Sig.
Assessment Process (AP)	Between Groups	10.734	8	1.342	3.053	.003
	Within Groups	81.753	186	.440		
	Total	92.487	194			
Assessment Fairness (AF)	Between Groups	28.353	8	3.544	5.994	<.001
	Within Groups	166.141	281	.591		
	Total	194.494	289			
Assessment Theory 1(AT1)	Between Groups	5.671	8	.709	1.141	.336
	Within Groups	180.856	291	.621		
	Total	186.527	299			
Assessment Purpose (AP)	Between Groups	1.577	8	.197	.615	.765
	Within Groups	89.725	280	.320		
	Total	91.302	288			
Assessment Theory 2 (AT2)	Between Groups	6.317	8	.790	1.290	.249
	Within Groups	163.423	267	.612		
	Total	169.740	275			
Negative Perspective about Assessment (NPA)	Between Groups	20.022	8	2.503	2.654	.008
	Within Groups	270.698	287	.943		
	Total	290.721	295			

Table 9 (cont.)

Time and Overuse of Assessment (TOA)	Between Groups	13.006	8	1.626	1.103	.361
	Within Groups	415.716	282	1.474		
	Total	428.722	290			
Motivation and Positive Impact (MPI)	Between Groups	11.829	8	1.479	1.888	.062
	Within Groups	220.894	282	.783		
	Total	232.723	290			

The ANOVA results revealed significant differences across groups for several factors related to assessment. Specifically, a statistically significant variation in perceptions of the Assessment Process, $F(8,186)=3.053, p=.003$, indicating that different groups perceive the assessment process differently. Additionally, perceptions of Assessment Fairness varied significantly across groups $F(8,281)=5.994, p<.001$, suggesting fairness is not uniformly perceived. Finally, significant differences were found in Negative Perceptions of Assessment (NPA), $F(8,287)=2.654, p=.008$, highlighting that some groups hold more negative views on assessment than others. These findings point to notable differences in how assessment is experienced and perceived across the studied groups.

In the robust tests of equality of means, the Welch test was used to account for potential violations of the assumption of homogeneity of variances. The results indicated significant differences in the means between groups for Assessment Process, $F(8,55.765)=3.444$, $p=.003$, and Assessment Fairness, $F(8,99.921)=5.675$, $p<.001$, suggesting that these factors are perceived differently across the groups studied. Additionally, significant differences were observed for Negative Perceptions of Assessment (NPA), $F(8,102.783)=2.691$, $p=.010$, indicating variability in negative views toward assessment among the groups. However, no significant differences were found for Assessment Theory, Assessment Purpose (APur), Assessment Theory 2 (AT2), Time and Overuse of Assessments (TOA), or Motivation and Positive Impact of Assessment (MPA), implying consistent perceptions across groups for these factors. These findings underscore the importance of understanding group-specific perceptions, particularly regarding the assessment process, fairness, and negative assessment perceptions.

The post-hoc Bonferroni tests, conducted following significant ANOVA results, revealed specific group differences in assessment perceptions (see Table 10). The GCIT group scored significantly higher in Assessment Fairness (AF) than the CLCS and SCE groups. Similarly, JNCE scored higher in Assessment Fairness (AF) than CLCS and SCE and higher in Assessment Purpose (AP) than GCB. The PCE group exhibited significantly higher scores in Assessment Purpose (AP) compared to both GCB and GCIT and in Assessment Fairness (AF) compared to CLCS and SCE. These findings indicate considerable variations in how different groups perceive the fairness and purpose of assessments.

Table 10: The Bonferroni Tests

Group Mean Diff (Sig.)	JNCE	PCE	SC
CLCS	.676 (.010) (AF)		
GCB	.732 (.001) (AF)		.60 (.041) (AP)
GCIT		-.972 (.037) (AP)	-.991 (.004) (AF)
		-.868 (.015) (AF)	
SC Mean	-.970 (.001) (AF)	-.742 (.006) (AP)	

* The mean difference is significant at the 0.05 level.

Conclusion

This study highlights the process of contextualizing an existing tool, the Approaches to Classroom Assessment Inventory Version 3 (ACAI-V3), to better understand faculty assessment beliefs at the Royal University of Bhutan. The contextualization process focused on two primary themes: adapting the ACAI-V3 (CART, 2019) dimensions to the local context and uncovering actionable insights that can guide the design of professional development (PD) initiatives (Malicka et al., 2019; Sims et al., 2020). The findings of this study provide a critical perspective on how faculty members perceive assessment, as well as the challenges they face when implementing assessment practices in their specific institutional and cultural context.

The ACAI-V3, originally structured around global theoretical constructs such as consistency, fairness, and balance, was designed to assess faculty beliefs on assessment. The tool's Part C focuses on four primary dimensions: assessment purpose, assessment process, assessment fairness, and assessment theory. However, the study revealed that these global constructs did not fully align with the realities of faculty experiences at the Royal University of Bhutan. To address this, the study employed a process of contextualization to adapt the tool and ensure it reflected local beliefs and practices (Behar-Hosenstein et al., 2014).

One of the key themes that emerged during this contextualization process was the adaptation of the dimensions of assessment purpose and fairness. The original ACAI-V3 categorizes fairness into standards, equity, and differentiation. However, faculty members at the Royal University of Bhutan indicated that their perceptions of fairness were shaped by local institutional policies, cultural norms, and specific challenges encountered during assessment implementation. In particular, fairness was often seen through the lens of aligning grading criteria with the diverse educational backgrounds of students, which presented additional challenges not captured by the original tool. Therefore, the contextualization of fairness required a deeper exploration of how these local factors influenced faculty beliefs, leading to a refined understanding of fairness within the Bhutanese educational context. Similarly, the dimension of assessment purpose, which traditionally includes assessment of learning, for learning, and as learning, was also adapted based on local practices. Faculty responses revealed a nuanced understanding of these purposes, where certain assessment functions were emphasized over others depending on the institutional context and teaching practices. This finding necessitated a revision of the assessment purpose dimension to capture better how faculty in Bhutan perceived the role of assessment in teaching and learning. Another significant area for adaptation was the dimension of assessment theory, particularly regarding consistency and contextualization. While the original ACAI-V3 strongly emphasizes consistency within assessment frameworks, the study identified that faculty at the Royal University of Bhutan faced significant challenges when trying to apply these theoretical frameworks in practice. This was primarily due to lacking resources, support, and clear guidance in implementing theoretical concepts in real-world assessments. Therefore, the tool was adjusted to reflect better the limitations faculty faced in applying theoretical constructs, particularly the need for more practical support in aligning assessment theory with local conditions.

The findings from this contextualized application of the ACAI-V3 tool emphasize the importance of tailored PD initiatives that address faculty members' specific needs and perceptions. The study revealed significant variation in faculty beliefs about assessment across different colleges within the Royal University of Bhutan. For example, some colleges

prioritized fairness and transparency, while others were more concerned with understanding the purpose of assessment. These findings underscore the inadequacy of a one-size-fits-all approach to PD (Behar-Hosenstein et al., 2014; Darling-Hammond et al., 2017; Malicka et al., 2017). Instead, PD programs should be customized to meet the distinct needs of different faculty groups, focusing on areas such as student-centered assessment strategies, innovative assessment tools, and enhancing faculty capacity to use assessment data for instructional decisions. The study also uncovered specific gaps in faculty practices related to negative perceptions of assessment, workload, and motivation. For instance, negative perceptions of assessment were often linked to high workloads, unclear assessment criteria, and perceived unfairness in grading. These issues pointed to a need for PD programs that address these concerns by providing strategies for managing assessment workloads, clarifying grading criteria, and improving fairness in assessment practices. Faculty members desired greater transparency in assessment processes, further reinforcing the need for PD programs to focus on these aspects.

Building on the insights gained from this study, several key areas emerge for future research and development to further refine assessment practices at the Royal University of Bhutan and similar institutions. One critical direction is developing context-specific professional development (PD) programs. This study identified significant gaps in faculty understanding of assessment fairness, the alignment of grading criteria with diverse student backgrounds, and the practical application of assessment theories. Tailored PD initiatives should be created to address these needs, focusing on enhancing faculty competence in these areas. Furthermore, continuous evaluation of PD programs will be necessary to ensure they remain relevant and practical, adapting to faculty members' changing needs and contexts over time (Desimone, 2009; Kohan et al., 2023). A second important avenue for future research involves cross-institutional and cross-cultural comparisons of assessment practices. The contextualization process used in this study offers an opportunity to explore how assessment tools, such as the ACAI-V3, can be adapted across different educational settings and cultural environments. By conducting comparative studies, researchers can better understand how universal constructs such as assessment fairness, purpose, and process might vary in different institutional contexts and the specific challenges faculty members face in each setting. This research could lead to broader insights into the flexibility and applicability of assessment frameworks.

Future studies could expand by incorporating student perspectives to provide a more holistic understanding of assessment practices. Comparing faculty and student perceptions of fairness, effectiveness, and alignment with learning objectives could uncover misalignments and improve assessment methods, ensuring they are fair, practical, and meaningful for all stakeholders. Additionally, exploring alternative assessment methods, such as formative, peer, and self-assessments, could address fairness concerns, reduce faculty workload, and increase student engagement. Research could also investigate how institutional policies shape faculty beliefs and practices, particularly regarding consistency and fairness, which could inform policies for more equitable assessment. Longitudinal studies could assess the long-term impact of contextualized assessment practices and PD interventions, identifying the most effective components. As technology becomes increasingly integrated into education, future research could explore how digital tools can streamline assessment, provide real-time feedback, and address fairness issues, modernizing assessment practices. Lastly, fostering collaboration among faculty in designing and reviewing assessment policies could reduce resistance to change, ensuring that assessment guidelines are practical and grounded in teaching realities and promoting ownership and accountability.

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Contact email: gembotshering.pce@rub.edu.bt

Detection of Particles With a Fog Chamber: Experiential Learning With IPN High School Students

Guillermina Ávila García, Instituto Politécnico Nacional, Mexico

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Abstract
This experience is derived from the SLTP (Spanish Language Teacher Programme) conducted at the European Organization for Nuclear Research (CERN), which is offered to science and technology teachers at the pre-university level. The SLTP integrates lectures, visits to the experimental facilities and workshops, particularly in this inquiry with emphasis on the fog chamber construction workshop. SLTP aims for teachers to return to their educational institutions as ambassadors to transmit and promote the study of particle physics with a scientific approach to their students. This work shows an experimental practice through the construction of a fog chamber in a high school of the National Polytechnic Institute in Mexico, this experience is a simplified version that is proposed in the teacher training courses at CERN. The exploratory qualitative approach methodology was implemented in a study with 40 students who participated in the fog chamber experiment. This study seeks to understand the perceptions and experiences of the students through semi-structured interviews and focus groups, allowing an in-depth exploration of their reactions and learning during the experiment. The data collected are oriented to how the visual results are interpreted and the impact of the exercise on the understanding of scientific concepts. The approach allows for capturing the richness of their experience and reflections, which provide a solid foundation for future research for extension throughout the IPN.

Keywords: Particle Physics, Fog Chamber, Scientific Knowledge

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Introduction

The experience presented in this paper is based on the Spanish Language Teacher Program offered by the European Organization for Nuclear Research (CERN), which is designed for science and technology teachers at pre-university levels. The program is mainly aimed at bringing modern science to the classroom, contributing to scientific culture and promoting studies in related fields.

One of the objectives of this program is to improve the skills of science teachers, so that they can later transmit scientific advances to their students and their communities in the Spanish language; this CERN project was developed with the idea of bringing CERN's cutting-edge scientific work to a wider audience.

Among the activities carried out in this program is the specialized workshop, in this research the emphasis is on the fog chamber workshop, which is one of the most popular educational and informative activities in the field of experimental physics (CERN, n.d).

In order to disseminate the knowledge understood at CERN is that the strategy is implemented with students of a high school in Mexico considering that they are studying the last semester in the educational institution and the last course of Physics in the same, being the objective of this inquiry was oriented in analyzing how the experience of the construction of the fog chamber and the observation of particles promotes the development of scientific skills, the formulation of questions and critical reflection of the study and understanding of particle physics with high school students, considering as research axis question: how does the observation of particle trajectories detected in the fog chamber influence the reflective thinking of the student?

Particle Physics

The physics of elementary particles, whose objective is to discover the basic pieces of which it is built and the laws that these obey, is a fundamental part of science (Barradas and Alameda, 2010) and when we talk about particles in educational institutions with students sometimes it seems frustrating, since students consider something unreal, The fog chamber activity takes into account that students can become familiar with the subatomic world and thus generate the curiosity that leads them to a critical and reflective attitude, but based on experimental verification (Barceló et al., 2010).

Prior to the construction of the fog chamber, questions about charged particles were considered, such as: how do they reach the Earth, where do they come from and how do they obtain so much energy? And with that, the concept of cosmic rays, which continually strike the atmosphere, is initiated. These cosmic collisions produce large amounts of high-energy particles that are scattered in all directions, some of which reach us here on the surface of the planet. However, most people are unaware of this bombardment; the particles are usually smaller than an atom and do not stimulate any of our senses, using a fog chamber, students can visualize the actual particle trajectories resulting from these cosmic rays (Hine & Davidowsky, 2018).

The fog chamber is a device used to visualize charged particles, such as cosmic rays, interacting with air in the atmosphere.

One way to observe cosmic rays is through a fog chamber that can be constructed with materials such as isopropyl alcohol, dry ice, and containers to supersaturate the chamber. When a charged particle, such as a cosmic ray, passes through the chamber, ions are generated along the particle's path and the alcohol vapor condenses (NMNS, 2024). This physics phenomenon is intended to allow students to observe particles and, in the process, become engrossed in learning particle physics through arguments and interaction with their peers.

Curriculum

The high school of the National Polytechnic Institute (IPN) offers several areas of knowledge, among which are: (1) Engineering and physico-mathematical sciences, (2) Social and administrative sciences, (3) Medical-biological sciences, this inquiry is based on area (1), according to the plan and program of studies, the physics learning unit is studied in the last four semesters. The Physics IV learning unit is in the last semester and the study methodology is based on the study of competencies, emphasizing the development of didactic sequences that meet the Learning Results (RAP).

Physics as a natural and experimental science requires a practical approach that integrates knowledge and reflection on the study of natural phenomena based on the laws and principles of Physics (IPN, 2008).

Project Based Learning (PBL)

PBL is one of the active strategies of teaching and learning, which allows the development of competencies according to the graduate profiles (Castro, 2022; Botella & Ramos, 2019) point out a reference that is oriented to meet the urgencies of reality by implementing research strategies, knowledge and skills that will be part of their new learning. One of the benefits indicated by Fernandes et al. (2018) is that collaborative and/or team work with which it is possible to build shared knowledge and in that sense, as mentioned by Cardoso (2018), collaborative work involves participation, the exchange of ideas of the members, enabling the acquisition of new knowledge.

Cobo and Valdivia (2016) mention and consider the following stages of PBL:

- Project approach and organization; where a series of ideas of the students' interests are presented, and the activities are designed.
- Research on the topic is the collection of information and is where the teacher guides and provides feedback for the realization of the project.
- Definition of the objectives and work plan; the objectives are established, what the students are expected to learn, as well as the resources to be used, the times and activities to achieve these objectives.
- Implementation; with a very relevant role for the teacher, since he/she must be attentive to the process, monitor and be aware of the difficulties and opportunities to make the necessary adjustments.
- Presentation of a particle physics expert and evaluation of the results; it is the implementation of the competencies, establishing the evaluation criteria to determine the objectives achieved.

In this active methodology that constitutes PBL involves the acquisition of knowledge, beliefs, attitudes, skills and behaviors, considering the implementation of linguistic,

cognitive, motor and social skills (Castro, 2022; Schunk, 2012), this methodology also entails that teachers are all the time vigilant and attentive to the resolution of doubts or solve problems that may arise during the process (Cesar et al., 2021); in addition this educational approach allows students to engage in critical thinking, collect information and analyze data (Osman et al., 2021), considering that it also stimulates interests (Ojaleye et al., 2018), with this PBL is a powerful tool, which significantly improves students' performance in physics (Nicholus et al., 2023).

In agreement with the previous authors, this staging is justified, due to the construction that the students carry out with their own means, and the questions that arise, in addition to issues that are proposed and that are jointly triangulated with the plan and syllabus of the educational institution.

Problem

A problem that has been identified in the learning unit of Physics IV is the extensive programmatic content, which integrates the study of physics; relativistic, quantum and high energy, the curriculum and syllabus states that these studies will be carried out at the end of the semester, which causes students to conduct a study without much depth, or even more so without a reflection of the subject associated with the laws that justify in physics phenomenon. On the other hand, the laboratory does not have the necessary resources to carry out these experimental practices with topics of this nature.

Physics is distinguished by the practicality of the experiments of physical phenomena, but in high energy physics it becomes a bit complex, being in this way has been chosen because students build their own fog chamber with simple materials available in their daily environment and thus relate the theory studied in class and verify with experience with particles.

Methodology

The methodology with qualitative approach based on Project Based Learning (PBL), in which 40 high school students of the Centro de Estudios Científicos y Tecnológicos No. 11 of the Instituto Politécnico Nacional in Mexico City participated in the year 2023, considering the plan and program of studies 2008, the students are studying the penultimate semester in the educational institution. The project was carried out in a period of 5 weeks.

The didactic sequence was planned according to the active PBL strategy, considering the objective of building a fog chamber for the observation of subatomic particles, promoting experiential learning and the development of scientific skills. The didactic sequence is described below:

Week 1. Approach to the activity, time: 2 hours.

Phase 1. The challenge and approach of the activity, to know the interests of the students, an initial survey was carried out with open questions: What do they understand by particle; if they have heard of the European Organization for Nuclear Research CERN, if they know the acronym of CERN, with a Likert scale: how much do they know about subatomic particles, how much they would like to know about particle physics, if they know the traces left by an airplane, if they know the traces left by an airplane, if they know the traces left by an

airplane, if they know the traces left by an airplane, How much do you want to know about particle physics, do you know about the traces left by an airplane, do you know that a particle can be observed through a detector, would you like to observe one or several particles? The form for this initial survey was hosted in the following space: https://bit.ly/3C7qNqo.

Subsequently, the concept of subatomic particles and their importance of study in Physics was presented; and images of a fog chamber were transmitted.

Week 2. Project design, time: 2 hours.

Phase 2. Research on particles and how to build the fog chamber; organization of work teams to start with the research on particles and the functioning of the fog chamber, the materials to carry out the construction of the chamber, possible challenges that would be faced in the search for the material, making block diagrams to keep track of the steps to follow in the construction of the fog chamber.

Week 3. Research and application, time: 4 hours.

Phase 3. Definition of the objectives; indicating to the students what is expected during the process of construction of the fog chamber, if there is need to make some modifications with respect to the material, time to achieve the activities for the achievement of the objectives, which in this case is to achieve that the students relate the theoretical concepts with the assembly of the fog chamber.

Week 4. Experimentation, time: 4 hours.

Phase 4. In this week, students carry out the construction of the fog chamber in the laboratory in a period of four hours, take photographs, record observations, take video and in teams reflect on the differences they find in the observed traces, guided by the questions.

Week 5. Presentation and evaluation, time: 2 hours.

Phase 5. In this phase the teams prepare presentations integrating their findings, challenges if any during the construction of the fog chamber. Presentation of the results and evaluation using the previously known rubric. As a closing, a self-evaluation of the experiment and group reflections are made. Finally, an expert culminates with a lecture on particle physics and other novelties of the universe, the guest is Dr. Javier Santaolalla, an expert disseminator.

Thus, teaching strategies as a set of actions that are projected and implemented in an orderly manner achieve a certain purpose (Jiménez & Robles, 2016); during the process of building the fog chamber four elements that acquire roles according to the moments are interrelated, which according to Castro (2022) are: the teacher, the student, the content and the variables in context (which refers to the characteristics of the school/classroom).

Results

With reference to the results of week 1, they are shown in the following table:

Table 1: Results of the Initial Survey on Particle Knowledge

Question	Answer	Descriptor
What do you understand by particle?	Something very small Structure of the atom The smallest part of the atom	This question considers the prior knowledge that students must identify improvement after implementation.
Have you heard of the European Organization for Nuclear Research (CERN)?	Yes = 2 students No = 38 students	The purpose of the question is to find out how much they know about the most important particle physics research center to date.
How much do they know about subatomic particles?	More than I would like = 1 About right = 30 Less than I would like = 9	Knowledge of this answer will be for the teacher's initiation to the topic.
Do you know the traces left by an airplane?	Yes = 8 No = 32	As can be seen from the responses, most do not know the traces, so the construction of the fog chamber will be an incentive to generate curiosity.
Do you know that a particle can be observed through a detector?	Yes = 12 No = 28	With this response, students show that they have at least heard of particle detectors.
Would you like to observe one or more particles?	Yes = 39 No = 1	The interest shown by students in this response is a first approach to what is expected in practice.

Table 1 shows the results and openness to the study of particles by the students and shows a good indication for collaborative work towards the construction of the fog chamber.

From phase 2, the students carry out a brief investigation on the particles and the operation of the fog chamber, together with the materials to carry it out, they make a block diagram that considers the steps to be followed for the construction. The research was discussed in class through brainstorming, from which the following main ideas were obtained and shown in Figure 1.

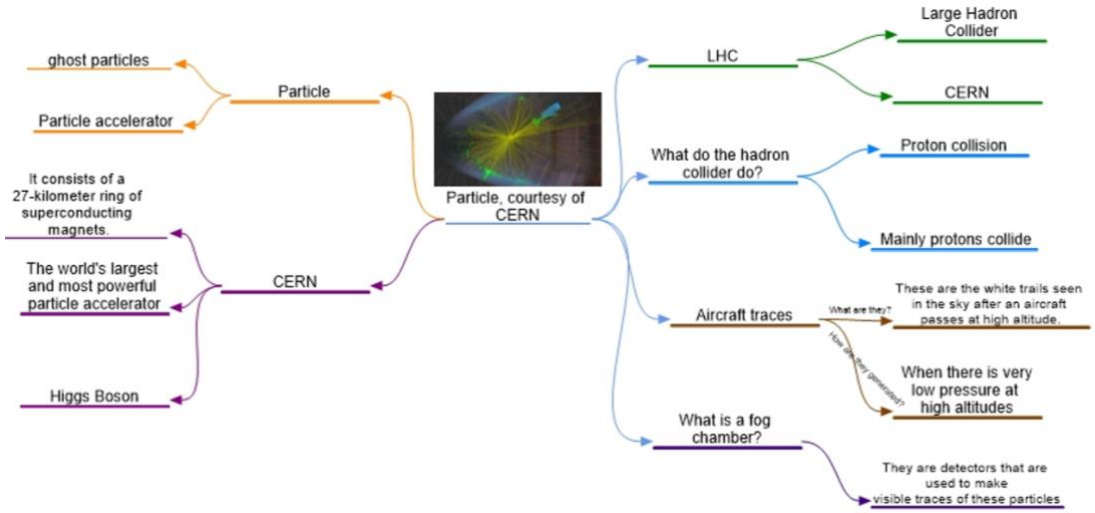

Figure 1: Brainstorming Is Based on the Research Carried Out. Own Production

In this sense, answers oriented towards the study of particles have been generated. Figure 1 shows the main ideas that were generated in the classroom during the review of the investigations.

In phase 3, the objective and the relation of concepts that the students have investigated are related. The lines followed in the inquiry are shown in Figure 2.

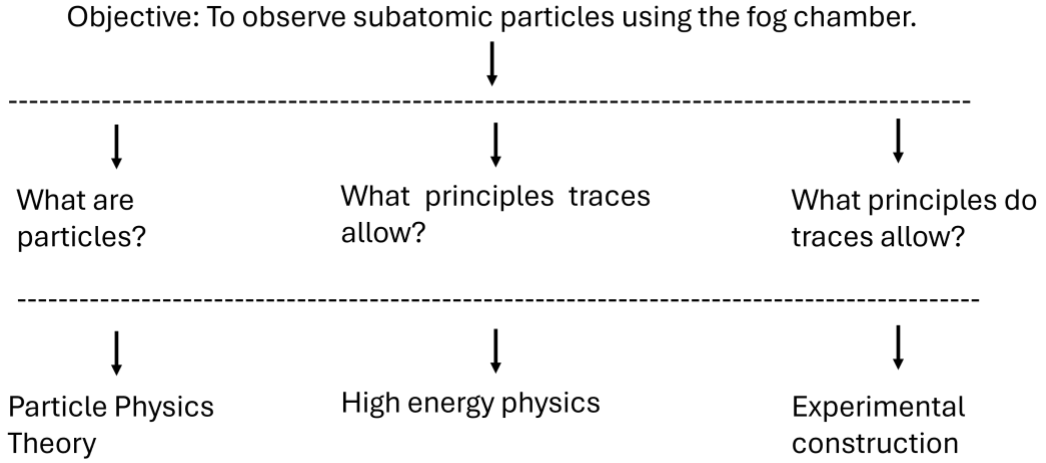

Figure 2: Relationship of Objectives and Concepts for the Construction of the Fog Chamber

Phase 4 is the heart of this inquiry, the construction of the fog chamber allowed a degree of interaction among students that enriched the little previous knowledge and exceeded the initial expectation that the teacher author of this work had, since at least two students will be dedicated to Physics in university studies. Organized into 8 teams of 5 people, they worked on the construction of the fog chamber.

The construction of the chamber generated new ideas that are illustrated in Table 2 below:

Table 2: Results of Questions Categorized by Order of Repetition

Category	Frequency	Example of a textual response
Significant learning	25	I enjoyed watching the experiment, it takes a long time, but it is worth it.
Conceptual learning	15	The concept of particles is a little clear to me, but I would like to know more.
Procedural learning	35	Experiments have something magical in science, you see it and understand it better.
Collaboration and teamwork	40	While some were making observations, others were building and that helps a lot because you realize where you are going wrong.
Technical challenges	30	It took a long time, I thought we could observe fast, the average was 35 minutes. But it was great.
Personal reflection	35	I keep the idea that the experiments are linked to the part you are investigating, it is very interesting to check something that is not simple to the human eye.

Creativity and innovation	25	Since the experiment wasn't coming out, we had to flip the sheet over, but the dry ice was starting to stop working. A darker place is what makes it easier, as well as using the dim light from the cell phone.
Project impact	38	I liked the project and the research I did so much that it made me want to study physics. I know that I must first study classical physics.
Difficulties	20	At the beginning, since we didn't read, we didn't know how to start making the camera. And I think all the teams were like that. But the teacher explained it to us and from there it was easier.
Improvement proposals	25	I know it is not valid to say that we should be told to wait some time, so as not to despair. But maybe it is good to mention it.
Interdisciplinary connection	21	Knowing mathematics and chemistry complements this experiment, because when I did the research, they mentioned equations and above all I saw a periodic table.

These results show the understanding of the theoretical concepts related to the project of the construction of the fog chamber, in addition to showing that through the experience through the construction and manipulation of materials it is possible to acquire certain skills such as observation, formulation of questions, reflective thinking and teamwork, in addition to the collaboration that is noticeable when they support each other and contribute ideas to solve technical issues, which led them to face challenges by adjusting the ideas they had at the beginning of the experience. Also, in addition to these learnings mentioned, it is relevant to note that students express personal emotions and a change of perception, for example, in the case of the two students who had no interest in making a fog chamber construction for particle observation.

The impact of this project goes beyond learning, it shows an interest in science, particularly in particle physics, by mentioning that they are eager to continue with this type of studies at the university level.

Each obstacle allowed them to enrich their visions, when comparing the comments of the teammates, although the students indicate the need to mention the waiting time to observe the particle or particles in the fog chamber, that this was the surprise inside the laboratory, it is undoubtedly that they optimized the time of observation and recording of anomalies during the experiment.

Only some students achieved a connection of other disciplines and that at the time of sharing a deeper reflection regarding chemistry was known in depth, since the research conducted by the students consisted of how the use of hydrogen in the form of compressed gas and it starts with this gas because it is the starting point to obtain protons needed for experiments, and it is an element studied in chemistry.

Castro (2022) insists that collaborative work involves participation and especially the exchange of ideas of the members, in this case the team members, which facilitated interaction and communicative skills through experiential learning, where also teacher played a crucial role because the guidance mentioned by the students that they received when they saw that their fog chamber did not work.

Phase 5. Evaluation and presentation by an expert researcher with Dr. Javier Santaolalla who attended the IPN facilities.

First, use was made of the rubric shown in Table 3, considering the following aspects.

Table 3: Rubric for Evaluation of the Presentation

	Descriptor		
Indicator	**Excellent**	**Intermediate**	**Low**
PPT presentation of the experimentation	The presentation shows photographs of the experience, explaining the events that occurred and justifying each of the events.	The presentation only shows pictures of the experience, ambiguously explaining either the facts or the justification of the facts.	Does not present any type of information.
Learning reflection	Reflects on the learning achieved for each activity and question posed. Shows the corrections of possible errors, indicating where he/she made a mistake and how he/she managed to understand the topic.	Reflects on the learning achieved by some activity and question posed. Shows the corrections of some possible errors, indicating where he/she made a mistake and how he/she managed to understand the topic.	Does not reflect on the learning achieved for each activity or question posed. Does not show corrections of possible errors, does not indicate where he/she made a mistake and how he/she managed to understand the topic.
Presentation and handling of concepts related to the fog chamber.	Explain scientific principles with precision and clarity, using appropriate technical terms and relevant examples. Correctly integrates related physics and chemistry concepts.	Explain the principles in a basic way, but with conceptual errors or oversimplifications. The use of technical terms is limited or confusing.	Fails to explain the scientific principles related to the fog chamber or shows significant misconceptions.

As a result of the rubric in each aspect, the following results were obtained:

Table 4: Results of the Evaluation Rubric

	Descriptor		
Indicator	**Excellent**	**Intermediate**	**Low**
PPT presentation of the experimentation	25 out of 40	8 out of 40	7 out of 40
Learning reflection	8 out of 40	20 out of 40	12 out of 40
Presentation and handling of concepts related to the fog chamber.	15 out of 40	15 out of 40	10 out of 40

Finally, the conference with Dr. Javier Santaolalla allowed students to realize and especially to corroborate the information they had already investigated and put into practice, the conference gave rise to a deeper reflection of the content of particle physics, some of the comments of the students are expressed below:

> [...] These conference experiences if that I like because of my learning I consider that this complete, it is a lot of emotion that if I could understand several things that Javier Santaolalla mentioned.
> [...] Javier Santaolalla is one of my favorites, I always follow him, seeing him in person and talking about what we did in the lab makes me excited. I have a very good knowledge in physics.
> [...] I think that now we had a very good tour of knowledge, and the conference, well, I can only say that it was great, it made me change my perspective of a common class.
> [...] Keep bringing lecturers of that stature, but I also hope that the teachers give us a well updated class, this was something very modern for me, combining many issues to learn the concept of particles.

Figure 3 shows an image of the lecturer and the students, who had the opportunity to interact briefly.

Figure 3: Relationship of Objectives and Concepts for Construction

Conclusions

PBL is a methodology that undoubtedly adds some gain in the conceptual part, in this case the progress of students becomes evident with the different stages that were experienced in the classroom laboratory.

For PBL to be a success in the classroom or in this case in the laboratory, the didactic design and the strategic plan, as well as the guidance of the teacher is undoubtedly a set of elements that allow an effective process and application.

The relationship of the different processes that lead to knowledge in students refers to the skills of dexterity, but above all of motivation and interaction with their peers in such a way that they build their knowledge using research and corroborating in an experiential way the theoretical part.

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Contact email: gavilag@ipn.mx

Enhancing English Language Proficiency for Primary School Students Through the Implementation of Online Interactive Multimedia Learning

BoMing Yang, Rajamangala University of Technology Thanyaburi, Thailand
Piyanan Pannim Vipahasna, Rajamangala University of Technology Thanyaburi, Thailand

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Abstract
This study investigates the use of online interactive multimedia learning to enhance basic English skills (listening, speaking, reading, and writing) among primary school students in China. Moving beyond traditional classroom methods and textbook content, the study aims to develop a comprehensive approach to improving students' foundational English abilities. The study has two main objectives include 1) to compare the pre-test and post-test results, analyzing whether there is a significant difference in English proficiency when using online interactive multimedia learning 2) to assess students' satisfaction with learning English through this method. The research was conducted with 15 primary school students in China, aged 8 to 10 years, in grades 3 and 4. These students were selected using a simple random sampling technique, ensuring no significant difference in their initial English proficiency. The findings reveal: 1) the average post-test scores were significantly higher than the pre-test scores, indicating a positive impact on students' English proficiency ($p < .05$), 2) online interactive multimedia learning was found to enhance teaching effectiveness, boost students' interest and enthusiasm, and foster greater interaction and communication among students and between students and teachers. This research underscores the potential of online interactive multimedia as a valuable tool in modernizing English language education, making it more engaging and effective for young learners.

Keywords: Online Interactive Multimedia Learning, Primary English, Basic English Skills

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Introduction

With the rapid development of network and information technology, interactive multimedia learning methods are also constantly updated. The role of traditional multimedia methods in education has gradually exposed its shortcomings of insufficient capabilities and lack of innovation. Nowadays, artificial intelligence-based interactive tools such as AI and AR are developing rapidly, and their perfect combination with other multimedia has brought great impetus to the innovation and development of the education industry.

As the world's largest language, English occupies a high position in the development of the education industry in various countries. English is a second foreign language for Chinese students. The teaching model of English learning and students' learning methods have always been the focus of Chinese English education practitioners.

1. Research of Objectives

This research aims to combine online interactive multimedia learning with the teaching of primary school students' basic English learning abilities (listening, listening, reading and writing), and realize the organic combination of network information technology and multimedia in teaching, so as to meet the needs of students' personalized learning and change Student learning methods and teacher teaching methods.

1.1 Investigate and study students’ learning effects before and after using online interactive multimedia learning.

1.2 Investigate and study the satisfaction of students with online interactive multimedia learning.

2. Research Definition

Through the study of the subject of English in primary school teaching, teachers are no longer limited to the teaching tasks of words, sentence patterns and basic grammar, but also allow teachers to update their teaching methods in the teaching tasks of basic English phonetic symbols. At the same time, it also allows students to say goodbye to boring vocabulary, phonetic symbol memory and tedious sentence grammar learning, allowing students to master the basic abilities of English learning in fun, and greatly mobilizes students' enthusiasm for English learning. Provide students and teachers with a good learning and teaching experience by making full use of different forms of interactive multimedia learning methods.

3. Research Methods

3.1 Variables

The independent variable is the online interactive multimedia learning software used for students’ English learning.

The dependent variable is (1) The students' performance before and after and the improvement of their basic English learning abilities (listening, speaking, reading and writing); (2) Students' satisfaction with online interactive multimedia learning and their development potential in teaching.

3.2 The population

The subjects of this study were 200 third and fourth grade primary school students from Xigu Primary School in Xigu District, Lanzhou City, Gansu Province. The sample for this study was 15 students from Xigu Primary School in Lanzhou City, Gansu Province, China. The 15 students were randomly selected from grades 3-4.

3.3 The research instruments consisted of:

1. Online interactive multimedia learning application software for English learning.
2. The students were pre-test and post-test.
3. "Questionnaire star" APP.

3.4 Data and Statistical Analysis

3.4.1 Evaluation of online interactive multimedia learning by sample students.

3.4.2 Use t test dependence to compare the situation test before and after using online interactive multimedia learning.

3.4.3 By means of mean and standard deviation, this paper studies students' enthusiasm for using online interactive multimedia learning to improve students' learning interest.

3.5 Content

First of all, This paper focuses on students' perception and feedback on interactive multimedia learning; secondly, the role of interactive multimedia learning in improving the four basic abilities of Chinese primary school students in English listening, speaking, reading and writing application; finally, there are precautions for developing and applying interactive multimedia learning in primary school English teaching in the future.

4. Conclusion

The analysis result of the above information answers to the research objectives as follows:

4.1 Comparison of students' learning tests in English classes using online interactive multimedia learning.

Table 1: The Effect of Using Interactive Multimedia Learning in the Classroom for English Learning

Items	n	$\bar{X}$	S.D.	t-test	Sig. (2-tailed)
Pre-test	15	10.87	1.125	-17.872	.000*
Post-test	15	17.67	1.291		

*p<0.05

The table shows the effect of using interactive multimedia learning in the classroom for English learning, which improves students' interest in learning English. The average score before the test was 10.87 points. The test score was 1.125, SD. After using interactive multimedia learning, the average score after the test was 17.67, and students' interest in

learning English increased significantly, with a score of 1.291, S.D. The t-test analysis before and after the test was -17.872, and the difference was statistically significant at the 0.05 level.

By comparing the learning performance of students using online interactive multimedia learning in English classes, the results show that after using online interactive multimedia learning, students scored higher in the post-class test of English classes, reaching a significant level of 0.05. When students choose to use appropriate online interactive multimedia learning to learn English, online interactive multimedia learning can produce effective learning effects. This is because novel technologies such as dynamic graphics and images, interesting video animations, clear and guiding audio and voice software can improve students' learning interest and efficiency (Xia Bing, 2021; Houria Kelkoul, Adil Zabadi, Youssef Zaz, 2023; Djusmaini Djamas, Vonny Tinedi, Yohandri, 2018) compared online interactive multimedia learning with traditional learning methods. The results showed that students who used online interactive multimedia learning achieved higher grades, with a significance level of 0.05.

4.2 Analyze students' satisfaction scores with English learning through interactive multimedia learning.

From the data results, it can be concluded that the average scores of students are between 4.20 and 4.80, which is above average. The highest average score is "the difficulty of the test questions is suitable for students" (4.80). The lowest average score is "the unit exercises are sufficient to check understanding", which is 4.20. The overall average score of this dimension is 4.52, indicating that students are highly satisfied with improving basic English skills (listening, speaking, reading and writing) through online interactive multimedia learning.

The above research results show that the application of online interactive multimedia learning in English learning has a significant effect on improving students' basic English ability and significantly improving their grades. At the same time, students are highly satisfied with the application of online interactive multimedia learning in English learning, which shows that online interactive multimedia learning is conducive to the improvement of students' learning and promotes the development of teaching models and methods. The above research results are consistent with the results and situation of literature research (Yang Yi, 2019; Wang Wenjing, 2021; Huang Chao, 2021).

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Podcasting in Teacher Education Can Enhance Critical Discourse and Collaborative Learning: Reflections From Researcher-Practitioners

Delecia Davids, Stellenbosch University, South Africa
Elzahn Rinquest, Stellenbosch University, South Africa

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Abstract
This study investigates the impact of podcasting on student engagement and learning within two distinct higher education modules: Information and Communication Technologies (ICTs) for Learning and Sociology of Education. Employing a Design-Based Research approach, the study integrated podcasting activities into these courses, exploring how this innovative pedagogy could foster critical thinking, creative expression, and collaborative learning. Drawing upon Gibb's reflective cycle for practitioner reflection, the study examined how podcasting can enhance student engagement and learning. Key findings reveal that podcasting significantly enhanced student engagement, with students demonstrating a deeper understanding of course content through critical listening and analysis of existing podcasts and by creating their own podcasts on educational topics related to the modules. Furthermore, podcasting fostered student autonomy and flexibility through asynchronous learning opportunities. Collaborative learning was significantly enhanced, as students engaged in peer feedback, group discussions, and shared decision-making during the podcast creation process. Notably, podcasting facilitated the creation of "third spaces" for learning, where students engaged with academic content in more personalised and reflective ways. This study provides valuable insights into the effective integration of podcasting into higher education curricula, stressing the importance of considering diverse learning styles, fostering critical listening skills, and creating supportive learning environments for successful implementation.

Keywords: Critical Discourse, Digital Pedagogy, Teacher Education, Third Spaces, Design-Based Research, Podcasting

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1. Introduction

This reflective essay documents our journey of integrating podcasting into two teacher education modules. Driven by the challenges of large class sizes and a desire to foster deeper student engagement, we employed a Design-Based Research (DBR) approach to explore the potential of podcasts to enhance teaching, learning, and assessment. This paper shares our reflections on the design, implementation, and evaluation of these podcasting activities, drawing upon Gibb's reflective cycle to guide our analysis.

1.1 Context and Background

We are reflecting on the first iteration of integrating podcast-related activities into the teaching, learning and assessment (TLA) across two modules in a teacher education programme at one South African University. Podcasts are "user-generated audio creations that are uploaded to hosting websites and delivered to listeners' electronic devices through various applications" (Lowe et al., 2021, p. 431) and have emerged as versatile educational tools, with diverse applications explored in recent literature. These applications encompass enhancing teacher professional development, encouraging interdisciplinary teaching methods, facilitating flexible and accessible learning experiences, and nurturing essential technical, communication, and critical skills. Our project had two aims: The first was to integrate podcasts into our teaching practice to overcome the challenges of large class sizes in higher education, and the second was to document the process and outcome to improve and critique our own practice as emerging scholarly teachers. The larger project, which we will call the podcast project, emanated from our early success in co-initiating and supporting students to create a co-curricular podcast called Staffroom Chatter in 2022. We collectively saw early signs of podcast activities deepening the student hosts' critical discourse and influencing their teacherly becoming, and we wanted all our students to develop these capacities in some way. At the end of 2023, we thus asked ourselves, how could we scale the podcast activities in the teacher education programme?

We then embarked on collectively conceptualising the activities we wanted to include in our TLA practices and the podcast research study. We were drawn to the Design-Based Research approach (Collins et al., 2004; Sayre, 2023). as it outlined systematic yet iterative cycles of design, implementation and evaluation phases, which we could map onto our teaching and learning calendar for the year. Along with exploring literature on podcasting in education and searching for a conceptual framework to guide our practice and our study, we developed a more specific question: How can we design authentic teaching, learning, and assessment (TLA) experiences incorporating podcasting across two modules in PST coursework? This question forms the basis of our reflective essay, which attempts to capture the "messy, unfinished, personal work of SOTL (Scholarship of Teaching and Learning)" (Healy et al., 2019, p. 32) by sharing our lived experiences and the meaning we derive from it, which often remains overlooked in other types of scholarship (Healy et al., 2019, p. 32). By reflecting on our experiences in designing, implementing, and scaling the podcasting project across two modules in the teacher education program at Stellenbosch University, we aim to gain a deeper understanding of the challenges, opportunities, and transformative potential of this innovative approach.

1.2 The Context of Teacher Education at the University

South Africa has experienced a massification of higher education, which has resulted in an increased lecturer-to-student ratio in classes. Large class sizes and traditional teaching methods often hinder student engagement, leading to passive learning, disengagement, and a lack of critical thinking. Our podcast project was thus born out of an attempt to overcome these challenges. Traditional educational settings often operate with a one-to-many framework, characterized by a single teacher addressing students over a hundred students in a lecture hall, which fosters a silent audience (Cope & Kalantzis, 2022, p. 12) and thus, not all students participate in the critical discourse which forms part of our teaching and learning practice.

At Stellenbosch University, a historic white university which is the context of our project and study, preservice teachers are enrolled for a four-year Bachelor of Education programme. Each year, the preservice teacher cohort ranges from 120 – 150 students per class group, yet in 2023, at our institution, the classes increased to approximately 270 students per group. While attempts were made to support teaching and learning within the context of increasing student numbers, the number of lecturers as primary teaching staff remained the same.

At our institution, we generally enjoy high rates of connectivity on campus, with Wi-Fi being accessible to all students and computer user areas available for use 24 hours a day. Additionally, our Moodle-based learning management system (LMS) serves as a platform for all asynchronous learning. The LMS has mainly been used as a repository for teaching and learning materials, although post the pandemic, more functionalities have found their way into the TLA activities, with the use of discussion forums and online quizzes increasing. However, the digital divide remains a significant issue in South Africa (Dlamini, 2022; Rinquest, 2023), as connectivity, access, and proficiency in using technological infrastructure are often limited for poorer communities, disproportionately affecting those with challenging socio-economic circumstances. Our practice as teacher educators thus operates in a particularly challenging context, having to prioritise the development of digital literacy among preservice teachers, which is not only a national requirement (MRTEQ, 2015) but also a (future) institutional graduate attribute captured by the idea of the digital knower (Stellenbosch University, 2023).

2. Literature and Theoretical Frameworks

During our conceptualisation phase, we began exploring existing literature on podcasting to gather ideas and insights from others' practices. Our project was thus informed by existing literature from the onset. To this end, we begin our journey by highlighting the literature that informed our practice and ultimately was integrated into our approach and reflections.

2.1 Exploring Existing Literature on Podcasting in Education

Researchers like Fernández-Batanero and colleagues (2022) have investigated podcasts as platforms for continuous teacher education. These studies highlight the need for teacher professional development focusing on digital skills enhancement and bridging disciplinary gaps through collaborative exploration of diverse topics among students and educators (Waldron et al., 2023).

Podcasts also stand out as tools for flexible and accessible learning when engaging with lecturer or expert-generated content. Scholars such as Shahrizal and colleagues (2022) and Strickland and colleagues (2021) have emphasised their asynchronous nature, allowing students to engage with educational content at their own pace. Moreover, podcasts enhance accessibility, offering students an accessible medium to access high-quality, peer-generated content. This accessibility fosters a sense of community and shared learning experiences, enriching the overall educational journey (Milligan et al., 2021). Podcasts also foster learner-teacher rapport, enhancing approachability and connections in online learning environments (Conroy & Kidd, 2022).

Furthermore, podcasts are instrumental in the development of technical and communication skills. Students engaging in podcast creation refine their technical abilities, including editing and production, enhancing their overall digital literacy proficiency. Additionally, podcasts serve as platforms for honing critical communication and storytelling skills, encouraging students to construct narratives, articulate ideas effectively, and engage diverse audiences (Waldron et al., 2023).

A noteworthy area of application for podcasts is in promoting critical race discourse and social justice education. Podcasts, as highlighted by Harris (2019), provide a unique space to discuss sensitive topics, challenge prevailing narratives, and foster critical thinking. Similarly, Ferrer, Lorenzetti, and Shaw (2020) have explored the role of podcasts in social justice education, demonstrating their capacity to bridge the academic-community gap. These studies underline podcasts as powerful tools encouraging deep engagement with societal challenges, promoting critical dialogue, and enhancing social awareness among students.

Our first cycle of TLA activities was thus informed by evidence-based practices elsewhere in the world and assisted us in making decisions about the type and number of activities to include. Armed with this knowledge, we embarked on the collective implementation of podcast-related activities across the two modules in the teacher education programme at Stellenbosch University. However, before we could begin our research related activities, we needed to ground ourselves in a particular theoretical framework, which we briefly discuss next.

2.2 Searching for Helpful Theoretical and Conceptual Frameworks

Since we had already noticed something to improve in our practice and articulated our design problem, we searched for a helpful theory within which to frame our practice and our future analysis of the data we would be collecting. Since both of us have our postgraduate scholarship rooted in the sociology of education, we drew on frameworks which we were familiar with, or we were beginning to explore in other areas of our research, but that could help us to understand and describe our podcasting project in a theoretically informed way. We present this in figure 1 below.

Elzahn: *During my PhD research on identity and school space, the works of Bhabha (1994) and Soja (1998) played a pivotal role in shaping my theoretical framework. Their concept of the "third space" offered valuable insights into how identities are negotiated and redefined within dynamic and contested spaces. While my original research focused on schools, I now find these ideas equally relevant in our exploration of podcasting as a pedagogical tool.*
Bhabha's notion of the third space as a realm of negotiation and hybridity helps us view podcasting as more than just a digital platform. It becomes a space where pre-service teachers (PSTs) engage with diverse perspectives, critically reflect, and collaboratively construct new identities. Similarly, Soja's interpretation of third spaces as socially and spatially contested sites offers a lens to understand how podcasting mediates power dynamics and societal struggles, encouraging PSTs to navigate and challenge established structures.

Both scholars emphasize the concept of emergence (Deleuze & Guattari, 1987), underscoring the fluid and evolving nature of identity. This idea resonates with my TLA practices, where creating reflective spaces for PSTs is central. By incorporating podcasting into our work, we aim to cultivate a third space that fosters critical engagement and the development of hybrid identities, connecting theory with practice. The intersection of Bhabha's and Soja's theories with podcasting highlights its potential as a transformative educational tool, bridging my research on school spaces with innovative pedagogical practices in teacher education.

Delecia: *When we conceptualised the project, I had just completed my PhD proposal, which used De Leuze and Guattari's (1987) assemblage theory as part of its conceptual framework. Assemblage theory views teacher education as a network of entangled relations and interactions, or "irreducible social wholes comprising of heterogenous elements" (Bacevic, 2019). These elements include the university, staff, classroom technologies, schools, and national/provincial policies, all of which exert some influence on PSTs' experiences. It made sense to me to explain podcasting in a traditional higher education classroom as a disruptive activity that deterretorialised the university setting – that is, it challenges the traditional notions of power and erodes boundaries and structures since the HE classroom and its conversations can become public through sharing student-created and curated podcasts online, for anyone to comment on and engage with. Assemblage theory and its related concepts thus gave explanatory power to understanding 'what happens' when we introduce new digital technologies and multimodal platforms in a traditional, large classroom setting, emphasising the sociomaterial nature of the TLA activities that we were planning to implement.*

Figure 1: Excerpt From Researcher-Practitioner Journal

By selecting these theories, we created a conceptual framework where we see podcasting as a transformative sociomaterial third space for teacher education. This means utilising podcasts as a medium for diverse cultural and social practices to intersect, where podcasting becomes a platform for these interactions, enabling PSTs to explore the fusion of various backgrounds. Moreover, podcasts are not just digital content; they epitomize dynamic social and spatial practices, where PSTs must engage in active negotiation and contestation of interests, challenging conventional power dynamics within higher education.

At this point of our journey, we understood that through intentional planning and implementation of well-thought-out activities, we could provide PSTs with opportunities to bring together diverse perspectives, challenge traditional narratives, and provide opportunities for critical reflection and identity formation.

3. Methodology: A Reflective Approach

We felt the need to reflect on our practice as we encountered both successes and challenges during the first iteration of our project and needed to make sense of these before embarking on the second iteration. We needed to take stock of what we were able to achieve and why things panned out the way they did. In the DBR approach, (re)developing the intervention after trying the intervention forms part of a mini cycle (see Figure 1) of implementation and evaluation.

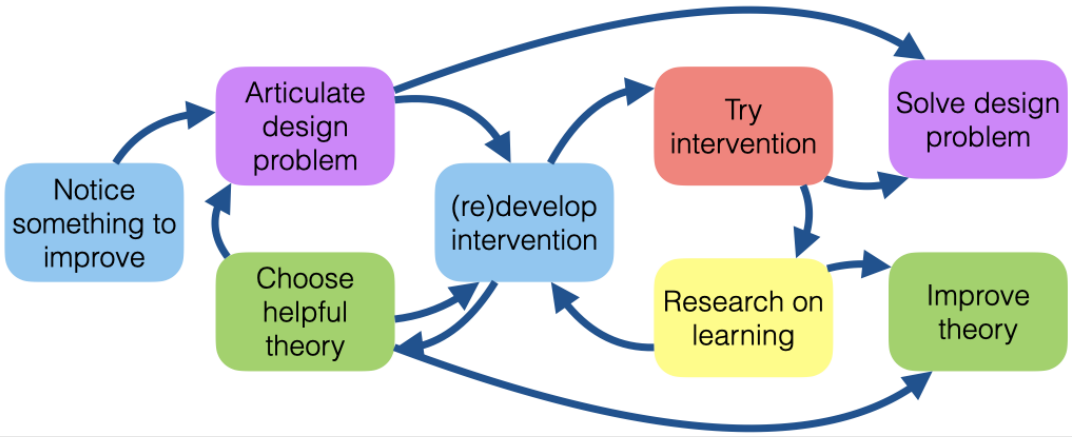

Figure 2: The Design Process From Start to End (Sayre, 2023. Available at: https://handbook.zaposa.com/articles/design-based-research/)

Since the DBR methodology does not explicitly include how one should go about reflection, we chose Gibbs' Reflective Cycle (1988) to guide our reflections, allowing us to analyse our experiences and identify areas for improvement systematically.

3.1 Gibb's Reflective Cycle

Gibbs Reflective Cycle (1988) involves six stages: description, feelings, evaluation, analysis, conclusion, and action plan. We reflected on our goals, challenges, student responses, and the overall impact of podcasting on teaching and learning during in-person and virtual meetings, and we also wrote an individual reflective essay for which questions were developed, corresponding to the six stages of Gibbs' framework. These individual and collective reflections will inform future iterations of our practice, fostering professional growth and our SOTL identities through writing (Healy et al., 2019, p. 32). To aid our reflections, we re-engaged with student artefacts that were submitted as assessments – these included podcast-listening analysis essays, reflective essays and student-produced podcasts and scripts to evaluate students' critical thinking, communication, collaboration and digital literacy skills. We also engaged in document analysis to assess the impact of podcasting on student learning and teacher development by analysing course materials (lecture slides, readings, assessments) to understand the pedagogical strategies and learning objectives behind the podcasting project. By examining these artefacts, we were able to identify the strengths, weaknesses, and potential improvements for integrating podcasting in our own practice. In addition to our project-specific insights, we also explored the socio-material dynamics of podcasting as a third space, including the interplay between technology, people and the learning context. We thus also offer some tentative theory-building insights which we gained from engaging in critical self-and collective reflection alongside existing literature.

By combining the rigorous methodology of DBR with the insights gained through reflective practice, this essay and larger study aim to contribute to the development of evidence-based, innovative, and effective educational practices at Stellenbosch University and beyond.

3.2 The Researcher-Practitioners

In this reflective essay and in our podcast project, we take on the roles of researcher-practitioners, since we are both studying our own and collective practice as early career researchers and teacher educators. Before we entered the collective relationship as researcher-practitioners, we collaborated with one another on a variety of smaller-scale projects and previously encountered one another in a supervision group cohort. Thus, we were comfortable and excited to collaborate on a more elaborate project together. We include short reflections on our roles in this project and who we are as researcher-practitioners, particularly as it relates to our podcast project (Figure 3).

Delecia: *I have been teaching in a part-time capacity at Stellenbosch University for four years, before securing a full-time position as a lecturer. During this time, I taught various modules related to Science Education, Environmental Education and Practical Learning (teaching methods). Since 2023, I have been responsible for the ICTs for Learning modules, which focus on developing preservice teachers' ability to critically engage with technology, to make informed decisions about integrating technology into their own teaching practice in schools, and to develop their own digital literacies. At the start of the project, I was particularly interested in developing PSTs' digital literacy, and podcasting was a relatively unexplored teaching method in our context. In this project, I used the ICTs for Learning 277 module as my site of experimentation, which had 277 students (half the cohort) enrolled for the module.*

Elzahn*: I have been lecturing in Sociology of Education to PSTs, where my focus has been on exploring innovative teaching methods to deepen student engagement with complex educational and sociological concepts. Inspired by a student's suggestion, I supported the development of Staffroom Chatter, drawing on my experience with recording software, radio hosting, and music production. In this project, I used the Sociology of Education module as a platform to engage pre-service teachers (PSTs) with themes such as Bourdieu's habitus and Fraser's theories on redistribution, recognition, and representation. Podcasting provided a creative medium for students to critically explore topics like access, privilege, and diversity while fostering collaboration and reflective practice. I believe this initiative has created an interactive space for co-constructing knowledge, bridging theory and practice, and empowering PSTs as reflective practitioners.*

Figure 3: Excerpt From Researcher-Practitioner Journal

In the larger podcast project and study, we are acutely aware of the importance of reflexivity in shaping research outcomes. Reflexivity involves critically examining one's own biases, assumptions, and values, and considering how these factors may influence the research process (Olmos-Vega et al., 2023). In this study, our roles as both a researcher and a practitioner have the potential to shape our interpretation of the data, which includes our own reflections. To mitigate the impact of these biases, we engage in ongoing self-reflection and critical analysis. By regularly reflecting on our own assumptions, beliefs, and values, we identify and challenge any preconceived notions that may influence our analysis. To this end, our collaborative approach (Barry et al., 1999) allowed us to question one another continuously and to challenge and support each other through incisive questions when we reflected collectively and as we engaged with each other's individual reflections.

Additionally, sharing our reflections and interpretations with colleagues through peer review, conference presentations, and the writing of such a reflective essay can provide valuable feedback and alternative perspectives, albeit with some vulnerability and the potential of being misinterpreted or misunderstood (Healy et al., 2019, p. 33). By being transparent about our positionality and the potential impact of our biases on our analysis of our reflections, we can enhance the credibility and trustworthiness of our accounts.

4. Lecturer Reflective Journeys

Both of us as teacher-educators embarked on a journey of integrating podcasts into our teaching practices, sharing a common goal of enhancing student engagement and critical thinking. While we shared a similar vision, our approaches to podcasting varied.

The integration of podcasts into teaching, learning, and assessment (TLA) practices was piloted in two distinct modules within the Bachelor of Education (B.Ed.) programme at our university: Information and Communication Technologies (ICTs) for Learning taken at the second-year level and Sociology of Education where students are enrolled in the third year of the programme. These modules served as complementary yet distinct contexts for experimenting with podcasts as an innovative pedagogical tool. The integration highlighted not only the specific focus and requirements of each module but also the broader impact of podcasting on student engagement, critical thinking, and interaction with course material. Delecia focused on podcasts as a multimodal TLA tool, emphasising the practical application of podcasts as a creative medium, while Elzahn used podcasts as a tool for critical reflection and analysis of specific content related to the course themes. We present our reflections in figure 4 below.

Delecia: *The ICTs for Learning module focused on equipping students with the knowledge and skills necessary to integrate digital technologies into educational practices. In this context, the use of podcasts facilitated digital literacy, multimodal engagement, and creative expression. I adopted a scaffolded approach, starting with the theoretical framing of audio as a multimodal tool and culminating in practical tasks, including podcast listening and creation. A guest lecture introduced students to professional podcasting practices, further bridging theory and application. Reflecting on the design of the module, I noticed that the ICTs module provided the opportunity to experiment with podcasts as both a teaching tool and a student-generated learning resource, encouraging students to think critically about how technology can transform educational experiences in the classroom and beyond.*

Elzahn: *The Sociology of Education module explored the social, cultural, and institutional factors influencing education. The integration of podcasts in this context focused on critical engagement with complex sociological themes, such as inequality, diversity, violence in education, gender and sexuality, and power dynamics. Students were tasked with listening to and analysing podcasts that addressed these themes, with guided reflection questions designed to deepen their understanding. In my reflections I noted that the Sociology module allowed me to see how students engaged with podcasts as a way of critically analysing societal issues, making connections between theory and lived experiences.*

Figure 4: Excerpt From Researcher-Practitioner Journal

Despite the differing applications, both modules shared a common pedagogical goal: to explore how podcasts could enhance student engagement with coursework by fostering active, reflective, and critical learning practices. This objective was particularly evident in the

podcast listening and analysis tutorial, which was implemented in both modules with slight variations. Submission rates and average grades suggested strong engagement, but the nature of the reflections revealed more profound insights into how students processed and interacted with the medium. Elzahn shared a particularly striking reflection from a student that impacted her deeply:

> Listening to podcasts made me think differently about the topic because it felt like a conversation rather than just another reading.

This shift from passive reception to active engagement aligns with the principles of constructivist learning, where students are co-creators of knowledge. Even though listening may seem like a passive task, students were encouraged to do active listening, with a variety of strategies shared with them during the lectures. Active, critical listening resulted in a rich and meaningful analysis of the selected podcasts across both modules.

The podcast creation assignment, primarily implemented in the ICTs module, further assisted creative and collaborative learning. The task required students to work in diverse groups to produce original podcasts on educational topics of their choice. While participation in this task was limited since students were given the option of an individual task different to the podcast-creation assignment, Delecia highlighted the transformative potential,

> Creating podcasts allowed students to explore topics in their own voices, using their own languages and dialects, which brought authenticity and diversity to their work.

This aspect of the project resonated particularly strongly with the multiliteracies framework (Cazden et al., 1996), which advocates for the inclusion of diverse linguistic and cultural resources in education.

The reflections also revealed the pedagogical challenges of integrating podcasts into these modules. Students' unfamiliarity with open-ended, creative assignments often led to initial resistance. In a collective reflection session, we noted that in both modules, students expressed discomfort with the creative aspects of podcasting, as they are accustomed to traditional forms of assessment. This discomfort seemed to have been a contributing factor to reducing the number of podcast-related activities in the Sociology module and was also the reason why students were given a choice to participate in the podcast-creation activity in the ICTs module.

However, we also observed that, over time, many students came to appreciate the flexibility and relevance of the tasks. One student from the ICTs class posted on LinkedIn about the importance of podcasts in teacher education. She reflects on the quality of the Staffroom Chatter podcast, where one episode was assigned for the podcast listening tutorial, and she expresses her interest and curiosity about the medium beyond the assigned activities. She writes in her post:

> As I've been thinking about the global teaching community, one question keeps coming to mind: What do teachers actually listen to? What mainstream platforms are they engaging with to vent, share experiences, and learn from one another? It's clear that there's a gap in the podcast space that could bring even more value to the education sector. In my own exploration, I've come across the fantastic podcast Staffroom Chatter by Stellenbosch University Education Faculty. Coming to the end

> of another amazing season, this year has been hosted by [...] and with incredible guests like Dr Shannon Bishop-Swart dropping incredible gems on teaching approaches and experiences. It's a great example of how powerful a podcast can be in, sharing knowledge, promoting reflection, and fostering a community of teachers...

These reflections demonstrate the relevance for this student to her professional identity and the excitement that the podcasting activities potentially activated within the student. This evolution in student perceptions and interest beyond the coursework underscores the importance of scaffolding and support in navigating innovative pedagogical approaches.

From a broader perspective, the integration of podcasts highlighted key observational insights into how students critically engaged with coursework across the two modules. While the ICTs module focused on the technical and creative dimensions of podcasting, the Sociology module concentrated on critical analysis and reflective learning. These differing emphases provided a rich comparative framework for examining the impact of podcasts on student engagement. Elzahn reflected,

> Although the modules had different goals, what stood out was how students engaged critically with content when using podcasts—they questioned, analysed, and made connections in ways that were deeper than expected.

The integration of podcasts into the two distinct modules served as a comparative study on how digital tools impact student engagement across different disciplines. We noted the importance of considering the diverse disciplinary and contextual needs when implementing innovative teaching tools. What was particularly striking was the variance in student engagement across the two modules—while both groups showed interest, the ICTs module students were more comfortable with digital tools, whereas students in the Sociology module needed more time and support to see the relevance of podcasts to the course content.

Despite logistical and institutional challenges, such as delayed ethics approvals and limited access to equipment, the project demonstrated the potential of podcasts to foster authentic and engaged learning in higher education. In both modules, podcasts served as a bridge between theory and practice, encouraging students to think critically, collaborate, and express their ideas creatively. Moving forward, we reconfirmed our commitment to refining the approach, since the integration of podcasts is a work in progress, but the insights gained from these modules provide a foundation for broader application in the B.Ed. programme.

The integration of podcasts into the ICTs for Learning and Sociology of Education modules illustrates the transformative potential of multimodal pedagogies in higher education. By situating these practices within the pedagogy of multiliteracies, the project highlights the role of podcasts in fostering digital literacy, critical engagement, and authentic learning experiences. The comparative insights from these two distinct contexts provide valuable lessons for future applications of podcasts in education, emphasizing their potential to enrich TLA practices across diverse subject areas.

5. Developing a Tentative Theory of Practice

We first highlight insights and improvements related to our TLA practices; thereafter, we move towards tentative theoretical insights that should inform our future work.

5.1 Strengthening Podcast-Making in Teaching, Learning and Assessment Practices

Podcast-making requires a sustained approach to integrating activities which begin at the individual level, and end with collaborative peer learning. From our reflections and engagement with literature, we propose for ourselves and others who are podcast-curious the following flow of activities, which could be implemented at different scales and with different intensities.

A. Establish Existing Podcast Practices

In both of our modules, we introduced our students to podcasts and related activities without understanding their level of exposure and engagement before we commenced with our activities. We thus suggest establishing students' current practices related to podcasts – do they listen to any specific shows, do they listen for educational purposes or purely for entertainment, what is the average length of podcasts they listen to, and how do they access podcasts? Are some questions, to begin with. Additionally, understanding their listening habits may be insightful at the start of implementation – do they do chores while listening or do they listen as they walk from one place to another, do they make notes or do they repeat key phrases to retain information – as this will give educators a gauge on how intense support for critical listening should be included in the course activities.

B. Critical Listening and Analysis of Podcasts for Educational Purposes

In the current cycle of our DBR project, this is where we had the most success, yet we can still improve. Our suggestions here are to curate podcasts for listening, both as formative and summative tasks. Many students would not have learnt how to listen and analyse critically, so they need multiple opportunities to hone this skill. You may consider playing with different lengths and forms of podcasts during this phase but choose topics intentionally. In this phase, the aim is to develop students' critical analysis and reflection capabilities with the podcast as a stimulus. Develop good marking guides, use commentary feedback and well-designed rubrics depending on the weight of the assessment. Additionally, you may consider giving students the option of choosing any episode from a particular series or show to increase student autonomy and agency during this phase of the podcast creation process.

C. Collaborative Peer Learning and Podcast Creation

Collaborative learning, distinct from traditional group work, emphasises peer-to-peer engagement and constructive feedback prior to the final grading process. This approach encourages active participation and fosters a deeper understanding of the content through dialogue and shared inquiry. However, assessments grounded in this method often introduce a productive tension for students, particularly when they are confronted with unfamiliar modes of evaluation that lack the conventional "memo" or prescriptive answers.

To navigate these challenges effectively, intentional shifts are required in both student and lecturer practices. These shifts demand a rethinking of traditional roles and responsibilities, as the collaborative process seeks to cultivate reflective practices and support the transformation of teacher identities, while students are co-creating a creative medium. By embracing this approach in our podcast creation process, we encourage students to take on specific roles in research, script writing and editing processes. The simple notion of turn-taking during the podcast conversation and dialogue encourages teams to negotiate

differences of opinion towards developing shared meaning and new knowledge. In this way, we emphasise the importance of moving beyond superficial compliance with assessment criteria. Instead, the focus shifts to fostering deeper reflective processes that align with the broader goals of teacherly becoming.

This intentionality necessitates designing assessments and learning experiences that not only challenge preconceptions but also scaffold students' engagement with the complexities of the teaching profession. In doing so, we can create a space where students can critically engage with their own learning and practice, developing the skills and dispositions necessary for their professional growth.

5.2 A Sociomaterial Perspective on Podcasting

It is evident from our analysis of our reflections that podcast-related activities can be integrated into various teaching and learning contexts. Even though our modules are within the same degree programme, our learning outcomes and module contexts differ greatly. The varied application of podcasts in the two modules highlights the distinct pedagogical contexts in which these tools were employed, which corresponds to Namakula and Prozesky's (2019) discussion of the potential for decolonial transformation within academic support programmes that adopt third space principles. In the sociology of education module, students engaged with social issues and historical injustices, while in the ICT module, the focus was on the technical integration of digital tools within a critical perspective. This dual application illustrates the flexibility of podcasts in supporting diverse educational aims, from fostering critical race discourse to enhancing digital literacy skills. The ability to cater to both content-driven and skill-oriented learning underscores the versatility of podcasts as educational tools, a point emphasised by Abraham (2021), who highlighted the transformative potential of third spaces in promoting culturally responsive pedagogy.

Additionally, the asynchronous nature of podcast-based learning, as noted in the reflections, also ties into the literature on the role of digital tools in breaking down barriers to participation. As Caldwell (2023) pointed out, cross-boundary collaborations in third spaces enable participants to engage in dialogue and learning outside traditional confines. The students' ability to access and reflect on podcasts independently fostered a deeper sense of autonomy and ownership over their learning process, supporting the notion that digital spaces can encourage more inclusive and participatory educational practices (Beck, 2020; Kozleski, 2011). This was also true for the podcast-creation task, which took place outside of the formal class time and in locations and during times that were convenient to the students.

5.3. A Third Space for Learning and Transformation

The integration of podcasts within these modules also aligns with the concept of third spaces in education, which are characterized by their ability to bridge gaps between formal and informal learning environments, enabling critical and transformative experiences. Seale et al. (2015) and Helleve and Ulvik (2019) describe third spaces as inclusive and collaborative, offering opportunities for students to engage with content in more personalized and reflective ways. Our reflection on students' experiences suggests that podcasts acted as such a third space, providing an opportunity to engage with academic content in a less formal yet deeply transformative manner. This approach echoes the work of Daza et al. (2021), who emphasised the importance of third spaces in fostering a fluid exchange of knowledge and ideas, where students can negotiate their roles and identities in the learning process. This was

particularly evident in the podcast-creation task, as groups had to negotiate speaking roles, turn-taking and decision regarding scriptwriting, hosting and editing responsibilities.

6. Conclusion

This study explored the integration of podcasts into two undergraduate education modules. Our journey as teacher-educators revealed the multifaceted potential of podcasts to enhance teaching, learning, and assessment. Key findings include heightened student engagement, evidenced by critical analyses of existing podcasts and the creative exploration of educational topics through student-generated podcasts. The podcast creation assignment proved particularly impactful, allowing students to express unique perspectives and connect course concepts to real-world scenarios. These findings align with a sociomaterial perspective, emphasising the dynamic synergy between social, cultural, and technological factors. The asynchronous nature of podcasting fostered student autonomy, while collaborative aspects encouraged peer-to-peer learning. Furthermore, podcasting created "third spaces" for learning, enabling personalised and reflective engagement. While challenges such as student resistance were encountered, the overall experience demonstrated the transformative potential of podcasts in higher education. Moving forward, we will continue to refine our approach and explore the broader implications of podcasting within the evolving landscape of higher education.

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Contact email: deleciad@sun.ac.za

Artificial Intelligence in Art and Design Education: A Bibliometric Study of Emerging Trends

Jirarat Sitthiworachart, King Mongkut's Institute of Technology Ladkrabang, Thailand
Zhaodi Li, King Mongkut's Institute of Technology Ladkrabang, Thailand
Thanin Ratanaolarn, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
The integration of artificial intelligence (AI) has revolutionized education, but its impact on art and design remains relatively unexplored. This study aims to comprehensively evaluate the research status and development trend in this field. Using bibliometrics and VOSviewer, the relevant literature on artificial intelligence in art design education in Scopus database is deeply analyzed. Artificial Intelligence in Education (AIEd) framework, a framework regarding the use of AI in education, is also used to evaluate results of bibliometrics analysis. Research in this field began in 2020, but the number of relevant papers is limited, only 164, with major contributions from China, the United States and Australia, and the literature retrieved is mainly in English. The gap between its maturity and potential benefits to education and its application in education is reviewed. This study highlights the key considerations for the effective AI integration into art and design education. However, based on AIEd Technologies framework, the research results show that there is still a lack of in-depth research on the application of Gen-AI technology, especially on expert systems, personalized learning system, and visualizations and virtual learning environments, in art design education in the existing literature. This study provides valuable references for art and design educators who are leading innovation in AI education and suggests further exploration of the educational potential of Gen-AI technology.

Keywords: Artificial Intelligence, Art and Design, Bibliometrics, Scopus, VOSviewer

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1. Introduction

The integration of education with technology has marked the dawn of a novel epoch in the realm of learning (Ayanwale et al., 2024). Since the 1970s, the field of Artificial Intelligence in Education (AIEd) has significantly influenced the application of technology to instruction and learning, aiming to improve the learning process and promote student achievements (Southgate et al., 2019). The recent advancements in big data analytics, machine learning algorithms, and natural language processing have catapulted AI's educational applications into a new phase of explosive growth, reshaping traditional paradigms of teaching, learning, and administrative processes (Singh, 2023).

In the realm of art and design education, fostering innovation and creative thinking remains a central pedagogical objective (Samaniego et al., 2024). The potential of AI in this context is particularly promising, as it aids students in creative design and artistic endeavors (Hutson, 2024), while equipping educators with data-driven insights into student learning behaviors, thereby facilitating personalized teaching content and methods (Yu et al., 2020). Despite the significant potential of AI in educational contexts, its specific applications and benefits within art and design education have not been exhaustively investigated, presenting a notable gap in the literature.

This study aims to address this gap by conducting a comprehensive bibliometric analysis and visualization of the literature on AI in art and design education within the Scopus database, utilizing tools such as VOSviewer. The research endeavors to elucidate the current state and trajectory of research in this domain, providing a deeper understanding of AI's role in art and design education. Furthermore, it offers guidance and inspiration for future educational practices and scholarly pursuits, ultimately promoting the fields innovative growth.

The AIEd framework serves as a theoretical model for assessing the impact of AI in educational contexts (Xu & Ouyang, 2022), providing a structured lens through which to evaluate its application in art and design education. This framework dissects AI's educational application across various dimensions, including social networking sites and chatbots, educational expert systems, intelligent tutors and agents, machine learning, personalized education systems, and virtual educational environments (Tapalova & Zhiyenbayeva, 2022). It enables researchers to pinpoint AI's educational applications, gauge its impact on learning outcomes, and explore optimization strategies to better serve educational goals (Bittencourt et al., 2023).

By conducting this study, we aim to contribute to the body of knowledge by highlighting the key considerations for the effective integration of AI into art and design education. Our findings will provide valuable references for art and design educators leading innovation in AI education and suggest further exploration of the educational potential of AI technology, thereby bridging the gap between AI's maturity and its application in art and design education.

2. Methods

This is about artificial intelligence in art design education research with bibliometric analysis.

2.1 Bibliometric Analysis Approach

Given the purpose of the research, This study carries out bibliometrics analysis, which includes a descriptive review of publications over a specific period and the creation of bibliometrics maps based on accepted guidelines in the scientific field, and follow the accepted guidelines for this type of research in the scientific field (Dávila Rodríguez et al., 2009).

2.2 Data Collection Strategy

To ensure a thorough and systematic search strategy, we utilized the Scopus database, which is renowned for its extensive coverage of peer-reviewed literature across various scientific fields (Baas et al., 2020). The query was conducted on August 26, 2024, at 15:50, considering titles, common keywords, and abstracts, as search criteria, all with the aim of obtaining a clear perspective on the direction of studies related to artificial intelligence in the field of art and design education (Baas et al., 2020).

The formula and search filters employed in Scopus included the following parameters: TITLE-ABS-KEY (“artificial intelligence” OR “AI” AND “design education” OR “art and design education” OR “Art Design Studies”). To ensure the relevance of the retrieved documents, we limited our search to articles published in English and filtered the results to include only scholarly articles and conference proceedings.

2.3 Data Visualization and Analysis Tools

The VOSviewer 1.6.20 software (VOSviewer - Visualizing Scientific Landscapes, n.d.). was instrumental in visualizing the bibliometric data, allowing us to map (Khodabandelou et al., 2022), and analyze the co-occurrence of keywords and the collaborative relationships among authors and institutions (Mishra et al., 2022). This software facilitated the creation of a comprehensive bibliometric map, which revealed the key themes and trends within the field. By examining the co-occurrence network of keywords, we were able to identify the central concepts and the interconnectivity between various research areas. The analysis of author collaboration maps provided insights into the research community’s structure and the extent of international cooperation in this domain.

We use VOSviewer to check author-collaboration mapping and keyword co-occurrence. Author collaboration refers to the contact between authors, participation in the contribution of the country or affiliated institution to the development of the discipline or field. For author collaboration analysis, we use all the data and set the minimum threshold to 1 time. On the other hand, keyword co-occurrence analysis is a semantic network that describes the relationships between keywords. In keyword co-occurrence mapping, we use full counting, with all keywords as the unit of analysis. In addition, the study placed limits on the analysis, for example, limiting the minimum number of keyword occurrences to five. Therefore, out of 1,210 keywords in 164 articles, only 43 keywords met this threshold. The VOSviewer mapped data is then verified against the data retrieved from the Scopus log file for calculation and tabulation to obtain a more complete understanding.

2.4 Application of the AIEd Framework

To further enhance the analysis, we applied the AIEd framework to evaluate the retrieved articles, which allowed us to assess the alignment of AI applications in art and design education with educational objectives, pedagogical strategies, and technological advancements. This framework-based evaluation enabled us to discern the transformative potential of AI technologies in enhancing educational practices and student outcomes.

2.5 Data Extraction and Preliminary Analysis

The data extracted from the Scopus database included bibliographic elements such as article titles, authors, publication dates, keywords, abstracts, and citation counts. A total of 164 articles were found, this information was exported in CSV and RIS formats for further analysis using VOSviewer. The meticulous organization and analysis of this data allowed us to present a detailed account of the research landscape in AI and art and design education.

3. Results and Discussion

3.1 Research Impacts

Figure 1 presents a visual representation of the growth in published literature on AI in art and design education, spanning from 1984 to 2024.There are 30 publications from 1984 to 2012, 34 from 2017 to 2021 and 102 published papers from 2022 to 2024. It was found that the number of publications in the latter one periods was nearly twice that of the first two period. This finding could be related to the strong rise of artificial intelligence technology in the past 3 years, particularly since November 2022, the date on which OpenAI began to release its generative artificial intelligence product, ChatGPT. This subsequently gave way to the emergence of similar technologies, such as Kimi, and Bard, among others.

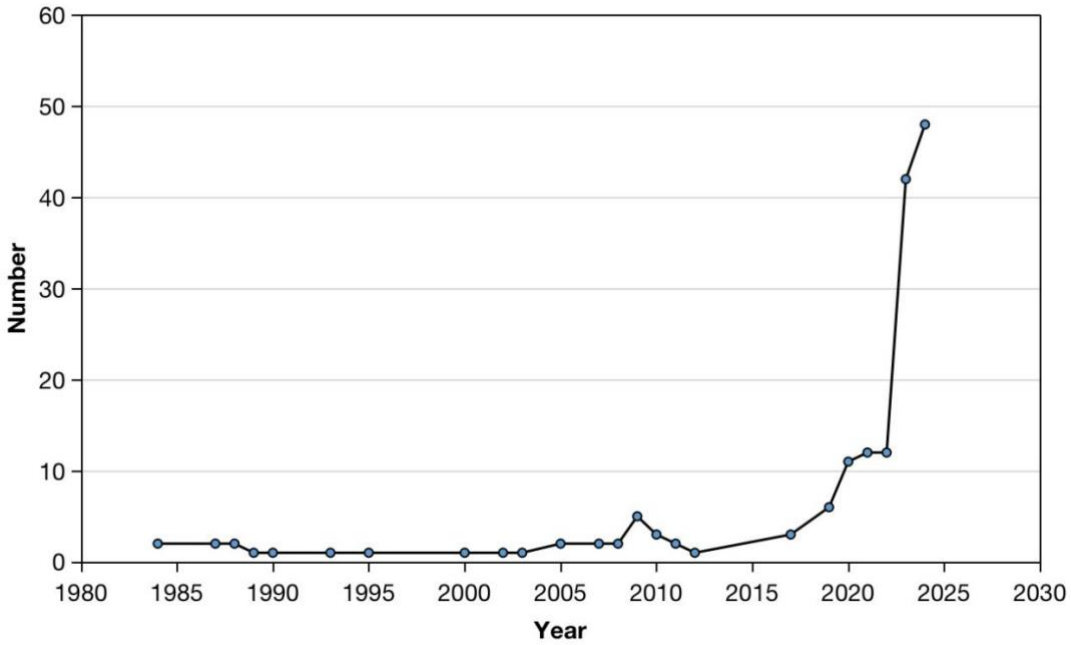

Figure 1: Published Literature on AI in Art and Design Education From 1984 to 2024

The significant rise in publications from 2022 to 2024 highlights the growing interest in AI's application in art and design education, mirroring AI's expanding influence across disciplines. This trend is set to continue, with research in AI and education expected to grow from 2025 to 2035, driven by ongoing AI advancements and educational tool integration. Initially discussed in 1984, AI's role in design education has evolved from theory to practical use in CAD (Radcliffe & Holt, 1984) and other areas. The field's development shows AI moving from a conceptual stage to an essential part of current educational and design practices.

Table 1 highlights the top 5 journals with the highest number of publications on artificial intelligence in art and design education, showcasing their academic rankings and influence within the field. IEEE Access leads the list, demonstrating exceptional prominence with the highest SJR value and H-index, indicative of its significant impact and scholarly recognition in the domain of artificial intelligence in art and design education. The remaining journals, including the ACM International Conference Proceeding Series, Applied Sciences (Switzerland), Lecture Notes in Networks and Systems, and E3S Web of Conferences, each with their respective SJR and H-index scores that mirror their standing and influence in the academic community. The quartile rankings (Q1 to Q4) offer a comparative measure of each journal's performance, with Q1 indicating the top 25% of publications, Q2 the top 50%, and Q4 representing the lower 25%. These rankings provide insight into the journals' academic reach and their contributions to advancing knowledge in AI applications for art and design education.

IEEE Access's leading position in the ranking highlights its significance as a top journal for AI research in art and design education. Other noted journals contribute to the field's discourse, with their rankings reflecting their academic impact and audience reach, from Q1 to Q4. These rankings are valuable for researchers considering where to publish and for identifying research opportunities.

Table 1: Top 5 Journals With the Highest Number of Publications on Artificial Intelligence in Art and Design Education

Ranking	Journal	Articles	SJR	Quartile	H-index
1	IEEE Access	40,115	0.96	Q1	242
2	ACM International Conference Proceeding Series	35,675	0.253	Q3	151
3	Applied Sciences (Switzerland)	34,291	0.508	Q2	130
4	Lecture Notes in Networks and Systems	24,954	0.171	Q4	36
5	E3S Web of Conferences	23,855	0.182	Q2	39

In total, there were 711 citations distributed across 80 documents, with the remaining 84 documents receiving none. The majority of the top ten cited articles were published after 2010, with only three exceptions from the years 2002, 2003, and 2009. On average, each of these cited articles garnered 8.8875 citations annually. Table 2 presents the 5 articles with the highest number of citations that address the field of artificial intelligence in art and design education. It was noteworthy that these ten articles alone had accumulated 414 citations. The article (Dove et al., 2017), with 280 citations, explores how ML in AI can be a part of UX design education through a survey of UX designers, discussing how new research and new curricula may help us unlock the power of design thinking to reimagine ML to enhance the teaching and learning process for the benefit of students.

Table 2: Most-Cited Articles

Rank	Title	Journal/Conference Name	Authors, Year	Total of Citations
1	UX design innovation: Challenges for working with machine learning as a design material	Conference on Human Factors in Computing Systems - Proceedings	Dove G.; Halskov K.; Forlizzi J.; Zimmerman J., 2017	280
2	The effectiveness of social media and multimedia-based pedagogy in enhancing creativity among art, design, and digital media students	International Journal of Emerging Technologies in Learning	Al Hashimi S.; Al Muwali A.; Zaki Y.; Mahdi N., 2019	45
3	Interactive storytelling for children	Proceedings of IDC2010: The 9th International Conference on Interaction Design and Children	Garzotto F.; Paolini P.; Sabiescu A., 2010	41
4	ChatGPT for design, manufacturing, and education	Procedia CIRP	Wang X.; Anwer N.; Dai Y.; Liu A., 2023	32
5	The challenge of integrating AI & smart technology in design education	International Journal of Technology and Design Education	McCardle J.R., 2002	16

The citation distribution underscores a trend of increasing scholarly attention to AI's role in art and design education, particularly in the last decade. The prominence of articles published after 2010 among the top-cited indicates a surge in impactful research that aligns with the broader technological advancements in AI. The significant number of citations for the Dove et al. study reflects its influential perspective on integrating AI into educational practices, highlighting the value of design thinking in shaping AI applications in education.

Among the 164 documents analyzed, a total of 377 distinct authors were identified. Notably, four authors Ali H., Kumar T. (VOSviewer - Visualizing Scientific Landscapes, n.d.), Sha Z., and Zhang X. each contributed a maximum of three documents, while the majority, 349 authors, were associated with a single document. This distribution results in an average of approximately 0.44 documents per author, pointing to a predominantly individual rather than collaborative authorship pattern.

In a corpus of 164 scholarly works, authorship was ambiguous in 18 cases, while 146 studies had clearly identified authors. Among these, 115 studies involved two or more authors, constituting approximately 78.76% of the total, suggesting that most of the research in this

domain is collaborative in nature, as solo-authored works represent a mere 21.23%. However, this collaborative effort seems confined to small, insular groups, with the most extensive collaboration observed across no more than two documents. This pattern implies a relatively limited scope of scientific networking and collaborative engagement among authors focused on this subject matter, with a notable absence of interconnectivity among these author collectives.

There are 160 affiliates out of 164 identified documents. Most institutions only produce one document. Only 33 institutions produce more than one. The University of İstanbul Teknik Üniversitesi was the institution that produced the most documents, numbering five. Arizona State University Polytechnic Campus，Indian Institute of Science，Georgia Institute of Technology，PES University and Ira A. Fulton Schools of Engineering produced three documents. Twenty-seven institutions, including Arizona State university and the Univerza v Mariboru case, each produced two documents.

Of the 164 articles examined, 35 countries were identified as participating in international scientific publications in the field of study. Of this group of countries,5 reached the minimum standard of having at least 10 articles and 15 citations. Table 3 shows the ranking of the 5 leading countries based on the number of publications and citations obtained. In terms of citations, it is worth noting Denmark，despite not featuring in the top article publications, stands out with the second-highest number of citations, 280, indicating potentially high-impact research. This table underscores the global distribution of scholarly efforts and influence in the intersection of AI and art and design education, with a notable emphasis on the leading roles of China and the United States in both publication output and research impact.

Table 3: Publications by Country and Citations by Country

Ranking	Country	Articles	Ranking	Country	Citations
1	China	39	1	United States	356
2	United States	33	2	Denmark	280
3	Australia	10	3	China	68
4	China-Taiwan	10	4	Australia	47
5	United Kingdom	10	5	Bahrain	45

Through a bibliometric map based on published articles, Figure 2 shows the cooperation between the countries participating in this analysis.

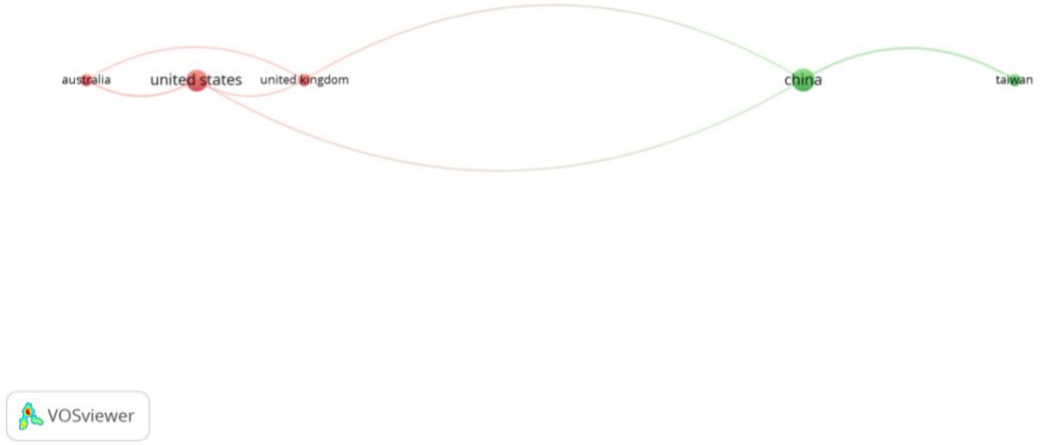

Figure 2: Global Collaboration Through Documents Published by Country, Based on Data Obtained From Scopus

Of the 164 documents, only 5 are in a non-English language, namely, Japanese, Korean and Slovenian respectively.

3.2 Research Clusters

A total of 43 keywords are included in the 164 Artificial Intelligence in Art and Design Education articles. Figure 3 shows the cluster analysis results generated by VOSviewer, including the dynamic change and network map. The most frequently used keywords are “artificial intelligence”, “design education”, “students”, “curricula” and “engineer education”. This research focuses on AI and its applications in the arts and education. However, this figure is far less than the 35,066 documents obtained using the keywords “artificial intelligence” and “education.” This wide disparity in search results indicates that the topic has not been widely studied.

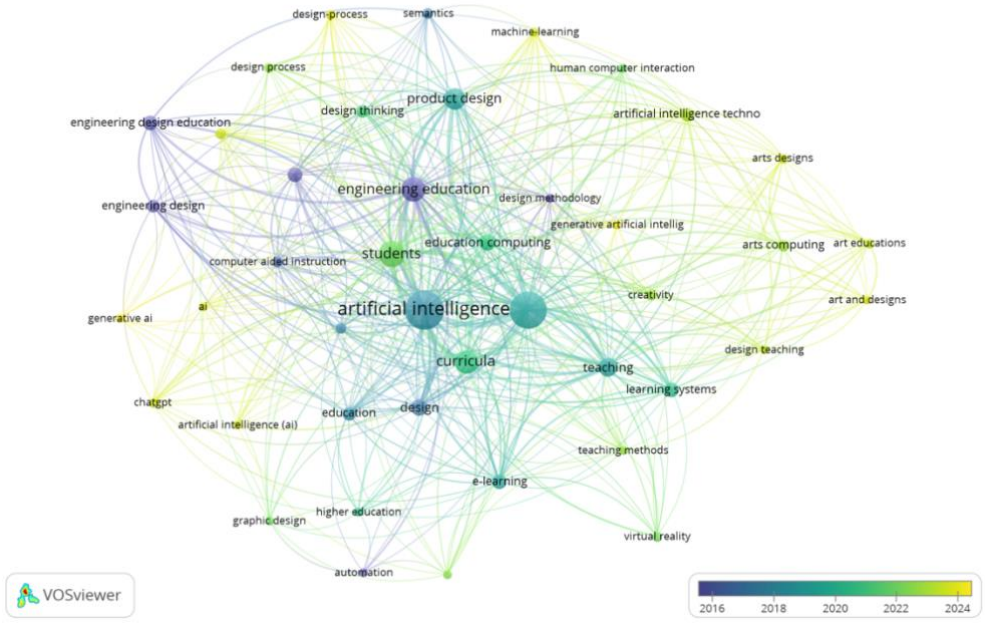

Figure 3: Analysis of Keyword Co-occurrence Between 1984 and 2024
(3.1) The distribution of the Art and Design Education research using the keyword by years.

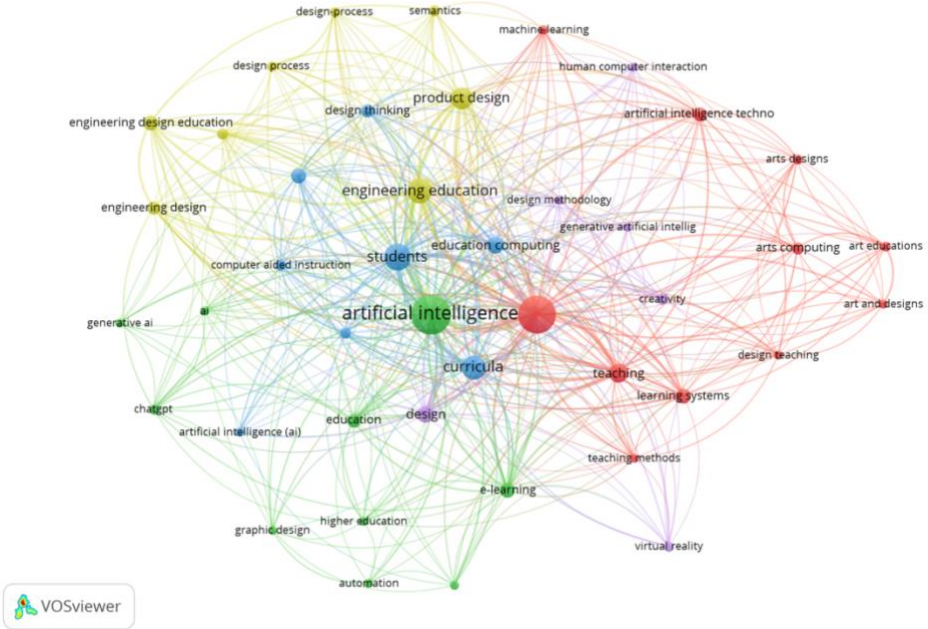

Figure 3: Analysis of Keyword Co-occurrence Between 1984 and 2024
(3.2) The most used keyword in the Art and Design Education research.

In addition to Art and Design Education, Figure 3.1 shows that the popular author keywords in recent studies are generative ai, ChatGPT, AI tools, art designs, design process and so on. This implies that the field of artificial intelligence, particularly generative AI, is experiencing a surge in interest and application across various domains such as art, design, and academic research. It suggests a significant shift towards integrating AI technologies into creative and intellectual pursuits， the integration of AI in art and design is leading to innovative approaches in design processes, enabling designers to explore new artistic expressions and

enhance their creative workflows. AI tools are being utilized to generate ideas, optimize designs, and even create unique art pieces that blend human creativity with AI-generated content.

Figure 3.2 shows 5 main clusters of Art and Design Education research, that is, “art and design learning”, “ai and education”, “AI-assisted and design Thinking”, “design process” and “design education”, as displayed in red, green，blue，yellow and purple.

The studies in Cluster 1(Art and Design Learning) focus on various aspects of art and design education and how artificial intelligence and machine learning techniques can be used to improve the quality and effectiveness of education.

Cluster 2 (AI and Education) focuses on the application of AI technologies in the field of education, specifically how to improve the quality of education and learning experience through technologies such as automation, generative AI, e-learning platforms, and visual communication.

Cluster 3 (AI-Assisted and Design Thinking) focuses on computer-aided design and teaching and cultivates students’ design thinking using artificial intelligence in curriculum design.

Cluster 4 (Design Process) focuses on engineering design and education, with a particular emphasis on how AI tools and techniques can be used to improve the design process.

Cluster 5 (Design education) focuses on design innovation, design methodology, and how to use artificial intelligence, human-computer interaction, virtual reality and other technologies to improve the design education.

3.3 Implications of Limited Research and Potential Benefits

While the current body of research on AI in art and design education is not extensive, it does indicate that AI has the capacity to enhance teaching methods (Omran Zailuddin et al., 2024) in areas such as product (Huang et al., 2024) and visual design (Li et al., 2024). It can be incorporated into collaborative teaching strategies, which may lead to more personalized (Tapalova & Zhiyenbayeva, 2022), efficient, and sustainable educational approaches. This integration could stimulate creativity (Almaz et al., 2024) across various design fields, including architecture (Almaz et al., 2024), graphic design (Fleischmann, 2024), industrial design (Chung et al., 2024), and user experience design (Zhang et al., 2024), and it may also encourage the development of critical thinking skills (Jung & Suh, 2024). Moreover, AI-driven design tools have the potential to assist students in discovering innovative (Barak et al., 2020) avenues for creative self-expression (Omran Zailuddin et al., 2024).

Although the analysis combined with AIEd technology framework reveals that the exploration of the application of Gen-AI technology in the field of art and design education is still in the early stage, there is a significant lack of in-depth research in these fields. While Gen-AI technologies offer great application potential for art and design education, further research is needed to explore how these technologies can be effectively integrated into curricula and to assess their specific impact on student learning processes and teaching practices.

4. Conclusions

The study utilizes bibliometric analysis to offer a comprehensive overview of the research topic "Artificial Intelligence in Art and Design Education," as indexed in the Scopus database. With the assistance of VOSviewer, the study reveals a significant increase in the number of publications, from 10 in 1984 to 40 in 2024, with substantial growth projections for the future. This trend clearly demonstrates the academic community's growing interest in the intersection of AI with art and design, underscoring the acceleration of research in this field due to recent advancements in AI technology.

Although we retrieved and evaluated 164 relevant documents through the AIEd framework, the findings indicate that there is a paucity of in-depth research on the application of Gen-AI technology in art and design education, particularly in areas such as expert systems, personalized learning systems, and visualization and virtual learning environments. This suggests that the integration of AI in art and design education remains in its nascent stages.

China, the United States, and Australia are prominent in terms of both the number of articles and citations, attesting to their significant influence in this field. However, while the UK and Taiwan (China) rank in the top five for the number of articles, they are surpassed by Denmark and Bahrain in terms of citations. This indicates that although Denmark and Bahrain produce fewer publications, their research exerts a broader impact.

In terms of research keywords, "artificial intelligence" and "art and design education" predictably dominate the list. It is intriguing to note the presence of terms such as "ChatGPT/Tools," reflecting the impact of user-oriented technical software, and "design process," indicating studies on the interplay within the design process. Terms like "pedagogy," "machine learning," and "learning systems" highlight the AI techniques and tools that have been extensively explored in the context of art and design education. These key terms reflect a diverse spectrum of perspectives on universal themes and areas of interest concerning the relationship between AI and art and design education."

The limitations of this study include a "single keyword array", "reliance on a single database (Scopus), and a focus on "only quantitative literature analysis." For future research, it is recommended to expand the array of search keywords, such as incorporating "machine learning" and "product design." Additionally, incorporating other databases like Web of Science could enrich bibliographic data. Finally, combining bibliometric analysis with systematic literature reviews could provide a deeper understanding of the analyzed topic. This approach would allow for a more comprehensive exploration of the research findings and methodologies of AI in art and design education, as well as consideration of the impact of global events and international collaborations.

The integration of AI in art and design education has the potential to be revolutionary, in addition to improving teaching efficiency, it can also stimulate students' creativity and develop skills such as critical thinking. However, realizing these benefits will require overcoming challenges such as AI-related technology integration, teacher training, copyright and ethical considerations for software, among others.

Next, the research hope to further explore the application of Gen-AI technology in art and design education in the future to promote students' creativity and design results. The first step is to assess the acceptance and demand of students and teachers for the application of AI

technology. Art and design educators are then encouraged to collaborate across disciplines with relevant experts, such as computer scientists and educational technology, to develop integrated strategies and assessments for cross-disciplinary curricula, while integrating AI technologies into curriculum frameworks, teaching methods, and assessment tools. It should also focus on ethical issues such as data privacy and algorithmic bias. Finally, it is suggested to adopt multi-dimensional, interdisciplinary and long-term research to gradually promote the progress and development of this field.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Development of Video With Microlearning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science and Engineering

Ming Dong, Rajamangala University of Technology Thanyaburi, Thailand
Thidarat Kulnattarawong, Rajamangala University of Technology Thanyaburi, Thailand

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Abstract
The objectives of this study were to: 1) develop video with microlearning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering, 2) compare the learning achievement of students between pre-test and post-test scores after using video with microlearning on soil research, and 3) study the satisfaction of students using video with microlearning on soil research. The sample of this study was 30 students majoring in environmental engineering at Sichuan University of Science and Engineering in China, in the academic year 2024. They were selected by using purposive sampling. The research instruments consisted of 1) video with microlearning on soil research, 2) questionnaire of content and media quality, 3) questionnaire of learning achievement, and 4) questionnaire of students' satisfaction. The research results revealed the following: 1) An evaluation of the video content quality on soil research by the experts showed the appropriateness at the excellent level (=4.83, *SD*=0.23) and an evaluation of media quality by the experts also showed the appropriateness at the excellent level (=4.50, *SD*=0.58). 2) The post-test scores of learning achievement were higher than the pre-test scores with statistically significant difference at the .05 level. 3) The student's satisfaction on using video with microlearning on soil research was at the satisfied very good level (=4.64, *SD*=0.54) as well.

Keywords: Video, Microlearning, Soil Research, Learning Achievement

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Introduction

In recent years, the rapid development of information technology has greatly improved all kinds of education mediated by video. In particular, the emergence of online education has made online courses with instructional videos as the carrier of knowledge dissemination highly favored by the public (Means B, et al., 2009). As an important part of online courses, teaching video has become the multimedia learning resource with the highest frequency and the largest scale of use in the context of education informatization with its powerful audio-visual multi-channel dynamic presentation of learning content (Marta et al., 2023) and has become the focus of the national construction and development of high-quality educational resources. The Ministry of Education has pointed out in the policy document "Education Informatization 2.0 Action Plan" that it is necessary to improve the quality of digital educational resources, bring together universities, enterprises, the government and other parties to provide high-quality large- scale online courses to strengthen the construction and sharing of high-quality digital educational resources. During the new crown epidemic, all kinds of schools around the country made full use of these online video courses to carry out the "no class, no school" teaching activities, providing students with a variety of free teaching video resources to ensure the normal development of education and teaching work. It can be seen that teaching video occupies a very important position in the construction of national digital educational resources and is an important teaching and learning resource in educational teaching activities. And the research on the development of teaching videos to improve college students' academic performance is of great significance in promoting the construction and development of high-quality educational resources (Gumisirizah et al., 2024).

Learning outcomes, usually refers to the outcomes of knowledge and comprehension, attitudes and values, skills and behaviors that students acquire after undergoing a learning experience (Rohmawati et al., 2023). The evaluation of college students' learning outcomes is a key factor in the quality assurance of higher education talent cultivation and an important way for colleges and universities to respond to social accountability and improve the quality of education within the school. Under the influence of "student-centered" education concept, learning outcome evaluation, which focuses on the value-added of students' learning and emphasizes the effectiveness of students' education, has gradually become an important benchmark for measuring the quality of talent cultivation in colleges and universities (Tang et al., 2023). At present, the evaluation system of applied undergraduate colleges and universities is generally subject to the shackles of "five only", without highlighting the orientation of application, and the talent cultivation has always existed the tendency of focusing on academics but not on application, theory but not on practice, which does not reflect the fundamental demand of applied talents of "learning to use". Therefore, it can be said that the learning outcomes of students in applied undergraduate colleges and universities should not only have the general learning outcomes in line with the social development of the new era, but also have the learning outcomes in the field of applied talents.

The need for students to learn about soil research is evident in several ways. First, as the foundation of agricultural production, soil is critical to healthy crop growth (Li et al., 2023). Through in-depth study of soil research, students are able to master key factors such as nutrients and microorganisms in the soil, providing scientific support for the training of future professionals in the field of agriculture. Secondly, as an integral part of the ecosystem, soil, together with water and air, forms the foundation of life on earth (Chakraborty et al., 2018). Through the study of soil research, students can understand the impact of human activities on

soil and actively participate in the protection and sustainable use of the ecological environment. In addition, the study of soil involves the management and sustainable development of land resources. By understanding the nature, fertility and conservation of soil, students are able to plan and manage land resources in a more scientific manner, and to promote the society in the direction of sustainable development (Zheng et al., 2020).

Micro learning videos are short, focused, and highly targeted learning resources designed to deliver specific learning objectives in a concise and engaging manner. Typically ranging from a few seconds to a few minutes in duration, these videos leverage multimedia elements such as visuals, animations, and narration to convey information effectively. Unlike traditional lengthy lectures or tutorials, microlearning videos aim to capture learners' attention and deliver key concepts swiftly, catering to their limited attention spans and on-the-go learning preferences (Naser, 2024). Thus, this study focuses on the integration of the video with micro learning and soil research content to enhance learning achievement of students at Sichuan University of Science and Engineering. With this approach, the students could develop their learning system in terms of learning behaviors, learning achievement and motivation.

Research of Objectives

1. To develop video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering.
2. To compare the learning achievement of students between pre-test and post- test scores after using video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering.
3. To study the satisfaction of students who using video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering.

Literature Review

Video of Learning

With the rapid development of information technology, video has become an indispensable medium in the learning process. Video can not only convey complex knowledge information but also improve learners' participation and interest through visual and auditory stimuli. Research has shown that Video of Learning can effectively promote knowledge understanding and memory, especially in online education and blended learning environments, which is becoming increasingly important (Noetel et al., 2021). At the same time, with the popularity of social media, the rapid spread of short videos and teaching videos also provide learners with more learning resources and flexible learning methods. Therefore, in-depth research on the application and influence of video in learning has important practical significance for improving the quality of education and learning effect.

Micro Learning

Micro Learning, as a new way of learning, has been widely concerned in the field of education because of its flexibility and efficiency. The core idea of micro-learning is to fragment knowledge and provide short and easily digestible learning content to adapt to the shrinking attention spans and fast-paced lifestyles of contemporary learners. Research shows that micro-learning can not only improve learners' learning motivation, but also significantly

improve knowledge retention rate and application ability (Samala et al., 2023). With the popularity of mobile devices, the forms and application scenarios of micro-learning are constantly enriched. From online courses to corporate training, micro-learning is gradually becoming an effective tool to improve learning results.

Soil Research

The importance of soil research in environmental protection and sustainable agricultural development cannot be ignored. Research has shown that the physical, chemical, and biological properties of soils have a direct impact on ecosystem health and agricultural production (Cardoso et al., 2013). With global climate change and population growth, the problem of soil degradation and nutrient loss is becoming more and more serious, which makes research on soil management and improvement particularly urgent (Gomiero, 2016). In this context, it is essential to carry out extensive research on soil properties and management strategies in universities to address local ecological challenges and improve agricultural productivity. By applying micro-learning videos to soil research courses, students can be helped to master complex soil science knowledge more effectively, thereby improving learning achievement.

3P Production

The 3P production model, i.e. pre-production, production and post-production, is a key step in the development of video content. Each stage of the process helps to ensure the quality and effectiveness of the final product. Pre-production involves scripting, planning, and design, and is the stage where a solid foundation is laid for the content (Paulaharju, 2021). The production phase focuses on actual shooting and recording and improves the quality and attractiveness of the material through technical means (Cunha et al., 2019). Post-production optimizes video effects through editing, special effects and audio processing to improve learners' experience and comprehension (Bolibok, 2022). Studies have shown that a systematic 3P production process can significantly improve the teaching effect of educational videos and students' learning outcomes (Johnson et al., 2014). Therefore, the application of 3P production mode in the development of teaching video can effectively support the realization of curriculum objectives and learners' knowledge mastery.

Learning Achievement

Learning Achievement is a core concept in educational research, which refers to the acquisition and performance of knowledge, skills and attitudes in a specific learning environment. In recent years, researchers have paid more and more attention to the influence of different teaching strategies and tools on learning achievement. For example, data support for problem-based Learning (PBL) and Blended Learning can significantly enhance student learning achievement by increasing engagement and providing diverse learning resources (Prince, 2004; Means et al., 2013). In addition, research has shown that interactive digital media, such as educational videos and online assessment tools, also have a significant positive impact on learning achievement, enhancing students' comprehension and memory by providing immediate feedback and multi-sensory stimulation (Zhang et al., 2006).

Research of Methodology

The research methods used in this paper include literature analysis, observations, interviews, questionnaires, and field studies. Based on the article analysis and practical teaching experience, this paper discusses about the development of video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering.

Population

The population of this study is 98 students at Sichuan University of Science and Engineering from College of Chemical and Environmental Engineering, year 2024, China. The sample of this study was 30 students majoring in environmental engineering at Sichuan University of Science and Engineering year 2024, College of Chemical and Environmental Engineering, China. They were selected by using purposive sampling that their major is closely related to soil research, which is conducive to improving their professional knowledge and broadening the scope of knowledge in different directions.

Research Instruments

The research instruments consisted of (1) video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering (2) content and media quality questionnaire for video with micro learning on soil research to enhance learning achievement of students (3) learning achievement of students between pre-test and post-test scores using video with micro learning on soil research to enhance learning achievement of students and (4) satisfaction questionnaires to assess students' satisfaction level for video with micro learning on soil research to enhance learning achievement of students.

Data Analysis

The data were analyzed using Mean, Standard Deviation and t-test. Data amassment, the researcher experimented with an experiment was one group pretest and post-test test scores design; the population selected by purposive sampling. The measure and statistics and assessment are video with micro learning on soil research to enhance learning achievement of students, questionnaire of satisfying data was mean, standard definition, t-tests the dependent sample statistics. Amassment statistics data after the experiment and calculate (O1) and (O2) for mean and compared, arrangement for the experimental model by video with micro learning on soil research to enhance learning achievement of students.

Variables

1. Independent variable is video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering.
2. Dependent variables are (1) the students' learning achievement after using video with micro learning on soil research to enhance learning achievement of students and (2) the students' satisfaction with video with micro learning on soil research to enhance learning achievement of students.

Conclusion

Study the Quality of Video With Micro Learning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science and Engineering

The results of the content quality assessment of the video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering evaluated by three content experts. The overall quality was excellent level (=4.83, *SD*=0.23). When considering each item, it was found that the content of the video accurately reflects the scientific principles and methods of saline-alkali soil improvement, the video comprehensively introduces the causes, characteristics and hazards of saline-alkali soil, the video describes in detail the various methods (e.g. physical, chemical and biological methods) of saline-alkali soil improvement, the video describes in detail the effects of saline-alkali soil on crop growth, the pictures, animations and diagrams in the videos are clear and intuitive and help in understanding the concept of saline-alkali soil improvement were excellent level (=5.00, *SD*=0.00), respectively.

The results of the media quality assessment of the video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering evaluated by three media experts. The overall quality was excellent level (=4.50, *SD*=0.58). In the evaluation of each project, it was found that the pace and rhythm of the video is good, the structure of the video content is clear, the images and animations in the video are vivid and educational, there are enough visual changes and transitions in the video to keep the viewer's interest and attention, Clear and concise details (=4.67, *SD*=0.58).

Compare the Learning Achievement of Students Between Pre-test and Post-test Scores Using the Video With Micro Learning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science and Engineering

Table 1: Compare of Average Score Before and After of the Students Using the Video With Micro Learning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science And Engineering

Items	**n**		***SD***	**df**	**t-test**	**Sig. (2-tailed)**
Pre-test	30	7.80	2.79	29	31.04	0.00*
Post-test	30	15.00	4.55			

*p＜.05

Table 1 presented the video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering. The mean score of pre-tests was 7.80, and the score of standard deviation (*SD*) was 2.79. The result after using the video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering constituted a substantial improvement in students which translated into a high post-test 15.00 and standard deviation (*SD*) 4.55 and t-test analysis before and after the treatment 31.04 which demonstrated a considerable difference was statistically significant at the .05 level.

Study the Satisfaction of Students Who Using the Video With Micro Learning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science and Engineering

The results of evaluation of students' satisfaction with the video with micro learning on soil research to enhance learning achievement of students at Sichuan University of Science and Engineering by 30 students. The overall students' satisfaction was very good level (=4.64, *SD* =0.54). When considering each item, it was found that the video provides successful cases and case studies to increase the practicality and credibility of the learning was very good level (=4.80, *SD*=0.48). The video content is accurate and detailed, clearly explaining the causes and hazards of saline-alkali soil, and the video employs a wealth of visual changes and switches to help keep the viewer's interest was very good level (=4.73, *SD*=0.45, =4.73, *SD*=0.52), respectively.

Discussion

Study the Quality of Video With Micro Learning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science and Engineering

The results of this study show that soil research videos based on micro-learning are excellent in improving the learning achievement of students in Sichuan Institute of Technology. Evaluations by content experts show that video content reaches a level of excellence in accurately reflecting scientific principles and methods (=4.83, *SD*=0.23). The video demonstrates in detail the multiple methods of saline-alkali soil improvement and their impact on crop growth, combined with clear and intuitive pictures and animations, greatly promoting students' understanding of complex topics (Mayer, 2002). In addition, the evaluation of media experts also shows that the media quality of video is also at an excellent level (=4.50, *SD*=.85). The rhythm, content structure and visual effects of the video were highly recognized, and sufficient visual changes and transition designs effectively maintained the interest and attention of the audience (Sweller et al., 2011). On the whole, this video based on micro-learning effectively combines content quality and media quality, which can significantly improve students' understanding and application ability of saline-alkali soil research. This is consistent with previous research showing that video learning can enhance learning through multi-sensory stimulation and interactivity (Zhang et al., 2006).

Compare the Learning Achievement of Students Between Pre-test and Post-test Scores Using the Video With Micro Learning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science and Engineering

This study has effectively improved the learning achievement of students in Sichuan University of Science and Engineering through video micro-learning. The results of the study showed that students scored an average of 7.80 (SD=2.79) on the test before watching the video and significantly improved to 15.00 (SD=4.55) after using the video. The T-test result was 31.04, indicating that the increase was statistically significant ($p<0.05$). This remarkable improvement indicates that video micro-learning, as a teaching tool, can effectively promote students' understanding and application of saline-alkali soil research. This is consistent with the findings of Zhang et al. (2006), which showed that multimedia instruction can improve student learning outcomes through rich visual and auditory stimuli. The advantage of video micro-learning is its ability to provide immediate feedback and multi-sensory stimulation, which facilitates students' understanding and memory of complex concepts (Mayer, 2002). In

addition, video micro-learning provides a flexible learning environment where students can learn according to their own learning pace, which improves their learning initiative and self-efficacy to a certain extent (Means et al., 2013). Therefore, this teaching method not only improves learning achievement, but may also play a positive role in students' long-term learning experience.

Study the Satisfaction of Students Who Using the Video With Micro Learning on Soil Research to Enhance Learning Achievement of Students at Sichuan University of Science and Engineering

To improve the soil research achievements of students in Sichuan University of Science and Engineering through video micro-learning. The results of the study showed that students' satisfaction with using video microlearning was very good level (=4.60, *SD*= 0.54). Specifically, students were most satisfied with the video provides successful cases and case studies to increase the practicality and credibility of the learning (=4.80, *SD*=0.48), indicating that these practical application cases significantly enhanced the practicality and credibility of learning. In addition, the accuracy and detail of the video content, especially in explaining the causes and hazards of saline-alkali soil, were highly appreciated by the students (=4.73, *SD*=0.45), and the rich visual transformation and switching design in the video also effectively maintained the interest of the audience (=4.73, *SD*=0.52). These results are consistent with the core principle of multimedia learning theory that learning can be significantly improved by integrating text, images, and multimedia elements (Mayer, 2002). Further research supports this view. Kizilcec et al. (2013) found that video learning can enhance students' learning effectiveness and satisfaction through multi-sensory stimulation and interactivity. In addition, Guo et al. (2014) showed that video length, visual effects and interactivity are key factors affecting the effectiveness of online learning. These findings suggest that video micro-learning can effectively improve student achievement and satisfaction, especially in complex subjects such as soil studies. In addition, this teaching method not only provides a flexible and adaptable learning environment, but also significantly enhances students' understanding and interest in practical application cases.

Recommendations

1. Integrate Interactive Elements: Incorporate interactive features like quizzes or discussion prompts within the micro-learning videos to actively engage students and reinforce their understanding of soil research concepts.
2. Implement Feedback Mechanisms: Establish a system for students to provide feedback on the videos, which will help refine content and delivery based on their experiences and needs.
3. Enhance Video Quality: Ensure high production values for the videos, including clear visuals, engaging graphics, and professional narration, to improve student comprehension and retention.

Suggestions for Further Research

1. Enhance Assessment Tools: Develop comprehensive assessment tools beyond pre- and post-tests, such as formative quizzes or reflective activities, to continuously gauge student understanding and provide immediate feedback throughout the learning process.
2. Pilot and Refine Content: Before fully implementing the micro-learning videos,

conduct a pilot study with a smaller group of students to gather detailed feedback. Use this feedback to refine video content and delivery methods to better meet the educational needs of the students.

3. Conduct Longitudinal Studies: Extend the research to evaluate the long-term impact of micro-learning videos on students' knowledge and application of soil research concepts beyond immediate test results.

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Contact emails: dong_m@mail.rmutt.ac.th
thidarat_c@rmutt.ac.th

Structural Equation Model of Causal Factors Affecting Achievement in Calculus 1 for Engineering and Architecture Students

Anek Putthidech, Rajamangala University of Technology Suvarnabhumi, Thailand
Amnaj Sookjam, Rajamangala University of Technology Suvarnabhumi, Thailand
Sangtong Boonying, Rajamangala University of Technology Suvarnabhumi, Thailand
Suwit Somsupaprungyot, Rajamangala University of Technology Suvarnabhumi, Thailand

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Abstract
This research aimed to develop and validate a structural equation model of causal factors influencing achievement in Calculus 1 for students in the Faculty of Engineering and Architecture. The sample consisted of 375 first-year students, obtained through stratified random sampling. Research instruments included questionnaires and an achievement test. Data were analyzed using Structural Equation Modeling (SEM). Results showed that the developed model was consistent with empirical data ($\chi 2$=6.45, df=5, p=0.07, RMSEA=0.038, CFI=0.95, GFI=1.00, AGFI=0.99). Factors directly influencing achievement in Calculus 1 were mathematical aptitude (β=0.07), achievement motivation (β=0.20), mathematical background knowledge (β=0.18), attitude towards calculus (β=0.25), and learning behavior (β=0.28). Achievement motivation and attitude towards calculus also indirectly affected achievement in Calculus 1 through learning behavior. This model explained 75.51% of the variance in achievement in Calculus 1. The results show a need to cultivate mathematical aptitude, improve motivation, and bridge mathematical background knowledge to facilitate achievement in Calculus 1. They also stress the influence of attitudes and achievement motivation on developing suitable learning habits. The results can be utilized to instruct pedagogical techniques and prepare students in engineering and architecture training programs to increase their learning performance in Calculus 1 courses.

Keywords: Academic Achievement, Calculus1, Structural Equation Model (SEM)

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Introduction

One of the fundamental equations that form the foundation of engineering and scientific education. The foundation of logical abilities is mathematics. Calculus, for instance, is an essential subject in engineering and architecture courses to grasp better the increasingly complex mathematical models used to explain physical systems, design processes, and architectural phenomena (Stewart, 2015). However, further advanced courses in engineering and architecture institutions usually require Calculus 1, which may contain limits, derivatives, and integrals. However, despite its importance, Calculus 1 remains a significant challenge for many students (Thomas et al., 2016). Calculus 1 is required for most engineering and architectural schools, and because of the subjects it covers (such as limits, derivatives, and integrals), it is frequently a prerequisite for more complex courses. Therefore, understanding the fundamental elements influencing students' success in this important subject is essential for educators and policymakers in various professions (Black & Smith, 2018).

Calculus learning is influenced by many factors, especially for first-year students in challenging majors like engineering and architecture (Zhu & Simon, 2020). Intrinsic elements like motivation, cognitive capacity, and prior mathematics knowledge are also crucial, even though extrinsic factors like the classroom atmosphere, instructional strategies, and resources available greatly influence student success (Barkley & Howell, 2017). In addition, students' attitudes toward the subject, their study habits, and their level of effort are other intrinsic factors that may impact their performance in mathematics (Boekaerts, 2011). Researchers have turned to structural equation modeling (SEM) to identify and quantify these effects systematically, a powerful technique for understanding the complex relationships between variables affecting student performance. This statistical approach provides a comprehensive grasp of how different internal and external factors interact to affect student success in a subject as complicated as calculus (Wang & Liu, 2019).

Numerous important elements have been shown to influence students' performance in university-level calculus, with particular attention paid to emotive, cognitive, and prior mathematical knowledge. One of the most important indicators of performance in college-level calculus courses is prior mathematical knowledge (Mason & Spence, 2014). According to Larsen (2013), students with a solid foundation in algebra and pre-calculus before starting college are usually better equipped to handle the more complex and abstract ideas covered in introductory calculus courses. However, past knowledge is not the only factor determining achievement; emotive and cognitive aspects are also important. Students' comprehension of calculus is also greatly aided by cognitive elements like spatial reasoning, logical reasoning, and the capacity to conceptualize mathematical ideas (Smith & Tisdale, 2017)—one of the fundamental equations at the basis of scientific and engineering education. Logical capabilities are based on mathematics. Calculus, for example, is a crucial subject in engineering and architecture courses to help students better understand increasingly intricate mathematical models that are used to explain physical systems, design procedures, and architectural phenomena (Stewart, 2015). Even so, calculus 1, which might include limits, derivatives, and integrals, is frequently required for later advanced courses in engineering and architectural schools. However, despite its significance, many students still struggle significantly with Calculus 1 (Thomas et al., 2016).

In addition to these individual-level components, children's achievement in calculus is influenced by other classroom-level and institutional factors. One key issue is the quality of

the instruction; students do better when they receive instruction from teachers who use active learning tactics, provide brief explanations, and build a joyful but secure co-learning culture in the classroom (Freeman et al., 2014). Positive results can also be ascribed to the availability of academic aid services, such as online learning platforms, peer study groups, and tutoring centers (Yusuf et al., 2020). Therefore, a greater context should be considered when teaching calculus and how it relates to students' performance. Instruction calculus presented unique difficulties for working students pursuing careers in engineering or architecture. They already have to acquire calculus abstract ideas and apply them to solve practical engineering design or architectural planning challenges because their degrees are application-oriented (Cowan, 2016). These two expectations may be an additional cognitive load for students, particularly those who struggle with abstract mathematical reasoning or mathematical theory issues (Park & Kim, 2018).

Courses in architecture and engineering are also quite time-consuming and prescriptive. As a result, students are left with limited time after understanding challenging concepts like calculus. Many students enrolled in Calculus I have high-stress levels, which can further hinder their success (Jones & Redd, 2021). The intricacy of these interrelated effects greatly determines the requirement for a thorough model to capture interactions between variables affecting calculus students' achievement.

SEM is a highly desirable approach because, unlike more traditional regression models, it can estimate the direct and indirect associations between all variables, whether observed or unobserved, considering the latter as latent constructs that influence the dependent variable of interest (Byrne, 2016). When applied to the study of calculus achievement in engineering and architecture students, it becomes clear which factors are most important for achieving success in the subject and how these factors further interact to shape the student's performance. Additionally, SEM may be able to uncover the underlying mechanisms through which various variables impact calculus achievement, which would provide helpful information for designing targeted interventions to improve student outcomes (Jöreskog & Sörbom, 2017).

The current research creates a structural equation model on the elements that cause engineering and architecture students to achieve Calculus 1. The primary correlations to be highlighted are prior mathematical knowledge, cognitive and affective characteristics, and contextual factors, including academic assistance and instructional quality (Zhang et al., 2018). Therefore, it is reasonable to assume that this will help better understand the issues and difficulties faced by the students in these programs and result in more evidence-based suggestions for teaching and learning calculus courses.

Review of Literature and Related Research

Numerous studies have examined the factors influencing students' performance in challenging courses, such as Calculus 1 for engineering and architecture students. According to Mason and Spence (2014), the most significant direct influences include mathematical aptitude, drive for success, prior mathematical knowledge, calculus mindset, and learning style. Because they find it simpler to understand abstract concepts, students classified as mathematically gifted—including advanced problem-solving, logical reasoning, and spatial ability—frequently perform higher on calculus tests (Smith & Tisdale, 2017). Similarly, prior mathematical knowledge or readiness from previous math classes significantly influences students' achievement (Larsen, 2013).

Motivation related to achievement is needed to become successful in the field of academia, and it has a direct impact on calculus performance. Studies show that the high internal motivation of students is related to working through challenging problems and higher rates of attaining learning outcomes (Boekaerts, 2011). Another factor is the attitude towards calculus, which plays a significant role in enhancing performance. “Students who like mathematics or have confidence in their ability to do well in calculus experience less anxiety and do better” (Schoenfeld, 2019).

In addition to directly influencing calculus achievement, both achievement motivation and attitude toward calculus also indirectly affect calculus achievement through the intervening variable of the learning behavior. Students who are motivated and have positive attitudes are far more likely to engage in practical learning behaviors, such as studying regularly, taking an active role in the course material, and so forth, which lead to excellent performance (Freeman et al., 2014). Deriving motivation, positive attitudes and beliefs are important for better learning strategies and academic success in calculus, as seen from the relationship above. On top of these ways of thinking, cognitive and emotional factors that affect how well you do in calculus are also important. This suggests that you might need more than one way to help you do better in calculus.

Hypotheses Formulation

H1: Mathematical background knowledge (MB) would positively and directly affect the achievement in Calculus 1 (AC)
H2: Achievement motivation (AM) would positively and directly affect the achievement in Calculus 1 (AC)
H3: Attitude towards calculus (AT) would positively and directly affect the achievement in Calculus 1 (AC)
H4: Mathematical aptitude (MA) would positively and directly affect the achievement in Calculus 1 (AC)
H5: Learning behavior (LB) would positively and directly affect the achievement in Calculus1 (AC)
H6: Achievement motivation (AM) would positively and indirectly affect achievement in Calculus 1 (AC) through learning behavior (LB).
H7: Attitude towards calculus (AT) would positively and indirectly affect achievement in Calculus 1 (AC) through learning behavior (LB).

Conceptual Model of the Study

The conceptual model of this study was prepared using concepts from the theoretical and empirical literature. It is presented in Figure 1.

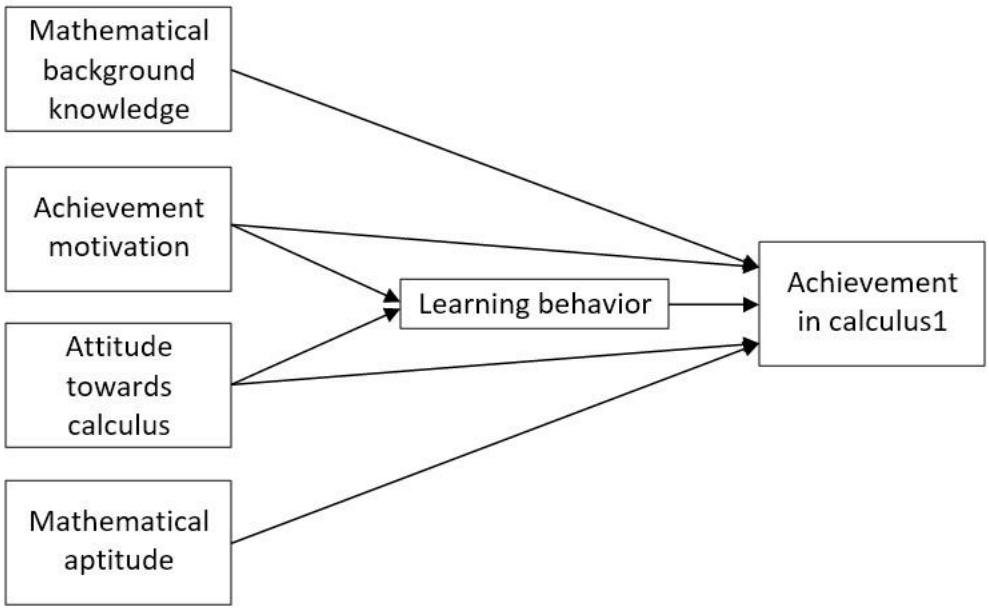

Figure 1: Proposed Theoretical Model

Research Methodology

Participant

The study participants were undergraduate students enrolled in a Calculus 1 course. They completed an online questionnaire covering Achievement Motivation (AM), Mathematical Background Knowledge (MB), Attitude Towards Calculus (AT), Learning Behavior (LB), and a Mathematical Aptitude (MA) test. Three hundred seventy-five participants were from the Faculty of Engineering and Architecture at Rajamangala University of Technology Suvarnabhumi. Among them, 312 were male (83.20%), and 105 were female (16.80%), with an average age ranging from 18 to 21.

Measurement

The questionnaire with a 5-point Likert scale measured Achievement motivation (AM), mathematical background knowledge (MB), attitude towards calculus (AT), and learning behavior (LB) variables.

The AM questionnaire included 10 items designed based on the four stages of AM: intrinsic motivation, extrinsic motivation, goal orientation, and persistence (Ryan & Deci, 2000).

The MB questionnaire included 10 items designed based on the four stages of MB: ability to solve algebraic equations, analysis and interpretation of graphs, understanding of functions, and basic knowledge of geometry (Allen, 2001).

The AT questionnaire included 10 items designed based on the five stages of AT: enjoyment, anxiety, perceived usefulness, and confidence in Calculus 1 (Wong & Chen, 2012).

The LB questionnaire included 10 items designed based on the four stages of LB: study habits, participation in class, self-regulation, and motivation (Zimmerman, 2002).

The MA questionnaire included 12 items designed based on the four stages of MA: numerical reasoning, algebra, geometry, and applied problem-solving (Usher & Pajares, 2009).

Achievement in Calculus 1 (AC) was measured by the value of academic achievement in Calculus 1, which was measured by the final value of the Calculus 1 score at the end of the semester.

Data Collection

An online survey administered in August 2024 was used to gather data. At that time, adequate data for analysis was considered. Potential participants were provided with links to the online questionnaire with their instructors' consent.

Validity and Reliability Instruments

30 participants' data were used for pilot testing for the MB, AM, AT, MA, and LB instruments. According to the results, Cronbach's alpha coefficients for dependability were 0.81, 0.82, 0.81, 0.83, and 0.80, respectively.

Statistical Analysis

To evaluate the present investigation, a structural equation model (SEM) was utilized, adhering to known best practices that advocate for a sample size of no less than 100–200 (5–10 observations per parameter estimate) (Kline, 2011). For Structural Equation Modeling (SEM), an adequate sample size is a minimum of 200 to 300 respondents who have completed the questionnaire (Muthén et al., 1997); thus, the total sample of 375 students is deemed appropriate. The studies used Jamovi v. 2.4.8 (The Jamovi Project, 2023) to assess descriptive statistics, correlation, and path analysis for model fit evaluation.

Results

The descriptive statistics, which include the means, standard deviations, correlations, and Cronbach alpha coefficients, are presented in Table 1. Prior to analyzing the data, the researchers made sure to make the necessary assumptions for path analysis. Satisfied. The sample consisted of 375 participants. Table 1 displays descriptive statistics, including the means, standard deviations, correlations, and All variables have Cronbach's alpha coefficients. Before conducting data Using a path analysis, the researchers tested the assumptions that were met. The researchers selected 375 subjects from the pool.

The Shapiro-Wilk test validated the regular distribution by the skewness and kurtosis values. Variables. Moreover, the means ranged from 4.57 to 62.30, and the standard deviations (SD) from 0.48 to 11.19. P was less than. All variables were significantly correlated (*p<.05), and Cronbach's alphas were more than 0.70 for all variables, reflecting their high reliability.

Table 1: Correlation Coefficients and Descriptive Statistics

Factors	Mean	SD	Skewness	Kurtosis	Cronbach alpha	MB	AM	AT	MA	LB	AC
1. MB	4.58	0.48	-1.15	0.63	0.81	1.00					
2.AM	4.59	0.49	-1.29	0.64	0.82	0.72*	1.00				
3. AT	4.57	0.47	-1.23	0.59	0.81	0.76*	0.75*	1.00			
4. MA	4.57	0.58	-1.49	0.53	0.83	0.57*	0.57*	0.54*	1.00		
5. LB	4.58	0.48	-1.30	0.82	0.80	0.77*	0.82*	0.82*	0.51*	1.00	
6. AC	62.30	11.19	-0.04	-0.51	-	0.76*	0.78*	0.80*	0.56*	0.82*	1.00

The obtained model fit indices, presented in Table 2, such as $\chi 2=6.45$, df=5, $\chi 2/df=1.29$, p=0.07, RMSEA=0.04, CFI=0.95, GFI=1.00, AGFI=0.99 demonstrated that the structural model adequately fit the data sets.

Table 2: Evaluation of Model Fit Indices

Fit index	**Acceptable**	**Model Value (standard)**	**Fit**	**Resource**
$\chi 2/df$	$0\leq\chi 2/df\leq 3$	1.29	Perfect	Kline (2011)
RMSEA	$0\leq RMSEA\leq 0.08$	0.04	Perfect	Hooper et al. (2008)
CFI	$0.90\leq CFI\leq 1$	0.95	Perfect	Tabachnick and Fidell (2007)
GFI	$0.90\leq GFI\leq 1$	1.00	Perfect	Hair et al. (2006)
AGFI	$0.80\leq AGFI\leq 1$	0.99	Perfect	Marsh et al. (1988)

The results of the path coefficients, presented in Table 3 and Figure 2, showed that MB ($\beta=0.18$, t value 4.15, $p<0.001$), AM ($\beta=0.20$, t value 4.01, $p<0.001$), AT ($\beta=0.25$, t value=4.82, $p<0.001$), MA ($\beta=0.07$, t value=2.24, $p<0.025$), and LB ($\beta=0.28$, t value=5.34, $p<0.001$) had significant positive direct effects on AC. Additionally, AM ($\beta=0.13$, t value=4.89, $p<0.001$) and AT ($\beta=0.14$, t value=4.91, $p<0.001$) had significant positive indirect effects on AC through LB. This model explained 75.51% of the variance in achievement in Calculus 1.

Table 3: Proposed Testing Results

Path	**Path coefficient**	**SE**	**t-value**	**P**	**Results**
AC⟵MB	0.18	0.04	4.15	< 0.001	Supported
AC⟵AM	0.20	0.05	4.01	< 0.001	Supported
AC⟵AT	0.25	0.05	4.82	< 0.001	Supported
AC⟵MA	0.07	0.03	2.24	0.025	Supported
AC⟵LB	0.28	0.05	5.34	< 0.001	Supported
AC⟵LB⟵AM	0.13	0.02	4.89	< 0.001	Supported
AC⟵LB⟵AT	0.14	0.03	4.91	<0.001	Supported

$R^2=0.7551$

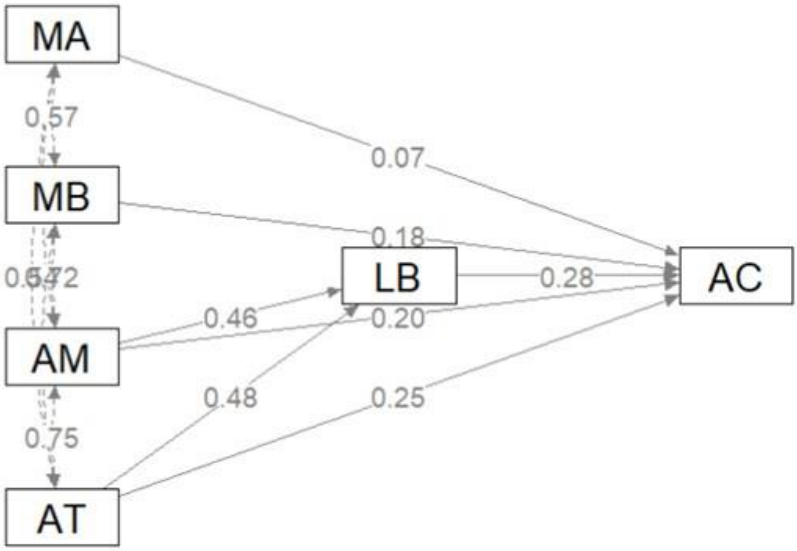

Figure 2: Results of Path Coefficients of the Research Model

Conclusion

Achievement in Calculus 1 (AC), a strong mathematical foundation, positively correlates with success in Calculus 1. This finding aligns with earlier research that showed that doing more complex tasks requires a strong foundation in the math needed (Usher & Pajares, 2008). Instead, it would be most advantageous for educators to utilize their time to strengthen the fundamental skills that prepare students for success.

Above all, the degree to which achievement motivation (AM) influences achievement in Calculus 1 (AC) demonstrates the impact of internal inspiration on academic performance. Motivated students perform better because they are more invested in the class and will find ways to work through obstacles (Deci & Ryan, 2000). This implies that fostering an inspiring learning environment could enhance Calculus 1 performance.

Finally, there is a strong relationship between students' attitudes toward calculus (AT) and achievement in Calculus 1 (AC), showing that how students feel about the subject affects how well they perform. Researchers commonly link the anticipation of success (a favorable attitude toward calculus) to the application of greater effort to succeed (Pajares & Kranzler, 1995). Such projects designed to encourage a positive mindset in math could be helpful, especially for struggling children.

The strong link between mathematical aptitude (MA) and success in Calculus 1 is another sign of how important it is to have hidden musical skills. According to Roberts et al. (2019), while it is possible to develop the skill, not every student pursues math. Each student could have thrived and succeeded with tailored instruction tapping their strengths.

The most substantial connection that can be made in Calculus 1 (AC) is to learning behavior (LB), which means that study habits, engagement, and other factors are more important for "studying" or doing well in school. Students using active studying techniques usually get more from their education (Pintrich, 2000). Educators here focus primarily on teaching effective learning strategies and helping students acquire these habits.

These results show that achievement motivation (AM) and attitudes toward calculus (AT) have positive indirect effects on students' performance in Calculus 1 (AC) through their learning behavior (LB). They also show that achievement motivation (AM) and attitudes toward calculus (AT) have positive direct effects on students' learning behavior (LB), which suggests that AM and AT are linked to academic success in some way, possibly through how they learn. This illustrates the intricate intertwining of multiple components (Schunk et al., 2008). According to Papanakou et al. (2021), positive attitudes and motivation lead to positive learning behaviors. When charting the way of doing and learning, education must ensure a conducive environment to motivate the students in the learning process; therefore, technology-enabled teaching must ensure a conducive environment.

Implication

These statistics indicate that achievement in Calculus 1 depends on several factors. An integrated approach may improve the comprehension of higher mathematics. These results further denote the connections between positive attitude, motivation, and learning the skills of calculus and their performance improvement. Timely intervention for students struggling with mathematics and teaching approaches featuring real-life applications and professional relevance could be key to turning things around. We hope educational policymakers, institutional administrators, and educators use these insights to inform curriculum design, teaching practices, and student support systems to improve calculus performance and build continued interest in STEM careers. By employing this holistic approach, which addresses cognitive, emotional, and behavioral domains, we may enhance calculus education and, by extension, all technical fields.

Limitation

Although it was adjusted for several relevant factors, many other important potential predictors may not have been measured. Factors like teaching quality, peer influences, or socioeconomic status, for example, could also play an important role in calculus achievement.

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Contact email: anek.p@rmutsb.ac.th

Application of Teachable Machine Program for Developing Volleyball Skills

Amnaj Sookjam, Rajamangala University of Technology Suvarnabhumi, Thailand
Anek Putthidech, Rajamangala University of Technology Suvarnabhumi, Thailand
Sangtong Boonying, Rajamangala University of Technology Suvarnabhumi, Thailand
Parinya Natho, Rajamangala University of Technology Suvarnabhumi, Thailand

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Abstract
This study examines the use of the Teachable Machine program to facilitate the development of volleyball skills, with particular attention to assessing both the improvement of the skill and the satisfaction of the participants. Specifically, the Teachable Machine, an AI-powered platform, was integrated into volleyball training sessions to enhance serve, pass, and spike skills. Using 30 participants we performed pre- and post-test evaluations of the participants, using a 1 to 10 skill level rating to score for accuracy, technique, and consistency. Statistical analysis of the data was performed using means, standard deviation, and the t-test for independent samples. The results show that pretest scores for serving, passing, and spiking were, on average, 4.33, 3.70, and 3.93, respectively, which means they were intermediate. However, there was a significant increase in overall performance in the post-test scores immediately after they learned to use the Teachable Machine, which increased the performance score to 6.87 for the serve, 6.83 for the pass, and 0.73 for the spike. Furthermore, participant satisfaction was based on a 1-5 Likert scale, with an average satisfaction score of 4.68 on this scale, representing very high satisfaction with the program. The Teachable Machine program also helps improve technical performance and promotes the continuity of practice, as shown by the participants' engagement when handling the game environment. Studies have been conducted on how technology can enhance traditional coaching methods to design training programs better, and this study is supposed to add to that body of knowledge.

Keywords: Teachable Machine Program, Volleyball Skills

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Introduction

For this reason, technology is an integral part of training for athletes, where old methods are complemented with modern techniques, incorporating everything from skill progression to overall performance. Being the most multifaceted game, including balance, flexibility, and accuracy, volleyball puts undue pressure on players to update their strategies gradually. Core skills such as serving, passing, setting, spiking, and blocking are essential to success in the sport; however, they take time and repetition. Most importantly, quality feedback is needed to be mastered. Traditionally, volleyball instruction heavily depended on noticing and providing input from a coach, exercising while providing practical information, and potentially biasing experiences (Kirkpatrick, 2016). This dependence on human cognitive reasoning significantly restricts the efficiency of talent acquisition, where vast numbers of athletes require tailored attention. Emerging technologies such as artificial intelligence (AI) are potentially disruptive. They offer new ways to practice skills and instantaneous, data-driven feedback while practicing, which may lessen some of the constraints.

One significant breakthrough is the wearable Machine, an artificial intelligence tool from Google. It started as a novice machine learning ML command line for images, sounds, and poses so that users could build and train their unique models on how they'd like them to respond to unique inputs, with no coding required. Implemented across multiple fields, including education, fitness, and sports, this technology has the potential to provide individualized, dynamic feedback for practitioners of various skills, revolutionizing how we train. The Teachable Machine can be trained to sense movements and provides feedback, accompanied by the ability to define what information is sent to the athletes in terms of identifying volleyball behaviors, thus allowing for real-time intervention that can enhance ideal technique (Garcia & Turing, 2020).

AI adoption in sports training fits into larger trends of integrating digital tools into performance enhancement. Research indicates that systems built on artificial intelligence increase the accuracy of executing skills, and the effectiveness of training and provide athletes with more insight into their own movements when merging with traditional training methods (Johnson & Liu, 2021). Such systems can help reduce the repetitiveness of skill acquisition through trial and error by providing feedback based on real-world data. For example, volleyball players can use Crowd Control to receive immediate, objective feedback on their techniques to quickly correct bad habits and reinforce good ones, leading to quicker improvement in specific skill areas like serving, passing, and spiking.

Because of its flexibility and ease of use, the Teachable Machine is especially well-suited to this application. Using video inputs, the machine is trained to recognize specific volleyball motions, such as the proper serve form or the best spike technique. When trained, the machine can then tell whether athletes' movements match the desired model in real-time and deliver instant feedback. This ability to provide immediate feedback makes the Teachable Machine a valuable complement to traditional coaching, as athletes typically have to wait until post-training analysis for feedback (Tan & Yeo, 2019). Artificial intelligence-based tools have decreased the feedback loop, allowing athletes to amend flaws as they occur, which is crucial in building muscle memory and developing technical efficiency.

This is important as not only do AI-powered tools like the Teachable Machine facilitate better skill acquisition, but they also do wonders in creating a training space that is supportive and breaks the mold of traditional learning. Research has indicated that individualized and

immediate feedback correlates positively with athletes' adherence to their training and their reported wellness (Wang et al., 2020). With validation methods, training can become more interactive since the proper techniques can be immediately reinforced beyond a simple visual representation of AI systems' general conditions, making them more energetic and fun. For volleyball players, this means focused, well-timed practice sessions in a data-supported environment with always progressing players.

This will definitely have a huge impact on sports. However, it should act as an improvement or supplementary tool to traditional coaching approaches rather than a substitute or negator. While AI tools can help a great deal in data analysis and strategy optimization (Schmidt & Miller, 2021), the subtle nuance of a human coach will always supersede any language model's prediction capabilities. Thus, AI is best regarded as a complementary device—a postmodern landscape yielding trains of thought for coaches and instilling them with additional devices to supervise the performance of athletes. In Teachable Machine, coaches can review data uploaded on the platform to detect trends in an athlete's statistics over time that might be difficult to notice by eye. This data could help spot superior therapies and training methods—optimizing an athlete's training as much as possible.

This study aims to apply the Teachable Machine program to building volleyball skills related to serving, passing, and spiking. The focus of the research is to determine the effectiveness of the program through skill level measurements before and after training sessions and evaluate athlete perceptions of AI technology use in their training. This research hopes to provide insights into how AI-powered platforms can facilitate a more innovative and engaging training experience for volleyball athletes.

It is not just merely a trend but the future of sports gaming. This work builds upon past work with the Teachable Machine for its use in volleyball training. It lays the foundation for more individualized, evidence-supported, and interactive practices in coaching that can keep up with the requirements thrust upon individuals in the modern age. Examining further the advantages offered through the use of AI concerning skill learning and satisfaction of athletes, this study adds to the existing literature concerning the importance of technology in aiding and expanding upon traditional coaching and developing more effective training practices.

Review of Literature and Related Research

Over the past few years, the use of artificial intelligence (AI) in sports training has begun to demonstrate its true impact and potential by providing athletes with sophisticated insights and new techniques that can take their performance to the next level. Traditional training methods often use repetitive drills, coach observations, and subjective feedback, which are effective but often lack the real-time and personalized feedback that athletes seek to test their boundaries. However, when it comes to training accuracy, efficiency, and athlete engagement, a machine-learning system such as the Teachable Machine could provide effective real-time data-based feedback for interfacing with AI technologies. This literature review will summarize existing literature that has been conducted on the subject of AI in sports (specifically volleyball), how it can or has influenced other research on athlete satisfaction, and whether technology-augmented training sessions can help develop said athlete skill.

Traditional Volleyball Training Methods

Until now, volleyball training has used conventional training methods; hence, these methods consisted of drill repetition, video analysis, and visual feedback (Kirkpatrick, 2016). Coaches then walk players through practice sessions designed to help them hone their technical ability (serving, passing, setting, spiking, etc.) and offer corrections based on their experience and observations. Although this technique does seem to work, its application has well-documented caveats. The size of the training group, an individual coach's biases, and plain human fallibility can limit a coach's capacity to provide individualized feedback. Also, there is a need to improve technique because athletes have to wait until the end of the session to be able to review what went wrong (Tan & Yeo, 2019). Such limitations emphasize the importance of more effective feedback mechanisms capable of providing accurate, unbiased, and on-time information about performance.

AI in Sports Training

Sports training is yet another vertical that AI has yet to explore. Conversely, data-driven coaching systems can process and analyze multiple data points, detect patterns, and provide real-time feedback as an interactive experience, allowing for a dynamic approach to coaching (Johnson & Liu, 2021). Even more precisely, machine learning algorithms can be trained to understand the movements that need to be made in a particular report so that the systems can adjust in real-time. This can be highly instructional in dynamic sports like volleyball, where players must constantly adjust their performance over short periods.

Studies have shown that AI-focused training tools can help enhance sports performance significantly. For example, Wang et al. (2020) observed that the level of technical accuracy and speed of improvement of an athlete trained by using AI-based systems was significantly higher than those trained with traditional systems. These systems allowed performers to receive real-time feedback on their movements, resulting in improved self-awareness of their technique and providing immediate correction, as opposed to time-consuming trial-and-error-based learning.

Teachable Machine in Sports

One of the AI platforms promising to provide some applications in sports training is Teachable Machine from Google. Thus, although the Teachable Machine originated as a simple illustration of machine learning regarding how computers interpret pictures, sounds, and poses, it has the potential to be used in other areas involving sports (Garcia & Turing, 2020). With the help of the Teachable Machine, coaches and players can train the system to recognize a few volleyball movements (what a powerful serve looks like, what a spike looks like) and track their performance during practice. The Falcon Gym application captures the user's location. It plays back in real-time so they can correct it immediately, providing instant feedback to the athlete. At the same time, they do their training, allowing for a more interactive experience that can take their training to another level.

Many studies have analyzed the advantages of artificial intelligence platforms like the Teachable Machine in various sports. Tan and Yeo (2019) also note a related issue regarding the use of AI in volleyball training, where a subset of athletes received real-time feedback on their technique from the AI system, while others relied on feedback from the coach and reported significantly greater improvement: The real-time feedback [from the virtual training

platform] to the athletes on using the proper technique during training sessions significantly assisted these athletes to improve in the shortest possible time. It also noted the potential benefit of AI systems providing consistent and objective feedback, which may help reduce the variability that human coaching can sometimes create.

Athlete Satisfaction With AI-Assisted Training

AI can coach athletes better for optimal performance. Highly relevant feedback Most importantly, this feedback delivered in real-time makes it possible for the athlete to act; it gives them information that closely relates to their performance and leads to better mental states (i.e., engagement and motivation) (Schmidt et al., 2021). AI systems provide all athletes with accurate and unbiased feedback, generating a data-driven ecosystem for all in which athletes' ability to quantify their development in real time gives them insight into which and how efforts generated improvement. Studies show this is much more engaging and rewarding for the trainee, as they maintain much more influence over the progression.

In a study by Wang et al. (2020), the performance of athletes who benefited from AI-based supported systems was not only better, but many of them also mentioned being more satisfied with their training process when compared to their conventional counterparts. The athletes said they enjoyed the instant feedback and the objectivity of the information the A.I. system provided, and they thought it gave them a more accurate understanding of their performance. Since the way AIs work is interactive by design, providing more visual or audio feedback helped the athletes to make it a more iterative and thus granulated process.

Challenges and Limitations of AI in Sports

Despite many advantages of implementing AI in sports training, some challenges and limitations remain. One main challenge is properly integrating the AI system with traditional coaching methods. Half-baked tools like the Teachable Machine are not designed to replace coaches but to supplement their expertise (Johnson et al. Coaches shed light, help emotionally, and decode the knotty, non-technical aspects of performance, such as an athlete's mental state or team dynamics. That being said, the deployment of AI systems must be done thoughtfully to help the human side of coaching, not to supplant it.

A curveball is that the usefulness of the AI system depends on the data that it's trained on. Where feedback is calculated based on poor data or non-complete data sets, it merely results in misleading results that, if anything, detract from, instead of help, an athlete's progression. As such, training and using AI systems in the sports world must be cautiously approached (Schmidt & Miller, 2021). It can be studied through literature and related research that AI systems (like the Teachable Machine) are decisive in determining the quality of volleyball tools used in training because of the specific real-time input feedback they provide. Not only does this reduce the time spent developing a specific skill, but it also improves athlete satisfaction, as training is more enjoyable and tailored to individual preferences. That said, while the fusion of the fast-evolving world of AI and the still-early-stage world of traditional coaching still feels borderline science fiction and in its infancy, the playing field of AI as a supplement to data-driven insights is more straightforward and more transparent. AI has started to play a more prominent role in sports, from training and skill development for athletes with the continuous advancement of such technology.

Research Methodology

Participants

The study participants were undergraduate students enrolled in a volleyball course. The study involved 30 participants. Seven were male (23.33%), and 23 were female (76.67%). Their average age ranged from 18 to 20 years.

Research Stages

The following will explain the stages of the research that will be carried out to explain the flow of the facial recognition system framework by utilizing the open-source teachable machine service and the literature used to support the research theory.

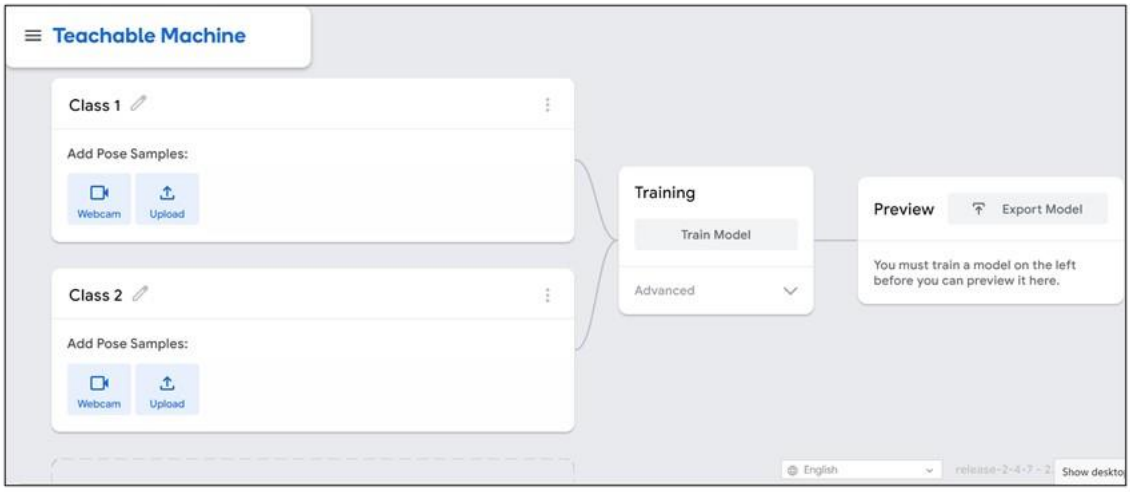


Figure 1: Teachable Machine User Interface

Figure 2: Image Recognition Stage (Teachable Machine)

This study's posture identification procedure used data from students who used to practice volleyball skills such as serving, passing, and spiking. Machine learning (ML) now allows these systems to analyze data and recognize patterns without being explicitly programmed to do so. The users can build and train their categorization models using a development platform like Teachable Machine (Carney et al., 2020). Teachers, designers, and students can all create and utilize their categorization using this model type.

Researchers first collect sample postures representing students' volleyball skills. These samples are then sent to the Teachable Machine platform for further classification and identification. This is followed by training, classifying, and testing the outputs. The phases of classification, training, and assessment leading to an ML classification model must be organized in a sequential order to establish a clear cause-and-effect relationship and facilitate use by novice users.

Users can select any model-building input, such as sounds, photos, or positions. Then, customers specify the classes that they want the model to learn and recognize (Pujari et al., 2022). We used webcam-captured poses to perform pose classification in this work. Using the Teachable Machine, each student entered poses that represented skills associated with volleyball that would submit to their respective classrooms. As many of the sessions were adjustable to suit different pupils, the methodology could train and identify positions during evaluation in an efficient manner.

TensorFlow trains power Teachable Machine and runs a model on your web browser: Js, a machine learning toolbox in JavaScript (Teachable Machine, 2022). Numerous models, such as GTM (Google Teachable Machine), use similar training methods, including CNN (Pujari et al., 2022). Training comes first, followed by evaluation (detection). Also Updated: Outputs now display the model's accuracy as a percentage instead of a ratio, and you can run the test using a camera or images from your sample. More development files, such as JavaScript, P5.js, Keras, Android, and other device system models, can also be exported as Coral files so that other programming languages can still run.

The first initial process is when the student logs in to verify the user's identity by entering the username and password. If successful, it will lead to the system meal, which will enter the attendance page. The face detection method in real-time uses the method that approaches the TensorFlow.js library previously created using The Teachable Machine service, exporting as *.js (JavaScript). Suppose the results of the face detection percentage have appeared. In that case, the student can save the student attendance data (ID, name, attendance time, face detection percentage, location, and other information) into the system database. The attendance process system is complete.

Results

The first step in building a website's system is to enter information data in the form of volleyball skills performed (with a range of 22–25 per class; more is better). This will train the sample data, which will then be organized and identified using a Convolutional Neural Network (CNN).

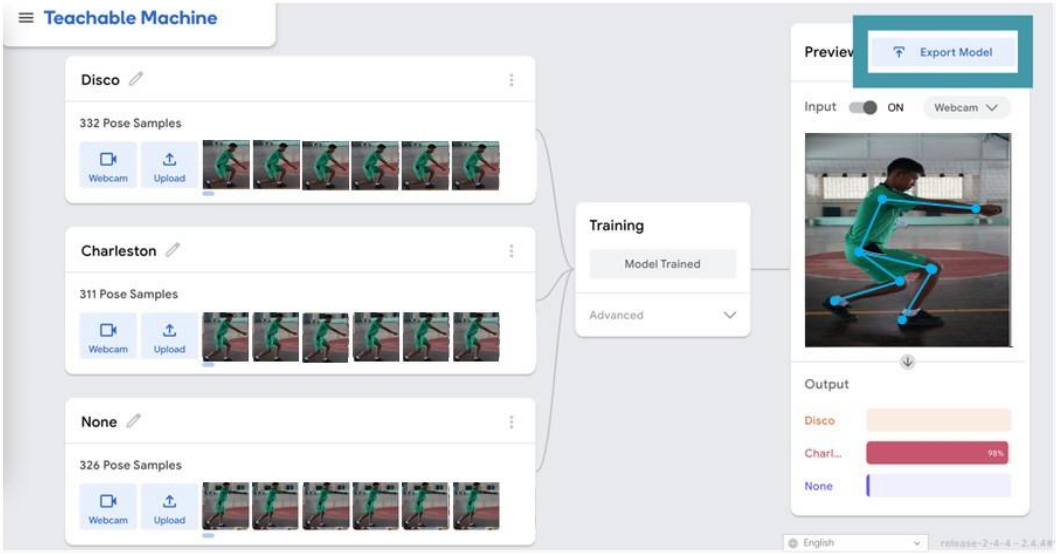


Figure 3: Input Data Sample and Testing (Simulation)

Figure 3 illustrates the composition of the test samples, which consist of three teams with varying volleyball experiences. Once we obtain the volleyball skills sample data, we train the data set using the default parameters (Epoch: 50, for example). Data till October 2023 is trained on this sample data and will improve that much till tested 50 times. Batch size: A single literacy instruction session uses 16 batches of samples. For example, this research considers 32 photos of each class. If we use a batch size of 16, then sample data will be divided into 32/16=2 batches. The second epoch will finish because the learning rate is 0.0001 (default), and both batches have been seen through the model (optimal value for batches=16, so do not touch it if possible—default). These will then be used as part of a JavaScript file, forming a student face detection-based website and displaying the results on the top right-hand side for testing before they are exported.

Once the class has trained all the data, the next step involves exporting the data. In this study, the author will take the source data in the form of a Javascript file (*.js). In the source file, the teachable machine service has prepared source code that will be connected to machine learning from TensorFlow using the Convolutional Neural Network (CNN) method approach. The file can be run on our localhost computer or cloud-based hosting later.

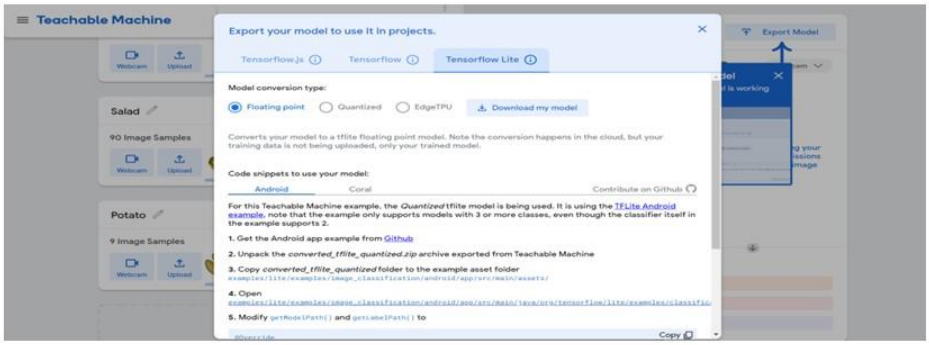
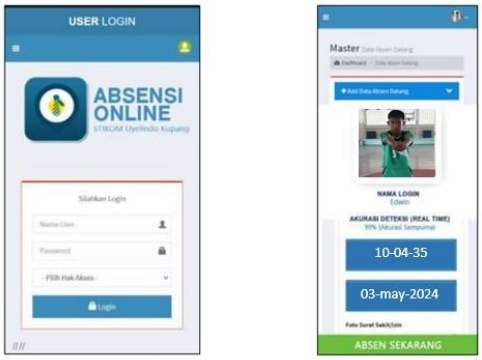


Figure 4: Export the Model and Download the Javascript.js File on the Teachable Machine

Figure 4 displays a script view of the Javascript language included with the Tensorflow.js package. This saves developers time scripting and enables them to understand the key characteristics of the downloaded script file (javascript.js).



(a) (b)

Figure 5: (a) Login System (b) Attendance Face Detection Online With Tenserflow.js (Teachable Machine)

Students will first log in and verify their identification in Figure 5 (a) using their username, password, and access privileges as either students or lecturers. They will enter the online attendance page that has been created and integrated with the Tensorflow.js library in Figure

(b) if this is accurate. Originally developed and exported as a javascript file from the Teachable Machine service, this library is subsequently altered on the previously stated website. By enabling students to take attendance in real-time, this tool enables the database to consistently record each student's attendance and determine the accuracy of each identified face.

Table 1: Distribution of Respondents by Key Skills

Key skills	N	Mean	SD	t	df	Sig.(2-tailed)
Pre_serving	30	4.33	1.49	-7.57	29	< .001
Post_ serving	30	6.87	1.04			
Pre_ passing	30	3.70	1.15	-9.36	29	< .001
Post_ passing	30	6.83	1.21			
Pre_ spiking	30	3.93	1.20	-7.99	29	< .001
Post_spiking	30	6.73	1.60			

Table 1 shows that an independent-sample t-test was conducted to compare the pre-and post-scores for serving, passing, and spiking regarding developing volleyball skills. There was a statistically significant difference in scores for Pre_ serving skill (M=4.33, SD=2.49) and Post_ serving skill (M=6.87, SD=1.04), t (30)=-7.57, p< .001, Pre_ passing skill (M=3.70, SD=1.15) and Post_ passing skill (M=6.83, SD=1.21), t (30)=-9.36, p< .001, and Pre_ spiking skill (M=3.93, SD=1.20) and Post_ spiking skill (M=6.73, SD=1.60), t (30)=-7.99, p< .001

Table 2: The Survey Results

Items	Mean	SD	Interpretation
1. The Teachable Machine program ideally suited my volleyball (serving, passing, spiking) skills.	4.83	0.37	Very high
2. The training sessions with the Teachable Machine program were engaging and interactive.	4.83	0.37	Very high
3. It provided a straightforward UI and easy commands through the Teachable Machine program.	4.63	0.60	Very high
4. The Teachable Machine program offered me personalized training based on my specific level of ability and needs.	4.33	0.47	high
5. It was creative and met the learning objectives, so I loved the Teachable Machine program's feedback, which was effortlessly provided as straightforward and constructive.	4.47	0.50	high
6. The skills I could learn through Teachable Machine I could apply to volleyball games in real life.	4.70	0.59	Very high
7. I was able to make the most use of my training time running the Teachable Machine program.	4.73	0.57	Very high
8. my experience with the Teaching Machine programs on volleyball training was quite satisfying.	4.77	0.50	Very high
9. If I could share the Teachable Machine with other volleyball players, I would.	4.60	0.49	Very high
10. If I were to implement this program through Teachable Machine into a volleyball training program I would give it a.	4.93	0.25	Very high
Total	**4.68**	**0.47**	**Very high**

As the survey results in Table 2 indicate, the Teachable Machine program is highly effective and well-received, making it a valuable tool for volleyball training. Respondents rated the

program highly across all areas of the program, with an overall average score of 4.68 out of 5. It was engaging, simple to use, and catered to their individual needs. They experienced major enhancements, which they implemented with practical games (volleyball). The program provided clear and constructive feedback and effectively utilized the training time. Participants had a strong willingness to continue to use the program and recommend it. These findings indicate that the Teachable Machine program helps improve volleyball performance and training motivation.

Conclusion

Results of this study show that the Teachable Machine program is highly effective at developing serving, passing, and spiking, all key volleyball skills. Independent-sample t-tests confirmed significant differences between pre- and post-training scores for all skill areas. Serving skills, for example, rise from a mean score of 4.33 to 6.87; passing skills increase from 3.70 to 6.83; and spiking skills rise from 3.93 to 6.73, all statistically significant at the $p<.001$ level. These results indicate that the initiative has an important positive effect on skills development.

In addition to quantitative gain, qualitative follow-up comments revealed that the participants enjoyed the Teachable Machine program and had a fantastic learning experience. Its average satisfaction score of 4.68 out of 5 shows how users found the program engaging, user-friendly, and adjusted to their personal needs. Participants noted that the program provided clear and constructive feedback, which helped them apply the skills they learned in real games relatively quickly. Finally, the program's hands-on feature made training sessions engaging and effective, and participants were left with significant motivation to continue using the tool in the long run and recommend it to their peers.

In summary, this study concluded that the Teachable Machine has successfully been an appreciative program to support skill education in volleyball. It is a welcome addition to modern-day volleyball training methodologies, as not only does the sport itself rack up some impressive skill advances, but it is also a beautiful way to keep the training fun.

Implication

Application of findings for volleyball trainers and sports learning in general. The first and most important point to consider is that such major improvement regarding the serving, passing, and spiking skills in the game indicates the need for harnessing the power of AI-based tools, like that of the Teachable Machine, to be used in the sports training for yielding better results. While traditional coaching can be valuable, it does not measure up to the real-time, data-driven analysis that AI can deliver, resulting in more efficient learning and significantly speeding up athletes' technical skills.

For coaches, platforms using AI allow athletes' skills to be developed both during and outside of training through technology, providing real-time assessment and confirmation of what needs to be changed and how to do so, eliminating some human error and bias. This is especially useful for larger training groups, which can be challenging to deliver one-on-one attention. By integrating AI tools, coaches can track progress more diligently, and the training methodology by monitoring performance data skewed toward precision, making training better.

With the focus on the athlete, the high level of satisfaction reported in this study suggests that AI-based training programs can stimulate motivation and engagement. The interactive and individualized feedback for each user provides a much more dynamic learning process. It can help keep athletes engaged in the training process to create a more significant commitment over an extended period. Such findings imply that AI technologies can and should be implemented to benefit performance-related results and improve the general quality of the athlete's journey within sports organizations and training facilities.

The study's results also lay the groundwork for further studies of the use of AI in other sports and skills. Not that this has any impact on this discussion of volleyball, but the promise of AI-assisted training can be applied to any sport that requires repetitive, high-accuracy execution of an idealized motion. This means AI becomes an integral part of the delivery of the offer in the field, further training models with human coaching to make learning an event that is not just faster but also fun.

Not only that, but the study ultimately demonstrates how AI-powered tools like the Teachable Machine can be transformative and relevant, taking sports training to the next level and making it effective and individualized, along with actually fun. For specific organizations seeking to improve their training methods, incorporating AI can profoundly affect training results, increasing the speed of skills acquisition and overall satisfaction to develop a long-lasting commitment to the sport.

Limitation

This study has several limitations. First, the sample size is small, limiting the generalizability of the findings. Second, the study focused only on short-term skill improvements without examining long-term retention or application in real-game scenarios. Third, participants' varying levels of technological proficiency may have influenced their ability to use the Teachable Machine program effectively.

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Contact email: amnat.s@rmutsb.ac.th

How Are New Metaphors Created? Evidence From Chinese English Learners

Ying He, Nanjing University of Aeronautics and Astronautics, China

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Abstract
For years, Conceptual Metaphor Theory has been a cornerstone in metaphor research. However, recent findings in psycholinguistics and neurocognitive science reveal that the creation of novel metaphors is more complex than previously understood. This study conducted a metaphor completion experiment with 60 Chinese university students to examine their metaphor production capabilities. We built a metaphorical corpus containing 170,000 words produced by native English speakers and utilized MIP (VU) and Wmatrix for comparative analysis. The findings are as follows: (1) Second language learners' metaphor production is primarily influenced by cognitive patterns rather than linguistic proficiency, leading to distinct differences in semantic categories and source domains compared to native speakers; (2) The novelty of metaphors is inversely correlated with second language learners' mastery of basic semantics, suggesting that novelty alone is an insufficient criterion for assessing metaphor quality; (3) Contrary to previous research, mental metaphors exhibit a bidirectional mapping process. Additionally, second language learners demonstrate both conceptual and grammatical asymmetry within a hierarchical metaphor network, even while being influenced by mother tongue transfer. These findings challenge traditional evaluation standards in language teaching and emphasize the need for refined criteria to assess metaphor quality, which could enhance metaphor recognition and creation in machine learning and AI language models. Furthermore, exploring the cognitive mechanisms and interlanguage differences in metaphor creation can improve concept teaching and facilitate cross-cultural metaphorical communication.

Keywords: Novel Metaphor, Metaphor Production, Second Language Acquisition, Mental Metaphor

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Introduction

Metaphors are essential in both everyday communication and cognitive processing, as they allow individuals to conceptualize abstract ideas through familiar experiences. Since the introduction of Conceptual Metaphor Theory (Lakoff & Johnson, 1980), metaphor has been recognized not only as a linguistic phenomenon but also as a reflection of deeper cognitive structures. While metaphor comprehension has been widely studied, the production of metaphors, especially by second language (L2) learners, remains less explored. This study investigates how Chinese English learners generate metaphors, particularly focusing on their ability to produce novel metaphors. The study aims to identify the cognitive and linguistic processes involved in metaphor creation in L2 contexts, shedding light on how learners navigate the challenges of cross-cultural communication.

Literature Review

Metaphor production in L2 contexts involves complex cognitive and linguistic processes that go beyond mere language proficiency. Lakoff and Johnson's (1980) Conceptual Metaphor Theory argues that metaphors are formed through mappings between a source domain (a concrete concept) and a target domain (an abstract concept), helping individuals understand abstract ideas through more familiar experiences. However, L2 learners often face challenges in producing culturally appropriate metaphors due to metaphorical transfer from their native language (Littlemore, 2010). This phenomenon can result in metaphors that are semantically or culturally incongruent with those of native speakers, reflecting the learners' reliance on their first language's conceptual structures.

Research indicates that metaphor production is influenced by cognitive patterns shaped by cultural experience. While L2 learners may have the linguistic tools to generate metaphors, their cultural and cognitive backgrounds play a significant role in the process (Casasanto & Bottini, 2014). For instance, novel metaphors—those that break away from conventional mappings—require more than just language proficiency; they demand a deep understanding of both linguistic and cultural nuances in the target language. Studies show that L2 learners often demonstrate asymmetries in their conceptual and grammatical structures when creating metaphors, suggesting that the production of metaphors reflects not only linguistic transfer but also cognitive constraints.

Metaphors are crucial in cross-cultural communication, as they reveal how different cultures conceptualize the world. While certain metaphors, like "TIME IS MONEY," may be common in English, L2 learners may face difficulties producing similar metaphors due to differences in cultural and cognitive frameworks (Kövecses, 2005). Success in metaphor production depends on the learners' ability to align their output with the target culture's metaphorical system, making metaphor competence both a linguistic and cultural skill. While much research has focused on metaphor comprehension, there is still limited understanding of how L2 learners create metaphors, particularly novel ones. This study aims to address this gap by examining the cognitive and cultural factors that influence metaphor production in Chinese English learners.

Methodology

Participants

The study involved 60 first-year English majors from Nanjing University of Aeronautics and Astronautics. All participants were native Chinese speakers learning English as their second language (L2). They were selected through random sampling to ensure representativeness and consistency in their language proficiency, with the group being at a similar intermediate level of English competence. Participants were briefed on the purpose of the experiment and signed consent forms prior to taking part. The participants' linguistic backgrounds were carefully screened to ensure that they had similar exposure to English instruction, thereby controlling for potential external variables that could affect their metaphor production.

Materials and Stimuli

The primary experimental task involved a metaphor completion test, specifically designed to elicit novel metaphor production from the participants. A total of 16 metaphor prompts were used, each designed to stimulate creative metaphor generation by leaving key portions of sentences incomplete for the participants to fill. These prompts included everyday and abstract concepts such as "tree," "money," "fear," "sea," and "death," which have been shown in previous research to generate high metaphor output among L2 learners. Each prompt was carefully selected and reviewed for clarity and suitability for the language proficiency level of the participants.

Prior to the main experiment, two rounds of pilot testing were conducted with 40 students who were not part of the final experiment. This pilot phase allowed for the adjustment of prompt difficulty and ensured the reliability of the test items in stimulating metaphorical thinking.

Procedure

The experiment was conducted in a controlled classroom environment to minimize external distractions. Each participant was provided with a printed booklet containing the metaphor completion tasks. Instructions were given orally and in writing, emphasizing that the participants should complete the sentences with creative, meaningful metaphors. Participants were encouraged to use their imagination but were cautioned to avoid literal translations from Chinese.

Each participant was given 60 minutes to complete the 16 prompts. The order of the prompts was randomized across the booklets to avoid sequence effects that might influence participants' responses. Throughout the process, participants worked independently under supervision to ensure that the data reflected their own individual thinking.

Data Collection and Analysis

Following the experiment, all responses were collected and digitized. The metaphorical expressions generated by participants were analyzed using two key tools: the MIP(VU) and Wmatrix. MIP(VU), developed by the Pragglejaz Group (2007) and Steen et al. (2010), was used to identify and categorize the metaphors in each participant's response based on their basic and contextual meanings. Wmatrix, a corpus analysis tool, was employed to conduct

semantic tagging and frequency analysis across the data sets, comparing the L2 learners' metaphorical output to established metaphorical norms in native English speakers.

To establish a baseline for comparison, a metaphorical corpus containing over 170,000 words produced by native English speakers was constructed using online texts. This corpus allowed for a direct comparison between the metaphors produced by L2 learners and those commonly used by native speakers in similar contexts.

The analysis focused on three key areas: the novelty of metaphors, source domain selection, and the appropriateness of metaphor use in context. Novel metaphors were identified based on their deviation from conventional metaphorical expressions, with particular attention paid to metaphors that demonstrated creativity but may have lacked cultural or linguistic appropriateness in English.

Discussion

Judgment of Novel Metaphor

The identification of novel metaphors is a key aspect of this study. Based on previous research, this study defines novel metaphors according to the following criteria:

a) Absolute Novelty: A metaphor is considered absolutely novel if its metaphorical meaning is not recorded in authoritative dictionaries of the target language and has not yet been established as a conventional metaphor through long-term use.
b) Relative Novelty: A metaphor is considered relatively novel if its metaphorical meaning is infrequently used within the target language community and lacks widespread recognition.

If a metaphor meets either of these criteria, it is classified as a novel metaphor. The specific evaluation can be referenced in Table 1.

Table 1: Criteria for Determining Absolute and Relative Novel Metaphors

	Absolute Novelty	**Relative Novelty**
Meaning	It was never said before, but now someone has said it	Others haven't said it; "I" say it this way
Question	How metaphors evolve over time	How metaphors spread across cultures
Evolution Process	Horizontal axis: semantic shifts in historical development	Vertical axis: semantic enrichment across linguistic differences
Opposite	Conventional metaphor	Literal expression
Judging Principle	No overlapping semantic domains	Low frequency of usage
Examples	1) The stock market keeled over. 2) Her tragic death punched everyone in the stomach.	1) Personality is an iceberg. 2) Life is a box of chocolate.

To quantify the occurrence of novel metaphors, the researcher used Wmatrix to analyze the frequency of semantic domains for each target word, comparing them to the corresponding frequencies in a native speaker corpus. The top 10 high-frequency semantic domains were selected, and their relative frequencies were compared with those in the native speaker

corpus. When the proportion of a semantic domain in the L2 learner corpus was higher than in the native corpus (overuse), it was marked with a "+"; if lower (underuse), it was marked with a "-".

Since novel metaphors are fluid and difficult to define by a specific value, a threshold was set for identification. Through data processing, it was found that marking a semantic domain as novel when its relative frequency (Q2) was less than 0.3% in the native speaker corpus could capture 4-6 novel metaphors for most themes, representing about 50% of the high-frequency domains. This threshold was thus used as a stable indicator of novel metaphor frequency. Topics with fewer novel metaphors indicated weaker creative performance by L2 learners, especially when high-frequency semantic domains overlapped heavily with the target word's basic meaning.

Patterns of Novel Metaphor Creation

L2 learners often tend to produce metaphors similar to conventional expressions in their native language, such as "TIME IS MONEY." Since the concept of time is inherently metaphorical and based on the projection of other conceptual domains, its source and target domains are relatively fixed, making it difficult to express time clearly without metaphors (Guyan, cited in Michon et al., 1988). When metaphors are closely tied to basic semantic structures, the novelty of the metaphor tends to decrease.

From a psychological perspective, traditional metaphor relationships are often the first stimuli activated in metaphor networks (Danesi, 2000). To create more novel metaphors, divergent thinking is necessary. This supports the idea that emotions, more than actions, lead to richer metaphorical expressions (Liu & Shi, 2013). The study also reveals that L2 learners, influenced by native language conceptual transfer, generate metaphors that differ significantly from those of L1 speakers, especially in culturally rooted topics. While this may result in more novel metaphors, it also highlights cognitive differences between language communities, posing challenges for cross-cultural communication (Littlemore & Low, 2006; Xu & Wang, 2019).

Table 2: High-Frequency Semantic Domains and Novel Metaphors for *Moon*

Semantic Domain	**F**[1]	**LL**[2]
Food*	23	0.26 +
Kin*	12	0.14 +
Residence*	14	0.16 +
Sad*	11	0.13 +
Relationship: Intimacy and sex*	10	0.11 +
Arts and crafts	32	0.37 +
Sailing, swimming, etc.*	20	0.11 +
Participating*	0	0.11 +
Light	86	0.99 +
Shape	48	0.55 +
Judgement of appearance: Positive	79	0.91 +
Religion and the supernatural	101	1.16 +

Note. *: Entries with this mark are marked as novel metaphors in this study.

[1] F: Frequency in the native language corpus.
[2] LL: Log-likelihood cut-off values.

As shown in Table 2, taking "Moon" as an example, the metaphor production of L2 learners is largely linked to the Mid-Autumn Festival, while L1 speakers emphasize the relationship between moon phases and time. This indicates that L2 learners' metaphors are influenced by cultural background, focusing on festival customs and cultural symbolism, whereas L1 speakers reflect different semantic structures. According to linguistic relativity, the differences in metaphor production between L1 and L2 speakers are at least partially due to their varying linguistic and cognitive structures. This supports the cognitive linguistic view that metaphor is not just a linguistic tool but a cognitive mechanism.

Table 3: High-Frequency Semantic Domains and Novel Metaphors for *Red*

Semantic Domain	**F**	**LL**
Interested/excited/energetic	73	0.82 +
Temperature: Hot / on fire	157	1.77 +
Anatomy and physiology	179	2.02 +
Violent/Angry	64	0.72 +
Relationship: Intimacy and sex	50	0.56 +
Happy*	13	0.15 +
Entertainment generally*	22	0.25 +
The universe	49	0.55 +
Time: Period	65	0.73 +
Objects generally	50	0.56 +

In contrast, Table 3 shows that while "Red" is also culturally significant in Chinese tradition, L2 learners did not produce metaphors similar to L1 speakers. This may be due to the strong emotional connections of the word "Red," overshadowing its cultural symbolism (such as New Year, celebrations, and wealth). In other words, emotional factors can have a stronger influence on novel metaphor creation than cultural factors, suggesting that cognitive patterns play a dominant role in L2 learners' creation of novel metaphors.

Overall, the ability of L2 learners to create novel metaphors is not low, which contradicts some earlier studies but aligns with Li's (2015) findings. L2 learners often produce metaphors that conflict with traditional conceptual categories. According to CMT, this suggests that metaphor transfer (or projection) does not rely on conceptual similarity but on the contributions of created or context-dependent features. Additionally, L2 learners tend to use material attributes for concrete topics and social attributes for abstract topics, highlighting the cognitive features of the target domain (Li, 2015). From a pragmatic perspective, the meaning of metaphors derives from their communicative function and their ability to shape thought and behaviour. Thus, instead of traditional structured writing, activities like "word chaining" and dialogic exercises may improve L2 learners' ability to create novel metaphors. Li (2020) also noted that more complex sensory experiences and abstract emotions lead to more divergent thinking, contributing to the creation of novel metaphors.

Open Strategies and Novel Metaphor Creation

L2 learners tend to create novel metaphors from source domains with clear semantic stances, indicating that more open word choice strategies can stimulate higher linguistic creativity. Compared to traditional conservative strategies, open strategies encourage L2 learners to break conventions and produce unique metaphorical expressions. Li (2020) suggests that when participants express distinct intentional attitudes, they tend to create novel metaphors, which Han & Wang (2011) interpret as highlighting new emergent meanings.

To foster L2 learners' ability to produce novel metaphors, it is essential to stimulate their critical thinking and encourage them to view metaphorical relationships from different perspectives. Additionally, learners should be encouraged to use the target language in innovative ways, extracting metaphors from different semantic positions and creating new form-meaning pairings. This training not only enhances learners' linguistic creativity but also helps them use metaphors more flexibly in cross-cultural communication.

Impact of Language Proficiency on Metaphor Production

Previous research has shown disagreement regarding the relationship between second language acquisition and metaphor production, particularly in terms of the influence of language proficiency and cognitive patterns. Chiappe & Chiappe (2007) argue that both cognitive ability and language proficiency influence metaphor generation. A comparison with native English speakers reveals that, although lower-proficiency participants may be constrained by their language skills, the primary difference in metaphor production lies in cognitive patterns rather than purely language abilities. This does not suggest a lack of metaphor production capacity but highlights a cognitive "gap" in cross-cultural communication.

However, lower language proficiency does affect metaphor production, which aligns with the findings of Azuma (2005) and Wei (2015). L2 learners tend to use superordinate terms in their metaphors, with generalized and broad vocabulary lacking specificity and precision. In contrast, native speakers more often use subordinate terms, which are more concrete and detailed, allowing for richer metaphorical expression. This can be explained by Prototype Theory and Basic Level Category Theory. L2 learners are still grasping basic conceptual structures in English and rely more on central prototypes, while native speakers have a more nuanced understanding of categorization, enabling them to create more specific and detailed metaphors.

Lexical Complexity and Register Construction

L2 learners display a richness in semantic domains for metaphor production, but their lexical complexity is lower than that of native speakers, indicating that their semantic networks are still developing. From a grammatical perspective, L2 learners predominantly use noun-based metaphors, resulting in more static descriptions, unlike Chinese, which is a verb-oriented language. In contrast, native speakers use a higher proportion of verbs, adding dynamism and reflecting physical experiences in their metaphors.

This difference aligns with Halliday's (1994) theory of Grammatical Metaphor, where varied expressions of meaning are key features of metaphor. L2 learners may prefer noun-based metaphors due to familiarity, avoiding the subtle differences between English verbs. For instance, in negative semantic domains, L2 learners often use "Monster" instead of more specific animals, echoing similar findings by Wei (2015), who also noted the frequent use of compound metaphors by foreign participants. Although language factors may not directly cause significant differences in semantic domains, they influence discourse coherence and contextual appropriateness. Danesi's (1992) concept of "conceptual fluency"—the ability to match surface structures of a language with its underlying conceptual framework—is especially relevant here, highlighting differences in metaphor source selection and semantic stances between L2 learners and native speakers.

Source Domain Selection in Positive and Negative Metaphors

By categorizing metaphors into positive (optimistic) and negative (pessimistic) themes based on semantic prosody, we found that L2 learners produce more diverse source domains in positive-themed metaphors, but their output tends to be more fragmented and lacks clear prototypes. This weakens the thematic relevance and contribution compared to L1 speakers. This pattern suggests that L2 learners' metaphor production aligns more with Radial Category Theory (RCT), where the semantic activation model resembles a network of points with no obvious central prototype.

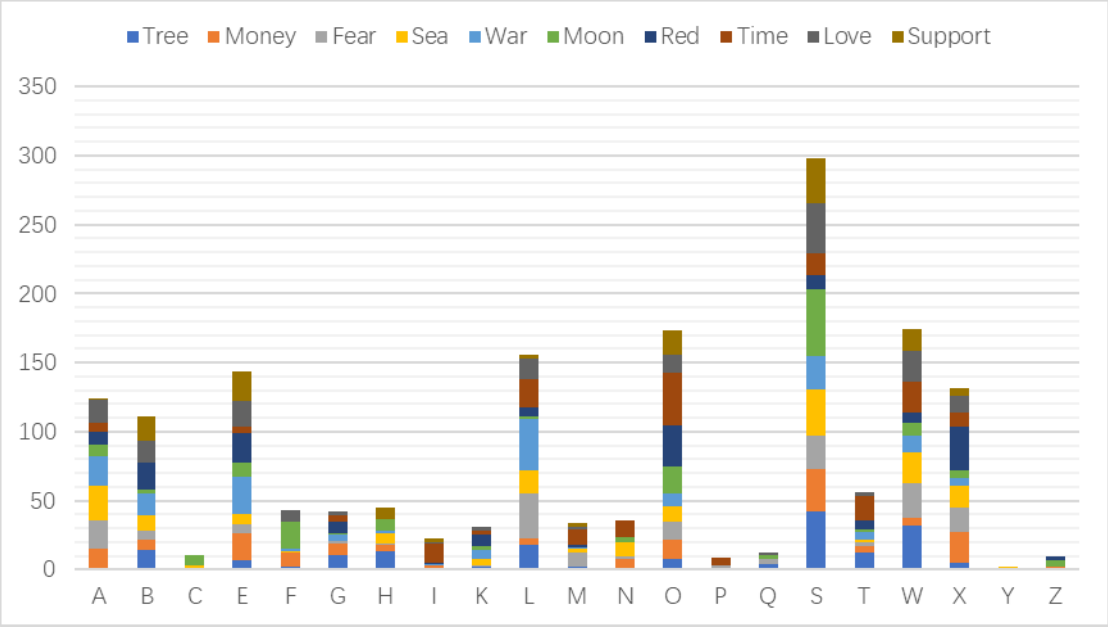
Conversely, in negative-themed metaphors, L2 learners demonstrated more systematic source domain selection, with stronger family resemblances between semantic categories. This indicates that when expressing negative emotions or content, L2 learners activate similar semantic domains. This finding supports the Connectionism model in neuroscience, where the activation of different stimulus nodes is interconnected, and psychological representation follows a hierarchical pattern (Cameron, 1999).

Li (2015) explained that this phenomenon may be linked to L2 learners' vocabulary categorization abilities or the specific concepts activated during metaphor production. In negative themes, L2 learners tend to use overlapping source domains, resulting in a homogeneity that limits the distinction of the target domain's uniqueness. This over-reliance on negative imagery suggests a lack of vocabulary in relevant semantic fields, making it difficult for readers to differentiate the nuances of their descriptions. This also reveals a common issue of Source-Target Asymmetry in L2 learners' metaphors, especially regarding metaphor directionality, where this asymmetry becomes more apparent.

Frequency Analysis of Semantic Domains

By integrating the source domains of all target words, a visual representation can be created, as shown in Table 4.

Table 4: Bar Chart of Semantic Domain Frequency



By integrating the source domains of all target words, a bar chart was created to visualize the frequency of semantic domains used by L2 learners. The results show that L2 learners' high-frequency source domains are closely related to daily life, emotions, personal experiences, and social interactions. These choices align with the embodied cognition theory, which suggests that metaphorical mappings are rooted in physical experiences and human knowledge. However, while L2 learners demonstrate variety in their source domain selection for positive themes, their metaphors tend to be more fragmented and lack the clear prototypes found in L1 speakers' metaphors. This suggests that their metaphorical expressions, while diverse, may lack the thematic coherence seen in native speakers.

In contrast, L2 learners' metaphors in negative themes show greater consistency, with higher overlap in source domain selection. This indicates that when dealing with negative emotions, L2 learners activate more uniform cognitive patterns, resulting in similar metaphorical expressions to L1 speakers. Emotional metaphors, in particular, show a high degree of cognitive alignment with native speakers, supporting the idea that shared human experiences play a key role in metaphor production. These findings suggest that L2 learners' metaphor creation is influenced by both cognitive and cultural factors, with emotional content providing a stronger foundation for metaphorical coherence.

Multidimensional Metaphor Quality Assessment Framework

Based on the previous findings, L2 learners exhibit unique characteristics in their metaphor production, which has laid the foundation for a new multidimensional metaphor quality assessment framework. This new framework aims to provide a more comprehensive evaluation of L2 metaphor production, addressing the limitations of traditional single-dimension approaches (such as focusing solely on language accuracy). The proposed framework evaluates metaphors on dimensions such as novelty, appropriateness, and cultural relevance, grounded in CMT, and considers cognitive, linguistic, and pragmatic aspects.

Traditional metaphor assessments often emphasize grammatical correctness or vocabulary usage, overlooking the creativity and conceptual depth of metaphors. Our findings suggest the need for a system that assesses both grammatical accuracy and the cognitive and cultural structure of metaphors. Given that L2 learners' metaphorical mapping is influenced by both their native and target languages, a multidimensional approach is crucial for capturing the full scope of their metaphor production. This framework will also serve as a theoretical basis for validating and testing in subsequent experiments.

Conclusion

This study has explored the distinctive features of metaphor production in L2 learners, highlighting the cognitive, linguistic, and cultural factors that shape their creative output. By proposing a new multidimensional metaphor quality assessment framework, we aim to provide a more holistic approach to evaluating metaphor use, one that accounts for novelty, cognitive complexity, cultural relevance, and pragmatic appropriateness. This framework not only addresses the limitations of traditional assessments but also helps to deepen our understanding of how metaphors function as bridges between languages and cultures.

As metaphors are not merely linguistic expressions but windows into the mind, they allow us to navigate the abstract and give form to the intangible. In the words of Lakoff and Johnson, "we live by metaphors"—they are the silent poets of our thoughts, shaping the way we

understand the world and each other. Through this research, we hope to continue uncovering the intricate beauty of metaphoric thought in second language learners, enriching the dialogue between language and cognition.

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Contact email: hollyho@nuaa.edu.cn

Proper Modalities of Input Facilitate Incidental Vocabulary Acquisition: Evidence From Advanced Chinese EFL Learners

Ying He, Nanjing University of Aeronautics and Astronautics, China
Siyu Wu, Nanjing University of Aeronautics and Astronautics, China

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Abstract
Previous research has largely focused on the effects of single input modalities on vocabulary acquisition, often overlooking the potential of multimodal teaching methods. This study addresses this gap by comparing the impact of reading, listening, and subtitled audiovisual input modalities in promoting incidental vocabulary acquisition among advanced EFL learners in China. We divided 40 advanced college English learners into 4 groups: a control group, a reading group, a listening group, and a subtitled audiovisual group. Participants took a pre-test, an immediate post-test, and a delayed post-test to assess vocabulary knowledge. The findings revealed that the subtitled audiovisual input modality led to the most effective immediate vocabulary acquisition, though its impact decreased over time. Conversely, the listening modality was associated with the most sustained vocabulary retention. These results highlight the importance of input modality in vocabulary acquisition, suggesting that while subtitled audiovisual materials can enhance short-term learning, listening exercises are more effective for long-term retention. The study offers insights for language instructors aiming to enhance vocabulary teaching strategies through multimodal input.

Keywords: Multimodal, Incidental Vocabulary Acquisition, Vocabulary Teaching

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Introduction

Incidental vocabulary acquisition refers to the process in which learners, while engaging in contextual activities such as extensive reading, watching, and listening, do not intentionally focus on a specific word but inadvertently expand certain aspects of their vocabulary knowledge (Nagy & Anderson, 1985). A substantial body of research has demonstrated that all types of communicative activities can provide opportunities for acquiring new vocabulary knowledge (Day & Haramatsu, 1991; Duppy & Krashen, 1993; Laufer & Hulstin, 2001; Pulido, 2003). Vocabulary learning is no longer merely a goal-oriented product confined to fixed teaching times and locations. Therefore, how to promote incidental vocabulary acquisition has become a key focus for researchers.

One of the key conditions for incidental vocabulary acquisition is language input. Much of the research in this area has focused on incidental vocabulary acquisition through reading activities (Brown & Donkaewbua, 2008; Wang, 2009; Zhang & Qi, 2009), with a few studies exploring the role of listening input in promoting vocabulary acquisition (Chang & Li, 2009; Vidal, 2011; Xu, 2012). With the development of multimodal theory, there has been an increasing number of studies using English audiovisual materials as language input to explore whether multimodal input can facilitate incidental vocabulary acquisition (Gu & Zang, 2011; Rodgers & Webb, 2011).

In terms of language output, learning tasks, as the most common form of language output activity, have received widespread attention for their learning effects. Factors such as task familiarity, task time, and task type can influence the effectiveness of learning tasks to some extent. Among these, the impact of task type is particularly pronounced, as different types of output tasks can trigger varying degrees of attention from participants, which in turn stimulates different levels of cognitive processing and ultimately leads to different acquisition outcomes. In light of this, the present study will compare the effects of incidental vocabulary acquisition through three types of input: reading materials, audio, and subtitled audiovisual content.

Literature Review

Before the concept of “incidental vocabulary acquisition” was proposed, Nation categorized vocabulary learning methods into two types: Direct Learning and Indirect Learning. He argued that “Direct Learning refers to activities and exercises where learners focus their attention on vocabulary; Indirect Learning refers to activities where learners focus on other aspects, especially the information conveyed by language, and vocabulary is acquired without deliberate focus on it” (Nation, 1990). Laufer’s definition of incidental vocabulary acquisition, which is widely accepted in the research community, is essentially aligned with Nation’s definition of Indirect Learning. She defines “incidental vocabulary acquisition” as the opposite of “Intentional Language Learning,” referring to situations where learners acquire vocabulary while engaging in other tasks, such as reading articles or listening to English songs (Laufer, 1998).

As an indirect method of vocabulary acquisition, “incidental vocabulary acquisition” is mainly supported by three major theories: the Incidental Vocabulary Learning Hypothesis, the Input Hypothesis, and the Interaction Hypothesis. The proponents of these theories have all demonstrated, through theoretical and scientific practice, the possibility of incidental vocabulary acquisition and its indispensability in vocabulary learning. It has become a

consensus in the research community that extensive reading in second language learning facilitates incidental vocabulary acquisition. With further research, Meara (1997) raised a more challenging issue in the study of incidental vocabulary acquisition, namely, the various factors that may influence incidental vocabulary acquisition.

Current research on incidental vocabulary acquisition mainly focuses on three areas:

1. Verifying the effects of incidental vocabulary acquisition through reading activities. Studies by Qian (2003) and Zhu & Cui (2005) have shown that learners can acquire a small number of words incidentally through reading, and there is a positive correlation between students' language proficiency, vocabulary size, and incidental vocabulary acquisition. Some studies have compared the effects of direct vocabulary learning and incidental vocabulary acquisition in reading, finding that the highest acquisition and retention rates occur when direct learning is combined with incidental acquisition, followed by direct learning alone, and the lowest rates for incidental acquisition. However, incidental acquisition results in the largest vocabulary gain, making it the most important route for vocabulary acquisition in reading classes (Gan, 2008b). Over extended periods of repeated learning, both methods show different characteristics at different times and are complementary to each other (Wu & Chen, 2012).
2. Research on the factors influencing incidental vocabulary acquisition in reading. Gan's series of studies (Gan, 2008a, 2009, 2010, 2011, 2014) found that factors such as semantic transparency, context, word structure, and word class all influence incidental vocabulary acquisition.
3. Studies on word-meaning guessing in reading. Researchers, through analysing the processing methods and influencing factors of learners' guessing process, found that morpheme meaning, the relationship between morpheme meaning and word meaning, word internal structure, polysemy, and learners' language proficiency all affect word-meaning guessing (Liu, 2001; Qian, 2003; Zhu & Zhou, 2007; Zhang, 2010; Gan, 2012).

Overall, researchers agree that incidental vocabulary acquisition in reading is widespread, and the extent of acquisition is constrained by multiple factors, including the reading material, word properties, and learner characteristics.

Multimodal refers to the interaction between humans and the external environment through three or more sensory modalities (Gu, 2007). Current research on incidental vocabulary acquisition primarily focuses on the following three areas:

1. The role of multimodal teaching methods in achieving classroom teaching goals. For example, Sheng et al. (2011) studied the role of multimodal teaching methods in college English listening instruction. They found that the audiovisual group performed better in improving listening comprehension than the listening-only group. However, there was no significant difference in incidental vocabulary acquisition between the audiovisual and listening-only groups, though the audiovisual group had a higher average and standard deviation.
2. The impact of multimodal input on second language input. Gu & Zang (2011) conducted a controlled experimental study to investigate the effects of visual, auditory, and audiovisual input on second language comprehension and incidental vocabulary acquisition. They found that the correlation between comprehension and vocabulary acquisition varied with different input modalities. Visual comprehension was found to be superior to auditory comprehension, while auditory input might interfere with the

processing of visual input. In terms of incidental vocabulary acquisition, the visual and audiovisual groups both significantly outperformed the auditory group, with little difference between the visual and audiovisual groups.

3. Research on the factors influencing incidental vocabulary acquisition in multimodal input. Mo (2017) explored the effects of incidental vocabulary acquisition and retention under auditory and reading input modalities, as well as the impact of input frequency and semantic transparency on incidental vocabulary acquisition and retention.

Internationally, there is also a growing body of research on incidental vocabulary acquisition in second language learning under different input modalities, as well as studies exploring the factors influencing vocabulary acquisition and methods for improving its effects (Vidal, 2011; Peters & Webb, 2018). Peters & Webb (2018) conducted a comprehensive study on the effects of video viewing, vocabulary knowledge, and learner-related factors on incidental vocabulary acquisition, pointing out that these factors all have varying degrees of facilitative effects on vocabulary acquisition. Vidal's 2011 study analyzed the differences between reading academic texts and listening to three lectures, comparing input modalities in terms of word frequency, word class, discourse type, and learners' ability to predict words. The study found that reading academic texts was most effective, with the longest retention time, while listening to lectures was slightly less effective with a shorter retention time. Other studies have used eye-tracking to investigate whether dual or multimodal annotations can relieve memory capacity and reduce cognitive processing difficulty, thereby promoting vocabulary retention (Boers et al., 2017).

However, from the perspective of both research breadth and depth, Chinese research on incidental vocabulary acquisition has mostly focused on reading, with less attention given to speaking, listening, and writing, and fewer studies exploring multimodal perspectives. With the continuous integration of computers and education, as well as the lessons learned from the recent pandemic, online courses have become an indispensable alternative to traditional classroom instruction. In the context of remote learning, multimodal input can play a more significant role. Audiovisual and subtitled audiovisual input modalities (Peters et al., 2016; Peters & Webb, 2018) are gradually becoming important teaching methods. As commonly used approaches in English classrooms, there is still no consensus on which input modality is most beneficial for incidental second language vocabulary acquisition. Therefore, this study focuses on three commonly encountered input modalities in daily life: reading, listening while reading, and subtitled audiovisual input, comparing their effects on incidental second language vocabulary acquisition.

Methodology

Research Questions

This study aims to explore the impact of three different input modalities (reading, listening, and subtitled audiovisual input) on incidental vocabulary acquisition among English majors. Specifically, it seeks to answer the following research questions:

1. Can English majors acquire vocabulary incidentally under the three input modalities (listening, reading, and subtitled audiovisual)?
2. Which modality leads to the best incidental vocabulary acquisition effect?
3. Which modality results in the longest retention of the acquired vocabulary?

Research Design

This study adopts a 4 (input modality) × 3 (vocabulary acquisition testing time) mixed factorial design. The input modality is the between-subjects variable and the manipulated independent variable of this experiment, including four conditions: reading, listening, subtitled audiovisual input, and a control group (no target material input). The vocabulary acquisition testing time is the within-subjects variable, consisting of three testing times: pre-test, immediate post-test, and delayed post-test. The dependent variable of this experiment is the participants' vocabulary knowledge of the target words.

Participants

According to previous literature, Laufer (2001) and other scholars suggest that second language proficiency is an important factor influencing the ability to acquire vocabulary incidentally during reading. Learners with higher second language proficiency are more likely to successfully infer the meanings of unfamiliar words. Therefore, this study selected 40 first-year graduate students majoring in English at a university in Nanjing, China. The participants were randomly divided into four groups: reading group, listening group, audiovisual group, and a control group, with 10 participants in each group, totaling 40 participants. All participants had taken the national English proficiency test for English majors within the past three years. The analysis of their test scores showed no significant differences between the four groups ($p=0.592>0.05$), indicating that, overall, the participants' English proficiency was comparable.

Experiment

Materials and Target Words.

The experimental materials required for this study include reading texts, audio recordings, and subtitled videos. Given that the participants are English major graduate students with relatively high English proficiency, the difficulty of the selected materials should be moderate. After screening, the final experimental material chosen for this study was J.K. Rowling's classic speech at Harvard University's commencement ceremony, which consists of 705 English words. The topic is familiar to students, the structure is clear, and its readability value according to the Flesch-Kincaid readability test is 61.6, indicating moderate difficulty. The speech transcript was used by the reading group, the audio recording by the listening group, and the video, after careful comparison of its subtitles, was used by the audiovisual group. The control group received no input of the target material.

To select the target vocabulary for this study, 11 English major graduate students, whose English proficiency was comparable to the participants but who were not involved in the experiment, were asked to mark unfamiliar words in the experimental material. From all the words marked, 11 words that were marked by at least 8 of the students were selected as target vocabulary. These words made up 1.6% of the total vocabulary. Additionally, some words marked by fewer students were chosen as distractors, also making up 1.6% of the total vocabulary. In total, there were 22 target and distractor words, comprising 3.12% of the total vocabulary. According to previous research (Laufer & Hulstijin, 2001), one prerequisite for incidental vocabulary acquisition is that learners must recognize at least 95% of the words in the text, and the word-to-unfamiliar word ratio in this study's experimental materials meets this condition.

Procedure.

All four groups of participants completed a pre-test on target vocabulary knowledge in the first week, lasting 15 minutes. To reduce the carryover effect, one week later, the three experimental groups received input of the experimental material through reading, listening, and subtitled audiovisual methods. To control for explicit vocabulary learning behavior and achieve the experiment's goal of examining true incidental vocabulary acquisition, participants were informed of the reading/listening comprehension tasks but were not told about the vocabulary knowledge test. The duration of input for listening, reading, and video was 15 minutes, with the audio and video played twice. After the input, the three experimental groups completed the immediate post-test on target vocabulary knowledge. The control group received no input of the experimental material and only participated in the vocabulary knowledge test, which also lasted 15 minutes. One week later, both the experimental groups and the control group completed the delayed post-test on target vocabulary knowledge, which also lasted 15 minutes. During the entire experiment, participants were repeatedly reminded that they were not allowed to use dictionaries or other resources to look up word meanings, and they were not instructed to deliberately recall the experimental materials after the test.

Measurement Tools.

The target vocabulary knowledge test used an adapted version of the Vocabulary Size and Knowledge Scale (VSK) by Paribakht & Wesche (1993). The scale and scoring criteria are shown in Table 1.

Table 1: Vocabulary Knowledge Scale

Categories	Score	
I.I don't remember having seen this word before	0 point	
II.I have seen this word before, but I don't think I know what it means	1 point	
III.I have seen this word before, and I think I know what it means	2 points	
IV.I know this word. It means (Synonym or translations)	1 point	Incorrect
	2.5 points	Partially correct
	3 points	Correct
V.I can use this word in a sentence: _____ (If you do this section, please also do category 4)	1 point	Incorrect in lexical meaning and incorrect in context
	2.5 points	Partially correct in lexical meaning and incorrect in context
	3 points	Correct in lexical meaning and incorrect in context
	3.5 points	Correct in lexical meaning and partially correct in context
	4 points	Correct in lexical meaning and correct in context

In the three vocabulary knowledge tests, the target words were randomly arranged and presented in different orders. After the completion of the three tests, data analysis was conducted using SPSS 26.0 software.

Results

Data Validation

To ensure the validity and reliability of the research data, outlier detection was first conducted on the collected data, with the results shown in Figure 1. Three outliers were excluded due to extreme values. As outliers mostly appeared in the pre-test scores, the decision was made to retain the data and include it in the subsequent analysis.

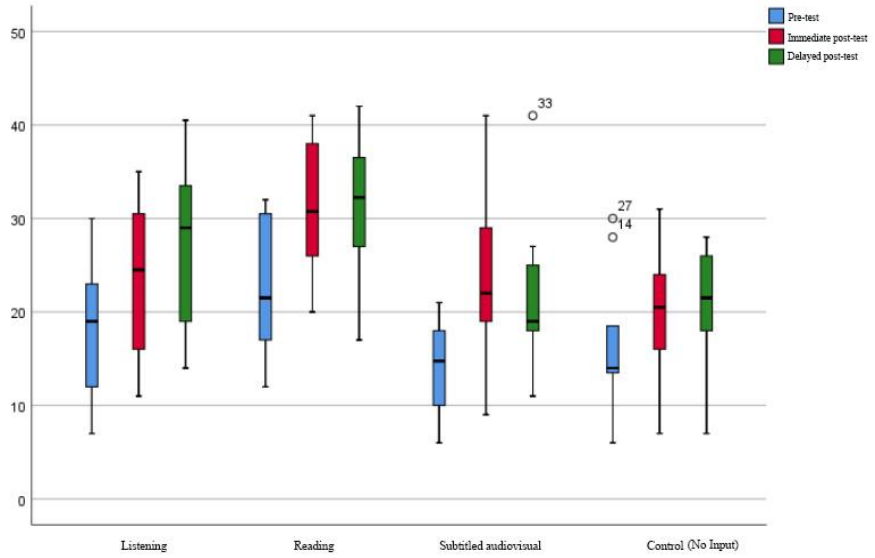

Figure 1: Box Plot of the Results

To verify whether there is multicollinearity between the independent variables, Pearson correlation coefficients and two-tailed significance tests were conducted. The correlation coefficients (r) for the pre-test scores, experimental scores, and post-test scores were found to be .668, .729, and .702, respectively. Since $|r|<1$, there is a certain degree of correlation between the multiple dependent variables, but multicollinearity does not exist. This indicates that while there is a relationship between the vocabulary acquisition patterns of different input modalities, they are not highly correlated, and thus, regression coefficients for vocabulary test results can be estimated reliably.

To verify whether the dependent variables follow a multivariate normal distribution, the Shapiro-Wilk test for normality was performed, and the results are shown in Table 2. All p-values were greater than .05, indicating that the three test scores in each group followed a normal distribution, and the residuals in each classification approximated a normal distribution. Therefore, it can be assumed that the vocabulary acquisition effects under different input modalities can be tracked.

Table 2: Results of Shapiro - Wilk Test

Group	p-value		
	Pre-test	Immediate post-test	Delayed post-test
Listening	.630	.389	.532
Reading	.364	.282	.741
Subtitled audiovusal	.508	.923	.087
Control	.115	.997	.211

At the same time, scatter plots were used to check for linear relationships between dependent variables within each group (as shown in Figure 2). Upon observing the scatter trends of the listening, reading, and audiovisual groups, it was found that, under different input modalities, the two post-test scores exhibited a linear relationship. Thus, the hypothesis that there is a linear relationship between the immediate and delayed post-test scores for each input modality is accepted. However, the scatter plot distribution of the pre-test and post-test scores was more dispersed or showed a curve, suggesting that the linear relationship is not significant. This leads to the conclusion that the grouping does not cause any differential effects on the experimental results, and that exposure to any modality of correlated or uncorrelated English input will impact the vocabulary acquisition effect.

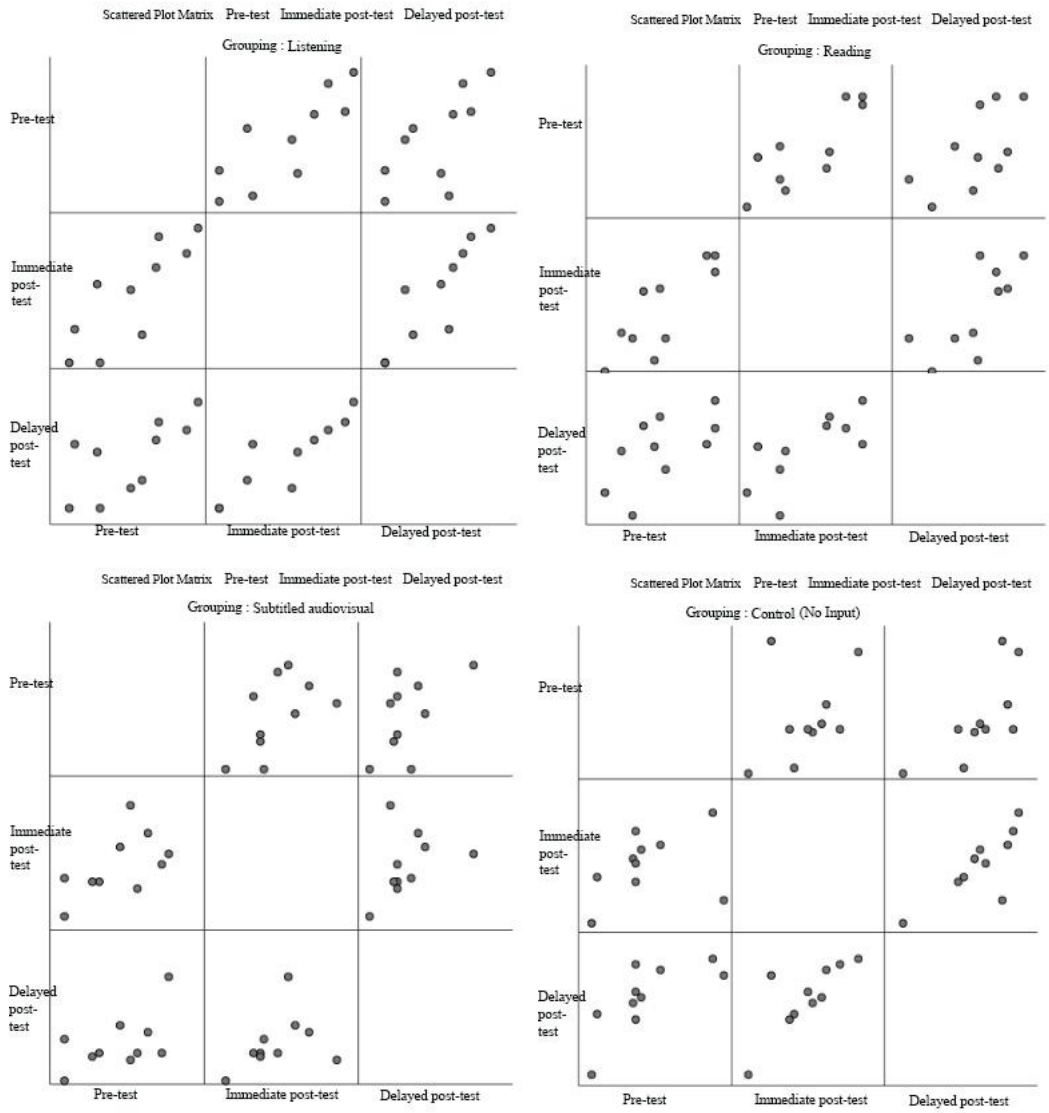

Figure 2: Scattered Plot Matrix of the Results

In the Box's Test of Equality of Covariance Matrices, F(3, 36)=1.070, p=.376>.001, indicating a positive correlation between the input modalities and vocabulary acquisition effects. In Levene's Test of Equality of Error Variances, the pre-test scores showed F(3, 36)=28.516, p=.733, experimental scores showed F(3, 36)=30.814, p=.787, and post-test scores showed F(3, 36)=31.616, p=.641. All three p-values were greater than .05, confirming the assumption of homogeneity of variance, i.e., equality of variances. A multivariate test using Wilks' Lambda showed a partial eta squared value of 0.142, which is greater than 0.14, indicating a large effect size. This suggests that the impact of different input modalities on vocabulary acquisition effects is substantial. Based on the above results, it can be concluded that the experimental data shows a highly significant effect, and the research findings are expected to have high practical value.

Experimental Results

The between-group difference test results are shown in Table 3. The p-values of the three tests gradually decreased over time, indicating that the differences between groups became more pronounced. This suggests that different input modalities have a substantial impact on vocabulary acquisition effects, and the results of this impact become more significant over time.

Table 3: Between-Group Difference Test Results

	ss	df	ms	F	*p*-value
Pre-test	398.069	3	132.690	2.589	.068
Immediate post-test	674.269	3	224.756	3.295	.031
Delayed post-test	688.425	3	229.475	3.721	.020

For the pre-test scores, F(3, 36)=2.589, p=.068>0.05, indicating that before the experimental intervention, i.e., without any language input, there were no significant differences in the English proficiency levels of the participants. In other words, the grouping in this experiment was random, and the participants' initial English proficiency did not influence the experimental results. The differences observed between groups in the post-tests likely stem from the experimental treatment. For the immediate post-test scores, F(3, 36)=3.295, p=.031, and for the delayed post-test scores, F(3, 36)=3.721, p=.020, both *p*-values are less than .05, indicating that after exposure to language input, the participants' vocabulary abilities were effectively differentiated. This shows that different input modalities had a significant impact on vocabulary acquisition effects among English major students.

Post-hoc Multiple Comparison Results

The post-hoc multiple comparison results indicate significant differences between the scores of different groups. In the immediate post-test, there was a significant difference between the reading group and the control group, with a p-value of .021, which is less than the significance level of .05. This result shows that the reading group performed significantly better than the control group. In the delayed post-test, there were significant differences between the reading group and both the audiovisual group and the control group, with p-values of .047 and .027, both less than .05. This indicates that the reading group's test scores differed significantly from those of the audiovisual and control groups. In both tests, the

control group scored significantly lower than the other three groups, suggesting that vocabulary acquisition with any input modality yielded better results.

One-Way ANOVA Results

The one-way ANOVA results for the average scores of the three tests are shown in Table 4. From the differences in the three tests, the listening group's scores increased by 5 points and 3.55 points in the two post-tests compared to the pre-test. The reading group's scores increased by 8.7 points and 0.4 points in the two post-tests, while the audiovisual group's scores increased by 10 points and decreased by 1.9 points in the two post-tests. The control group's scores increased by 3.8 points and 1.3 points in the two post-tests. This data shows that the audiovisual input modality yielded the best immediate vocabulary acquisition results, but the worst delayed memory effects. In contrast, the listening input modality produced the opposite result. The control group had the smallest increase in the immediate post-test, indicating that even irrelevant language exposure can have some effect on vocabulary acquisition, but its effectiveness was less significant than the other three input modalities.

Table 4: One-Way ANOVA Results for the Average Scores of the Three Tests

Group	Pre-test		Immediate post-test		Delayed post-test	
	mean	SD	mean	SD	mean	SD
Listening	18.100	8.0305	23.100	8.9032	26.650	9.1865
Reading	22.350	7.1182	31.050	7.7834	31.450	7.6502
Subtitled audiovusal	13.800	5.3965	23.800	9.0897	21.900	8.0616
Control	16.000	7.7924	19.800	7.0993	21.100	6.2263

It is worth noting that, except for the audiovisual group, the listening group, reading group, and control group all showed an improvement in their delayed post-test scores.

Discussion

English Majors Can Acquire Vocabulary Incidental to Their Learning.

According to the between-group difference test in Table 3, the P-values gradually decrease across the three tests, indicating that the inter-group differences increase over time. This suggests that different input modalities have an impact on vocabulary incidental acquisition, with the effects becoming more significant as time progresses. The P-value for the immediate post-test is 0.031, and for the delayed post-test is 0.02, both of which are less than 0.05. This indicates that after exposure to language input, the participants' vocabulary abilities were differentiated, demonstrating that different input modalities significantly affect the vocabulary incidental acquisition of English major students.

The Best Immediate Vocabulary Incidental Acquisition Effect in the Audiovisual Input Modality.

According to the descriptive statistics in Table 4, the listening group's pre-test mean was 18.1, the immediate post-test mean was 23.1, and the delayed post-test mean was 26.65, with

increases of 5 points and 3.55 points respectively. The reading group's pre-test mean was 22.35, the immediate post-test mean was 31.05, and the delayed post-test mean was 31.45, with increases of 8.7 points and 0.4 points. The audiovisual group's pre-test mean was 13.8, the immediate post-test mean was 23.8, and the delayed post-test mean was 21.9, with increases of 10 points and a decrease of 1.9 points. The control group's pre-test mean was 16, the immediate post-test mean was 19.8, and the delayed post-test mean was 21.1, with increases of 3.8 points and 1.3 points. These results show that the audiovisual modality produced the best immediate vocabulary incidental acquisition effect, but the poorest delayed retention effect, while the listening modality showed better long-term retention of vocabulary.

This outcome can be explained through the lens of Cognitive Load Theory. First, combining both auditory and visual information maximizes the learner's working memory, thereby improving listening comprehension. Vocabulary presented with images helps participants with short-term memory and acquisition. Learners can create associations between the images and vocabulary, which prevents the auditory information from being entirely replaced by the visuals.

However, because audiovisual materials require learners to allocate attention between multiple discrete sources of information, this can interfere with learning. The limited attention resources available to learners prevent them from processing both linguistic and visual information simultaneously. Instead, they tend to rely more heavily on the visual system to store the information, processing auditory material through the video mode. In this case, learners are more likely to use visual cues to understand the content rather than linguistic forms (Van Pattern, 1990). The extralinguistic characteristics in audiovisual input can provide cues to understanding, and the difficulty level of the task can play a coordinating role. However, the non-verbal information in the video can interfere with both short- and long-term memory of vocabulary, which has a significant impact on the learners.

During the process of acquiring information from auditory input and forming mental representations, the continuous influx of sounds results in a very brief retention time for each piece of information in working memory. Only the parts that are understood and mentally represented are retained in long-term memory (Clark & Clark, 1977). The listening group is less likely to bypass difficulties like new words to gain understanding compared to the visual group, whereas the visual modality's relative durability may encourage learners to use strategies such as ignoring certain words to achieve comprehension, thus making it more difficult for them to retain vocabulary over time.

Conclusion

Findings

Based on the experimental results, the following conclusions can be drawn:

First, after learning a complete piece of material, learners can acquire incidental vocabulary through listening, reading, or audiovisual input, but the amount of vocabulary acquired varies across groups. After one week of learning through the three different input methods, learners who were exposed to listening and reading inputs retained a certain amount of vocabulary knowledge.

Second, there are statistically significant differences in the amount of vocabulary knowledge acquired and retained through the three input modes. Audiovisual input has the greatest impact on incidental vocabulary acquisition; while listening input has the most significant impact on vocabulary retention.

Finally, to achieve the best vocabulary retention effect, learning outcomes need to be reinforced in a timely manner.

Recommendations for English Teaching

First, based on the experimental results, it can be concluded that participants in the audiovisual group achieved the best incidental vocabulary acquisition. Compared to traditional classroom teaching, which focuses on imparting systematic knowledge, audiovisual teaching provides rich, authentic, and natural language materials. Students can acquire relevant language knowledge from both the visuals and subtitles, and the real-world communication context in videos can stimulate students' interest in learning. Therefore, teachers can implement this method according to the actual teaching needs, but attention should be paid to the following points during implementation:

Improving Audiovisual Teaching With Subtitles.

Teachers should design different teaching activities before, during, and after watching the video to maximize the role of audiovisual teaching in promoting incidental vocabulary acquisition.

Tailoring to Students' Actual Learning Situation.

Teachers need to pause the video at appropriate points based on students' understanding of the material and assess their comprehension of previous content. Teachers should also explain key and difficult points to deepen students' memory and cognitive processing of the material.

Reinforcing Vocabulary Learning.

The experimental results show that the listening group had the best retention of vocabulary. Therefore, teachers should encourage students to speak more and practice standard pronunciation in future lessons. They can emphasize the importance of using auditory memory to learn vocabulary by quickly activating word information in the brain upon hearing the audio input, which will improve listening comprehension and facilitate incidental vocabulary acquisition. The delayed post-test results show that if new words are not fully understood or reviewed regularly, students are likely to forget them. Therefore, to help learners fully master vocabulary, teachers should use various tasks or practices to encourage frequent exposure to these words, helping to consolidate and strengthen memory. For example, teachers can assign tasks around key words, main content, and cultural differences, allowing students to increase their understanding of the video material through classroom discussions, oral reports, and role-playing activities, thus promoting the mastery of incidental vocabulary.

Limitations

Sample Limitations.

The results of this study are based on an experiment involving 40 English major students, which represents a small sample size. This may not reflect the general level of all English majors. Future research can aim to include a larger sample, ideally encompassing students at various proficiency levels and from different backgrounds, in order to make the sample more representative and enhance the applicability of the experimental findings to the overall vocabulary acquisition levels of English major students.

Limitations in Variable Control.

The vocabulary testing lasted for three weeks, which is quite lengthy. Although the researchers informed the participants that the purpose of the test was to determine whether they could comprehend the material and made efforts to prevent participants from guessing the experiment's purpose, the repeated testing procedures might have led participants to prepare for the second round of vocabulary post-tests. This preparation could compromise the incidental nature of vocabulary acquisition, thus reducing the validity of the Incidental Vocabulary Acquisition (IVA) measurement. Furthermore, although the influence of external variables was minimized, other factors such as individual differences and vocabulary-related factors were not considered. Future research should strive to control for potential confounding variables to ensure a higher degree of rigor.

Limitations in Experimental Subjects.

The experimental subjects in this study were limited to graduate students majoring in English, and the results cannot be generalized to all English learners. Future studies could explore the impact of the three modes of input on vocabulary acquisition among learners of varying English proficiency levels, to enhance the validity of the results and ultimately support vocabulary learning among all second language learners.

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Contact email: hollyho0515@gmail.com

Factors Related to Entrepreneurial Intention Among Engineering and Technology Undergraduates in Thailand: A Confirmatory Factor Analysis

Piyanan Wongtaweelat, King Mongkut's University of Technology Thonburi, Thailand
Tanes Tanitteerapan, King Mongkut's University of Technology Thonburi, Thailand
Mongkhon Narmluk, King Mongkut's University of Technology Thonburi, Thailand
Sirimonpak Suwannakhun, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
The purpose of this research paper is to explore the factors related to entrepreneurial intention of undergraduate engineering and technology students in Thailand. The sample group consisted of 420 valid questionnaires from final-year bachelor's degree students in engineering and technology from 7 public and private universities. The research tool was a questionnaire on students' opinions regarding various factors, including attitudes, self-efficacy, social norms, entrepreneurial network relations, and entrepreneurship policies that promote entrepreneurial intention to become entrepreneurs. The conceptual framework was based on the Theory of Planned Behavior (Ajzen, 1991). Data analysis used first- and second-order Confirmatory Factor Analysis. The results showed that all five factors positively and significantly affect students' entrepreneurial intentions at a good level, with CFI=1.00, NFI=0.99, and GFI=0.97. Component weights were statistically significant at the .01 level in all aspects, ranging from .84 to .95, indicating that all 5 components are statistically significant. Factors related to entrepreneurial intention, from most to least influential, are self-efficacy (0.95), entrepreneurial network relationships (0.90), social norms (0.85), and entrepreneurship policy and attitude, both equally at (0.84). The research found that students tend to view various situations as good opportunities to start their own new businesses and are confident that they have sufficient knowledge to start their own new businesses. As a result, this research can be used to revise university curricula and serve as a guide to develop and promote entrepreneurship for engineering students after graduation.

Keywords: Entrepreneurial Intention, Engineering and Technology Undergraduates, Confirmatory Factor Analysis (CFA)

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Introduction

The world is facing many business crises. This situation made many external factors effected to Thailand. Such as: The COVID-19 pandemic, the ongoing Russia-Ukraine conflict, the Israel-Hamas war, and the escalating US-China trade tensions. These interconnected events have precipitated significant market disruptions, characterized by product oversupply and monetary inflation. The World Bank Group (2024) reports a marginal decline in global GDP, reducing projections from 2.6% to 2.4% in 2024, underscoring the pervasive economic uncertainty. At the same time, many internal factors also affect in Thailand, such as: Data from the Department of Industrial Works (2024) reports that in 2023, 1,377 factories closed (averaging 111 closures per month), and in the first five months of 2024, over 567 closures have been recorded (averaging 113 per month). Additionally, the National Statistical Office (2024) reports that in the first quarter of 2024, the unemployment rate among recent graduates reached 1.67%, or approximately 410,000 individuals, reflecting a mismatch between graduate skills and labor market demands. In this context, promoting entrepreneurship, particularly among undergraduate students in engineering and technology fields, becomes a crucial strategy for economic recovery and growth, as this group has high potential for creating innovations and new technology businesses (Maresch et al., 2016). This aligns with the recommendations of the National Higher Education, Science, Research and Innovation Policy Council (2021), which identifies entrepreneurship promotion as a key strategy for driving the country's economy.

In Thailand, studying in factors affecting entrepreneurial intentions among engineering and technology students remains limited (Luekitinun et al., 2023; Meechai & Chantuk, 2022). Most research has focused on students across all disciplines, particularly business administration, with fewer studies on engineering students (Viyaporn & Thongprasert, 2022). Previous research has found that engineering students typically possess strong technical knowledge but lack entrepreneurial skills and intentions, largely due to an education system that emphasizes academics over business creativity and inspiration (Asawapiboon & Toart, 2019; Piperopoulos & Dimov, 2015). However, the effectiveness of curriculum programs in fostering entrepreneurial intentions, especially among engineering and technology students, remains unclear (Setiawan, 2022). There is also a lack of empirical data that can be used for appropriate policymaking and curriculum design (Wongsupachat et al., 2018). The Office of the Education Council (ONEC, 2021) reports that the evaluation of approaches to promote entrepreneurial intentions among undergraduate students is not yet systematic. Research on entrepreneurial motivation among engineering students in Asia, compared to other fields, shows that only 15-20% of engineering students are likely to become entrepreneurs (Pan et al., 2024). Furthermore, a research study conducted by the Enterprise Incubation Center at King Mongkut's University of Technology Thonburi in 2022 found that more than 70 percent of engineering students participating in the technology business incubation program felt they lacked confidence in applying their engineering knowledge to business creation (Enterprise Incubation Center, King Mongkut's University of Technology Thonburi, 2022).

This research is significant in several dimensions. The findings will enhance understanding of factors influencing Thai students' entrepreneurial intentions, particularly in the context of engineering and technology fields, which have unique characteristics different from other disciplines (Barba-Sánchez & Atienza-Sahuquillo, 2018). The research findings will benefit educational institutions in developing effective entrepreneurship promotion curricula and activities (Nabi et al., 2017) and assist government agencies establish policies and support measures that align with these students' needs and motivations (Souitaris et al., 2007).

Furthermore, the research can align with government policies promoting young entrepreneurs, as evidenced in Thailand's Startup Promotion Plan 2016-2021 (National Innovation Agency, 2016), which focuses on developing the country's startup ecosystem. Additionally, the research also aligns with the National Strategy 2018-2037 in promoting student entrepreneurs, particularly in engineering and technology, to increase the number of tech startups, which are crucial mechanisms for creating innovation and driving economic growth (Office of the National Economic and Social Development Council, 2023).

Related Work

This research uses Ajzen's Theory of Planned Behavior (TPB) from 1991 as its theoretical foundation. It is a theory that explores the connection between attitudes and behaviors, aiming to predict how individuals might engage in specific behaviors by measuring beliefs, attitudes, and intentions. The theory was developed from the Theory of Reasoned Action (TRA) and builds upon entrepreneurial intention research by Liñán, Chen, Ajzen, Krueger, Reilly, and Carsrud. The study examines various factors that influence entrepreneurial intentions among engineering students, including: 1. Attitudes, 2. Self-Efficacy, 3. Social norms, 4. Entrepreneurial network relationships and 5 Entrepreneurship policies. This theoretical framework draws from multiple scholarly sources, including works by Ajzen (1991), Liñán and Chen (2009), Schlaegel and Koenig (2014), Krittakorn Sahakijpicharn (2017), Luo Xiaojing and Huang Xuefei (2018), Barba-Sánchez, V., & Atienza-Sahuquillo, C. (2018), Zhang and colleagues (2022), Nie Yifan (2023), Pan and colleagues (2024), and Asee (2024).

Conceptual Framework

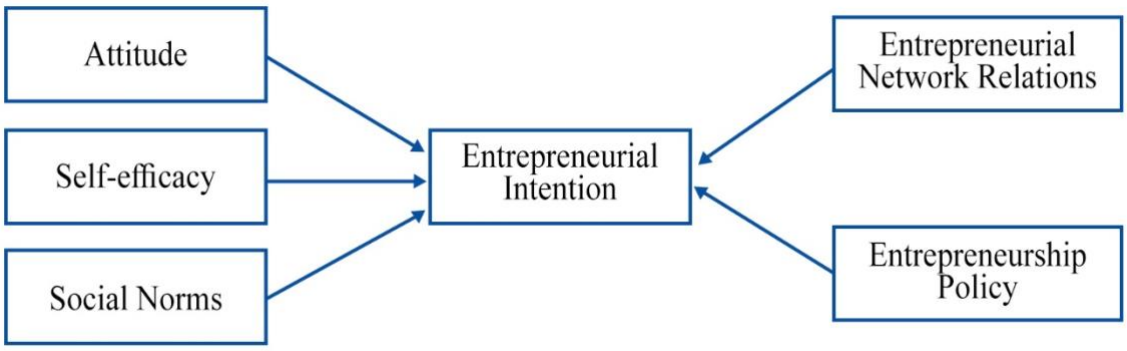

Figure 1: The Factors Related to Entrepreneur Intention as Adapted From Ajzen (1991), Liñán and Chen (2009), Krittakorn Sahakijpicharn (2017), and Nie Yifan (2023)

Figure 1 illustrates the research framework, which is based on the Theory of Planned Behavior (TPB) established by Ajzen (1991). A review of the literature reveals that TPB is widely accepted for studying students' entrepreneurial intentions, demonstrating superior predictive accuracy compared to the Theory of Reasoned Action (Basu, 2010; Chowdhury et al., 2012; Solesvik, 2013; Zapkau et al., 2015; Nie, 2023). The theory has been successfully applied in diverse contexts, including both developed and developing countries, such as Thailand (Iakovleva et al., 2011; Poolsawat, 2020). Moreover, previous research highlights that business network relationships and entrepreneurship policies play a significant role in shaping students' entrepreneurial intentions (Cui, 2022; Sahakijpicharn, 2017; Zaefarian et

al., 2017). Therefore, this study adopts Ajzen's (1991) TPB as the primary conceptual framework, focusing on the influences of attitudes, self-efficacy, social norms, entrepreneurial network relationships, and entrepreneurship policies on the entrepreneurial intentions of engineering students (Liñán & Chen, 2009; Nie, 2023; Sahakijpicharn, 2017).

Research Objectives

a. The objective of this study is to examine the factors influencing attitudes, self-efficacy, social norms, entrepreneurial network relations, and entrepreneurship policy related to entrepreneurial intention among engineering and technology undergraduates in Thailand.
b. It aims to explore the correlation between behaviors and the intention to foster entrepreneurship among these students, utilizing Confirmatory Factor Analysis.

Research Methodology

The Research Methodology Design

This study used quantitative research and conducted a structural validity analysis using Confirmatory Factor Analysis (CFA), including First and Second-Order CFA, to validate the measurement model of five factors including attitudes, self-efficacy, social norms, entrepreneurial network relations, and entrepreneurship policies to entrepreneurial intention among engineering and technology undergraduates in Thailand and ensure its alignment with empirical data.

Population and Sample Group

The population comprises students from seven universities in Thailand. The sample group consists of 420 volunteer fourth-year undergraduate engineering students enrolled in the first semester of the 2024 academic year.

Research Instruments

The research employed a self-administered questionnaire distributed via Line and Google Form, comprising 22 observable variables validated by three experts through the Index of Item-Objective Congruence (IOC) and approved by the Institutional Review Board (IRB) under Human Research Ethics Protocol Number: KMUTT-IRB-COE-2024-144. Each question was assessed using a Likert scale ranging from "Strongly Disagree" (1 score) to "Strongly Agree" (5 scores).

Data Analysis

The analysis involves processing survey data using the LISREL program to determine the Cronbach's alpha coefficient, percentage values, frequency (f), mean ($\bar{x}$), and standard deviation (S.D.). Data collection is carried out alongside the application of both First and Second-Order Confirmatory Factor Analyses (CFA) to evaluate the conformity of the measurement model with the empirical data. The model's fit is assessed based on Conformance Index values, including Chi-square (χ^2), P-value, χ^2/df, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Tucker-Lewis Index (TLI) or Non-Normed

Fit Index (NNFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR).

Data Symbols Representative

In this study, the research analysis involved 22 observable variables across five key factors, with their corresponding symbols as follows: Attitude (ATD Y1-Y5), Self-Efficacy (SEF Y6-Y10), Social Norm (SCN Y11-Y14), Entrepreneurial Network Relations (ENR Y15-Y18), and Entrepreneurship Policy (EPL Y19-Y22).

Results of Correlation Coefficient Analysis

Table 1: Correlation Values of Observable Variables Comprising Entrepreneurial Intention Among Undergraduate Students in Engineering and Technology Fields in Thailand

Variables	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21	Y22
Y1	1																					
Y2	.531**	1																				
Y3	.425**	.501**	1																			
Y4	.384**	.438**	.498**	1																		
Y5	.337**	.470**	.467**	.564**	1																	
Y6	.341**	.456**	.426**	.486**	.490**	1																
Y7	.316**	.427**	.399**	.415**	.456**	.518**	1															
Y8	.314**	.402**	.376**	.364**	.322**	.428**	.466**	1														
Y9	.303**	.335**	.389**	.328**	.297**	.341**	.401**	.471**	1													
Y10	.222**	.346**	.413**	.354**	.371**	.417**	.411**	.458**	.532**	1												
Y11	.319**	.424**	.373**	.351**	.346**	.396**	.397**	.417**	.437**	.516**	1											
Y12	.248**	.266**	.197**	.318**	.267**	.272**	.280**	.322**	.416**	.390**	.423**	1										
Y13	.213**	.153**	.235**	.183**	.139**	.177**	.172**	.211**	.289**	.291**	.333**	.232**	1									
Y14	.155**	.154**	.275**	.222**	.201**	.177**	.184**	.121*	.306**	.235**	.141**	.113*	.282**	1								
Y15	.405**	.461**	.456**	.408**	.346**	.496**	.417**	.438**	.319**	.382**	.373**	.271**	.255**	.274**	1							
Y16	.297**	.409**	.436**	.293**	.363**	.412**	.399**	.439**	.348**	.444**	.415**	.245**	.293**	.269**	.605**	1						
Y17	.367**	.372**	.496**	.377**	.351**	.394**	.413**	.427**	.387**	.473**	.384**	.303**	.223**	.304**	.558**	.540**	1					
Y18	.267**	.330**	.350**	.323**	.294**	.326**	.341**	.416**	.412**	.485**	.400**	.329**	.267**	.253**	.370**	.412**	.486**	1				
Y19	.245**	.284**	.304**	.364**	.252**	.260**	.342**	.351**	.399**	.356**	.327**	.283**	.299**	.421**	.381**	.378**	.442**	.495**	1			
Y20	.291**	.354**	.371**	.341**	.306**	.367**	.262**	.329**	.430**	.469**	.415**	.281**	.313**	.317**	.395**	.444**	.396**	.488**	.560**	1		
Y21	.278**	.352**	.325**	.400**	.355**	.421**	.403**	.373**	.370**	.428**	.377**	.338**	.331**	.282**	.419**	.460**	.440**	.471**	.572**	.596**	1	
Y22	.257**	.346**	.363**	.332**	.338**	.358**	.331**	.273**	.394**	.383**	.314**	.238**	.300**	.367**	.435**	.459**	.482**	.468**	.516**	.537**	.565**	1
Mean	4.18	4.10	4.10	4.15	4.23	4.30	4.28	4.09	4.02	4.16	4.08	4.08	4.02	3.89	4.20	4.20	4.16	4.00	3.88	4.05	4.09	4.07
S.D.	0.73	0.77	0.81	0.87	0.77	0.69	0.74	0.79	0.76	0.75	0.74	0.81	0.92	0.98	0.74	0.76	0.79	0.85	0.83	0.80	0.79	0.81

KMO : Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .941

Bartlett's Test of Sphericity = 4012.691, p = .000, df = 231

*p < .05, **p < .01

According to Table 1, the result showed that, the Pearson correlation coefficients among 22 observed variables across 5 components range from 0.113 to 0.596, all significant at the .01 level. The results of Bartlett's Test of Sphericity yielded a chi-square χ^2 equal to 4012.691 ($p<.001$). The Kaiser-Meyer-Olkin (KMO) equal to .941, therefor all data and indicating of the variables in this dataset are suitability for confirmatory factor analysis (CFA).

Result of Confirmatory Factor Analysis (CFA)

Result of CFA 1st Order

Table 2: CFA 1st Order for Attitude Towards Entrepreneurship

Variable	Weight of all the indicators		t	r^2
	b (SE)	β		
CFA 1st Order Analysis				
1. Attitude				
ATD Y1	1.00	.56	<------>	.31
ATD Y2	1.22 (.11)	.68	11.33**	.46
ATD Y3	1.38 (.13)	.74	10.28**	.54
ATD Y4	1.19 (.12)	.66	9.64**	.44
ATD Y5	1.10 (.12)	.62	9.26**	.38

In Table.2, all indicators were statistically significant at the .01 level. Attitude components towards entrepreneurship elements ranged from of 31.00-54.00%. The most significant observed variables were "I will start my own new business because it is fun and challenging" (ATD Y3), followed by "I find it attractive to have my own new business" (ATD Y2).

Table 3: CFA 1st Order for Self-Efficacy Towards Entrepreneurship

Variable	Weight of all the indicators		t	r^2
	b (SE)	β		
CFA 1st Order Analysis				
2. Self-Efficacy				
SEF Y6	1.00	.62	<------>	.38
SEF Y7	1.01 (.08)	.62	11.94**	.39
SEF Y8	1.09 (.10)	.67	11.22**	.45
SEF Y9	1.11 (.10)	.69	10.88**	.48
SEF Y10	1.13 (.10)	.70	11.59**	.49

In Table 3, all indicators were statistically significant at the .01 level. Self-Efficacy towards entrepreneurship elements ranged from 38 percent to 49 percent. The most significant observable variable was "I look for great situations and opportunities to start my own business" (SEF Y10), followed by "I believe I have enough knowledge to be an entrepreneur" (SEF Y9).

Table 4: CFA 1st Order for Social Norms Towards Entrepreneurship

Variable	Weight of all the indicators		t	r^2
	b (SE)	β		
CFA 1st Order Analysis				
3. Social Norms				
SCN Y11	1.00	.73	<------>	.53
SCN Y12	.76 (.08)	.56	9.48**	.31
SCN Y13	.65 (.08)	.47	8.39**	.22
SCN Y14	.68 (.09)	.49	7.56**	.24

In Table 4, all indicators were statistically significant at the .01 level. Social Norms towards entrepreneurship elements ranged from 22.00 percent to 53.00 percent. The most significant observable variable was “My important person is ready to support and encourage me in starting my own new business” (SCN Y11), followed by “My important persons often speak positively about running my own business being good” (SCN Y12).

Table 5: CFA 1st Order for Entrepreneurial Network Relation Towards Entrepreneurship

Variable	Weight of all the indicators		t	r^2
	b (SE)	β		
CFA 1st Order Analysis				
4. Entrepreneurial Network Relation				
ENR Y15	1.00	.76	<------>	.58
ENR Y16	1.01 (.07)	.77	15.13**	.59
ENR Y17	.93 (.07)	.71	14.28**	.50
ENR Y18	.93 (.08)	.71	12.13**	.50

In Table 5, all indicators were statistically significant at the .01 level. Entrepreneurial Network Relation elements ranged from 50.00 percent to 59.00 percent. The most significant observable variables were: “Building relationships with entrepreneurial networks gave me the confidence to start my own business” (ENR Y16), followed by “Building relationships with an entrepreneurial network was an important factor in starting my business” (ENR Y15).

Table 6: CFA 1st Order for Entrepreneurship Policy Towards Entrepreneurship

Variable	Weight of all the indicators		t	r^2
	b (SE)	β		
CFA 1st Order Analysis				
5. Entrepreneurship Policy				
EPL Y19	1.00	.71	<------>	.50
EPL Y20	1.08 (.08)	.76	14.26**	.58
EPL Y21	1.11 (.08)	.78	14.61**	.61
EPL Y22	1.01 (.08)	.71	13.40**	.51

In Table 6, all indicators were statistically significant at the .01 level. Entrepreneurship policy towards entrepreneurship elements ranged from 50.00 percent to 61.00 percent. The most significant observable variables were: “The policy of promoting entrepreneurship by supporting free vocational training responds to my intention to start a new business” (EPL Y21), followed by “The policy of promoting entrepreneurship by supporting low-interest rates made me think that I could start a new business” (EPL Y20).

From the above discussion, it can be concluded that all indicators developed in this research for the components of entrepreneurial intention among undergraduate students in engineering and technology fields in Thailand are statistically significant at the .01 level. These indicators have positive factor loadings, which means that higher scores on these indicators correspond to higher entrepreneurial intentions among the students.

Result of CFA 2nd Order

Table 7: The Results of CFA Second Order in the Entrepreneurial Intention of Undergraduate Engineering and Technology Students in Thailand

Variable	Weight of all the indicators		t	r^2
	b (SE)	β		
CFA 2nd Order Analysis				
Attitude	.47 (.04)	.84	10.38**	.71
Self-Ef	.59 (.05)	.95	12.80**	.91
Soc-Norm	.61 (.05)	.85	13.51**	.72
Net-Rel	.69 (.04)	.90	15.70**	.82
Policy	.59 (.04)	.84	13.60**	.71
Chi-square=164.00, df=160, p-value=.40, χ^2/df=1.03, GFI=.97, AGFI=.95, NFI=.99, TLI Or NNFI=1.00, CFI=1.00, RMSEA=.008, RMR=.030, SRMR=.030				

Correlation matrix observed variables	Attitude	Self-Ef	Soc-Norm	Net-Rel	Policy	**Ent-Intention**
Attitude	1.00					
Self-Ef	.80	1.00				
Soc-Norm	.71	.81	1.00			
Net-Rel	.76	.86	.76	1.00		
Policy	.71	.80	.71	.76	1.00	
Ent-Intention	.84	.95	.85	.90	.84	1.00

** p < .01, The numbers in parentheses are the standard tolerances.
<------> No value is reported SE and T because it is a mandatory parameter (constrained parameter)

From Table 7, the results of the CFA 2nd Order show that the Chi-square value is 164.00, with a probability value of .40 at 160 degrees of freedom (df = 160). The ratio of Chi-square to degrees of freedom is 1.03, which is less than 2. This means that the Chi-square value is not significantly different from zero at the .05 statistical level, indicating acceptance of the null hypothesis that the measurement model is consistent with the empirical data. The Goodness of Fit Index (GFI) is .97, the Adjusted Goodness of Fit Index (AGFI) is .95, the Normed Fit Index (NFI) is .99, the Tucker-Lewis Index (TLI) or Non-Normed Fit Index (NNFI) is 1.00, and the Comparative Fit Index (CFI) is 1.00. The Root Mean Square Error of Approximation (RMSEA) is .008, the Root Mean Square Residual (RMR) is .030, and the Standardized Root Mean Square Residual (SRMR) is .030.

The results of CFA 2nd Order of entrepreneurial intention revealed that the five components had standardized factor loadings ranging from .84 to .95, statistically significant at the .01 level. Self-efficacy demonstrated the highest factor loading, followed by entrepreneurial network relations and social norms. Attitude towards entrepreneurship and entrepreneurship policy had equal loadings. The shared variance in explaining components was 91.00%, 82.00%, 72.00%, and 71.00%, respectively. Additionally, the five components exhibited high positive interrelationships (r=.71 to .95), indicating they are not independent but interconnected, as detailed in the second-order confirmatory factor analysis model in Figure 2.

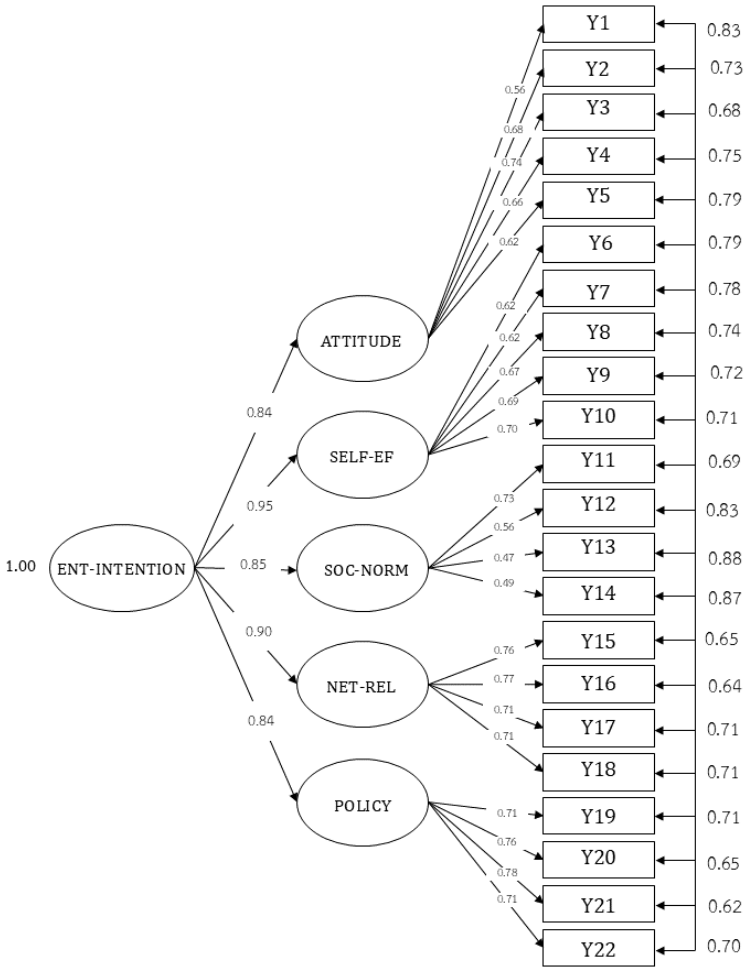

Figure 2: Results of the CFA Second Order Analysis Model of Entrepreneurial Intention for Undergraduate Engineering and Technology Students in Thailand

Discussion and Conclusion

From the Figure 2, the results showed that the confirmatory factor analysis model, which demonstrates five components including: 1. Attitude. 2. Self-efficacy. 3. Social norms. 4. Entrepreneurial network relations and 5. Entrepreneurship policies had standardized factor loadings between .84 and .95, statistically significant at the .01 level. Indicating that these five components are statistically significant factors of entrepreneurial intention. from most to least influential are self-efficacy (0.95), entrepreneurial network relationships (0.90), social norms (0.85), and entrepreneurship policy and attitude, both equally at (0.84) respectively. This analysis demonstrates that all five factors are significantly related and have substantial weight in determining the entrepreneurial intention of engineering students in Thailand.

Therefore, this research developed a measurement tool that demonstrates validity and reliability, confirmed through by both 1st and 2nd order confirmatory factor analysis. The tool can be applied to curriculum development, teaching and learning management, and entrepreneurial support policy planning for engineering and technology students in Thailand. This aims to effectively promote entrepreneurship, which is a crucial index for the country's economic and innovation development.

Finding

The confirmatory factor analysis model, which demonstrates the relationship between components of entrepreneurial intention among undergraduate students in engineering and technology fields in Thailand, reveals that the self-efficacy component has the highest statistical significance on entrepreneurial intention. The observed variables with the highest importance weights are: “I often look at various situations and think of good opportunities to start my own new business” (SEF Y10) “I believe I have sufficient knowledge to start my own new business” (SEF Y9) and “I am confident that I can be a good new business entrepreneur” (SEF Y8) This research result reflects that this group of students has a positive attitude and high confidence towards entrepreneurship, especially among engineering students. These new findings can be applied to improve and develop more effective entrepreneurship curricula. Moreover, it can also serve as a foundation for future research and development of entrepreneurship training programs to enhance students' potential to become successful entrepreneurs.

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Contact email: Piyanan.wong@kmutt.ac.th

Effect of Dance Learning Experience on Audiovisual Information and Body Synchrony

Mizuki Nakajima, Jissen Women's University, Japan
Takeshi Sato, Jissen Women's University, Japan
Hiroyuki Morikawa, Tokyo University of Technology, Japan
Kimie Nakajima, Kiryu University Junior College, Japan

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Abstract
This study aimed to investigate whether dance education experiences have any impact on reaction times and physical synchrony when responding to auditory and visual stimuli. The main focus of this study was on the relationship between auditory and visual stimuli in generating synchronized body movements. The study included 11 healthy adults who were asked to perform knee extension and flexion movements in reaction to visual and auditory stimuli. The stimuli consisted of circles moving up and down at different frequencies, and participants were instructed to perform the movements in response to the stimulus for a period of 1 minute per trial. The presentation of the stimulus was random and occurred at six different speeds: 0.2, 0.4, 0.6, 0.8, and 1.0/1.2 Hz to prevent participants from acquiring a sense of rhythm. The collection of audio and visual stimuli, as well as the corresponding knee joint movements, were continuously documented. This study was demonstrated that reaction times were more rapid when behaviors were prompted by visual stimuli as opposed to a combination of visual and auditory stimuli. Additionally, the study found that reaction time was prolonged when the knee was in an upward position with the knee extended, and in a downward position with the knee bent. These findings were observed in Japan, where dance education has recently been implemented. This suggested that performing the down rhythm of lowering the hips with sound may be more challenging.

Keywords: Motor Learning, Dance Education, Synchrony

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Introduction

Rhythmic limb movements are often steered to a particular point or region during the movement cycle. The previously reported changes in reaction times due to tapping and vocal responses in rhythms. It is well known that the patterns of reaction times are clearly different between auditory and visual stimuli, and auditory stimuli are faster (Yoshioka & Ishikura, 1987). Movement coordination with external auditory rhythms plays a crucial role in dancing. Body movement coordination was performed using visual feedback. In terms of reaction time, auditory sound stimulation is faster than visual stimulation. However, when auditory and visual stimuli are varied in successive movements, there is insufficient data on which stimulus is more significant for tracking body movement.

There are two basic rhythm movements in street dance: down and up the hip, which involves bending the knees to the beat of the rhythm, and stretching, which involves stretching the knees to the beat of the rhythm. A previous study conducted experiments on professional dancers who performed these two types of rhythmic movements to a metronome at various speeds, and the results showed that anyone could easily perform down rhythmic movements at various speeds. However, it became clear that although it was possible to perform the upward rhythmic movement slowly, if you try to perform it quickly, it would unintentionally switch to the downward rhythmic movement. Street dance experts overcome the phase transition from top to bottom (Miura et al., 2018). This previous study focused on down and up movements by professional dancers but did not examine rhythmic changes in the difference between visual and auditory sensory input.

To examine changes in the rhythm of timing up and down the hip continuously in auditory and visual stimuli. The purpose of this study was to examine reaction times following successive changes in stimulus frequencies rather than simple responses to visual and auditory stimuli.

Methods

Subjects

Eleven healthy adults, comprising of four males and seven females, were recruited for this study, which had an average age of 22.3 years, with a standard deviation of 1.1 years. The male participants had an average height of 166.8 cm, with a standard deviation of 4.0 cm, and a weight of 68 kg, with a standard deviation of 9.4 kg. The female participants had an average height of 159.3 cm, with a standard deviation of 4.4 cm, and a weight of 51.9 kg, with a standard deviation of 5.7 kg. Only one female dancer actively participating in collegiate sports was included in the study. The study protocol was approved by the local ethical committee of Jissen Women's University.

Experimental Procedure and Protocols

The experimental tasks were developed using the programming language C# with UNITY (Unity Technologies). A program was created to serve as a visual stimulus, which projected a clear white circle on a black background with up-and-down motion at an arbitrary frequency on a computer screen. Additionally, different alarm tones were played at the peak of the up-and-down motion to provide auditory stimulation. Each subject participated in all three trials of the experiment (Figure 1).

1. Visual stimulation: In the image where the circle moves up and down in front of the monitor, a rhythm was created to go down according to the visual information.
2. Auditory stimulation: the position of the circle on the monitor was at the top when it moved up and at the bottom when it moved down, and a short notification tone was emitted to provide auditory information only, alarm sound.
3. Visual & Auditory stimulation: the positions of the markers moving up and down on the screen set off alarms in sync with the marker positions.

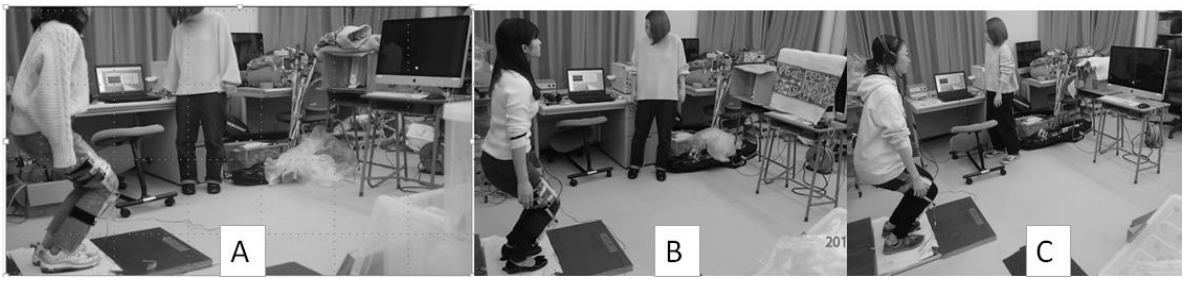

Figure 1: Experimental Settings,
A: Visual And Auditory Stimulus, B: Auditory Stimulus, C: Visual Stimulus.

Figure 2: Typical Experimental Scene Stimulus Maker in Bottom With Knee Down

The subjects were equipped with a potentiometer (Tokyo Cosmos Electric Co., Ltd., TCQ96A02, B103) on their right leg and performed bending and stretching movements (down rhythm) in response to the stimulation on the ground reaction force sensor (Kistler, Force Plate, 9286BA) at a sampling rate of 1KHz for 1 minute each trial. The stimuli were presented at six different speeds: 0.2/0.4/0.6/0.8/1.0/1.2Hz, and stimulus presentation was randomized for one minute, respectively.

Measurements and Analysis

The fluctuating control stimulus was coordinated with the vertical axis at the zenith and nadir points of the Force Plate and the knee goniometer. The reaction time was gauged by sequentially examining the X coordinates of the control stimulus and knee extension/flexion data. This was done by visually inspecting the X coordinates using Matlab scripts. The time difference from the zenith and nadir of the control stimulus, i.e., the variation in the X coordinate, was calculated and utilized as the reaction time, respectively. The mean and standard deviation of all the aforementioned parameters were determined. Analysis of variance (ANOVA) was initially applied for subjects, comparing the disparities among the three distinct conditions (visual and auditory stimulus, auditory stimulus alone, and visual stimulus alone). All tests were carried out using SAS (SAS Institute, USA), and the statistical significance was considered at a p-value lower than 0.05.

Results

Figure 3 depicts the individual reaction time of a single dance skilled student. Moreover, the time gap between stimulation and knee extension (i.e., the peak position or alarm sound) and flexion (i.e., the bottom position or alarm sound) was measured for all subjects.

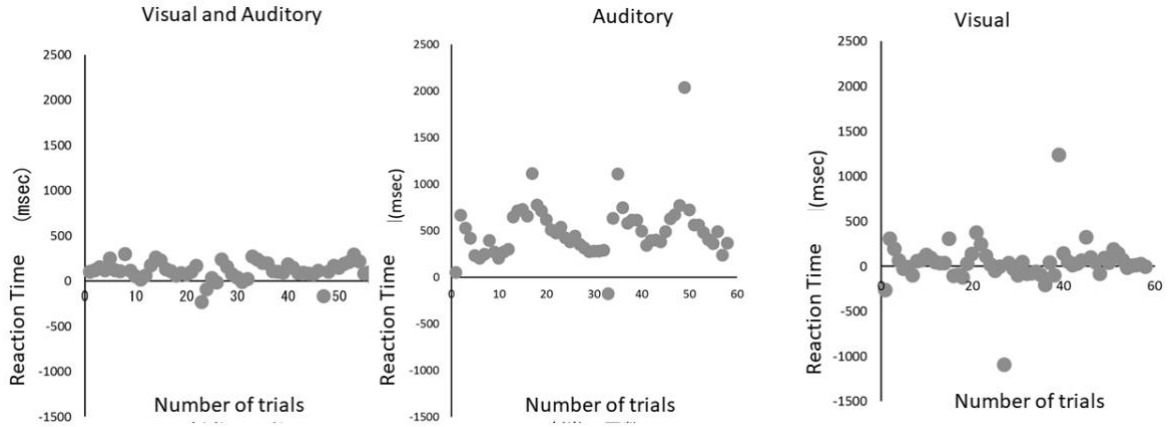

Figure 3: Result of Individual Responses in Three Conditions, College Dance Experience Subject

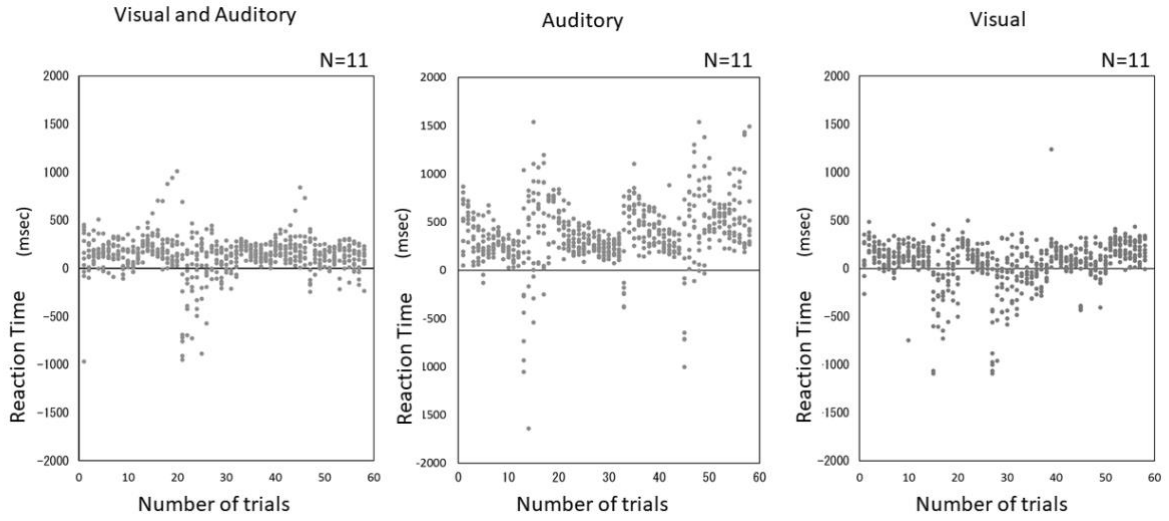

Figure 4: Result of Individual Responses for All Subjects

Reaction times to stimuli for all subjects were plotted in Figure 4, with faster movements to stimuli indicated by negative time zone in reaction times. Comparing Figures 4 and 5, it was observed that the early responses to the stimuli tended to be very less for the experienced. In the case of visual-only stimuli, it was often observed that the movement was faster than the stimulus.

As results, the average reaction time were showed that when the experiments were performed flexion and extension of the knee using only auditory stimuli, there was the greatest difference in reaction time with sound stimulation (Figure 5). There was significant difference between visual auditory stimulus and auditory, auditory and visual stimulus. Auditory stimuli had significantly longer reaction times.

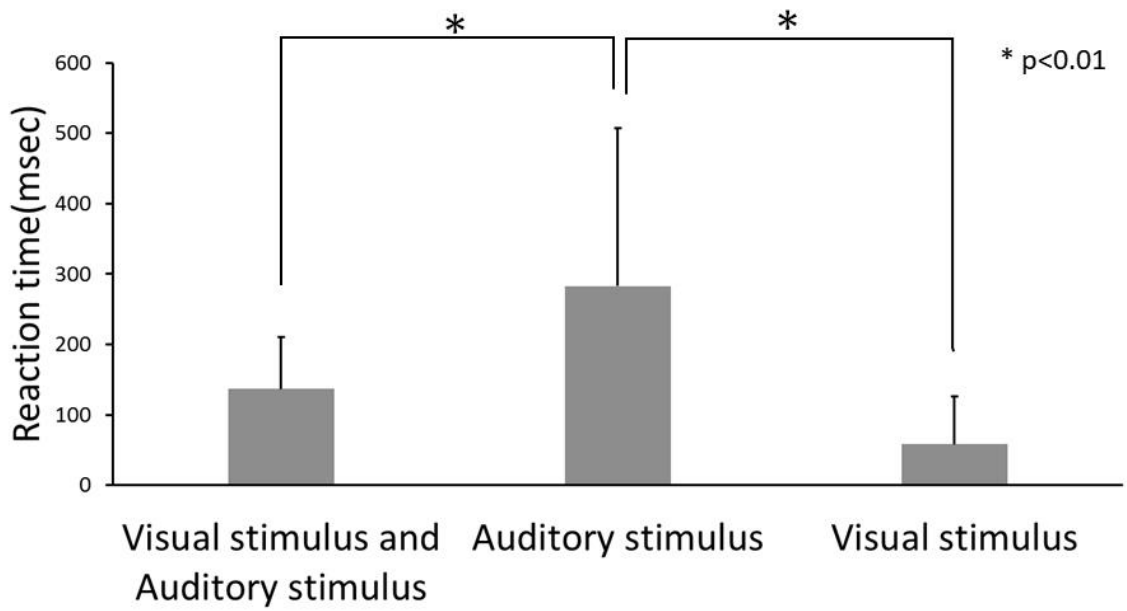

Figure 5: Results of Reaction Time for All Subjects

It was compared the reaction times when flexion and extension of the knee during flexion and extension exercises. It was the difference in reaction time that smaller when the knee was extended than when it was in all trials for visual and auditory stimuli, auditory stimuli, and visual stimuli. In other words, it could be said that synchrony was higher when the knees were flexion (Figure 6).

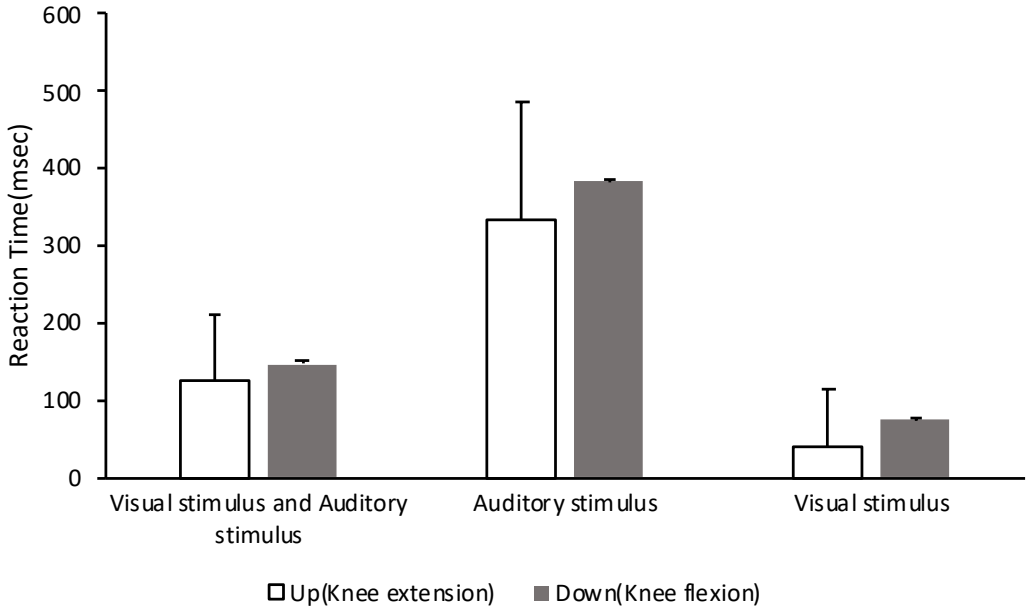

Figure 6: Average Reaction Time During Knee Extension and Flexion for All Subjects

Discussion

As a result of this study, we found that the difference between stimulus and reaction time was larger for auditory stimuli and smaller for visual stimuli. In other words, we showed that visual stimulation was important for synchrony. This was thought to be due to sensory-motor learning in which vision was dominant and synchronized the vertical movement and flexion/extension movements of the circle displayed on the screen. Mergner (1998) showed that rather it was meant as a plea to embed our knowledge, which has been accumulated in the past on human spatial behavior on earth and under microgravity, into a broad conceptual framework and to use this as a guideline for future research in space and under Ž. altered gravity conditions, such as on Mars. They demonstrated that this framework would be incomplete if it did not include biomechanics and multi-body dynamics, since these shapes our postural behavior and the related perception to a considerable degree, they assume that the down- and up-channeling mechanisms described here develop through experience of inertial and gravitational reaction forces. Also, the feedback Ž .and possibly feed-forward loops used for postural control still need to be worked out. They showed that the complexity of the human organism and its interaction with the environment may discourage researchers from adopting such a global approach. However, they hold that current developments in computer science and robotics provide us with a number of tools that allow an integrative approach to be taken, alternating in an iterative way between dynamic modeling and experimentation, thereby overcoming the immense complexity of the system. It was certainly distinct from the one which tries to solve the question of how the mechanisms were implemented in the Ž brain on a neural or molecular level a question which, conceivably, was considerably more difficult to solve. This suggested that learning the down rhythm was difficult because the difference in physical response time between knee extension and flexion was smaller when the knee is extended. In previous studies, it was said that the rhythm of the up movement was difficult, but since the subjects were professional dancers, it was thought that they had mastered the rhythm of the down movement.

Conclusion

In conclusion, visual information was important for synchrony. A large variation in reaction time for up and down was observed. It was difficult to learn the rhythm of down dancing. When the participants demonstrated physical coordination to follow the rhythmic changes caused by auditory and visual stimuli, it was found that, unlike previous studies, visual stimuli had the shortest reaction time and could be followed more accurately. Since they created a program that could change the frequency of stimulation, it was thought that it could be applied to games for the elderly to prevent dementia in the future.

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Contact email: 1317061n@jissen.ac.jp

Future of Civil Engineering Education: Trends and Challenges

Yasser E. Ibrahim Mansour, Prince Sultan University, Saudi Arabia

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Official Conference Proceedings

Abstract
This paper examines stakeholder satisfaction with civil engineering academic curricula and their preparedness for current and future challenges. It discusses emerging technologies, major infrastructure issues, the role of sustainable practices, essential skills for future engineers, and overall satisfaction with the profession. An extensive survey was designed to gather valuable feedback from diverse stakeholders within the field of civil engineering. The survey encompassed a wide range of participants, including students, trainees, academics, and civil engineers with varying levels of experience and professional roles. The survey was conducted through LinkedIn and social media networks. A total of 68 responses (mostly from Middle East) were collected. Among the participants, about 57% were academics, offering educational insights, while 40% were engineers from various industry roles. Most respondents had over 10 years of experience in civil engineering, with approximately 8% having less than 5 years, bringing fresh perspectives from emerging professionals. Participants emphasized the importance of sustainable development for the future of civil engineering. The survey highlighted that essential skills for future engineers include proficiency in innovative software, effective management, and advanced technological expertise. Additionally, about 74% of participants expressed concerns that current academic programs do not sufficiently prepare the next generation to tackle anticipated global challenges.

Keywords: Civil Engineering, Challenges, Curriculum, Sustainability, Future Trends

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Introduction

In today's rapidly changing technological landscape and amidst the numerous challenges faced by communities worldwide, such as climate change, resource scarcity, poverty, the need for sustainable development, and digital transformation, it is imperative to continually review and revise academic curricula to ensure they remain relevant and responsive to the evolving demands of society. Among the various academic disciplines, engineering curricula, particularly civil engineering, hold a position of high priority in this regard.

Civil engineering curricula must be continuously updated to equip students with the knowledge and skills necessary to tackle the pressing challenges faced by communities. It is crucial to bridge the gap between academic theory and real-world industrial practices and trends. This responsibility lies jointly with educational institutions and industry stakeholders. In this regard, Abdul Karim (2016) proposed a new course "Principles of Management, Finance and Entrepreneurship" to be added to the revised curriculum of civil engineering. Other elective courses were offered with possibility of having Entrepreneurship Minor Program before graduation of students of college of engineering. These skills are needed and welcomed by students. Another initiative aimed at bridging the gap between academia and industry was undertaken by Saint-Petersburg Polytechnical University (Tuchkevich et al., 2015). This initiative involved reaching out to well-established companies and prominent employers in the civil engineering field, with the objective of providing valuable resources and opportunities for both students and faculty members.

There is ongoing research addressing the need for updating the engineering education to include the new concepts and utilize the evolving technologies to meet the demands of the changing world (Duderstadt, 2008; Graham, 2018). Engineering education 5.0 is a newly introduced concept that describes a forthcoming educational framework connected to a perspective of engineering education marked by an ongoing requirement for development for achieving a future that is both environmentally sustainable and socially compassion-ate. Lantada (2020) characterized several key features of the Engineering education 5.0 including dynamic and continuously evolving, personalized for joint personal and professional development, combining knowledge-based and outcomes-based approaches, sustainability focused, holistic, guided by ethics, collaborative and open source, involving international experiences, including external academic internships, supported by project-based learning activities, technology-supported and artificial intelligence-aided, oriented to lifelong learning, enjoyable for enhanced results, and Equitable.

Building Information Modeling (BIM) is a robust tool in the construction industry that utilizes planning and cost and provides visualization of the executed construction tasks over a period of time (Wang et al., 2014). Construction 4.0 is the integration of advanced technologies and digitalization in the construction industry. These technologies include connected systems of sensors, intelligent machines, mobile devices, and innovative software applications. Examples of these technologies include utilization of drones for surveying and inspecting construction sites, advancements in additive manufacturing, such as 3D printing, implementation of 3D scanners to allow for the creation of digital models of intricate structures, using Global Positioning System (GPS) and Radio Frequency Identification (RFID) to track materials, equipment, and workers (Gerbert, 2016; Hilfert & König, 2016).

A research group from Faculty of Engineering at the University of Porto have high-lighted two essential aspects of the teaching practices employed: the Construction Sites of the Future,

which involved a laboratory-based education initiative, and the Digital Products Catalogue, which aimed to support Project-Based Learning in Construction. The intended learning outcomes of these initiatives included enhancing knowledge of innovative solutions, developing skills to implement actions in the con-text of Industry 5.0, and fostering human-centered and sustainable attitudes and values. According to their findings, the incorporation of Project-Based Learning and Laboratory-Based Education initiatives, complemented by teaching in Project Management, Information Technology, and Sustainable Building, provides a robust pathway towards Engineering Education 5.0. As a result, they have devised a plan to gradually integrate and evaluate these topics within the existing curricular units to-wards Civil Engineering 5.0 academic path (Calvettia, 2024).

Nearly 200 research papers from the period of 2009 to 2020 were reviewed and analyzed to gain deeper insights into the prevailing trends and identify any gaps or areas requiring further research in the area of Construction 4.0 (Perrier et al., 2020). They observed a strong connection between research on Construction 4.0 and the construction phase itself. Furthermore, they concluded that the most extensively researched topics revolve around the management processes associated with quality, risk, and health and safety. These topics can be introduced to the students in their undergraduate study in relevant fields.

Methodology

A survey was designed to seek the feedback about the current challenges and future trends of the civil engineering in both aspects; the educational curriculum and the profession itself.

The survey included a variety of questions to gather comprehensive insights about civil engineering and civil engineers. It started with general questions about the participant's occupation, role, and experience, followed by technical multiple-choice questions on the monetary value and salaries of civil engineers. The survey also explored the emerging technologies and challenges that have the most significant impact on the future of civil engineering, the importance of sustainable development for civil engineering careers, the skills needed for the next generation of civil engineers, and the adequacy of current civil engineering academic programs. Additionally, it included open-ended questions asking civil engineers to address and face future challenges, explain how emerging technologies can transform the field, discuss the vital role of sustainable practices, and provide any other helpful thoughts or suggestions.

Different stakeholders including students, academics, and civil engineers with different roles and experience within the civil engineering field participated in the survey. A total number of 68 participants have participated through direct emails, social media, and professional websites. This sizable dataset provides a robust foundation for analysis and allows for statistically significant conclusions to be drawn. The geo-graphical scope of the survey encompassed several regions, namely North Africa, the Gulf region, South Asia, and North America. This deliberate selection of regions ensured a diverse range of perspectives and experiences, taking into account variations in civil engineering practices, regulations, and challenges across different parts of the world with a majority from North Africa and Gulf region.

By incorporating these different viewpoints, the survey aimed to generate insights that would be applicable in various international contexts. Approximately 57% of the participants were academics, who brought their specialized knowledge and educational perspectives to the

survey. Their insights provided valuable input from an educational standpoint, shedding light on the latest research, trends, and emerging practices within the field of civil engineering. The remaining 40% of the respondents were practicing engineers, representing a diverse range of roles such as site engineers, office engineers, and construction project managers. This diverse representation of professionals with hands-on experience in different aspects of civil engineering adds depth and richness to the findings. Their practical insights and real-world experiences con-tribute to a more comprehensive understanding of the challenges, opportunities, and best practices within the industry.

Overall, the extensive survey successfully captured a global perspective on civil engineering by incorporating participants from different regions and professional back-grounds. The dataset obtained from the survey, along with the diverse representation of stakeholders, lays a solid foundation for in-depth analysis and meaningful conclusions regarding the current state of civil engineering.

The survey seeks feedback on the emerging technologies that will significantly impact and transform the field, the major future challenges facing the profession and how to address them, the importance of sustainable practices in shaping the future of civil engineering, the skills required of future civil engineers, and the adequacy of current academic curricula.

Results

The results of the survey questions are shown in Figures 1-6. According to the participants, the emerging technologies mentioned, such as 3D printing, artificial intelligence, and machine learning, have the potential to transform the field of civil engineering. These technologies offer various benefits, including reducing construction time and cost through efficient design and simulation models. They also promote environmental sustainability by using new construction materials and reducing CO_2 emissions. Additionally, these technologies enable better prediction of infrastructure performance over time. As shown in Figure 1, the participants selected the artificial intelligence and machine learning to be the most needed emerging technology with a percentage of 60.3%. In the second stage, the 3D printing and new construction materials received 57.4% of the selection of the participants. Overall, the emerging technologies can improve the quality, efficiency, and economic viability of civil engineering projects. By incorporating these technologies, civil engineering can become more advanced, easier to manage, and more environmentally friendly. It may also lead to changes in construction practices, such as the use of new materials and increased automation.

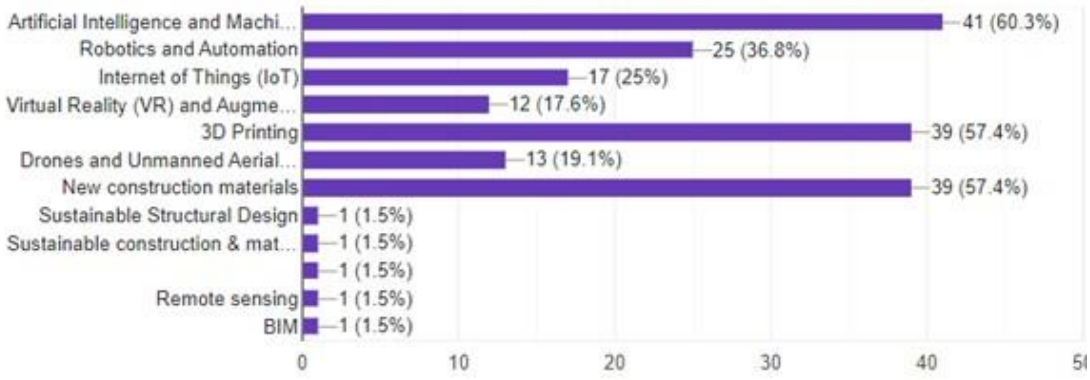

Figure 1: Most Significant Emerging Technologies for Future Civil Engineering

Figure 2 depicts the most challenges that civil engineers can face and need to address them in the future. According to the survey results, these challenges are aging infra-structure, climate change and extreme weather conditions, and population growth, respectively. In order to address the challenges and requirements in civil engineering, incorporating new technology, devising innovative construction materials, and considering urban and social needs are crucial. Advanced technologies combined with the expertise of civil engineering professionals can effectively respond to these challenges. Governmental strategies, study, analysis, education, and training play important roles in implementing these solutions. Sustainability, continuous monitoring of structures, and strict measures against violations are essential considerations. Brainstorming, research, and continuous skill enhancement are necessary for progress. Additionally, addressing transportation obstacles, environmental changes, and population growth are important factors in designing and maintaining resilient and sustainable infrastructure. A comprehensive plan that includes assessment, deliberate design, and collaboration can help meet the increasing demands of growing populations.

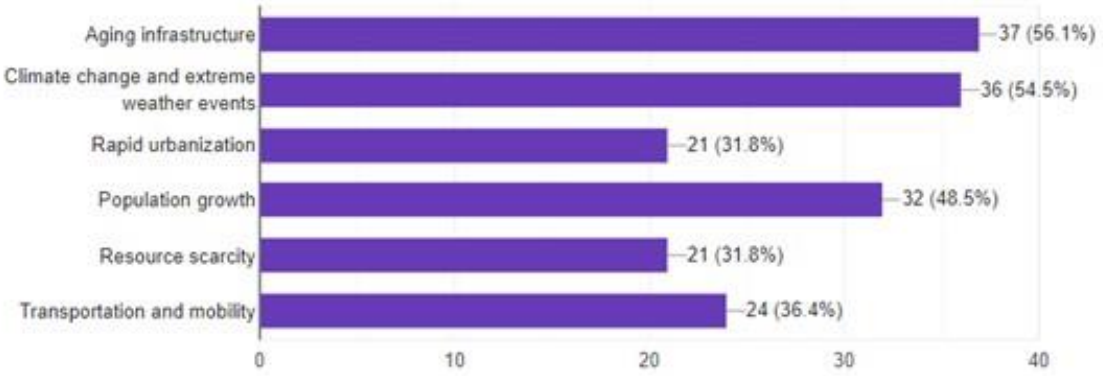

Figure 2: Significant Challenges Expected to Face Civil Engineers in the Future

Around 33% of the participants classified the sustainable development as extremely important aspect for the future of civil engineering and 24.8% categorized it as very important, as shown in Figure 3. Sustainable practices, such as using recycled materials, minimizing waste, and adopting clean energy, are important for reducing green-house gas emissions and addressing climate change. The use of sustainable and natural materials, finding alternatives to concrete, and implementing innovative engineering management approaches are important considerations. Energy conservation, sustainable energy regimes, carbon emissions, and recycling are key areas of focus. The role of civil engineers in improving the quality of life for others is important, although they may not always receive adequate benefits in return. Water management, life-cycle assessment, waste reduction, climate resilience, and the use of software and construction methods are additional aspects to consider. BIM, renewable energy, green materials, smart design, water management, and circular economy principles are expected to shape the future of civil engineering. Additionally, the use of auto-mated machines and robots is becoming more prevalent in the field. Participants were asked about the necessary skills for the future generation of civil engineers to effectively address upcoming challenges. The findings revealed that the most preferred skill was the application of innovative technical software and tools, which received 69.7% of the votes. Managerial skills ranked second, with a percentage of 59.1%. Other notable skills mentioned included advanced technological proficiency (54.5%), effective communication (53%), and teamwork and collaboration (50%). The survey also emphasized the importance of data analysis and ethical/social awareness. Figure 4 provides a visual representation of the survey results.

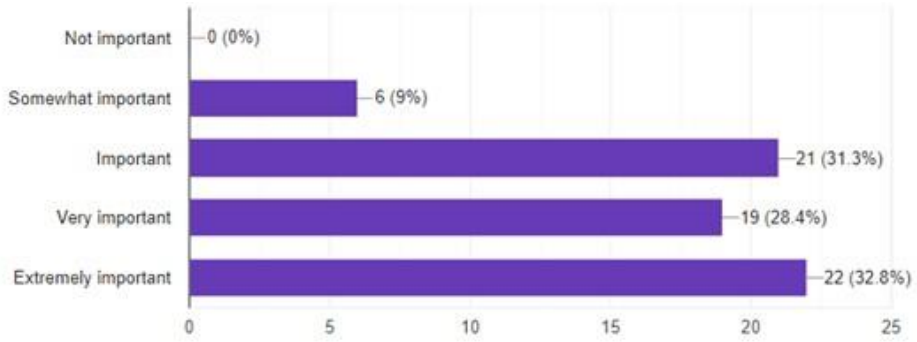

Figure 3: Importance of the Sustainable Development on the Future of Civil Engineering

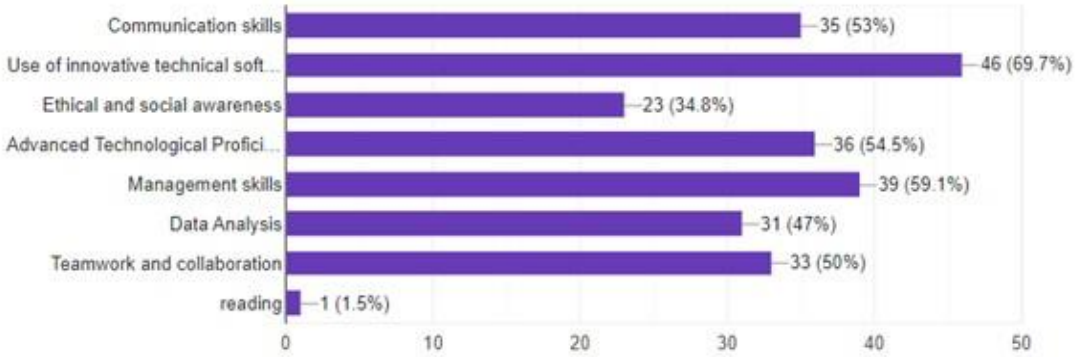

Figure 4: Skills Needed for the Future Civil Engineers

Based on the perspectives of the survey participants and in response to the changing world and its associated challenges, a majority of participants believe that the existing civil engineering curriculum should be revised to adequately prepare future generations for the role of civil engineers. As indicated in Figure 5, 74.2% of the respondents expressed the opinion that the curriculum requires improvement, while 13.6% considered the current curriculum sufficient without any need for changes. Figure 6 provides a list of topics that should be incorporated into the current educational curriculum of civil engineering in order to enhance its effectiveness. The most highly prioritized topic, selected by 73.1% of participants, was emerging technologies such as Building Information Modeling (BIM), 3D printing, robotics, drones, and new construction materials. Other significant topics that should be considered include sustainability and green infrastructure (62.7%), smart cities and the Internet of Things (IoT) (38.8%), data science and analytics (35.8%), and virtual design and construction utilizing virtual reality and augmented reality (34.3%). Additional areas of interest included the legal aspects of engineering, licensure and professional practice, and field training.

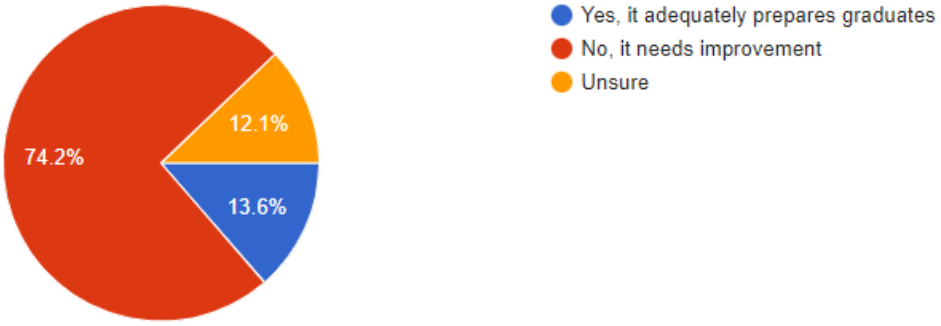

Figure 5: Does Current Civil Engineering Curriculum Adequately Prepare Graduates?

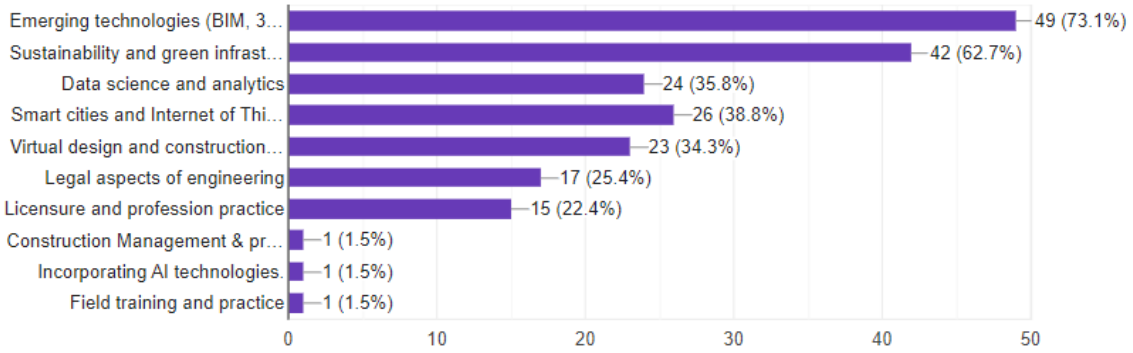

Figure 6: Topics Should Be Included in the Educational Civil Engineering Curriculum to Prepare the Graduates for the Future Challenges

Conclusion

The topic of the future of education is a subject of active research that garners significant attention from researchers. Civil engineering, as a discipline, requires constant updates to adapt to evolving global changes and to incorporate emerging technologies utilized by advanced companies in the field. To gather valuable insights, a survey was conducted involving 68 participants who represented various stakeholders in the civil engineering field. These participants included students, trainees, academics, and civil engineers with diverse levels of experience and professional roles. Based on the survey findings, it was determined that certain emerging technologies will have a substantial impact on civil engineering in the future. These technologies include artificial intelligence and machine learning, 3D printing, and the utilization of new construction materials. Participants expressed their insights regarding the most significant challenges that civil engineers are anticipated to encounter in the future. These challenges include addressing aging infrastructure, mitigating the effects of climate change, and accommodating population growth.

The participants emphasized the importance of sustainable development for the future of civil engineering. Regarding the essential skills for future civil engineers, the survey revealed that proficiency in innovative technical software and applications, effective management skills, and advanced technological proficiency are highly valued. It was noted that approximately 74% of the participants expressed concerns that current academic programs are insufficient in preparing the next generation of civil engineers to effectively confront the future challenges that are expected to arise globally.

Acknowledgement

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Contact email: ymansour@psu.edu.sa

A Design Framework for Illustrating Malay Proverbs: Shaping Learning Modalities for Generation Alpha

Neesa Ameera Mohamed Salim, Universiti Teknologi MARA, Malaysia
Mohd Nor Shahizan Ali, Universiti Kebangsaan Malaysia, Malaysia
Syahrini Shawalludin, Universiti Teknologi MARA, Malaysia
Nurul 'Ayn Ahmad Sayuti, Universiti Teknologi MARA, Malaysia
Azhar Abd Jamil, Universiti Teknologi MARA, Malaysia

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Abstract
Proverbs have played a crucial role in shaping civilizations and humanity throughout history. As intangible elements of national art and cultural heritage, Malay proverbs convey the wisdom of previous generations, defining and preserving the essence of a particular culture. This study introduces a design framework based on the ARCS (Attention, Relevance, Confidence, Satisfaction) model, aimed at illustrating Malay proverbs to enhance learning among Generation Alpha. The study explores how design, specifically children's illustration styles, plays a significant role in integrating educational psychology and child-centered design to convey these culturally rich proverbs. By combining design and motivational principles, the study develops illustrations that not only capture attention but also facilitate deeper comprehension and retention. Findings from the study reveal that Generation Alpha shows a strong preference for "Cartoon Style" illustrations, which are both appealing and engaging for young learners. By aligning design principles and visual strategies with the preferred learning modalities of Generation Alpha, the study contributes to the field of art and design, as well as education supporting the integration of traditional cultural content into modern learning platforms.

Keywords: Malay Proverbs, Illustration Design, ARCS Model, Cartoon Style

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Introduction

Proverbs are generally employed as metaphorical forms of communication, characterized by their structured, concise, and precise phrasing that conveys a clear and accurate meaning (Jalaluddin, 2014). Within the rich tapestry of Malaysian culture, proverbs serve as an essential linguistic heritage that encapsulates the Malay community's collective wisdom, values, and moral teachings. However, this heritage is increasingly forgotten and is at risk of being overlooked and underappreciated, particularly among the millennial generation who are increasingly immersed in digital content and modern educational approaches (Kamarul, 2024; Norleyza et al., 2020). The traditional approach to learning is increasingly irrelevant to Generation Alpha, who are digital natives. Prensky (2001) asserted that traditional teaching methods, which rely on lecturing, verbal presentations, and step-by-step logic aimed at memory recall, fail to account for the learning preferences of digital natives. As a result, such methods lead to disengagement and a negative perception of school. This observation is further supported by Tapscott (2009), who identified that digital natives typically value autonomy, the ability to personalize content, engagement through conversation and collaboration rather than lectures, and a preference for speed in learning (Jones, 2011).

This shift underscores the need for innovative and creative approaches to preserving and teaching culture-based languages. Language teaching, when designed effectively, offers authentic, valuable, and engaging learning experiences that foster language acquisition, communicative competence, and learner autonomy. It reflects real-life communication scenarios, is purposeful and meaningful, integrates diverse language skills, promotes interaction, contextualizes learning, empowers learners, and serves as an authentic tool for assessment (Jin, 2024). Consequently, the research question emerges: How can Malay proverbs be visually represented to optimize learning experiences for Generation Alpha, using the ARCS (Attention, Relevance, Confidence, Satisfaction) model? This study aims to address this challenge by developing a design framework that captures the essence of these proverbs and aligns them with contemporary pedagogical methodologies that resonate with younger, tech-savvy learners. The objectives of this study are twofold; first, to identify and categorize key Malay proverbs that reflect cultural values and norms, and second, to design educational illustrations that utilize the ARCS model to foster engagement, comprehension, and motivation among the Generation Alpha. By marrying traditional wisdom with modern educational tools, this study holds the potential to bridge the generational gap in understanding cultural narratives, reinforcing the importance of identity and heritage. Academically, it contributes to the discourse surrounding culturally responsive pedagogy and the integration of indigenous knowledge within formal educational frameworks. Practically, it aims to equip educators with innovative and creative strategies to facilitate meaningful learning experiences that honor both cultural heritage and the diverse learning preferences of modern learners. The findings of this study will not only serve to empower educators but also enhance cognitive and motivational engagement among learners, thereby nurturing a deeper appreciation for Malay proverbs and, by extension, the rich cultural heritage they represent. Ultimately, this study underscores the critical need for adaptive educational frameworks that respect and celebrate traditional narratives while making them accessible and relevant in today's globalized educational landscape (Fomina et al., 2023). Various pedagogical models and frameworks based on the ARCS Model have been adapted for real-world educational settings, as evidenced by studies in the field (Hannig et al., 2013; Hong et al., 2019; Keller & Keller, 2010; Li & Keller, 2018).

Literature Review

In the quest for effective educational methodologies, the integration of cultural elements into learning processes has emerged as a significant focus in recent years. Recognizing the need to engage newer generations in a meaningful way, educators and researchers are increasingly exploring how traditional forms of knowledge, such as proverbs, can be employed in contemporary teaching practices. This is particularly pertinent for Generation Alpha, the cohort born from 2010 and 2024, who are growing up in an era marked by rapid technological advancements and multicultural exposure (Spasova, 2022). The increasing reliance on digital tools necessitates innovative approaches to learning that not only convey content but do so in ways that resonate with the learners' intrinsic motivations and cultural identities. One such framework that stands out is the ARCS model, which emphasizes Attention, Relevance, Confidence, and Satisfaction as essential components in motivating learners. To date, literature indicates that proverbs, as encapsulations of cultural wisdom, serve as effective educational tools that can develop their cognitive abilities and enhance cultural appreciation among learners (Davranovna & Nilufar, 2024; Mammadova, 2024). Several studies have illustrated the positive impact of integrating proverbs into curricula, notably in fostering deeper connections to cultural heritage and improving language skills (Munir & Nudin 2021; Ngalim & Stanislaus 2020). For instance, study has demonstrated that utilizing proverbs in language teaching encourages learners to engage with the material on a personal level, thereby enhancing retention and comprehension. By merging traditional wisdom with design principles and visual strategies, educators can tap into the cognitive, emotional, and motivational drivers of learning processes. However, despite the promising findings, significant gaps remain in the literature regarding the systematic design frameworks for incorporating Malay proverbs into learning experiences tailored for Generation Alpha. Most existing studies have either focused predominantly on theoretical perspectives or have failed to provide concrete implications that tie together proverbs, culturally relevant pedagogies, and specific learning modalities through a structured framework. Furthermore, there is a need for exploration into how the nuances of cultural identity and engagement can be optimized within educational settings that cater to a digitally native generation (Peng & Patterson, 2022). Through this comprehensive review, this study aims to elaborate on the existing body of study but also to propose a structured design framework that educators can employ, thereby enriching the learning experience while preserving the rich tapestry of Malay proverbs for future generations. This exploration is essential in paving the way for more effective and culturally responsive educational practices that resonate with today's technologically savvy youth. Early discussions surrounding the use of proverbs as educational tools largely emphasized their cultural importance and moral teachings. Scholars such as Mammadova (2024), Davranovna and Nilufar (2024), Ngalim and Stanislaus (2020), and Munir and Nudin (2021) have emphasized how proverbs encapsulate indigenous wisdom while fostering cognitive abilities by bridging traditional knowledge with modern-day challenges.

As technology advanced, the integration of design principles began to reshape the approach to illustrating these proverbs, illustrating a shift towards creative learning modalities (Gan & Leung, 2020). By the late 2010s, emphasis shifted towards more structured learning principles, such as the ARCS Model, which seeks to enhance learner motivation through Attention, Relevance, Confidence, and Satisfaction. The application of the ARCS Model in illustrating proverbs allows educators to create engaging contextual experiences that resonate with the digital literacy of Generation Alpha. This transition towards incorporating innovative teaching methods, supported by ongoing study (Fomina et al., 2023), reflects a broader trend in educational psychology aimed at creating learning environments that are not only informative

but also appealing to the emerging generations who are accustomed to interactive digital experiences. The incorporation of Malay proverbs within educational frameworks can significantly enhance learning experiences for Generation Alpha, a group characterized by their engagement with technology and diverse learning modalities. A design framework that utilizes the ARCS (Attention, Relevance, Confidence, Satisfaction) model can effectively facilitate this integration. For instance, the attention component can be captured through dynamic presentations of proverbs using design elements, or any visual strategies, which have shown promise in making content more appealing for young learners. Studies have emphasized the role of culturally relevant pedagogy in fostering connections between students' backgrounds and educational content, thereby increasing their investment in learning since it is equally critical in this context. Unfortunately, the teaching of proverbs often fails to capture students' attention as it merits, primarily due to the widespread belief that proverbs have lost their relevance in contemporary society. Additionally, the symbolic and metaphorical nature of proverbs demands advanced cognitive skills for interpretation, which contributes to their lack of engagement and interest among students (Nasir & Subet, 2023). When educators contextualize proverbs within contemporary examples and tailored to their preference and experience, it will illustrate timeless wisdom in ways that resonate with learners' daily lives, building confidence and cultivating critical thinking skills (Fomina et al., 2023). Satisfaction, the final element of the ARCS model, can be achieved through positive feedback mechanisms, where learners see the real-world applications of proverbs. The incorporation of peer collaboration and reflection has been shown to heighten satisfaction levels in educational settings. The application of the ARCS (Attention, Relevance, Confidence, Satisfaction) model provides a structured approach to this integration, enhancing engagement through contextually rich proverbs. Additionally, sociocultural theory emphasizes the importance of cultural context in learning. By embedding cultural proverbs within instructional design, learners can build connections between their personal experiences and traditional wisdom, promoting deeper comprehension and retention (Nadeem et al., 2024). This connectivity highlights the relevance aspect of the ARCS model, suggesting that culturally enriched materials foster a sense of belonging and ownership among learners.

On the other hand, some critiques arise concerning the potential oversimplification of cultural narratives when applied in educational settings. Critics argue that without careful consideration of the complexity within these proverbs, there is a risk of perpetuating stereotypes or misrepresentations (Fomina et al., 2023). However, when aligned with pedagogical strategies, these concerns can be mitigated, ensuring that proverbs are presented with context and variety, thereby enriching the learning experience. Moreover, the use of technology, especially with design frameworks that incorporate design principles, adds another dimension by making proverbs more visually appealing and accessible, which may significantly enhance the satisfaction and engagement of Generation Alpha learners. Together, these theoretical perspectives offer a holistic foundation for advancing the design framework needed to utilize Malay proverbs effectively in contemporary educational settings. The main discussion of this review underscores the importance of merging traditional cultural knowledge with contemporary educational methodologies to support the educational needs of Generation Alpha. Engaging with the richness of Malay proverbs through innovative, creative and more personalized approaches not only cultivates a sense of belonging and cultural pride among learners, but also equips them with critical skills necessary for navigating an increasingly complex world.

Methodology

In this study, the focus centres on Generation Alpha, specifically targeting six-year-old pre-schoolers, who are at the preoperational stage of cognitive development characterized by symbolic thought (Lowenthal, 1975). The sample consists of 41 pre-school learners drawn from four kindergartens—two located in urban areas and two in rural settings in Central and North Malaysia. Employing a focus group discussion method, the study is organized into eleven groups to facilitate structured dialogue. A total of six illustration styles (Salisbury & Styles, 2018) were presented: (i) Whimsical, (ii) Cartoon, (iii) Black and White, (iv) Line, (v) Realistic, and (vi) Sketchy, as illustrated in Figure 1. The selection process for illustrations incorporated 'sticker voting' to collectively define individual preferences based on the six illustration styles. All these illustrations were developed based on one specific Malay proverb, *"Sikit-sikit, lama-lama jadi bukit,"* which translates into English as "Take care of the pennies, and the pounds will take care of themselves."

This is followed by grouping participants based on chosen thematic illustration styles. This is complemented by discussions aligned with the indicators of the ACRS Model, culminating in a thematic analysis that seeks to identify prevalent trends and insights within children's illustrative preferences, thus advancing the understanding of their cognitive engagement with visual stimuli. This analysis helps to distil key insights from these discussions, providing clarity and direction for interpreting the outcomes. This systematic approach not only enhances the validity of the research but also acknowledges the unique cognitive characteristics of Generation Alpha, reflecting the importance of tailored methodologies in developmental studies.

Figure 1: Illustration Styles

Findings & Discussion

The findings reveal a clear preference among Generation Alpha for the 'cartoon style' illustration, which garnered 56.1% of the votes, highlighting its effective engagement with young audiences. This overwhelming endorsement can be attributed to the dynamic and colorful nature inherent in cartoon visuals, which capture children's attention and create an immersive experience. As noted, cartoons engage young minds through vibrant imagery that not only entertains but also nurtures imagination and curiosity (Bedekar & Joshi, 2020). This styles ability to blend imagination with storytelling allows children to connect deeply with

relatable characters, creating emotional ties that invite further exploration of the narratives presented. Furthermore, cartoons serve a dual purpose: while they entertain, they also convey educational content and important life lessons, acting as effective pedagogical tools (Siddiqui & Islam, 2022). It also aligns well with the learners' characteristics, reflecting their preference for visually engaging, vibrant, and technology-friendly content which requires an approach grounded in negotiation and compromise (Spasova, 2022).

In stark contrast, other styles such as whimsical and sketchy illustrations received much lower preferences, at 31.7% and 3%, respectively. The minimal votes for the monochromatic and realistic styles suggest limited appeal, indicating that children may prefer vibrant, imaginative depictions that immerse them in adventurous worlds. Overall, this preference underscores the importance of dynamic visuals in fostering not only engagement but also educational opportunities through entertaining narratives. The heightened understanding exhibited by this study indicates that the realization of cultural identity through learning materials and activities aligns with several studies that advocate for culturally responsive pedagogy as a means to strengthen learners' relationship to content (Altugan, 2015; Vickov, 2007).

A careful review of the findings shows that using the ARCS (Attention, Relevance, Confidence, Satisfaction) model to illustrate these proverbs significantly boosts learners engagement and comprehension, while also encouraging deeper inquiries into the significance of cultural content in modern educational contexts. The incorporation of visual elements plays a pivotal role in shaping learners' aesthetic preferences and boosting their engagement with diverse subjects. Illustrative drawing serves as a crucial tool for fostering visual literacy, enabling students to connect emotionally and intellectually with the material they encounter. Through illustrations, children gain a better understanding of literary texts, as these visuals elucidate complex themes, characters, and narratives, thereby enriching their comprehension of the written word. This kind of engagement is essential as it helps cultivate moral ideals and a deeper appreciation for the arts. By immersing students in the illustrative world, educators can nurture both creativity and critical thinking, preparing learners to interpret and appreciate artistic expressions in a more profound manner. As mentioned, utilizing design principles and visual strategies within educational frameworks can stimulate either emotional or technical awareness, ultimately enhancing the individual's overall aesthetic experience (Farhodovna et al., 2023 ; Tursunmurotovich, 2020). These findings have significant implications for both theoretical and practical applications, suggesting that incorporating local cultural narratives into curricula enables educators to cultivate more inclusive learning environments that not only honor learners' preferences but also improve educational achievements (Fomina et al., 2023). Educators must ensure that teaching and learning materials are up-to-date and aligned with learners' preferences and current educational trends, as this can improve their information retention and increase their motivation to learn (Gan & Leung, 2020).

The ARCS model serves as a foundation for exploring technology-enhanced learning techniques across diverse subject areas beyond proverbs, highlighting its broader potential for various educational applications. As more scholars and educators recognize the importance of culturally informed teaching, this study contributes valuable insights that could influence policy and curriculum design at multiple educational levels (Rachabatuni et al., 2024), sparking vital conversations about the role of cultural narratives in contemporary education (Isnah et al., 2021). The combination of cultural heritage and technological advancement in this context highlights the possibilities for multi-modal learning strategies to effectively engage diverse learners, paving the way for future scholarly exploration of the intersection between culture, technology, and education (Rachabatuni et al., 202). Such initiatives reinforce the need for

aligning educational practices with students' cultural backgrounds and values, thus progressing pedagogical theories and nurturing the socio-cultural understanding critical for shaping informed global citizens. Overall, the results from this study represent a significant step toward revitalizing cultural education and equipping the next generation to appreciate and engage with their heritage more fully.

Conclusion

In conclusion, this study thoroughly examined the design framework for illustrating Malay proverbs, with a particular focus on how the ARCS (Attention, Relevance, Confidence, Satisfaction) model influenced Generation Alpha's preference for the 'cartoon style' illustration as a motivating factor in learning Malay Proverbs. The study provided key insights into the importance of proverbs as significant cultural treasures that align with modern educational methods. The central research issue, which aimed to effectively incorporate traditional Malay proverbs into educational systems, was addressed through the creation and evaluation of a structured illustration technique that enhanced both understanding and engagement. The findings revealed significant improvements in learners' awareness and appreciation of Malay proverbs, thereby supporting the strategies promoted by the ARCS model, culturally responsive pedagogy, and the integration of design principles and visual strategies. The implications of these results extend beyond academic settings, offering practical recommendations for educators across various environments who wish to weave cultural heritage into contemporary curricula. By integrating local wisdom into instructional and creative resources, educators can cultivate a stronger bond between learners and their cultural identities, ultimately fostering engagement while aiding in collective identity formation and emotional connections.

Furthermore, embracing such frameworks can help bridge generational divides, ensuring that the values reflected in Malay proverbs are successfully passed down to future generations in ways that are both relevant and meaningful. Looking forward, there are numerous avenues for further investigation in this field. Longitudinal studies that track the lasting impacts of educational interventions based on the ARCS model could also provide further validation of its effectiveness across diverse educational settings. Ultimately, fostering collaborations among educators, cultural practitioners, and researchers is crucial to advance the discussion regarding the significance of cultural heritage and its incorporation into the education of Generation Alpha. Such initiatives will be instrumental in enriching the educational landscape while fostering a deeper appreciation for cultural narratives and the pivotal role of design principles among future learners (Rachabatuni, 2024). Moreover, expanding this framework to include other cultural expressions or proverbs from diverse contexts could provide valuable comparative insights (Fomina et al., 2023; Zhou et al., 2024). The findings indicate that the quality of design principles in educational tools has a significant impact on children's engagement and motivation in learning Malay proverbs.

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Reshaping Visual Learning Through the Design Thinking Model: Board Games and Dyslexic Children's Mastery of Malay Proverbs

Mohd Nor Shahizan Ali, Universiti Kebangsaan Malaysia, Malaysia
Neesa Ameera Mohamed Salim, Universiti Teknologi MARA, Malaysia
Noor Alaudin Abdul Wahab, Universiti Kebangsaan Malaysia, Malaysia
Karim Harun, Universiti Kebangsaan Malaysia, Malaysia
Norashikin Hamzah, Dyslexia Association of Malaysia, Malaysia

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Abstract
This study explores the design and use of an educational board game as a pedagogical tool to introduce Malay proverbs. It focuses on demonstrating the creative process through the Design Thinking Model by discussing the board game's potential to enhance linguistic cognitive, and social skills, particularly in facilitating the understanding of Malay proverbs through a creative and engaging approach within the Malaysian cultural context. The study integrates the concept of design thinking into five core competencies: "exploring the problem, gaining insight, creative design, prototyping, as well as analysis and iterative optimization," based on a detailed examination of the design thinking framework. A total of 112 mild dyslexic learners (ages 8 to 10) from the Dyslexic Association of Malaysia participated in this study. Qualitative data, including the final product of the board game, focus group discussions, and observations, were collected. Results suggest that the Design Thinking Model presents an effective approach for combining design (board game) with motivational factors (reward systems and series of challenges), forming a favorable active methodology. The learners were highly engaged, which justifies the increase in their motivation to learn Malay proverbs.

Keywords: Design, Culture, Proverbs, Dyslexic, Visual Strategies, Board Game

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Introduction

In recent years, there has been a growing interest in educational methodologies that cater to diverse learning needs, particularly for children who struggle with reading and comprehension (Kotzer, 2024; Mehrabian & Salehi, 2019). Dyslexia, a common learning disability characterized by difficulties with accurate and fluent word recognition and poor spelling and decoding abilities, affects a significant number of children worldwide（Snowling et al., 2020; Stein, 2018). Traditional education systems often fail to adequately engage students with dyslexia, leading to a critical need for innovative pedagogical approaches that enhance their learning experiences (Bratu et al., 2018; Demazière, 2021; Ogwuegbu, 2023). The development of various teaching models grounded in experiential learning has greatly enhanced the process of building knowledge. One such model is design thinking, a nonlinear approach that may not be immediately apparent but allows for a deeper understanding of individuals, exploration of potential solutions, and redefinition of problems to create innovative and unique outcomes. The Design Thinking model, known for its user-centered approach to problem-solving, has emerged as a promising framework for developing educational tools and creative resources that can foster engagement and comprehension among preschool learners (Yalçın, & Erden, 2021).

The central research issue explored in this study pertains to the insufficient impact of traditional educational methods in aiding dyslexic children to grasp intricate language elements, such as Malay proverbs, which are deeply rooted in cultural heritage and frequently present considerable comprehension difficulties. This study aims to explore how incorporating the Design Thinking model into the design of board games can reshape visual learning experiences, thereby increasing dyslexic children's mastery of Malay proverbs. By integrating game-based learning with visual strategies, the study seeks to promote active engagement, cognitive development, and increased retention of the target content (Li et al., 2024). Teaching and learning strategies incorporating game-based elements are increasingly adopted to enhance student engagement and motivation (Anastasiadis et al., 2018; Plass et al., 2015; Wouters et al., 2013). Interactive games that encourage collaboration and aid in knowledge retention are recognized as valuable tools for supporting learning outcomes (Stiller & Schworm, 2019) and improving self-efficacy (Oprins et al., 2015). The objectives are to investigate the impact of creative innovations on enhancing comprehension and retention, while also analyzing the benefits of a constructive and interactive educational environment. Academically, this study contributes to the growing body of educational research on inclusive practices and the integration of visual learning aids (Booker & Mitchell, 2021). It highlights the significance of creating customized educational materials that address the specific needs of dyslexic learners while drawing from evidence-based approaches in cognitive psychology and instructional design (Wiggins, 2011). Practically, the findings have relevance for educators, curriculum developers, and policymakers in special education, as well as for parents and caregivers who play a critical role in supporting the language acquisition of dyslexic children. By introducing innovative methods that enhance educational outcomes, the findings aim to inspire a fresh perspective on teaching children with learning differences. The ultimate goal is to create an inclusive and nurturing learning environment where every child has the opportunity to succeed and reach their full potential.

Literature Review

The intersection of design thinking and visual learning presents an innovative approach to address the educational needs of diverse learners, particularly those with dyslexia. In recent

years, the traditional educational frameworks have faced scrutiny as they often fall short in accommodating varied learning styles and cognitive profiles, necessitating a shift toward more inclusive pedagogical strategies (Bratu et al., 2018; Demazière, 2021; Ogwuegbu, 2023). The deployment of board games as a medium for facilitating mastery of regional languages, specifically Malay proverbs, within this context underscores a unique avenue for enhancing engagement and retention among dyslexic children. Existing literature suggests that incorporating interactive and playful elements can significantly improve learning outcomes for students experiencing challenges with conventional learning methods (Bratu et al., 2018; Demazière, 2021; Hawkinson, 2013; Ogwuegbu, 2023). Research has increasingly emphasized the importance of visual aids and gamification in education (Chetan et al., 2018; Mashrafovich, 2025), particularly for dyslexic learners, who tend to excel in settings that utilize visual elements and interactive, hands-on activities (Bacon & Handley, 2010; Ortiz, 2014; Stein, 2014). Notably, studies have demonstrated that game-based learning can bolster students' comprehension and application of language concepts by providing contextualized experiences that support memory retention (Ibbara, 2020; Salgarayeva, 2021; Wong & Yunus, 2021). The incorporation of design thinking principles further enriches this approach, as it emphasizes empathy, ideation, and iterative processes, permitting educators to tailor their interventions to meet the unique needs of dyslexic learners. Evidence from therapeutic and educational settings suggests that child-centered design methods can lead to significant advancements in language acquisition, enhancing not only knowledge but also self-efficacy (Jerónimo Yedra & Almeida, 2021; Kormos et al., 2009; Van, 2004). Despite the promising findings, several gaps remain in the current body of research. For instance, while there is a burgeoning interest in game-based interventions for dyslexic learners, few studies have systematically explored the specific effects of board games designed through a design thinking framework on the mastery of cultural language elements, such as proverbs (Bolotina & Borzenkova, 2017; Papanastasiou et al., 2022). The potential of board games to incorporate design thinking and foster meaningful cognitive and emotional engagement with learning materials remains largely untapped. Additionally, there is still much to explore about how cultural context influences the learning experiences of children with dyslexia, especially when it comes to Southeast Asian languages and educational practices (Kritsotaki et al., 2024).

This study highlights the urgent need for teaching approaches that not only engage dyslexic learners but also nurture their linguistic and cultural understanding. In today’s globalized and multicultural world, finding ways for dyslexic children to connect with and value their cultural heritage is more important than ever. By integrating the cultural depth of Malay proverbs into board games, educators can create a more enriching and effective learning experience. Given that dyslexic learners often excel in visual and interactive settings (Andreou & Vlachos, 2013; Beacham & Alty, 2006), the use of board games combines these strengths with engaging, hands-on methods. This forward-thinking method enhances comprehension and retention (Chih-Ming, 2018) while seamlessly connecting traditional cultural wisdom with contemporary teaching strategies. It cultivates both an appreciation for and a mastery of linguistic and cultural knowledge, simultaneously boosting confidence in language use among dyslexic children. Moreover, the Design Thinking Model could serve as a robust pedagogical framework to effectively engage dyslexic learners. Its iterative, human-centered approach aligns well with the needs of diverse learners, emphasizing empathy, creativity, and problem-solving. By using this model to design board games, educators can create tailored, meaningful experiences that promote not only linguistic fluency but also a deep understanding and appreciation of cultural heritage. This dual focus ensures that the

learning environment is inclusive, adaptive, and responsive to the unique challenges faced by dyslexic learners.

The integration of design thinking in educational contexts has evolved significantly, particularly in addressing the needs of children with dyslexia. In the early 2000s, educators began to recognize the potential of multimodal learning strategies, suggesting that visual learning could greatly enhance comprehension for dyslexic students, particularly in language acquisition contexts (Shofwan et al., 2023). As scholars explored into different teaching methods, board games emerged as a promising tool for education. Offering a hands-on, visual, and interactive learning experience, board games align seamlessly with design thinking principles, which focus on user-centered strategies. Studies also highlight the importance of visual aids in enhancing comprehension and memory retention among dyslexic learners, particularly in the Malaysian context (Hashim et al., 2023; Nordin & Omar, 2022; Rahman et al., 2018; Syahraz et al., 2024). The hands-on nature of board games, coupled with design thinking principles, encourages collaboration and problem-solving among peers, which has been found to enhance learning outcomes for children struggling with traditional educational methods.

Studies showed that blending traditional education with gamified approaches not only boosted student motivation but also helped them better understand abstract concepts like Malay proverbs. This move towards play-based learning environments led to innovative initiatives, where board games were specifically crafted to teach a range of topics, leveraging design thinking frameworks to create engaging and impactful educational experiences (Idzham et al., 2024). Recent research highlights that this approach not only aids memory retention but also enhances overall language skills and fosters a deeper comprehension of linguistic nuances, ultimately improving academic performance among dyslexic learners (Nordin & Omar, 2022). The chronological evolution of design thinking as applied to board games exemplifies a productive convergence of educational theory and practical application, particularly in supporting dyslexic children in mastering complex language elements, such as Malay proverbs.

Studies have consistently shown that dyslexic children often face challenges with traditional learning methods due to cognitive processing differences. However, the integration of visual elements within board games has proven to significantly enhance their understanding and retention of proverbs. The interactive nature of board games promotes active engagement, which research indicates improves both motivation and learning outcomes (Hashim et al., 2023; Nordin & Omar, 2022; Rahman et al., 2018; Syahraz et al., 2024). For instance, games incorporating cultural, linguistic, and design components enable dyslexic children to contextualize proverbs, bridging the gap between abstract concepts and tangible understanding. This approach aligns with findings that suggest experiential learning fosters greater retention in students with learning disabilities (Ibbara, 2020; Salgarayeva, 2021; Wong & Yunus, 2021). Moreover, the iterative nature of Design Thinking promotes continuous feedback and adaptation, which is critical for meeting the diverse needs of dyslexic learners (Bostanchi, 2022; Schut et al., 2020). By regularly refining the game mechanics and visual aids based on student feedback, educators can tailor the learning experience to effectively support mastery of certain subject matter. This approach highlights the transformative potential of innovative methodologies in enhancing literacy among disadvantaged learners. The design thinking model has emerged as a transformative approach in education, particularly for students with dyslexia. Furthermore, qualitative studies examining the impact of board games highlight significant improvements in student

engagement and motivation, emphasizing the need for adaptive learning environments that cater to diverse learners (Farkas et al., 2024; Wardani et al., 2023). These insights underscore the value of a balanced yet flexible approach that integrates visual learning, game design, and multicultural content to create an inclusive educational framework. This methodological variety enhances our understanding of how design thinking can transform learning experiences for dyslexic children, facilitating their language development and retention of proverbs within the Malay cultural context. The convergence of design thinking and visual learning has garnered increased attention, especially in developing tailored strategies for children with dyslexia.

Cognitive learning theories emphasize the profound impact of visual inputs on memory retention and comprehension (Parrila & Protopapas, 2017). This perspective highlights the necessity of a blended model that integrates diverse learning theories while prioritizing visual design as a crucial tool for helping dyslexic children master complex language structures, such as proverbs. By synthesizing these theoretical approaches, educators can establish a robust framework capable of transforming visual learning for dyslexic children, fostering both academic achievement and cultural fluency. Exploring the intersection of design thinking, visual learning, and dyslexia unveils a promising path for enhancing language acquisition, particularly within the context of Malay proverbs. Incorporating design thinking into visual learning methodologies offers substantial potential to improve educational outcomes for dyslexic learners by connecting them to culturally significant language elements. The insights drawn from this literature review lay a strong foundation for further research and innovation in teaching strategies, with the ultimate goal of creating an inclusive educational environment that nurtures linguistic and cultural growth for all children.

Methodology

The study's research design included 112 mild dyslexic learners aged 8 to 10 from the Dyslexic Association of Malaysia, who took part in the intervention cantered around a board game. A qualitative approach was utilized to collect data, encompassing the completed board game, focus group discussions, and observations of informants interactions and engagement. The study integrated the Design Thinking Model, which consists of five stages: Empathize, Define, Ideate, Prototype, and Test.

Empathize

The Empathize stage focused on developing a comprehensive understanding of the needs and challenges experienced by mild dyslexic learners. Preliminary observations were conducted in the learners' natural environments, alongside interviews with teachers and caregivers, to explore the cognitive, emotional, and social obstacles these learners face in conventional educational settings. Additionally, existing literature on dyslexia was reviewed to identify prevalent difficulties. Insights from this stage guided the development of the intervention, ensuring that the board game and its features were specifically designed to meet the unique needs of these learners.

Define

In the Define stage, the data collected during the Empathize phase was analyzed to clarify the central problem that needed to be addressed. It was determined that mild dyslexic learners often struggle with maintaining focus and motivation during learning activities. Findings

identified that a lack of engaging and interactive learning tools, coupled with insufficient motivational stimuli, contributed to these struggles. As a result, the core challenge defined was the need for an engaging educational intervention that could simultaneously promote focus, learning, and motivation among dyslexic learners.

Ideate

During the Ideate stage, the focus was on defining potential solutions. They conceptualized a board game as an educational tool, incorporating elements designed to make it both engaging and instructional. To sustain learners' interest and encourage positive reinforcement, motivational features such as reward systems and progressive challenges were included. Multiple versions of the board game design were explored, evaluating various game mechanics, educational content (emphasizing language skills and cognitive exercises), and motivational approaches. Ultimately, the team settled on a game structure that enabled learners to advance through levels and earn rewards based on their performance, effectively supporting both learning and motivation.

Prototype

The Prototype stage involved creating an initial version of the board game. The design team developed a tangible prototype incorporating the game mechanics, challenges, and reward systems that were outlined in the Ideate stage. The board game included elements that would cater to the needs of mild dyslexic learners, such as clear instructions, visual cues, and simple tasks that were engaging yet not overwhelming. The study also ensured that the game would be flexible enough for individual learners to engage with at their own pace. The prototype was then tested in a small group of learners to gather feedback and make any necessary adjustments.

Test

In the Test stage, the finalized board game prototype was introduced to the entire group of 112 mild dyslexic learners. The implementation involved observing the game in use and collecting data through focus group discussions and additional observations of the learners' interactions with the game. Key aspects such as engagement, focus, and motivation were assessed during this process. Furthermore, feedback was obtained from both the learners and their teachers to evaluate the game's effectiveness in enhancing learning outcomes and boosting motivation.

By following these five stages, the research design was able to create an effective intervention that met the needs of mild dyslexic learners, demonstrating the value of the Design Thinking Model in educational settings. The results indicated that the Design Thinking Model was successful in combining design and motivational elements, forming a favorable active methodology for enhancing learning experiences for dyslexic learners.

Findings and Discussion

Board games developed using the innovative framework of the Design Thinking model have proven to be an effective method for enhancing dyslexic children's understanding of complex linguistic concepts, such as Malay proverbs. The study's findings reveal that informants who engaged with these specially designed board games demonstrated significant improvements

in visual learning and proverb retention compared to traditional teaching approaches. Assessments conducted before and after the intervention showed a statistically significant rise in mastery, with informants achieving over 75% accuracy in understanding proverbs post-intervention, compared to an average of 40% beforehand. This improvement aligns with prior research highlighting the benefits of interactive learning environments in supporting dyslexic learners' progress in language acquisition. The findings from the focus group discussions further underscore the efficacy of the board game as an educational tool, particularly through its emphasis on cultural sensitivity, gamified learning, and inclusive design *(See Figure 1).*

Cultural Sensitivity

Informants noted that the game effectively fostered a sense of identity and belonging among dyslexic learners by making cultural wisdom, such as Malay proverbs, relatable and engaging. The materials were thoughtfully tailored to local contexts, incorporating familiar imagery, themes, and language. This culturally grounded approach not only enriched the learners' understanding of proverbs but also deepened their connection to their heritage, creating a meaningful and culturally resonant learning experience.

Gamified Learning

The game's visual and interactive elements significantly reduced cognitive load, enabling learners to grasp abstract concepts with greater ease. Gamification was found to enhance comprehension and retention by transforming the learning process into an engaging and enjoyable activity. The incorporation of play-based elements, such as challenges, rewards, and quiz-like instructions, fostered sustained motivation and active participation, further reinforcing the learners' understanding of the proverbs. The board game also featured quiz-like prompts designed to encourage critical thinking and reinforce learning, with the added engagement of a total of 50 local characters introduced to interact with and guide the learners. These characters, rooted in culturally familiar contexts, served as relatable figures that not only enriched the learning experience but also helped sustain interest and connection to the material.

Bridging the Gap

The board game's use of visual storytelling and experiential learning was highlighted as a key factor in helping dyslexic learners internalize proverbs through first-hand experiences. This approach bridged the gap between abstract linguistic constructs and practical understanding, empowering diverse learners to engage with proverbs meaningfully. The inclusive, locally inspired design of the board game addressed the unique needs of dyslexic learners by ensuring accessibility and fostering confidence while promoting skill development in mastering complex linguistic constructs. By integrating elements of local culture and identity, the game bridged the gap between learners and the material, encouraging an appreciation of cultural heritage and instilling a sense of pride in their cultural identity. This culturally grounded approach not only made learning more relatable but also reinforced the value of preserving and understanding traditional wisdom, such as Malay proverbs, within a modern educational framework.

These findings collectively demonstrate the board game's capacity to support dyslexic learners in a culturally relevant, engaging, and inclusive manner, offering valuable insights into the potential of design-driven educational interventions.

Figure 1: Concept and Design

Conclusion

This study underscores the transformative potential of visual communication, the Design Thinking model, and gamified learning in addressing the unique educational needs of dyslexic learners. By incorporating culturally relevant elements, the board game not only engaged learners but also fostered a deeper appreciation for local culture and heritage, empowering students to connect with their identity through the learning process (Harianto et al., 2023). This approach highlighted the importance of designing learning tools that are accessible, inclusive, and sensitive to the needs of diverse learners, including those with special needs, such as dyslexia (Ekawati et al., 2024). When designing games for young learners, user-centered design practices emphasize the importance of involving children in the design process, as they can offer valuable insights. A common mistake in designing products for children is the failure to involve them in the design process, which is often a result of the traditional power imbalance where adults are viewed as "all-knowing" and children as "all-learning" (Druin, 2002).

Being sensitive to these needs requires an empathetic approach to design, recognizing that each learner is different. For dyslexic learners, this sensitivity might mean using strategies that reduce cognitive overload, such as breaking complex tasks into smaller, manageable steps or incorporating games and rewards that foster motivation and provide positive reinforcement. In turn, these tools empower learners by offering them alternative ways to engage with content that suits their learning styles and helps them overcome barriers. Ultimately, such an approach not only supports academic success but also promotes self-confidence, self-awareness, and a lifelong love of learning, ensuring that all learners, regardless of ability, can access, interact with, and benefit from educational experiences.

The significance of the study lies in its ability to bridge the gap between traditional educational methods and the evolving demands of today's educational landscape (Bratu et al., 2018; Demazière, 2021; Ogwuegbu, 2023). As education increasingly embraces creativity and innovation, this project demonstrates how design thinking can play a pivotal role in

developing engaging, effective, and inclusive educational tools. By focusing on visual learning, the study provides valuable insights into how visual communication strategies can support dyslexic learners and other students who benefit from alternative learning methods (Kristjansson & Sigurdardottir, 2023). Reshaping visual learning through the Design Thinking model, this study highlights the power of board games as an innovative educational tool that enhances dyslexic children's mastery of Malay proverbs. The game's design, which incorporates local cultural elements, visual storytelling, and interactive gameplay, offers a dynamic and engaging approach to mastering complex linguistic constructs. This study emphasizes the potential of creative and inclusive educational strategies to break through barriers and foster meaningful learning experiences. Ultimately, the findings advocate for a future where educational design continues to evolve, fostering an environment where creativity, cultural relevance, and innovative thinking empower all learners to reach their full potential (Collard & Looney, 2014; Hernández-Torrano & Ibrayeva, 2020; Kaplan, 2019; Kevin & Hélène, 2024).

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Development of a Digital Embroidery Museum Integrated With VR for the Preservation of Intangible Cultural Heritage

Ran Shao, King Mongkut's Institute of Technology Ladkrabang, Thailand
Juntao Li, Yunnan Technology and Business University, China
Thoriq Tri Prabowo, UIN Sunan Kalijaga Yogyakarta, Indonesia
Atit Tippichai, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
Embroidery is an important part of cultural identity, showcasing the traditions, stories, and symbols unique to specific communities. It plays a crucial role in preserving cultural practices alive across generations. This study developed a VR-based digital embroidery museum to innovate the preservation of Yunnan embroidery as an intangible cultural heritage. The platform combined high-resolution visuals and interactive designs to enhance user engagement and cultural appreciation. This research employed a convergent mixed-methods design, utilizing Unreal Engine (UE) software and virtual reality (VR) technology. Five experts were selected through simple random sampling to evaluate the developed digital museum both quantitatively and qualitatively. The assessment employed a questionnaire survey to gauge user perceptions of authenticity within the digital museum, utilizing a 5-point Likert scale for responses. Quantitative data were processed through descriptive statistics, while qualitative data underwent thematic analysis. Expert evaluations suggested that the digital museum had significant potential for preserving intangible cultural heritage, achieving an average score of M=4.73 (SD=0.27). VR offers an immersive and engaging experience that connects users with the cultural heritage of embroidery. Despite some challenges—such as the need for high-quality hardware and software for optimal performance, as well as the necessity for continuous updates and maintenance—the study demonstrated that VR provided a highly immersive experience. This allowed users to engage deeply with the cultural heritage of embroidery, fostering a greater appreciation and understanding of traditional crafts and sparking excitement about the potential of VR technology in cultural preservation.

Keywords: Virtual Reality (VR), Digital Museum, Yunnan Embroidery, Intangible Cultural Heritage (ICH), Cultural Heritage Preservation

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Introduction

Intangible cultural heritage, like traditional embroidery, involves passing down skills, rituals, and art forms from one generation to the next. These traditions help strengthen cultural diversity and identity (Zhuang, 2021). However, modernization and globalization have made it harder to keep these traditions alive, especially among younger people. Many young people no longer have the chance or interest to learn these skills (Isa et al., 2018). As a result, digital tools like virtual reality (VR) are becoming important (Zhong & Qi, 2020).

Digital technology is significantly transforming the way we engage with cultural experiences. Virtual reality (VR), in particular, serves as a prime example of this transformation. It enables individuals to virtually traverse museums from the comfort of their own homes, thereby enhancing accessibility to cultural heritage. This technology facilitates global engagement with fading cultures and contributes to the preservation of art from various historical periods. In essence, virtual reality acts as a digital conduit, fostering connections between diverse cultural narratives and contemporary audiences. By offering immersive and interactive experiences, VR technology addresses the challenge of preserving endangered embroidery, which faces a decline in skilled artisans and shifting market dynamics. It allows people from all over the world to experience and appreciate these cultures (Bougaa et al., 2016).

Embroidery transcends mere thread weaving; it serves as a repository of cultural heritage. Nevertheless, the forces of modernization and globalization pose significant risks to these time-honoured techniques, leading to their potential extinction (J. L. Li, 2020). For instance, Yunnan Yi embroidery, characterized by its elaborate designs and profound cultural significance, is increasingly at risk as the number of skilled artisans dwindles and market dynamics shift (Condell et al., 2021). For instance, Yunnan Yi embroidery, characterized by its elaborate designs and profound cultural significance, is increasingly at risk as the number of skilled artisans dwindles and market dynamics shift. It lets us digitally save these works and showcases them in a virtual museum. This way, everyone can appreciate their beauty and history without harming the originals. Think of it like a protective time capsule made of ones and zeros (Cecotti, 2022).

This study looks into the practical use of virtual reality (VR) technology in preserving embroidery-based intangible cultural heritage, focusing on the development process, effectiveness, and user feedback. By making a VR-based digital embroidery museum, the study tries to solve the challenges caused by physical damage to embroidery heritage, create a platform to save detailed embroidery patterns and skills, and promote the worldwide spread of cultural heritage (Rizvic et al., 2019).

This study highlighted the key role of VR in passing on embroidery traditions and closing the gap between culture and embroidery (Yu, 2023).Existing research points out the need for studies that explore how VR can help restore the authenticity of cultural heritage items and how it can connect with users to create emotional and educational bonds (Zhong & Qi, 2020). Also, international audiences and younger generations are not very familiar with these traditions, and there is little research on how VR can be used for different user groups (Liu et al., 2022).This study looks at how virtual reality (VR) technology affects engagement and the perceived authenticity in preserving embroidery, and explores some factors that influence user engagement. The goal of this research is to give suggestions for managing immersive systems, ensuring authenticity, and improving user experience (Siyu & Abdul Ghani, 2023).

Research Questions

One research questions presented to guide the study.

RQ: How to develop Digital Embroidery Museum Integrated with VR for the Preservation of Intangible Cultural Heritage?

Methods

This study used research methods combining quantitative and qualitative data. This method takes the good parts of both research types and helps fix their weaknesses. Because of this, it provides a deeper and more complete look at the research questions. The study thoroughly examines how virtual reality (VR) can help preserve embroidery as an essential cultural tradition by gathering both data types. A survey was done using WeChat and the WenJuanXing platform to collect information about how users interact, feel immersed, and understand the culture.

Participants and Sampling

The study included five university professors, with various level of experience from 5-25 years. They also came from several levels of professorship, from assistant professor till full professor. They come from different fields, like digital media art, art and design, digital media technology, and landscape architecture from two universities; Yunnan Technology and Business University and Kunming University of Science and Technology. They all have much experience and knowledge in using digital technologies to help preserve cultural heritage. These experts were selected using purposive sampling. This method ensured they could give valuable ideas and suggestions for the VR Enhanced Digital Embroidery Museum project. By choosing experts with the right skills, the study could focus on the most essential areas and collect valuable data on using VR technology to preserve embroidery.

Instruments and Data Collection

This research examined the application of virtual reality (VR) in conserving intangible cultural heritage within the embroidery sector. It employed a mixed-methods approach, integrating both quantitative and qualitative techniques. In the quantitative part, the study used a questionnaire created by Li et al. (2024) to look at the VR user experience in a virtual museum. The survey encompasses 12 dimensions, such as functionality, design, performance, and interactivity, to thoroughly assess user experiences within the VR embroidery museum. Critical areas of emphasis include emotional authenticity and the acknowledgment of cultural value, aimed at investigating the role of VR in cultural transmission. These 12 areas are the main parts of the system.

Each part of the questionnaire has several closed-ended questions. Participants rate these questions on a 5-point Likert scale. The qualitative part of the study is also based on these areas. It uses open-ended questions to gather more detailed insights from participants. These questions explore their thoughts and suggestions on the dimensions discussed.

The questionnaire was shared online through the WenJuanXing platform. WeChat contacted participants and gave them a link to the questionnaire. The research tool was designed to cover

several areas. This helped to understand better how VR-based museums influence cultural heritage preservation. It also made the study broader and the analysis more thorough.

Data Analysis

Quantitative Data Analysis: Descriptive Statistics.

The quantitative analysis used simple statistics, like the Mean and Standard Deviation, to look at participant feedback on three areas. These areas were (1) heightened enjoyment, (2) experience needs; and (3) the intention to visit.

Qualitative Data Analysis: Thematic Analysis.

Qualitative data were gathered through open-ended questionnaires and subjected to thematic analysis to uncover significant patterns, such as 'increased user engagement,' 'effects on cultural preservation,' and 'practical obstacles.' The process involved initial coding, categorization of themes, and validation to guarantee systematic and dependable results.

Results

The results are presented in two sections, quantitative result section and qualitative results sections (See section 4.1 and 4.2).

Quantitative Results

Table 1 shows what experts said about the VR-based Digital Embroidery Museum. The overall score was 4.73, which is very positive. One clear strength is the immersive experience (M=4.80). Users felt very engaged and emotionally attached. Another important point is the strong desire to visit the real museum locations shown (M=4.87).

These results show how well VR technology works to keep and share intangible cultural heritage. The enjoyment part got a Mean of 4.60, which is good overall. But some areas, like the museum tour enjoyment, had lower scores. This shows the content can still be improved. Even so, the feedback shows that the project balances cultural preservation with modern digital tools well.

The consistent scores and small differences show that VR has great potential to help people appreciate culture and boost tourism. It gives a lasting and new way to protect intangible cultural heritage.

Table 1: Questionnaire Items

Questionnaire Items	M	SD
The heightened enjoyment		
1. In this virtual tour, time seems to pass quickly	4.6	0.89
2. In this virtual tour, I forgot about time flow	4.6	0.55
3. In this virtual tour, I felt even happier	5	0
4. In this virtual tour, my emotions were aroused	4.8	0.45
5. In this virtual tour, I enjoyed museum tourism more	4	0.71
Overall	4.60	0.37
Experience needs		
6. I feel like I am in the environment displayed by the VR	4.6	0.55
7. It seems I really participated in the action in the VR system	4.8	0.45
8. My real location seems to have been transferred to a VR environment	5	0
9. I feel like I am personally in the scene presented in the VR environment	4.8	0.45
Overall	4.80	0.16
The intention to visit		
10. I am willing to visit the places shown in my virtual tour in the near future	4.8	0.45
11. I will strive to visit the places shown in my virtual tour	4.8	0.45
12. I plan to visit the places shown in my virtual tour in the near future	5	0
Overall	4.87	0.12
Overall	4.73	0.27

Qualitative Results

The expert feedback collected during the evaluation process highlighted several important insights and areas that need improvement in the VR-based digital embroidery museum. Based on their qualitative assessments, experts found out key aspects that influenced the overall user experience and suggested ways to improve the system for future versions.

1) Visual and Functional Features: Experts praised the system's clear and vibrant visual effects, stressing how important these are for creating an immersive cultural experience. The system successfully captured the elaborate details of the embroidery, making the cultural value of the art visually striking. However, they recommended changing the control features to better meet individual user needs and improve personalization.
2) User Familiarity with Virtual Museums: Familiarity with virtual museum systems was important for users to adapt. Experienced users found the platform easier to scout, while new users indicated that they needed more guidance and support to improve their experience.
3) Emotional Engagement and Enjoyment: The system performed well in terms of enjoyment and emotional engagement, with interactive storytelling and immersive design fostering strong emotional connections. However, experts noted that the system should balance interactive complexity and simplicity, especially in terms of stimulating curiosity. An easy-to-use design is vital, especially for users from different backgrounds.
4) Cultural and Emotional Authenticity: Experts appreciated the system's accurate representation of artistic details and historical content, which contributed to the cultural and emotional authenticity of the experience. However, they suggested improving the

community interaction features to help users feel more connected to the culture and engaged with it.

Discussions

Experts say the VR-based Digital Embroidery Museum has clear strengths and some areas that need improvement. When looking at these results, we need to think about factors that influence how happy users are. These factors include how it looks and works, how used to virtual museums users are, how much they enjoy and connect emotionally, and how real the culture feels.

Visual and Functional Features

The success of a VR museum mostly depends on how it looks and works. Experts rated "Experience Needs" (average score 4.80) highly. This shows the Digital Embroidery Museum is immersive and looks good. Good visuals, simple navigation, and quick responses are important for keeping users happy. Banfi (2021) says that designs focusing on users, like moving visuals and smooth interactions, are vital for better experiences. Improving features, like faster loading and fewer tech problems, can make users happier(Cecotti, 2022).

User Familiarity With Virtual Museums

How well users know VR technology also affects how satisfied they are. Experts gave high ratings for immersion and presence. This could be because of their technical knowledge and experience with VR. But new users might find it harder to use the system. This could make their experience less enjoyable. Cecotti (2022) says it’s important to make user interfaces simpler and give tutorials to help new users. Making the virtual museum easier to use can attract more people, including experts and everyday users.

Emotional Engagement and Enjoyment

The lower scores for "Heightened Enjoyment" (M=4.60) show that while users liked the VR experience, emotional satisfaction could be better. Emotional involvement is connected to how good the storytelling and interactions are in the virtual tour. Yang et al. (2023) says emotional engagement is vital for keeping users interested in VR cultural heritage platforms. Using interactive storytelling, gamification, or personalized experiences can make the experience more enjoyable and emotionally engaging.

Cultural and Emotional Authenticity

Cultural and emotional authenticity is an important part of making users happy in virtual museums, especially for intangible cultural heritage projects. The high "Intention to Visit" score (M=4.87) shows that the VR museum keeps and shows culturally real experiences well. Cecotti (2022) says that showing traditional embroidery designs correctly and adding cultural stories helps users connect deeply. This method not only helps people learn but also makes them feel more connected emotionally. Working with cultural experts and local groups can keep the museum's content real and valuable.

Conclusion

This study looks at the important role of virtual reality (VR) technology in keeping intangible cultural heritage, focusing on the digital preservation of Yunnan embroidery. The findings showed that VR-based digital embroidery museums helped users saw and enjoyed embroidery culture through immersive and interactive experiences, while building emotional connections. The study found out that this system clearly showed the artistic value and cultural truth of embroidery. Experts said that the system could bring in different user groups, helped with cultural education, and grew cultural tourism. The research points out that it was vital to meet different user needs when designing and to keep making the technology easier to use and maintain. This study gave a useful way to keep embroidery culture digital and helped with new ideas for passing on and sharing intangible cultural heritage worldwide.

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Contact email: 67026002@kmitl.ac.th

Effectiveness of Game Based Teaching in Topic of Human Resource Management for Vocational College Students

Tan Qiulan, Rajamangala University of Technology Thanyaburi, Thailand
Tiamyod Pasawano, Rajamangala University of Technology Thanyaburi, Thailand

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Abstract
The research objectives are as follow: 1) to design a game-based teaching technology course suitable for students and verify the effectiveness of student learning outcomes after game-based learning, 2) to explore the methods and techniques for promoting student learning in human resource management classes, thereby quickly bringing human resource talents to enterprises and helping to achieve the enterprise's long-term development goals, and 3) to contribute to the popularization of game-based teaching. The sample in the study was 64 students in two classes of Guangxi Peixian International Vocational College, China. The research sample was selected by Simple random sampling method. The instruments consisted of a questionnaire survey form, Interviews, pre-test questionnaires for the human resource management major, and post-test questionnaires for the human resource management major. Statistics used for data analysis were Mean, Standard deviation, Difference in scores 4. Square of the difference in scores, and Effectiveness index. The results revealed that in the human resource management major, the score before and after game teaching assumes that the relevant samples are drawn from two normal distributions, and the overall difference is also normally distributed. The average of game-based teaching techniques in human resource management courses consisted of pre-test (76.68), post-test (80.85), difference value 142, difference value square 644.

Keywords: Human Resource Management, Game-Based Teaching, Vocational College Students

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Background and Statements of the Problem

In enterprise management, the traditional human resource management concept is backward, the enterprise management system is backward, the strategic planning is not clear, these problems seriously affect the operation efficiency and development speed of enterprises. In order to solve these problems, the Chinese government has issued a series of policy documents to encourage enterprises to strengthen human resource management and improve management efficiency. The Outline of the National Medium-and Long-term Talent Development Plan (2010-2020) puts forward a series of specific measures for talent training and use. Relevant personnel should respond to the call of the government and seek effective methods to improve the efficiency of enterprise human resource management. As a vocational university, there are some disadvantages in the traditional teaching mode in the knowledge transmission, such as standardized teaching leads to students'lack of initiative in learning traditional teaching modes often pay too much attention to standardized teaching, and teachers often regard students as containers to accept knowledge, rather than guiding them to actively explore and learn. This teaching method is easy to make students fall into a passive, lack of initiative and creativity. The programmed teaching is boring and simple. The traditional teaching mode often adopts fixed teaching procedures and methods, which may limit the students' innovative thinking and exploration spirit. For example, teachers will strictly follow the teaching plan and are unwilling to increase the scope of the teaching plan, which may make the teaching process become single and boring, the serious teaching atmosphere leads to a dull classroom. Also, too much attention is paid to the transmission of knowledge. The traditional teaching mode often pays too much attention to the transmission of knowledge but ignores the cultivation of students'ability and interpersonal skills. This will lead to students'lack of problem-solving skills despite having professional knowledge when faced with practical problems after graduation. in order to solve these problems, in the human resource management education course into the new teaching mode, such as personalized teaching, game teaching, can better meet the needs of students, improve the teaching effect, play the student is the main body of learners, let the student actively explore learning, practice, improve students' practical ability and problem solving ability, make learning more meaningful, can improve the student employment field ability, improve the efficiency of enterprise human resource management.

Objectives of the Study

1) To design a game-based teaching technology course suitable for students and verify the effectiveness of student learning outcomes after game-based learning.
2) To explore the methods and techniques for promoting student learning in human resource management classes, thereby quickly bringing human resource talents to enterprises and helping to achieve the enterprise's long-term development goals.
3) To contribute to the popularization of game-based teaching.

Research Question and Hypothesis

The study of the HRM course may have the following problems:

1) Disconnection between theory and practice some students may find that although they have learned a lot of human resource management theory, they are difficult to respond in practice need. This maybe because the curriculum does not have enough practical links, or the teachers lack practical work experience to effectively guide students on how to apply theoretical knowledge to practice.

2) Low learning enthusiasm some students may not be highly motivated to learn the human resource management course, which maybe because they lack interest in this field or feel that the content of the course is more difficult and difficult to understand and master.
3) Teachers strength in some schools, teachers of HRM courses may be engaged in theoretical research work and lack practical work experience, which may make it difficult for them to combine theoretical knowledge with practical experience in teaching and cannot guide students to carry out practical operation well. in order to solve these problems, the game-style teaching starts from the following aspects:
    a. The orientation of practical teaching is clearly defined, taken as an important part of the human resource management course and integrated into the teaching content and learning objectives of the course and combined with theoretical teaching.
    b. Optimize the teaching content, update the teaching material content, increase the training of practical cases and practical operations, and improve the students' understanding and application ability of the whole process of human resource management.
    c. Innovate teaching methods, and use case teaching, group discussion, role-playing and other game teaching methods in the teaching process to stimulate students' interest in learning and increase the opportunities for interactive and experiential learning.

The Scope and Limitations of This Study

The sample in the study was 64 students in two classes of Guangxi Peixian International Vocational College, China. Choose by the simple random sampling from the two classes who learning in subject of human resource management. The first class is 34 students in the first semester of grade 2022, and the second class is 30 students in the first semester of grade 2023. The study was conducted in the first semester of 2023 and exploration of the study was limited to the HM specialty. The study method are as following:

1) Investigation method, to study by talk, the way of questionnaire research.
2) Field investigation and observation method, field investigation, direct observation of the research objects.
3) Literature research method, through the investigation of the literature to fully and correctly understand the study.
4) Quantitative analysis: the empirical data will be collected for statistical analysis to reveal the relationship between the data. Data analysis was performed using the t-test.

Conceptual Framework

Human resource management is a process of managing relevant human resources inside and outside the organization through recruitment, selection, training, remuneration and other management forms under the guidance of economics and people-oriented thought.

The six modules of human resource management refer to the following parts:

1) Enterprise human resource planning: this stage is mainly a process of clarifying the goals, clarifying the status quo, and formulating policies and plans. In order to achieve the development goals, enterprises predict the demand and supply of human resources and try to balance them.

2) Talent recruitment and allocation: According to the job requirements, to attract, select and employ talents scientifically and reasonably, and to allocate the appropriate people to the appropriate positions at the appropriate time, and to arrange the appropriate work tasks.
3) Staff training and development: The key to enterprise management is human management, and the key to human management is to constantly tap human potential, turn human resources into human capital, and constantly appreciate human capital. It is crucial to realize the development of potential through training.
4) Performance management: Develop performance evaluation standards, regularly evaluate employee performance, and provide feedback, guidance, rewards or corrective measures accordingly.
5) Salary management: Design and implement a competitive salary system, including fixed salaries, bonuses, benefits and retirement plans.
6) Labor relationship management: manage the relationship between the organization and employees, ensure the harmony and compliance of the working environment, and solve labor disputes.

There are close links between these modules, which together constitute an organic whole and affect the balance of the system.

Contribution to Knowledge

1) Effectiveness of game-based teaching technology course suitable for students, to help them into the classroom and reality situation, better content deep impression and understanding, and through the teaching technology and innovative.
2) To improve students' classroom participation such as to simplify for learning and memory, reduce the rigidity of teacher knowledge infusion, deepen the understanding of learning content, improve students' learning efficiency and academic performance.
3) To a certain extent, the innovation of teaching mode can improve students' interest in learning and save the teaching resources needed by this subject.

After forming a good relationship between teachers and students through the interaction of game mode, teachers will be more skilled in the application of game-style teaching mode,which can eventually form a benign teaching ecological cycle, and even can function in the learning of other subjects. After graduation, students majoring in human resource management can have comprehensive basic knowledge of economics, management, psychology, law and other disciplines, as well as theoretical knowledge and practical ability of human resource management, labor laws and regulations, interpersonal communication and organizational coordination. Graduates can be engaged in human resources management and administrative management related work in various enterprises and government departments and can also enter human resources consulting and service companies to engage in talent recruitment, management consulting work, or further study, or start their own businesses. Therefore, this study can help the students studying in this major to apply their knowledge to practical work faster.

Research Methodology

Research Design

In the game teaching, the role of our teachers has also changed, not only the teacher of knowledge, but also the director and participant of the game. Teachers should integrate the elements and methods of the game into the teaching process to improve the interest, participation and effect of learning. This requires integrating points, badges, and leaderboards into the game design. We also need to apply the game model to the course design, such as the following ARCS model. It is a motivation theory model in gamified learning proposed by John Keller, which is widely used in traditional teaching courses and online teaching classes. The ARCS model includes four elements: Attention (attention), Relevance (correlation), Confidence (confidence), and Satisfaction (satisfaction). This model can help teachers to design gamified learning activities to consider how to attract and maintain students' attention, how to ensure the relevance of learning content, how to build students' confidence, and how to make students gain satisfaction in the learning process.

After determining the research content and object, the author consulted the relevant knowledge of game-style teaching from the library and searched the literature materials of game-style teaching in the CNKI academic journal database and dissertation database. We compared, classified and filed the found literature data, sorted out the useful data of this study and put them into the file package, which provided strong literature data support for the subsequent implementation of game teaching in this study. Questionnaire survey method: design the research questions into a number of specific questions, design the question form, give it to the respondent to fill in the answer, and then withdraw the sorting, analysis, so as to draw a conclusion.

Through the student questionnaire survey, the students 'learning situation was investigated from the aspects of students' gender and the skills of teachers' class. At the sometime questionnaire survey and interview were conducted on the teachers of this major to further understand the ideas of the learning subjects and the classroom guides.

Use the observation method: immersive, the observation object, the scene experience. The author went to the students to observe the teaching situation. This game-based teaching technology is taught in human resource management, using literature, observation, interview, questionnaire, action research and quantitative analysis method.

The first round of action research used data from pre-test, post-test and classroom performance to determine whether students 'performance has improved?

The second round of action research will be conducted as a semester of game teaching after the pre-test, with a total of 34 students, role playing according to the game teaching.

Quantitative analysis: the empirical data collected is statistically analyzed to reveal the relationship between the data. Data analysis was performed using the t-test.

Population and Sample

The study sample is 64 students from two classes of human resource management in Guangxi Peixian International Vocational College. The first class is 34 students in the first semester

of grade 2022, and the second class is 30 students in the first semester of grade 2023. Selected by simple random sampling. This sample is only part of students in one of the 33 majors in the school.

According to the game-based teaching technology enables the participants to learn effectively, which helps to achieve their learning goals. According to the learning results of game-based teaching technology, to improve the academic performance of students in Guangxi Peixian International Vocational College, China. Helps to achieve your learning goals.

Research Tools

1) Questionnaire survey form
   In this study, the measurement instruments included educational questionnaires, pretest, posttest, and faculty interviews. Prior to the study, take the test, pretest, and complete the test within the prescribed 45 minutes to understand the students before the test. Collect students' test data; test students after a semester of game teaching, complete the test within 45 minutes, and then compa.re the pre-test with the post-test data. Game teaching is helpful to improve students' performance.
2) Interview
   In order to improve the validity and reliability of this study, on the basis of testing and questionnaire survey of students, the class teachers who also use the game trial teaching use the interview method to further understand the students' learning situation, and the interview results have been input into the paper, in the paper case.
3) Human resource management professional pre-test and post-test paper
4) Satisfaction form to collect an opinion from students who are learn in topic of human resource management.

Relevant data were obtained by mean and difference values for statistics and analysis.

Steps of Game Design

1) Before testing: Do the performance test before the test. Determine the game goals, follow the game model design principles,
2) Classification and selection of games. There are many kinds of game teaching, according to the implementation of games, which can be divided into intellectual games, knowledge games, physical games, competitive games, roleplaying, etc. Teaching game for each stage of teaching and various types of teaching most are applicable, just form, content, difficulty and requirements are different, teachers can according to the needs of the teaching task and students age, knowledge level, appropriately selected different difficulty of game material, as long as the student's learning enthusiasm is fully mobilize, game teaching will achieve good results. The author's common classroom games can be roughly divided into the following two categories: "cooperative competition" teaching games, sitcom performance game mode, etc. Specifically, they are role-playing, more than memory, etc. The first is the "cooperative competition-style" teaching game. This kind of game can help complete the teaching while also establish students' sense of teamwork and sense of honor and disgrace. Let the students imperceptibly experience the strength of the collective, deepen the friendly feelings between the students, cultivate the spirit of cooperation and mutual assistance. For example: class election class dry.

3) Plot design of the game: combine the teaching knowledge points with the game content, and combine the cases for role-playing.
4) After testing: feedback and reflection summary after the game, data collection and sorting.

Application of the Game Design Model

The ARCS model is a motivation theory model in gamified learning proposed by John Keller, which is widely used in traditional teaching courses and online teaching classes. The ARCS model includes four elements:

1) Note: Be interested in a certain knowledge point, want to explore its principle, but also want to understand it in various ways. So, there's perceptual activation, inquiry activation, and variability. (Seeing that it is interesting, I want to learn it.)
2) Association: How to make the knowledge and the usual practical experience related, let me know that it is very useful tome? Through goal orientation, motivation matching and familiarity, I know the value of learning it and make corresponding learning goals, and I can integrate my knowledge through the correlation of practical experience. (Knowing that it is useful will stimulate my learning motivation.)
3) Confidence: give yourself some heart hints, let some stage of success to enhance their confidence in learning. In the teaching process, express expectations, create opportunities for success and let everyone know that the achievements of learning are inseparable from their own efforts and ability.
4) Satisfaction: Are you satisfied with your academic performance, and whether the knowledge or skills you have learned can be applied? Did you get some feedback, and do you feel fair? Through the practical operation of motivation stimulation, through others praise to maintain motivation and maintain good study habits, through equal evaluation to let people feel that efforts will gain.

Data Collection

Step 1: Divide into two groups of students to teach related courses, one group is students who implement research strategies, and the other group is students who do not intervene.
Step 2: Create a pretest for students to obtain data.
Step 3: Conduct learning activities with students based on the pre prepared lesson plan.
Step 4: After two groups of students have completed the relevant courses, they will be tested, and their scores will be statistically analyzed.

Statistical Analysis

1) The steps for researchers to conduct data analysis are as follows:
   1. Three content experts and three media experts evaluate the relevant strategies of this study through mean and standard deviation to enhance students' engagement in learning.
   2. Comparing the performance tests of two groups of students before and after, obtaining relevant data for statistics and analysis, in order to improve students' learning with game-based teaching.
   3. Research students' satisfaction with teaching through means and standard deviations, obtain relevant data for statistics and analysis, and thus improve students' learning with game-based teaching.

3. Result

Analysis Results of Pre-test and Post-test

Table 1: Students Learning Results of Pre-test and Post-test

Source management, and the paired group	X2 before detection	X1 after detection	Difference value D=X1-X2	Difference value square D^2
1	80	85	5	25
2	73	78	5	25
3	73	77	4	16
4	80	83	3	9
5	81	86	5	25
6	74	78	4	16
7	81	85	4	16
8	75	78	3	9
9	74	77	3	9
10	79	83	4	16
11	79	85	6	36
12	76	80	4	16
13	77	81	4	16
14	80	86	6	36
15	72	74	2	4
16	70	72	2	4
17	71	74	3	9
18	78	82	4	16
19	81	87	6	36
20	77	82	5	25
21	77	83	6	36
22	77	81	4	16
23	81	86	5	25
24	73	76	3	9
25	79	84	5	25
26	80	87	7	49
27	73	77	4	16
28	81	84	3	9
29	74	76	2	4
30	75	78	3	9
31	72	76	4	16
32	76	81	5	25
33	80	85	5	25
34	78	82	4	16
amount to	26.07	27.49	142	644

In the human resource management major, the score before and after game teaching assumes that the relevant samples are drawn from two normal distributions, and the overall difference is also normally distributed. Average pre-test (76.68), post-test (80.85), difference value 142, difference value square 644,

Taking the significance level of α =0.05, d f =34-1=33. The critical value is 2.035, which can be obtained from the critical value, t=19.608> 2.035, p <0.05, so the game- style teaching has a significant impact on students' performance, and the students have improved significantly.

Table 2: Evaluation Results of Course Satisfaction for Students Participating in the Class of Human Resource Management With Game-Based Teaching Performance

Assessment	$\overline{X}$	S.D.	Result
1. In game-based teaching, I often participate in discussions and exchanges on topics in the classroom or platform.	4.59	0.26	Strongly Agree
2. I proactively check the learning resources on the game-based teaching.	4.88	0.11	Strongly Agree
3. After class, I will reflect on my classroom learning effectiveness and makeup for any shortcomings.	4.24	0.19	Agree
4. In game-based teaching,I often answer questions raised by teachers.	4.88	0.11	Strongly Agree
5. In game-based teaching,I have developed a learning plan for myself.	4.88	0.11	Strongly Agree
6. I often supervise my learning process and once distracted,I immediately shift my attention to learning.	4.59	0.26	Strongly Agree
7.I am able to carefully analyze the reasons for any errors that occur in assignments or exams and solve them.	4.94	0.06	Strongly Agree
8. I feel very happy during the learning process of this course.	5	0	Strongly Agree
9. I have a strong sense of achievement in the process of game-based teaching.	5	0	Strongly Agree
10. I am very satisfied with the learning resources and environment provided by this course.	5	0	Strongly Agree
Integral	4.8	0.11	Strongly Agree

From Table 2. it can be seen that through the class of the human resource management with game-based teaching overall score show that strongly agree average score ($\overline{X}$) 4.8 and standard deviation (S.D.) 0.11.

4. Conclusion

The game-based teaching is scheme quickly brings students into the professional field. The practical game of human resource management theory in college class management requires teachers to study more before class, and how to integrate into the classroom and life. Human resource management professional knowledge can only be transformed into ability in practice, so to strengthen the experimental practice teaching, need the school in university-enterprise cooperation, at the same time of promoting the human resources construction, and human resources service industry enterprise construction more high quality practice base, let students have more opportunities into the work scene, face to face with industry real problems, to improve professional knowledge, skills and vision.

The professional experience of the teaching staff plays a very important leading role in the career development of students. Human resource management is a major with strong application. Whether full-time teachers have rich professional experience will directly affect their cognition of the industry, profession and position, and then indirectly affect the cultivation of students' relevant knowledge and skills. If full-time teachers lack practical experience in the human resource service industry and enterprises, and do not have the digital skills of human resource service, their students will be difficult to adapt to the challenges brought by the digital transformation and upgrading of the industry to their career development.

Through the theoretical research and practical effect discussion of game-style teaching, we can understand that this model can not only innovate teaching forms and promote teaching innovation, but also significantly improve students' learning ability and academic performance, which can play a great role in the teaching application of human resource management professional classroom. But at the same time, we should also pay attention to the application limits and methods of this mode to ensure the application effect and avoid adverse reverse effects.

This research mainly analyzes and expounds the application feasibility of game teaching in human resource management, In view of their own difficulties encountered in the actual teaching activities, Try to adopt the game-style teaching mode for classroom teaching, And found that this class style can really stimulate students’ interest in learning, Improve the classroom atmosphere, And through the game-based teaching, Improve the students' academic performance, at the same time, Also developed their communication and organization skills, Game-based teaching improves the classroom teaching atmosphere, This teaching model introduces students into established game scenarios, Put it into the role, Students truly become active participants in classroom teaching, compere, And not just the passive recipients, executant, At the same time, teachers can also timely correct the knowledge mistakes in the activities, teach through lively activities, To achieve a win-win teaching effect. Of course, in the teaching classroom, the teacher should see the classroom situation flexible use of the game for teaching. Classroom game teaching is an effective teaching means of human resource management teaching. Human resource management takes the principles of practicality and fun, and combines the knowledge points with practical operation.

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Contact emails: qiulan_t@mail.rmutt.ac.th
tiamyod@rmutt.ac.th

Navigating Challenges and Strategies: Malaysian ESL Secondary School Teachers in Differentiated Reading Instruction

Aimi Liana Ahmad, Universiti Malaya, Malaysia

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Abstract
This study examines differentiated instruction (DI) practices in Malaysian ESL secondary school reading classrooms, focusing on strategies and challenges. With the integration of the Common European Framework of Reference (CEFR) into Malaysia's English curriculum and the adoption of mixed-ability classrooms under the Kurikulum Standard Sekolah Menengah (KSSM), differentiated instruction has become essential for addressing diverse student needs. The research draws on Tomlinson's DI framework, emphasizing content, process, and product differentiation tailored to students' readiness, interests, and learning profiles. A qualitative case study design explores how three ESL teachers in the Petaling Perdana district implement DI strategies, using semi-structured interviews, classroom observations, and document analysis. Thematic analysis reveals impending strategies such as collaborative learning, tiered assignments, and digital tools integration to enhance engagement and comprehension. However, potential significant challenges include time constraints, insufficient resources, and inadequate professional training pose threats to effective implementation. The findings aim to inform professional development initiatives, addressing the practical barriers to DI and fostering more inclusive and effective teaching practices. By addressing these challenges, the study contributes to enhancing English reading literacy in mixed-ability Malaysian ESL classrooms, aligning with national educational goals and global educational equity standards.

Keywords: Differentiated Instruction, Reading Instruction, Mixed-Ability Classrooms

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Introduction

The Malaysian English language curriculum, transformed with the full implementation of the Common European Framework of Reference (CEFR) in 2021, aims to enhance students' English communication skills. The Ministry of Education has revamped the English program, emphasizing reading as a fundamental skill. Effective reading instruction is crucial for language acquisition, with approaches like top-down and bottom-up instruction highlighted (Ismail et al., 2022). Mixed-ability classrooms have been introduced under the Kurikulum Standard Sekolah Menengah (KSSM), fostering inclusivity in education, which aligns with UNESCO's Sustainable Development Goal 4. Therefore, differentiated instruction is essential for addressing the diverse proficiency levels in these classrooms, allowing teachers to meet varying student needs. Tomlinson's model includes three components: content, process, and product, adapting lessons to students' readiness, interest, and learning profiles, ensuring equitable learning opportunities (Tomlinson, 2001).

Malaysian students' reading literacy has declined since 2015, with PISA 2022 scores indicating a significant gap compared to OECD averages. A notable issue is the ineffective one-size-fits-all teaching method prevalent in classrooms. In mixed-ability settings, proficient students can become disengaged while struggling students may feel overwhelmed. Research suggests that differentiated instruction can meet the diverse needs of these learners (Ismail et al., 2022). Teachers have employed various strategies to address differences, such as tiered assignments and peer tutoring. However, significant challenges remain for effective implementation, including limited training and resources, time constraints, and the complexities of managing diverse instruction simultaneously.

The study aims to analyse differentiated instruction practices among Malaysian ESL secondary school teachers, specifically focusing on 1) types of tasks used in reading lessons considering content, process, and product, 2) implementation of differentiated strategies based on students' readiness, interests, and learning profiles and 3) challenges faced in accommodating varied reading abilities. The findings will enhance understanding of Malaysian ESL teachers' challenges and strategies in differentiated instruction, contributing to more equitable reading education. Identifying effective strategies offers insights for professional development and aligns with national educational goals. Limitations include a small sample size, potentially affecting the generalizability of findings and the risk of response bias during interviews. Observational limitations may also occur if participants are uncooperative. Additionally, context-specific findings may not apply universally across Malaysia.

Theoretical Background of the Study

This study is based on social constructivism theory, emphasizing collaborative learning and the role of teachers as facilitators. The theory intersects with Tomlinson's differentiated instruction model, focusing on the Zone of Proximal Development (ZPD) and tailoring instruction to meet students at their knowledge levels. Tomlinson's differentiated instruction model addresses diversity in mixed-ability classrooms through differentiation in content, process, and product. This study will analyze how teachers apply these components and explore strategies to accommodate students' readiness, interests, and profiles.

Overview of Differentiated Instruction Practices in ESL

Differentiated instruction, designed for mixed-ability classrooms, allows teachers to adjust their methods according to students' varying needs. Strategies include collaborative learning, tiered assignments, varied materials, and integrating digital technology (Alghonaim, 2020; Allison, 2022; Bratsch-Hines et al., 2020; Clark, 2023; Jones et al., 2022; Labordo, 2024). Research indicates that differentiated instruction can positively impact student proficiency levels (Smith et al., 2023; Sun, 2023; Tajik et al., 2024; White & Vibulphol, 2020).

Differentiated Instruction Practices in ESL Reading Classrooms

In ESL reading classrooms, both top-down and bottom-up approaches are employed (Amini et al., 2020). The bottom-up approach focuses on decoding linguistic units, while the top-down method utilizes prior knowledge and context to derive meaning from texts. Effective reading instruction requires systematic teaching of both approaches (Moats, 2020). However, studies often overlook student variances in reading abilities and the necessity for equal learning opportunities.

Differentiation of Content, Product, and Process

Teachers differentiate content by providing reading texts of varying difficulty levels, aiding engagement and understanding (Moats, 2020). For example, studies by Sun (2023) and Saleh (2021) show that allowing students to choose appropriate reading texts boosts confidence and participation. Magableh and Abdullah (2020) found increased engagement and improved reading performance when materials were differentiated. To differentiate the learning process, collaborative strategies, such as group discussions, are effective. Clark (2023) notes that grouping students with mixed proficiency fosters collaboration and support. Additionally, differing time allocations based on reading capabilities can enhance student opportunities to complete tasks (Ismail et al., 2022). Differentiating products involves varied demonstration tasks, such as using digital tools or creative assignments, which allow students to exhibit their understanding in various formats (Sun, 2023; Magableh & Abdullah, 2020).

Differentiation According to Students' Readiness, Interests, and Learning Profiles

Teachers differentiate reading tasks based on students' readiness by evaluating their proficiency through activities like read-aloud sessions (Clark, 2023). Identifying reading levels enables tailored task assignments. Addressing students' interests is crucial for motivation; studies show that providing varied genres increases engagement (Moats, 2020; Sun, 2023). Accommodating diverse interests keeps students willing to read instead of seeing it as a chore. Differentiating based on learning profiles caters to students' varied learning styles, such as using technology to enhance understanding (Smith et al., 2023). Studies indicate that integrating digital tools can improve student engagement and receptivity in reading activities (Mifsud, 2021).

Impacts of Differentiated Instruction on Reading Skills

Research shows that differentiated instruction positively impacts ESL reading skills. Labordo (2024) reported increased interest and critical thinking through collaborative learning environments. Similarly, Silva-Maceda and Camarillo-Salazar (2021) found experimental groups demonstrating improved reading comprehension performance compared to controls.

While these studies highlighted positive educational outcomes, they often occurred outside natural classroom settings, which may not fully represent actual educational complexities. Despite the benefits, numerous challenges hinder effective implementation, including limited knowledge and resources.

Challenges to Effective Differentiated Instruction Implementation

General Challenges in ESL Contexts

While many studies recognize the advantages of differentiated instruction, numerous implementation challenges persist. Significant challenges include teacher workload and time constraints (Akhmetova et al., 2023; Endeshaw, 2021; Karimi & Nazari, 2021). Akhmetova et al. noted that preparing differentiated lessons requires considerable time and effort, which can overwhelm teachers. Large classroom sizes exacerbate these challenges. Teachers struggle with classroom management and providing individualized support, making differentiation more challenging (Akhmetova et al., 2023; Endeshaw, 2023). Insufficient resources further complicate implementation (Hatmanto & Rahmawati, 2023). Educational facilities like reliable internet, photocopying services, and projectors are necessary for effective differentiated instruction, yet many teachers report a lack of funding for these essentials (Idrus et al., 2021). Additionally, teachers' knowledge gaps hinder effective differentiation. While some teachers have theoretical knowledge of differentiated instruction, they may lack practical experience or proper attitudes towards its implementation (Endeshaw, 2023). Students' diverse needs also present significant challenges. Catering to individual learning styles can complicate lesson delivery in mixed-ability classrooms (Hatmanto & Rahmawati, 2023). Non-cooperative students can diminish the effectiveness of differentiation strategies (Idrus et al., 2021).

Specific Challenges in Malaysia

Malaysian ESL teachers encounter similar challenges. Limited knowledge and training in differentiated instruction impede its effective implementation (Lavania & Nor, 2021). The introduction of the KSSM curriculum in 2018 did not provide adequate training for teachers on differentiated practices. As a result, many teachers revert to traditional, teacher-centered approaches amid increasing class sizes. Time constraints are prevalent in Malaysian classrooms, where teachers struggle to plan and execute differentiated lessons alongside heavy workloads (Ismail & Aziz, 2019; Lavania & Nor, 2021). Moreover, Malaysian classrooms are often overcrowded, which exacerbates the challenges of differentiation (Umar & Aziz, 2024). Further complicating matters, teachers may lack the understanding needed to identify students' diverse needs effectively (Khairina Ismail et al., 2022). Recent studies have indicated that curriculum-related issues, including textbook difficulty and insufficient support for differentiation, hinder effective instruction (Lavania & Nor, 2021; Umar & Aziz, 2024).

If these issues remain unaddressed, teachers may revert to traditional methods, undermining the goal of differentiated instruction in fostering student learning in mixed-ability environments. Overall, substantial challenges impede the effective implementation of differentiated instruction in Malaysian ESL classrooms. Addressing these obstacles is crucial for enhancing student learning experiences and outcomes.

Research Design

The study employs a qualitative case study design, focusing on three Malaysian ESL secondary school teachers with experience teaching mixed-proficiency students. According to Cresswell (2017), qualitative research enables in-depth exploration of human experiences, making it suitable for understanding differentiated instruction in ESL reading classrooms. Semi-structured interviews, classroom observations, and document analysis (e.g., lesson plans) will be used. Data will be analysed using Braun and Clarke's (2006) six-step thematic analysis to address the research questions. A case study approach is appropriate for investigating differentiated instruction practices, challenges, and strategies, as it allows in-depth examination of specific instances (Merriam & Tisdell, 2015). While prior studies largely used quantitative methods, such as questionnaires, this research fills a gap by providing deep qualitative insights into the unique individual challenges faced by teachers.

Sampling Procedure

The study will focus on three ESL teachers from secondary schools in the Petaling Perdana district, an urban area with diverse student demographics. Purposive sampling will be used to select participants who meet the following criteria: at least three years of ESL teaching experience, current experience teaching mixed-ability classrooms, and familiarity with differentiated instruction methods. This method ensures the inclusion of participants with rich, relevant insights (Cresswell, 2017).

The selection process involves consultation with the Petaling Perdana District Office for recommendations, followed by contact through school principals. Participation is voluntary, and informed consent will be obtained. Participants will be briefed on the study's purpose and their right to withdraw at any time.

Data Collection Methods

Multiple data collection methods will be employed to enhance trustworthiness (Merriam & Tisdell, 2015):

Semi-Structured Interviews.

Interviews will explore teachers' understanding of differentiated instruction and their strategies for accommodating student diversity. Questions will be pre-approved by an expert and piloted with a non-participating teacher. Interviews will take place at participants' schools, with additional questions asked as needed.

Classroom Observations.

Observations will examine reading instruction practices in real-time. An observation checklist will systematically document strategies and challenges, providing corroborative data for interviews and documents.

Document Analysis.

Lesson plans and teacher reflections will be analysed to supplement interview and observation findings. These documents provide evidence of instructional strategies and challenges, enhancing data validity.

Data Analysis Techniques

Data will be analysed using Braun and Clarke's (2006) 6-step thematic analysis framework with following order; familiarisation with data, generating initial codes, identifying patterns and themes, reviewing themes, defining and naming themes and interpreting and reporting findings. Atlas.ti software will aid in coding and organising data. Validity will be ensured through expert review and member checking. Themes will align with Tomlinson's differentiated instruction framework, addressing research questions on strategies and challenges.

Ethical Considerations

The study adheres to ethical standards by ensuring confidentiality and anonymity. Participants will be fully informed about the research purpose and procedures, and their participation will be voluntary. Ethical approval from the university will be obtained, and informed consent will be secured from participants and their schools.

Trustworthiness and Rigour

Trustworthiness will be ensured through triangulation by using multiple data sources (interviews, observations, documents), expert validation in reviewing interview questions, member checking by allowing participants to verify data accuracy and dependability in ensuring consistent analysis through independent review.

Expected Findings

Teachers are expected to use strategies such as collaborative learning, varied materials, and digital integration to address diverse student needs. Collaborative learning involves high-proficiency students assisting peers, fostering a supportive learning environment. Digital tools align with the Ministry of Education's Digital Education Policy. Anticipated challenges include time constraints, limited resources, and insufficient professional training. Teachers may struggle with preparing differentiated materials due to heavy workloads and lack of support.

Conclusion

This study aims to explore the challenges and strategies of Malaysian ESL teachers in implementing differentiated reading instruction. Findings will inform professional development programs and provide insights for other educators managing mixed-ability classrooms. By addressing current gaps, the research seeks to contribute to more effective teaching practices in Malaysian ESL contexts.

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Curriculum Reform in Data Science Education: Enhancing Learning Outcomes With Scaffolding Learning Through Data Storytelling (SLDS)

Yiyun Fan, National University of Singapore, Singapore
Kah Loon Ng, National University of Singapore, Singapore
Wan Mei Amanda Soon, National University of Singapore, Singapore

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Abstract
Data storytelling (DS) employs narrative and visualization techniques to communicate insights from data, offering potential benefits for educational settings. This study introduces the framework of "Scaffolding Learning through Data Storytelling (SLDS)" as an explanatory approach to enhance students' learning outcomes in an undergraduate general education course on data literacy. Building on the key DS principles from Ryan (2016) and Knaflic (2015), we created a series of data stories to address students' diverse challenges in learning data science, taking into account their varied academic backgrounds, including STEM and non-STEM disciplines and differences in academic years. Incorporating Hadwin and Winnie's (2001) concept of "tacit scaffolds," SLDS integrates these stories into the curriculum stage by stage, aiming to enhance student engagement and understanding by encouraging them to read and think without explicitly directing or instructing specific studying activities. The effectiveness of SLDS was assessed through students' self-reported metrics of learning attention, relevance, confidence, and satisfaction, as well as multiple-choice questions measuring content comprehension. We anticipate that SLDS will improve learning outcomes more effectively than traditional methods, providing insights into easy-to-approach data narrative structuring and visualization design and its educational benefits for students from all backgrounds. This study aims to offer evidence on the application of DS in teaching and learning, laying a foundation for incorporating DS techniques into curricula and informing future educational practices for various educational levels and disciplines.

Keywords: Data Storytelling (Ds), Data Science Education, Curriculum Reform, Scaffolding in Learning, Learning Perception, Learning Comprehension

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Introduction

Data science has emerged as a prominent discussion topic in education, with its widespread applications evident in everyday life. It touches nearly every discipline and professional field that involves working with large datasets. At its core, "data literacy," by its simplest definition, refers to a learner's ability of analyzing and communicating data. As society becomes more data-driven, the importance of developing data literacy skills has gained significant attention. In higher education, for instance, this has led to the introduction of numerous courses and degree programs focused on data science and statistics. By 2016, over 200 institutions had launched data science-related programs (De Veaux et al., 2017). Despite this progress and attention, there remains a significant shortage of professionals trained in data literacy to meet the growing demand in the workforce (Deja et al., 2021). Consequently, data science education still has a long way to go.

The swift advancements in educational technologies have equipped researchers with a myriad of tools to collect and analyze extensive datasets from learners, aiming to enhance and optimize the learning process through a practice known as learning analytics (Nunn et al., 2016; Yap et al., 2022). Many scholarly works have highlighted the importance of tracking and analyzing factors that can affect students' learning to improve overall teaching and curriculum design (LAK, 2011). However, in today's data science education, scholars continue to encounter various challenges in enhancing students' learning, especially at the curriculum level (Cassel & Topi, 2015). Efforts have been made to design and implement formal curricula that can make a meaningful impact on students across different age groups and within higher education settings (e.g., Dierker et al., 2017; Li et al., 2023). As a result, exploring ways to integrate different types of learning analytics into refining and advancing data science curricula remains essential, addressing both educational goals and societal demands.

In face of a large-context course with diverse student populations, effectively updating data science curricula, enhancing data literacy, and leveraging learning analytics to improve teaching and learning remain as significant challenges. One key challenge is addressing the varying needs of students from STEM and non-STEM backgrounds. While students from STEM fields typically receive more specialized training in statistics and mathematics, it is increasingly important to bridge the gap between these diverse groups. For instance, the concept of "creative data literacy" was introduced to engage students from non-STEM background in data science education (D'Ignazio, 2017). In Kim et al.'s (2024) study, they came up with a scale development process (Devellis, 2017; Boateng et al., 2018) to identify essential data literacy competencies. Additionally, Lim et al.'s (2021) study highlighted that the increasing number of students and the diversity of student population impact how learning analytics are applied in self-regulated learning (SRL).

Therefore, innovative approaches in data science education are crucial to facilitate active learning, especially in diverse educational and society contexts where students come from varying backgrounds but share a common goal of enhancing their data literacy skills. By incorporating new teaching and learning strategies into the curriculum, we can better address the needs of both STEM and non-STEM students, bridging knowledge gaps and supporting individualized learning. This approach not only improves learning outcomes and academic performance but also empowers students to regulate their own learning, preparing them for success in an increasingly data-driven world.

Data storytelling (DS), by its literal meaning, is a method of communicating insights from data using storytelling elements. DS emerges as a promising approach to address some of these challenges. DS, characterized by its ability to compress information and convey key elements through narratives and data visualizations (Ryan, 2016), holds the potential for enhancing learning experiences. It has been reported by recent scholars that DS elements, albeit with limited pedagogical constructs, have a promising future in educational settings (e.g., Chen et al., 2019; Echeverria et al., 2018; Martinez-Maldonado et al., 2020). Building upon this foundation, our study proposes the framework of "Scaffolding Learning through Data Storytelling (SLDS)" as an explanatory approach to enhance students' learning outcomes in an undergraduate general education course. By integrating the idea of "scaffolding" into the learning process (Wood et al., 1976), we aim to create more engaging, real-world, and accessible SRL content that resonates with students from diverse academic backgrounds. This method not only helps bridge gaps between different student populations but also provides the necessary self-learning support to foster deeper understanding and retention of data science concepts.

At the end of the study, we aim to leverage SLDS to create impact on students' perception and comprehension of introductory data science knowledge and assist with their data literacy development. By integrating SLDS into a course's curriculum, we seek to provide students with a structured curriculum framework for engaging with data and extracting meaningful insights. At the end of this study, we hope to answer the following two Research Questions (RQs) from both theoretical and practical aspects:

(1) How can generic data storytelling (DS) elements be incorporated into a data science course's curriculum?
(2) Does this incorporated design create impact on students' learning outcomes as they engage throughout the course?

Data Storytelling: What is it?

The power of stories stems from their presence in every aspect of our daily lives. From a young age, we engage in storytelling, weaving narratives that begin, unfold, conclude, and are retold, drawing upon our senses and personal experiences. While stories are inherently captivating, their impact is amplified when combined with data, offering audiences the ability to "refer, remember, and learn from them and how they affect our actions" (Tversky, 2024, p. 20). The storytelling of data, therefore, revolves around the origin of the data, the intended audiences, and the methods of its delivery, shaping diverse interpretations and influencing people through the narratives constructed.

The technique of DS serves as an information compression technique designed to convey important insights to audience (Ryan, 2016). Rooted in classic Information Visualization (InfoVis) principles and narrative storytelling elements (Tufte & Schmieg, 1985), DS is inherently explanatory (Martinez-Maldonado et al., 2020), with the aim of explaining insights within data and the importance of them to the audience (Echeverria et al., 2018). Recent applications of DS span various domains, including presentation of data using visualizations (Knaflic, 2015), data journalism (e.g., Ojo & Heravi, 2018), and teaching practices (e.g., Echeverria et al., 2018), although with somewhat limited pedagogical frameworks.

Understanding the principles of DS is crucial for leveraging its potential in educational contexts. As identified by Ryan (2016) and Knaflic (2015), DS is goal oriented, drives an

audience's focus of attention, relies on choosing appropriate visuals, and adheres to core InfoVis design principles.

"Scaffolding" in Learning

The concept of "scaffolding" was originally introduced by Wood et al. (1976) to describe facilitative tools and skills that foster learner autonomy. Recent scholars including Renninger and List (2012), have further expanded on this, defining it as "a sustained interactive process that involves the fading of assistance/gradual task modifications by an expert" (p. 2923). Scaffolding in learning operates reciprocally, aiming to provide support that enables learners to engage in tasks independently. This approach differs from one-time and directive feedback or resources, focusing instead on an ongoing process of feedback provision.

There are various categories of scaffolding in learning. Hannafin et al. (1999) state that they include: (1) contextual—hints within contexts, (2) metacognitive—support specific for a particular task, (3) procedural—recourses for aiding task completion, and (4) strategic—different techniques or models. Such categories offer a more distinguished lining of scaffolding for supporting learning in classes.

Further discussion by Hadwin and Winne (2001) suggests "tacit scaffolds"—embedded tools that help to "cue students to attend to aspects of their studying without explicitly directing or instructing those studying activities" (p. 322). The process includes task understanding, setting goals and planning, enacting study tactics and evaluating and adapting metacognition. This differs from explicit scaffolds that have been brought about, further supporting the development of SRL.

Scaffolding Learning Through Data Storytelling

Scaffolding Learning through Data Storytelling (SLDS) is a theoretical framework that integrates a data storytelling-driven SRL approach with the principles of scaffolding in learning. Aimed at fostering students' self-regulation in learning data science, SLDS is proposed to be implemented in introductory data science courses through two distinct stages.

In the first stage, we propose the creation of specific forms of data storytelling (e.g., stories, comics, videos) that embed key data science knowledge and concepts. Leveraging the concept of tactic scaffolds (Hadwin & Winne, 2001), this approach emphasizes non-teacher-directed SRL, using fictional characters or narrative subjects who collaboratively discuss and analyze datasets. Through implicit tasks—such as setting research goals, engaging in character-driven discussions, making decisions, and evaluating analysis outcomes—the data storytelling-driven materials should progressively deepen the complexity of data analysis. These materials should also incorporate visualization tools to enhance readability and engagement. Additionally, their development must consider the concept of metacognition to align with students' cognitive processes (e.g., logical thinking during analysis), motivation (e.g., the interests of the stakeholders, the importance of datasets), and emotional engagement (e.g., analysis conflicts, team discussion, debates, leadership), ensuring the content is both compelling and resonates with students' learning needs (Hannafin et al., 1999).

In the second stage, SLDS emphasizes on addressing the structured phases of study in a data science course. Recognizing the challenges students might face—such as unmet learning needs or feeling overlooked due to the large scale of the course or difficulties in academic

backgrounds (e.g., STEM vs. non-STEM, year one vs. year four)—SLDS highlights the importance of SRL throughout the course. To accommodate these diverse needs, the integration of data storytelling-driven materials should align with the course's structure and progressively match its levels of difficulty. For instance, in a data science course with four chapters of lecture content, the data storytelling-driven SRL materials should be strategically distributed at intervals throughout the course. This approach allows students to self-regulate their learning and reinforce the knowledge acquired in earlier chapters (see Figure 1).

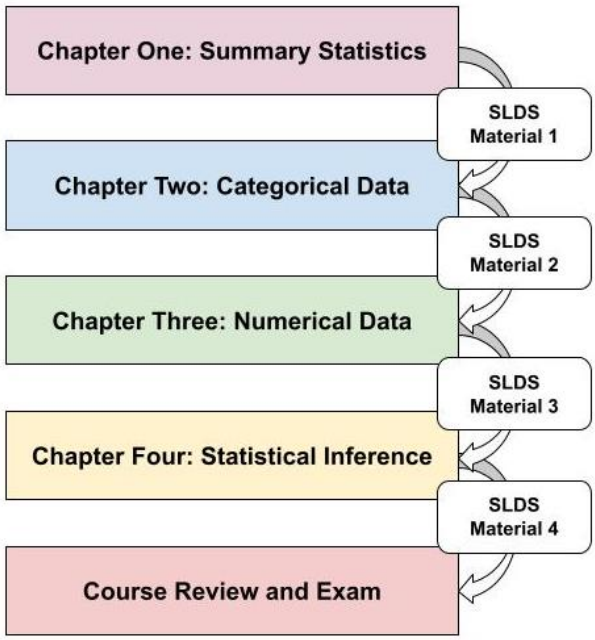

Figure 1: Example of SLDS Course Integration

Methodology

Participants

This study focused on students enrolled in an introductory data science course at a prestigious local university in Singapore. In the Academic Year 2023/2024 Semester 2, 2104 students were enrolled in the course, and 180 consented to provide access to their reported data. These students had no prior experience with data science-related courses at the university and were informed about the study's goal of enhancing their data science learning through a method called data storytelling.

The introductory data science course is a foundational entry-level program featuring a carefully curated curriculum designed by a teaching team of mathematicians and data scientists. Each semester, it attracts first- or second-year undergraduate students from diverse majors across the university. The course is designed to equip students with essential data literacy skills for analyzing data and making informed decisions in the face of uncertainty. It introduces basic principles and practice for collecting data and extracting useful insights, with examples drawn from various application domains (e.g., smoking and cancer correlations, housing market analysis). The data story materials used in this study were developed based on selected topics from the course, with the goal of supporting and enhancing students' learning experiences.

Data Story Materials and Evaluation Instrument

For the presentation of data storytelling-driven SRL materials, we opted to design four data stories that incorporated real-world scenarios and fictional characters within a data research team, simulating how data science projects or a set of research data unfold in real life. The design of the data stories followed the rules identified by Ryan (2016) and Knaflic (2015). There were four sets of stories in total, written and examined by a group of professionals, each with over five years of teaching experience in data science courses or expertise in pedagogical design.

These four data stories centered on a research team's efforts to analyze a dataset that included students' pre-entry scores at the university, their GPA trajectories over four years, and their subsequent employment outcomes and salaries. The narratives captured realistic actions and responses within a team-based data analysis setting, ensuring that the content was both engaging and authentic. Key concepts and knowledge points from the introductory data science course were seamlessly integrated into the stories, presented naturally through dialogues and visualizations to smoothen learning. Figure 2 showcases a visualization based on undergraduate admission data from a local university, accompanied by a narrative framework derived from the visualization. The narrative included a description of the visualization, questions posed by a fictional character to stimulate critical thinking, and a team discussion designed to deepen the analysis.

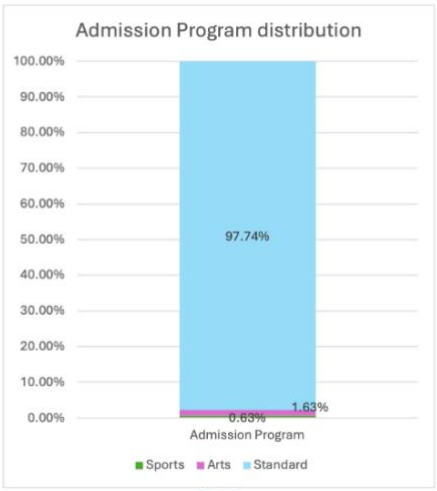

Figure 2

Descriptions of visualization

The chart indicates that 97.74% of the students were admitted through the standard procedure of earning a Pre-Entry Score above the cut off value for the cohort. 1.63% of students entered NUT due to their talents in arts, and 0.63% were admitted because of their sports talents.

Luke: "Now it's quite clear that there are much more students under the standard admission procedure than through the special programs. It's like 43 to 1 in favour of the standard process! Can we filter out the special program students now?" **Provoking critical thinking**

Jayce: "In this case, as currently we're discussing the impact of Pre-Entry Scores on students' future GPAs, maybe we can exclude data from these students for now because NUT's admission office looked at their talents instead of their academic records, right? It feels like they thought these students would make their mark on the university in non-academic ways. My guess is if we exclude these students who were selected outside the normal process, we will have a better chance of seeing patterns more clearly." **Team discussion that deepens the analysis**

Jennifer: "Well, I agree with Jayce. If we know the cut off for the first pass was 79 and the upper limit is 100, maybe we can include Pre-Entry Scores between 79 and 100. Records with Pre-Entry

Figure 2: Excerpt Extracted From One Data Story

Evaluation of the proposed approach included two main components—learning perception and learning comprehension. In the first component, participants were encouraged to evaluate

their learning perception using a three-point Likert scale (yes, no, and uncertain) to indicate their perceptions. To interpret students' learning perceptions, we adopted Keller's (1987) and Keller and Kopp's (1987) ARCS framework, which classify learning evaluations into four dimensions: attention, relevance, confidence, and satisfaction. The index of attention reflects learners' interest in or motivation for learning. Relevance measures the extent to which a learner perceives the current content as connected to their prior knowledge or experiences. Learning confidence represents learners' positive expectations for achieving successful learning outcomes. Satisfaction evaluates whether the learning outcomes align with learners' expectations, indicating their ability to understand the material provided in this study's context and offer positive feedback. Previous studies have demonstrated that the ARCS model effectively tailors to students' needs and interests, stimulating attention, attracting interest, encouraging learning, and fostering satisfactory learning outcomes (e.g., Afjar et al., 2020; Karyani, 2017; Liu & Hou, 2021). To understand students' learning, the ARCS model was deemed most suitable for this study, allowing students to assess their own learning outcomes during the learning process. For instance, Figure 3 shows some examples of the learning perceptions questions from our evaluation survey.

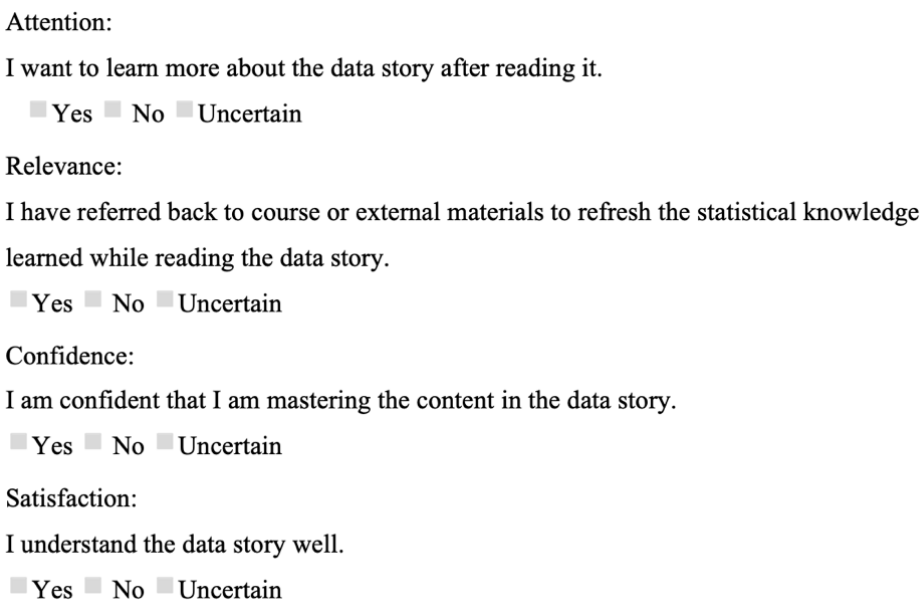

Figure 3: Examples of Learning Perception Questions

In the second component, we focused on a more objective evaluation of learning outcomes. Participants were tasked with reading the data stories and completing a series of multiple-choice questions (MCQs) and multiple-response questions (MRQs) to test their comprehension. These questions were carefully crafted to align with the knowledge presented in the stories, emphasizing key concepts and addressing areas that students might commonly misunderstand. By assessing participants' responses, these questions served as objective measures to gauge learners' comprehension and retention of the key concepts in the course introduced through the SLDS approach. Figure 4 is an example of a learning comprehension question.

The R value of Pre-Entry Score vs. Term 1 GPA is at 0.417 and the one of Pre-Entry Score vs. Final Term GPA is at 0.114. Based on what you have learned, what do these two figures mean to you? Select all that apply.

A. The strength of the linear relationship between the Pre-Entry Score and the Term 1 GPA is stronger than that between the Pre-Entry Score and the Final Term GPA.
B. R value at 0.114 indicates that Pre-Entry Score and Final Term GPA are almost unrelated to each other.
C. Correlation coefficient R shows the strength of the linear relationship between variables.
D. R value at 0.417 indicates that the Pre-Entry Score and Term 1 GPA are moderately associated with each other.

(Suggested answers: A, C, and D)

Figure 4: Example of a Learning Comprehension Question

Collectively, these evaluation methods provided comprehensive learning analytics insights into the effectiveness of SLDS in impacting on students' learning outcomes and promoting deeper understanding among learners. Future educators can use the student-reported analytics data to better tailor the content and context of SLDS, accommodating the diverse learning abilities of various student groups, especially in a large population.

Data Collection Procedures

The reflection surveys were distributed to students through the course's online learning system. For each set of data story materials, students were required to read the content and complete the corresponding reflection survey within a two-week period. Students were encouraged to read the data story first and then complete the survey to evaluate their understanding and learning. To encourage participation, students who completed each reflection survey received 0.5 points toward their final grade. After all responses for the four reflection surveys were collected, we assessed participant eligibility by verifying two criteria within the survey: (1) whether they had provided full consent for their survey data to be included in the study, and (2) whether they had acknowledged reading the full data story before proceeding to the survey.

Analysis

Learning Perceptions

In terms of learning perception questions related to learning attention, relevance, confidence, and satisfaction, we gave two marks if a participant indicated *Yes*, one mark for *Uncertain*, and 0 mark for *No*. Table 1 presents the average marks for each survey in terms of the four attributes of the 180 participants' learning perceptions.

Survey	Attention	Relevance	Confidence	Satisfaction
1	3.11	1.03	6.57	1.77
2	2.44	0.87	6.39	1.77
3	2.83	1.04	6.54	1.76
4	2.68	0.96	6.30	1.69

Table 1: Average Scores for Each Attribute Across All Four Surveys

Based on participants' average scores, we calculated the proportions of the 180 participants who scored above and below average, for each attribute in learning perception, across all four surveys. Table 2 summarizes the results. Overall, the majority scored above average in learning attention questions in all the surveys, with a slight dip in survey 2. Learning relevance showed a more balanced distribution, with surveys 2 and 4 slightly towards below-average scores. For learning confidence, the majority consistently scored above average, with percentages fluctuating between 57.78% and 62.78%. Lastly, learning satisfaction consistently had the highest above-average scores among the four attributes, peaking at 79.44% in survey 1.

	Attention		**Relevance**		**Confidence**		**Satisfaction**	
Survey	Above average	Below average	Above average	Below average	Above average	Below average	Above average	Below average
1	61.00%	39.00%	51.67%	48.33%	62.78%	37.22%	79.44%	20.56%
2	41.11%	58.89%	43.33%	56.67%	57.78%	42.22%	78.33%	21.67%
3	64.44%	35.56%	52.22%	47.78%	60.56%	39.44%	77.78%	22.22%
4	59.44%	40.56%	47.78%	52.22%	60.00%	40.00%	73.78%	27.22%

Table 2: Proportions of Participants Who Scored Above and Below Average for Each Survey

To deepen our analysis, we also performed an ANOVA test on R to see if there are statistically significant differences in the learning perception outcomes across the four surveys. We obtained an F-value of 6.405. Note that the F-value represents the ratio of the variance of the scores between the surveys to the variance of the scores within the surveys. The corresponding *p*-value of 0.000287 showed significant differences in scores between at least two of the surveys. This suggests that students' self-reported answers may have been influenced by the specific story and survey they completed.

Learning Comprehension

For learning comprehension questions, we designed multiple-response questions (MRQ) and multiple-choice questions (MCQ) that tested participants' understanding of the knowledge presented in the stories. We awarded two marks to a participant only if all the correct options for an MRQ were chosen, one mark for a partially correct answer, meaning the participant had chosen at least one correct option, and 0 mark if none of the correct options was chosen. For MCQs with only one correct option per question, we offered one mark for a correct answer and 0 mark for a wrong answer.

Table 3 presents the average marks for the learning comprehension questions, along with the proportions of the 180 participants who scored above and below average across all surveys. Over half of the participants scored above average in surveys one and two. However, as the complexity of the knowledge presented in the stories increased in later surveys, participants appeared to struggle with comprehending all the concepts. This likely contributed to generally lower scores in surveys 3 and 4.

Survey	Learning comprehension	Above average	Below average
1	3.633/5	55.56%	44.44%
2	5.610/7	63.89%	36.11%
3	4.120/6	32.78%	67.22%
4	3.122/6	30.00%	70.00%

Table 3: Average Score and Proportions of Participants Who Scored Above and Below Average for Each Survey

We conducted an ANOVA test on R to determine whether there were statistically significant differences in participants' learning comprehension across the four surveys. The analysis yielded an F-value of 152.809 and a *p*-value of 1.357625e-71 (essentially 0), indicating significant differences in scores between at least two of the surveys. This suggests that students' comprehensions may have been influenced by the variations in the type or depth of content presented in the different stories.

Conclusion

In this study, we aimed to achieve two key objectives: (1) to explore how generic DS elements can be scaffolded to enhance students' learning experiences, and (2) to assess the potential impact of DS on students' self-reported learning perceptions and objective comprehension. We focused on identifying effective strategies for structuring and presenting SRL materials in hope of improving students' engagement in learning. The feedback in learning perceptions and comprehension data collected from students served as valuable learning analytics, offering guidance for refining and optimizing the SLDS content in the future.

The significant differences between surveys in both learning perception and learning comprehension components showcase that SLDS could possibly have a positive impact on students' SRL of introductory data science knowledge. However, we were also cautious about the data collected due to several limitations. Firstly, as the data was self-reported by participants, the subjective nature of learning perception introduces some uncertainty regarding the impact. Secondly, with only 180 students participating in this voluntary study, the sample might not be fully representative given the large course enrollment. Thirdly, data storytelling-driven SRL materials are not limited to the format of traditional data stories. The technique of data storytelling allows for various forms of creative applications. However, with vague guiding principles and no specific instructions provided, these materials can take on different formats, making their implementation in SRL flexible yet potentially inconsistent.

Nevertheless, this study's investigation furnished practical evidence on the potential effectiveness of SLDS in curriculum and pedagogical practices, thus offering a pathway for future researchers and math educators to integrate DS techniques into their everyday teaching practices. Moreover, SLDS can provide insights into students' performance. The data obtained from evaluations (i.e., learning perception and comprehension) can be instrumental in upgrading future content and adapting teaching and learning varieties across different educational contexts (e.g., K-12 and other higher education contexts). By adapting scaffolded data stories, or other innovative formats of SRL materials, to cognitive processes and

motivations, we provided insights into the potential benefits of SLDS framework in fostering a deeper understanding of the data knowledge and analytical processes.

Acknowledgement

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Contact emails: yiyunfan@nus.edu.sg
kloon@nus.edu.sg

Preparing Organizations for the Digital and AI-Driven Economy: Building Dynamic Capabilities Through Continuing Education

Siw M. Fosstenløkken, Oslo Metropolitan University, Norway
Annita Fjuk, Digital Norway, Norway

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Abstract
This article examines the role of continuing education in fostering the development of dynamic capabilities essential for navigating the demands of a digital and AI-driven economy. Through a qualitative analysis of reflections from participants enrolled in university-level programs on digital transformation and artificial intelligence (AI) in Norway, the research identifies three core dynamic capabilities cultivated through these programs: (i) the ability to sense and recognize digital opportunities, (ii) the capacity to seize these opportunities by applying theoretical insights and practical tools to organizational challenges, and (iii) the competence to transform and reconfigure organizational strategies to drive digital transformation. The findings highlight the value of integrating theoretical frameworks with practical applications to enhance professional practice and organizational adaptability. This study contributes to the literature on lifelong learning and dynamic capabilities by demonstrating how continuous education can enable individuals and organizations to remain competitive in dynamic and technologically complex business environments.

Keywords: Digital Transformation, AI, Dynamic Capabilities, Continuing Education, Lifelong Learning

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Introduction

University courses of continuing education typically bring together scholarly knowledge from theory and practitioners with hands-on experience in organizations (Fjuk & Fosstenløkken, 2021). With the high pace of digital technological development and particularly the growth of AI (artificial intelligence), knowledge and new practice are required, perhaps to a faster and greater extent than ever before. From practice, we see that worldwide, leading companies are at the inception of a paradigm shift pushed by rapid technological advancements, particularly in generative AI and large language models (Daugherty et al., 2023; Singla et al., 2024). Organizations increasingly integrate generative AI across multiple business functions, reporting both cost reductions and revenue growth (Singla et al., 2024). As AI and digital technologies continue to transform industries, continuing education is essential for individuals and organizations to remain competitive and resilient in the new AI- and technology-driven economy (Cetindamar et al., 2022; OECD, 2024; Singla et al., 2024). This swift pace of development engenders new and critical competency requirements across value chains and sectors to ensure competitiveness and value creation.

In Norway, the utilization of AI and digital technologies could augment the country's value creation by 5,600 billion NOK by 2040, with generative AI alone contributing an increase of 2,000 billion NOK (Jordel, 2023; Oslo Economics, 2022). McKinsey & Company (2023) estimates that one in two Norwegians have job tasks that could be more than 50 % automated through generative AI, with the most significant impact anticipated among highly educated knowledge workers. Nevertheless, only 24 % of Norwegian enterprises currently employ AI, with a lack of competence cited as the primary barrier (Jordel, 2023). Consequently, Norwegian companies are presently ill-prepared for this emerging paradigm—driven not only by rapid technological progress but also by the unpredictable and constant nature of these changes (Fagerland et al., 2024). Furthermore, in response to the accelerated pace of change that arises from the emergence of AI and the inherent unpredictability of continuous technological innovations, these drive the importance of developing *dynamic capabilities* (Fagerland & Fjuk, 2025). Dynamic capabilities are essential not only for leveraging sustainable business value in changing business environments (Teece et al., 1997; Teece, 2007; Teece, 2014), but also for proactively shaping the future through innovation and strategic agility (Breznik & Hisrich, 2014; Helfat et al., 2007; Song et al., 2005).

Universities, therefore, play a pivotal role in equipping the workforce with the competence and skills needed to navigate and thrive in such dynamic environments (Fagerland et al., 2024; Fjuk & Fosstenløkken 2021). Furthermore, the incorporation of AI in education highlights its transformative potential to enhance teaching and learning processes. AI technologies demonstrate the capacity to personalize educational experiences, streamline learning pathways, and foster improved engagement and performance (Gligorea et al., 2023; Wang et. al., 2024). Adaptive learning systems, underpinned by AI and machine learning algorithms, have shown significant potential in customizing educational experiences to meet individual needs, thereby enhancing learning outcomes (Gligorea et al., 2023; Nurjanah et al., 2024). Generative AI tools, including virtual tutors and digital assistants, are revolutionizing education by providing tailored learning trajectories and fostering interactive engagement (Holmes et al., 2022). This article, thus, explores how continuing educational programs in digital transformation with AI contribute to developing critical dynamic capabilities among the participants. We outline the following research question: *How do continuing education programs in digital transformation with AI contribute to the development of dynamic capabilities?*

Dynamic Capabilities as Theoretical Framework

The concept of dynamic capabilities was introduced by Teece and colleagues (1997) and emphasize an organization's strategic adaptability to thrive in unpredictable and rapidly changing environments through the continuous reconfiguration of resources and competencies (Eisenhardt & Martin, 2000; Helfat et al., 2007; Teece et al., 1997). These capabilities reflect an organization's capacity to identify opportunities and threats, seize opportunities through deliberate strategic actions, and reshape its resource base to sustain competitive advantage and ensure long-term evolutionary fitness (Kræmmergaard, 2024; Teece, 2007). The concept of dynamic capabilities is particularly relevant in the context of digital transformation and AI, where technological advancements and market conditions are in constant flux (Fagerland & Fjuk, 2025). The increased accessibility of advanced digital technologies and AI have introduced significant new dimensions to the concept of dynamic capabilities, enhancing organizational adaptability in an increasingly complex digital economy (Ellström et al., 2022; Gómez & De Pablos-Heredero, 2020). The interplay between AI and dynamic capabilities underscores the strategic imperative for organizations to invest in AI not merely as an operational tool but as a transformative enabler of the competencies required to succeed in complex and unpredictable markets (Ellström et al., 2022). By fostering strategic adjustments, dynamic capabilities enable organizations to navigate digital transformation processes, thereby enhancing their responsiveness and adaptability to external changes.

AI, as a transformative technology, enhances all components of dynamic capabilities by promoting value creation, operational efficiency, and strategic adaptability (Gómez & De Pablos-Heredero, 2020). Specifically, AI amplifies organizations' sensing capabilities by leveraging advanced data analytics, machine learning, and predictive modeling, which enable firms to identify subtle shifts in market trends, customer behaviors, and emerging opportunities with unprecedented speed and accuracy. This enhanced capacity for environmental sensing allows organizations to be more proactive and strategically aligned, particularly in industries where AI-driven solutions facilitate personalized services and optimized customer relationship management, thereby strengthening competitive positioning (Gómez & De Pablos-Heredero, 2020).

AI is increasingly acknowledged as a critical enabler of dynamic capabilities, supporting the continuous adaptation and transformation required to succeed in today's digital economy (Ellström et al., 2022). Dynamic capability, however, should also be conceptualized as a form of dynamic imagination, wherein organizations must not only adapt to changing circumstances but also creatively envision and implement innovative technological solutions to maintain competitiveness. This interpretation extends beyond traditional views of dynamic capabilities as purely adaptive mechanisms, highlighting the imaginative and anticipatory dimensions that are essential for fostering innovation and achieving sustainable competitive advantage (Fagerland & Fjuk, 2025).

Three key components of dynamic capabilities can be derived from this literature: First, *sensing opportunities and threats.* This involves identifying and assessing opportunities and threats in the business environment. It requires a firm to be vigilant and proactive in scanning the market, technological trends, and competitive landscape. In the context of digital transformation, this might include recognizing the potential of emerging technologies like AI, blockchain, or the Internet of Things (IoT). Second, *seizing opportunities.* Once opportunities are identified, firms must act on them by mobilizing resources and capabilities. This includes

making strategic decisions, investing in new technologies, and developing new products or services. For instance, a company might invest in AI-driven analytics to enhance its decision-making processes or customer service operations. Third, *transforming and reconfiguring.* This component involves the continuous renewal and reconfiguration of the firm's resources and capabilities to maintain competitiveness. It requires flexibility and adaptability, enabling the firm to pivot in response to changes in the environment. In the realm of digital transformation, this could mean restructuring the organization to better integrate digital technologies or retraining employees to develop new skill sets.

Dynamic capabilities are not only applicable to organizations but also to individuals (e.g. Buil-Fabregà, 2017), which is of particular relevance in this context of continuing education and lifelong learning. As the pace of technological change accelerates, individuals must continuously update their skills and knowledge to remain relevant in the workforce. Lifelong learning enables individuals to develop dynamic capabilities by: *Sensing*: Staying informed about the latest trends and developments in their field. *Seizing*: Taking advantage of learning opportunities, such as enrolling in university courses or professional development programs. *Transforming*: Applying new knowledge and skills to adapt to changing job requirements and career paths.

Therefore, university courses can play a crucial role in developing the dynamic capabilities of lifelong learners by equipping them with the competence (skills and knowledge) needed to succeed in the era of digital transformation and AI.

Methods

This study employs a qualitative research design (Patton, 2015) to explore the contributions of university courses to the development of dynamic capabilities in digital transformation and AI. The course content focused on Digital transformation and leadership as well as Strategic leadership of digital processes and AI. More specifically, we conducted a qualitative document analysis to interpret and understand data derived from written documents (Østbye et al., 2023). Data were collected directly from the primary source, consisting of 140 students.

The unit of analysis was the students' perceptions of their own learning, interpreted from written materials. The data comprised written submissions such as assignments, reflection notes, evaluations, and exams. A central element in these texts was each student's own project of Digital Change, chosen from real work practice in the respective organization. The Digital Change project consisted of the planning, strategic choices, analyses and implementation of digital processes, of which typically AI was involved, particularly in the latter course. In the document analyses, it was crucial to highlight both the unique perspectives of each student and the commonalities across students. The material was coded based on thematic analyses of micro-processes focusing on dynamic capabilities: *Sense*: New insights through theory and practice. *Seize*: Digital competence and project execution. *Transform*: Development and implementation of action plans.

The students were enrolled in five courses on digital transformation at OsloMet between 2020 and 2024. Each course awarded 10 ECTS credits, with one course specifically focusing on artificial intelligence. The students had an even gender distribution and was mainly aged 30–50 years. The courses were fully online, which also included digital seminars with the teacher. The courses were part of a continuing education program for leaders and employees

in both private companies and public sector organizations. Throughout the courses, students systematically and process-orientedly engaged with theory and practical tools. To ensure practical relevance, tools were applied to real problems from the students' workplaces, such as tools for innovation processes and tools for digital transformation and leadership.

The use of the students as primary sources ensure high validity as the informants are the closest source to their own learning perceptions. The fact that the documents were made concurrently with or immediately after ongoing learning further strengthens the validity of the data. The written documents served various purposes but were all produced to enhance the students' learning outcomes and foster more reflection on the educational value in their professional practice. Variations in learning perceptions were observed, but there was little difference across the courses, as shown in the next section.

The Role of Continuous Education in Building Dynamic Capabilities for Sustained Competitiveness in the Digital Economy

The study examines the enhancement of dynamic capabilities among adult learners, structured around three principal themes: *Sensing new understanding and recognition of concepts.* The programs strengthened the participants' capabilities in digital transformation through three key aspects:

1. Gaining New Conceptual Understanding and Theorization

The participants reported that the program provided them with a deeper understanding of theories and concepts, as illustrated by one reflection: *"Everyone knows businesses need digitalization, but it has been incredibly valuable to learn the theories underpinning these processes."* They also emphasized the importance of interaction, flexibility, and diverse pedagogical resources as catalysts for learning: *"The course has significantly broadened my knowledge base. I have not only learned and practiced theories but also gained insights from knowledge-based companies about relevant topics."*

2. Gaining New Insights Into Drivers, Trends, and a Holistic Perspective on Digital Transformation

The participants realized that digital transformation encompasses more than technology, particularly focusing on customer-centricity: *"What strikes me is that customer focus and engaged change leadership are more important than ever."* They also highlighted the interplay between technology and business development: *"The course has given me a deeper understanding of digital transformation as a whole, beyond just the technical aspects."*

3. Practical Understanding Through the Use of Tools in Real-World Challenges

The combination of theoretical and practical approaches in the course was deemed valuable: *"It has been an engaging approach that expanded my insights into innovation processes and the opportunities presented by digitalization."* Students also noted increased motivation and flexibility through online learning: *"The program is impressive in its breadth, challenging students to learn at their own level and pace."*

The program enhanced participants' understanding of digital transformation by deepening their grasp of underlying theories and concepts. Participants appreciated the interactive and

flexible pedagogical approach, which broadened their knowledge base. They also gained a holistic perspective on digital transformation, recognizing the critical role of customer-centricity and the interplay between technology and business development. The integration of theoretical and practical approaches provided valuable tools for real-world challenges, with the online learning format offering motivation and flexibility.

Addressing and Acting on Digital Opportunities

The program equipped the participants with tools and insights to apply theories to real-world challenges, particularly in two ways: (i) *addressing customers and stakeholders:* The participants found the tools useful for organizational development and digitalization efforts: *"The course has provided me with new models to work with colleagues and customers, and I feel more confident in handling various demands and situations."*. And secondly through (ii) *analyzing organizational potential and competitiveness:* Through practical tools and theoretical insights, the participants developed the ability to identify opportunities for innovation: *"I have become more conscious of how I can apply theories on innovation and digitalization in my work environment."* This has improved practices and enhanced their ability to leverage digital opportunities within their organizations.

The program effectively enhanced participants' abilities to apply theoretical concepts to practical organizational challenges. Participants reported increased confidence in engaging with colleagues and customers, stating that the program provided them with new models for collaboration and digitalization efforts. Additionally, they developed a heightened awareness of how to apply theories of innovation and digitalization within their work environments, leading to improved practices and an enhanced capacity to leverage digital opportunities within their organizations.

Developing and Planning for Digital Transformation

The participants reported valuable learning experiences related to the future application of knowledge and skills, particularly through the development of action plans for change projects: *Building structure for innovation and decision-making:* The courses encouraged holistic thinking and boldness in innovation: *"I have learned the importance of gathering information and using resources effectively to create value.". Refining customer focus in transformation work:* Several participants highlighted increased customer orientation as central: *"I now see the necessity of planning for better customer experiences in my digital systems." Career development and labor market impact:* For some, the course led to significant career advancements: *"I was motivated to apply for, and secured, a new role focused on digitalization processes."*

This way, the program fostered holistic thinking and encouraged boldness in innovation, enabling participants to effectively gather information and utilize resources to create value. It emphasized the importance of customer-centric planning in digital systems, leading to improved customer experiences. Additionally, the course facilitated significant career advancements for some participants, motivating them to secure roles focused on digitalization processes.

Conclusions and Implications

The purpose of this study was to explore how continuing education fosters the development of dynamic capabilities for transformation within organizations and professional practice. The findings highlight three essential capabilities for successful digital transformation:

1. *Sensing and recognizing opportunities*: Identifying new digital business opportunities and gaining fresh insights.
2. *Analyzing and addressing digital challenges*: Applying advanced skills to evaluate and act on digital opportunities.
3. *Driving and planning change and transformation:* Leading change, plan and developing actionable strategies for digital transformation.

The program effectively combined theory and practice, equipping participants with practical skills to navigate transformation efforts. The courses have proven valuable for participants, enhancing their ability to contribute meaningfully to their organizations. We can thus conclude that the continuing education program has developed key dynamic capabilities, providing practical value in transformation efforts for the participants and their organizations.

As the need for rapid workplace transformation grows, so does the demand for continuous skill development. Future research should explore the interplay between dynamic capabilities and transformation processes across industries and how individuals and organizations can be motivated to invest in lifelong learning to remain competitive in a fast-evolving landscape.

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A Theoretical Framework for Ubiquitous Learning in Creative Music Arrangement: Enhancing Skills Development for Thai Youth

Nattaphob Aoonlamai, Khon Kaen University, Thailand

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Abstract
The rapid digitalization of music education presents challenges in developing creative music arrangement skills among Thai youth. This study investigates the application of ubiquitous learning principles to enhance music education in the Thai context. The research objectives were to: 1) analyze key concepts and components of ubiquitous learning applicable to developing creative music arrangement skills, 2) examine the relationship between ubiquitous learning principles and the process of developing these skills, and 3) present a theoretical framework for designing ubiquitous learning innovations for Thai youth. Through comprehensive literature review and conceptual analysis, this theoretical study focused on ubiquitous learning, music education, and the Thai cultural context. The study identified five crucial components of ubiquitous learning (permanency, accessibility, immediacy, interactivity, and context-awareness) and their applications in developing creative music arrangement skills. It revealed significant relationships between these principles and four key aspects of creative music arrangement: sound crafting, musical architecture, rhythmic patterning, and emotional articulation. The research culminated in a novel theoretical framework comprising four main components: adaptive learning environment, collaborative music creation, continuous skill development, and cultural integration. This framework provides a foundation for designing culturally relevant, technologically advanced music education tools, potentially influencing future research, educational practices, and policymaking in music education.

Keywords: Ubiquitous Learning, Creative Music Arrangement, Thai Youth, Music Education, Theoretical Framework

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Introduction

The rapid digitalization of music education presents significant challenges in developing creative music arrangement skills among Thai youth, particularly in preserving cultural heritage while embracing technological innovation. The integration of ubiquitous learning principles in music education offers promising opportunities to address these challenges, yet its implementation requires careful consideration of cultural and pedagogical factors (Hwang, 2014; Liu et al., 2024).

Studies by Chen (2024) and Wang et al. (2022) have demonstrated the potential of AI-powered systems in supporting music arrangement learning through automated feedback and adaptive content delivery. Furthermore, Jiang and Zheng (2024) explored the relationship between musical modes and emotional expression in cross-cultural contexts, highlighting the importance of cultural considerations in music education technology.

However, significant research gaps persist in understanding how ubiquitous learning principles can be effectively adapted for music arrangement education, particularly in specific cultural contexts. While studies have demonstrated the effectiveness of ubiquitous learning in general education (Chin et al., 2015), limited research exists on its application in creative music arrangement for youth education (Subiyakto et al., 2019). Additionally, existing studies primarily focus on technical implementation rather than pedagogical effectiveness and cultural preservation.

The integration of ubiquitous learning with cultural elements presents unique challenges, as identified by Westerlund and López-Íñiguez (2024). Traditional approaches to music education often struggle to balance technological innovation with cultural preservation, particularly in the Thai context, where maintaining cultural integrity while adopting modern educational technologies is crucial.

To address these gaps, this study pursues three primary objectives:

1. Analyzing key concepts and components of ubiquitous learning applicable to developing creative music arrangement skills
2. Examining the relationship between ubiquitous learning principles and the process of developing these skills
3. Presenting a theoretical framework for designing ubiquitous learning innovations for Thai youth

This research contributes significantly to the field by developing a comprehensive theoretical framework that integrates ubiquitous learning principles with creative music arrangement skills in the Thai context. The framework provides practical guidelines for educational institutions implementing ubiquitous learning technologies while maintaining cultural integrity in music education. The study's findings offer valuable implications for educational institutions, technology developers, and policymakers, potentially influencing future research and practice in music education technology.

Literature Review

Concepts and Components of Ubiquitous Learning in Music Arrangement Skills Development

Recent technological advancements have transformed educational paradigms, particularly in music education where ubiquitous learning (u-learning) offers unprecedented opportunities for skill development. Current research identifies five essential components of ubiquitous learning that significantly impact music arrangement skills: permanency, accessibility, immediacy, interactivity, and context-awareness (Wang et al., 2015; Jeong & Yi, 2014; Ben Salah et al., 2020). These components create a comprehensive framework for understanding how u-learning environments can enhance music education.

Research by Chen (2024) and Wang et al. (2022) demonstrates how AI-powered systems can support music arrangement learning through automated feedback and adaptive content delivery. However, these studies primarily focus on technical implementation rather than pedagogical effectiveness. The theoretical foundation for u-learning in music arrangement draws from constructivist learning theories (Peña-Ayala & Cárdenas-Robledo, 2019) and context-aware learning principles (Bayoudh Saâdi et al., 2021).

Implementation challenges include infrastructure requirements (Liu et al., 2024), privacy concerns (El-Haggar et al., 2023), and the need for effective assessment methods (Virtanen et al., 2017). Recent studies by Xu and Xia (2023) and Yang (2022) highlight the potential of combining u-learning principles with specialized music education technologies, though their research primarily focuses on instrument-specific applications rather than comprehensive arrangement skills.

Creative Music Arrangement Skills Development

The development of creative music arrangement skills requires a structured approach that integrates technical proficiency with artistic expression. Research indicates four fundamental aspects of music arrangement skills: sound crafting, musical architecture, rhythmic patterning, and emotional articulation (Chen, 2024; Wang et al., 2022; Barnabò et al., 2023). Terao et al. (2023) demonstrated how AI-assisted learning platforms can enhance arrangement capabilities through stepless difficulty control, while Jiang and Zheng (2024) explored the relationship between musical modes and emotional expression in cross-cultural contexts.

Research by Pérez Mora Bowen and Fernández Pérez (2024) emphasizes the importance of understanding spatial and acoustic elements in arrangement, while Westerlund and López-Íñiguez (2024) highlight the role of social and cultural contexts in compositional practice. Current research gaps include limited understanding of how different learning approaches affect skill acquisition (Tang et al., 2024) and insufficient attention to cultural influences on creative development (Jiang & Zheng, 2024).

Designing Ubiquitous Learning Innovations for Thai Youth

The design of ubiquitous learning innovations for Thai youth requires careful consideration of technological, cultural, and pedagogical factors. Recent research emphasizes the importance of culturally responsive design in educational technology (Liu et al., 2024;

Hwang, 2014). Studies demonstrate that effective u-learning systems must incorporate adaptive learning environments (Chiu et al., 2017), collaborative features (Kong et al., 2017), and context-aware capabilities (Bayoudh Saâdi et al., 2021).

While studies by El-Haggar et al. (2023) and Subiyakto et al. (2019) address u-learning implementation in different cultural contexts, they don't specifically examine music education or youth development needs. Recent innovations in AI and machine learning offer promising opportunities for personalized learning experiences (Chen, 2024; Wang et al., 2022). The literature suggests four essential design considerations: cultural integration (Jiang & Zheng, 2024), technological accessibility (Liu et al., 2024), pedagogical effectiveness (Virtanen et al., 2017), and user engagement (Chin et al., 2015).

Research Methodology

Research Design

This theoretical study employed a qualitative, non-empirical research design to investigate the application of ubiquitous learning principles in developing creative music arrangement skills among Thai youth. The methodology focused on theoretical analysis and conceptual development, chosen for its suitability in exploring complex, interdisciplinary topics and generating new theoretical insights.

Research Process

The research process consisted of three main phases:

Comprehensive Literature Review.

The initial phase involved reviewing literature across multiple disciplines, including ubiquitous learning theory, music education and pedagogy, creative music arrangement techniques, and Thai cultural context. Sources included peer-reviewed academic journals, books, conference proceedings, and relevant theses. The review process involved systematic searching, screening, and analysis using predefined inclusion criteria to ensure relevance and quality.

Theoretical Analysis and Synthesis.

The analysis employed various theoretical techniques:

1. Conceptual analysis to clarify key terms and concepts
2. Comparative analysis to identify similarities between ubiquitous learning principles and traditional music education approaches
3. Systems thinking to understand interactions between ubiquitous learning and music arrangement skills

Conceptual Framework Development.

Based on the literature review and theoretical analysis findings, a new conceptual framework was developed to:

1. Integrate ubiquitous learning principles with creative music arrangement skills
2. Provide theoretical foundation for designing ubiquitous learning innovations

3. Address specific needs of Thai youth in music education

Data Collection and Analysis.

Data collection involved gathering and organizing relevant literature and theoretical concepts. The analysis process included:

1. Thematic analysis of literature to identify recurring concepts
2. Concept mapping to visualize relationships between theories
3. Critical evaluation of existing theories
4. Synthesis of ideas to generate new theoretical insights

Validity and Reliability.

To ensure research quality, several measures were implemented:

1. Comprehensive coverage of relevant literature
2. Triangulation of sources
3. Clear documentation of theoretical assumptions
4. Expert consultation to validate the conceptual framework

Ethical Considerations.

While this study did not involve human participants, ethical considerations included proper attribution of sources, transparent reporting, and consideration of implications for Thai youth and culture.

Research Result

Analysis of Key Concepts and Essential Components of Ubiquitous Learning Applicable to Developing Creative Music Arrangement Skills

The study reveals five crucial components of ubiquitous learning that can be applied to develop creative music arrangement skills, as shown in Table 1.

Table 1: Analysis of Ubiquitous Learning Components and Their Application in Developing Creative Music Arrangement Skills

Component	Description	Application in Developing Creative Music Arrangement Skills
1. Permanency	Information or learning materials remain available when learners revisit them	- Store musical ideas and arrangements in the cloud - Create personal databases for music arrangement techniques
2. Accessibility	Learners can access learning resources at any time they need	- Use mobile applications for music arrangement - Access online resources about music arrangement techniques
3. Immediacy	Learning materials must be delivered to learners quickly	- Utilize AI systems for real-time music arrangement technique suggestions - Use instant audio processing systems to experiment with musical ideas

Component	Description	Application in Developing Creative Music Arrangement Skills
4. Interactivity	Learners can interact with instructors, peers, or learning content	- Participate in online music arrangement communities - Collaborate with other musicians in real-time through digital platforms
5. Context-Awareness	The learning system adapts to learners' situations or environments	- Use AI to suggest arrangement techniques based on the user's style and preferences - Adapt learning content based on the learner's skill level and musical genre interest

Relationship Between Ubiquitous Learning Principles and Creative Music Arrangement Skills Development.

The research identified significant relationships between ubiquitous learning components and four core aspects of creative music arrangement: sound crafting, musical architecture, rhythmic patterning, and emotional articulation. These relationships are presented in Table 2.

Table 2: Relationships Between Ubiquitous Learning Principles and Creative Music Arrangement Skills

Ubiquitous Learning Principle	Sound Crafting	Musical Architecture	Rhythmic Patterning	Emotional Articulation
Permanency	Enables storage and retrieval of unique sound combinations and effects	Allows for saving and revisiting complex musical structures	Facilitates the archiving of diverse rhythmic patterns	Supports the preservation of emotional expressions in arrangements
Accessibility	Provides constant access to sound libraries and editing tools	Offers anytime access to musical scores and structural templates	Allows for rhythm experimentation regardless of location	Enables access to emotional reference points in various musical contexts
Immediacy	Supports real-time sound manipulation and instant feedback	Facilitates quick structural changes and immediate auditory feedback	Enables rapid rhythm adjustments and instant playback	Allows for immediate emotional expression through quick musical changes
Interactivity	Enables collaborative sound design and shared audio experiences	Supports collaborative composition and arrangement processes	Facilitates rhythmic interaction between multiple arrangers or instruments	Enhances emotional communication through interactive musical dialogues

Ubiquitous Learning Principle	Sound Crafting	Musical Architecture	Rhythmic Patterning	Emotional Articulation
Context-Awareness	Adapts sound choices based on environmental and cultural contexts	Suggests structural changes based on performance context or audience preferences	Adjusts rhythmic elements to suit different musical genres or cultural settings	Tailors emotional expression to specific performance contexts or listener demographics

Theoretical Framework for Ubiquitous Learning Innovations.

The research culminated in a theoretical framework comprising four main components:

1. Adaptive Learning Environment
   - Personalized learning paths
   - Context-sensitive content delivery
   - Adaptive difficulty levels
2. Collaborative Music Creation
   - Real-time collaboration tools
   - Peer feedback mechanisms
   - Virtual ensemble spaces
3. Continuous Skill Development
   - Progress tracking systems
   - Micro-learning modules
   - Spaced repetition techniques
4. Cultural Integration
   - Integration of Thai musical elements
   - Cultural context-based challenges
   - Preservation of traditional techniques

Discussion

Analysis of Ubiquitous Learning Components in Creative Music Arrangement

The identification of five core ubiquitous learning components extends beyond traditional frameworks by demonstrating specific applications in music arrangement education. The permanency component's role in supporting sound craft development aligns with Wang et al.'s (2015) findings on knowledge preservation, while extending to cloud-based storage systems for musical development (Mouri & Ogata, 2015; El-Haggar et al., 2023). The accessibility component's implementation supports Chiu et al.'s (2017) work on blended learning environments, specifically addressing music arrangement tools and resources.

The integration of AI-powered systems for feedback and content delivery, as highlighted by Chen (2024) and Wang et al. (2022), represents a significant advancement in supporting music education. However, our findings emphasize the importance of balancing technological innovation with pedagogical effectiveness, addressing gaps identified in previous studies (Virtanen et al., 2017).

Relationship Analysis Between Ubiquitous Learning and Creative Music Arrangement

The relationships revealed between ubiquitous learning principles and creative music arrangement skills extend current understanding in the field. The connection between accessibility and musical architecture builds upon Terao et al.'s (2023) research on stepless difficulty control, demonstrating how ubiquitous access facilitates structural understanding. This particularly resonates with Pérez Mora Bowen and Fernández Pérez's (2024) emphasis on spatial awareness in composition.

Interactivity's role in rhythmic patterning development supports Jiang and Zheng's (2024) research on cross-cultural musical expression while adding technological dimensions. The strong correlation between context-awareness and emotional articulation demonstrates unique applications in ubiquitous learning environments, particularly benefiting from AI integration (Tang et al., 2024).

Framework Development for Ubiquitous Learning in Thai Music Education

The theoretical framework's four components - adaptive learning environment, collaborative music creation, continuous skill development, and cultural integration - address critical gaps while providing practical implementation guidelines. The adaptive learning environment component builds upon Hwang's (2014) smart learning environment principles while incorporating cultural considerations highlighted by Liu et al. (2024).

The framework demonstrates how traditional Thai musical elements can be effectively integrated with modern technology, supporting Jiang and Zheng's (2024) research on cross-cultural musical expression. This integration provides a model for preserving cultural heritage while embracing technological innovation in music education.

Implications and Future Directions

The findings suggest several key implications for music education:

1. Educational institutions can utilize this framework to design culturally responsive learning environments
2. The integration of AI-assisted learning platforms with cultural elements offers promising opportunities
3. Balance between technological innovation and traditional methods is crucial for effective implementation

Future research directions should include:

1. Empirical validation of the framework in various Thai educational settings
2. Investigation of long-term impacts on skill development
3. Cross-cultural comparative studies to explore framework adaptability
4. Development of specific assessment tools for measuring effectiveness

Research Recommendations

Recommendations for Research Implementation

Future research implementation should prioritize:

1. Empirical Validation
    - Conduct comprehensive studies in diverse Thai educational settings
    - Track student development in creative music arrangement skills
    - Examine framework adaptability across different cultural contexts
    - Measure specific learning outcomes in digital environments
2. Assessment Development
    - Create specialized tools for evaluating creative music arrangement skills
    - Develop metrics for measuring cultural preservation effectiveness
    - Design assessment methods for ubiquitous learning outcomes

Recommendations for Educational Practice

Educational institutions should focus on:

1. Implementation Strategy
    - Balance traditional methods with technological innovation
    - Provide comprehensive teacher training in ubiquitous learning
    - Adopt gradual integration based on feedback
    - Ensure cultural sensitivity in technology deployment
2. Policy Development
    - Establish clear standards for music education technology
    - Create guidelines for cultural preservation in digital education
    - Support continuous teacher professional development
    - Invest in balanced technological infrastructure
3. Collaborative Approach
    - Foster partnerships between educational institutions and technology developers
    - Engage cultural preservation experts in implementation
    - Create support networks for sharing best practices
    - Maintain ongoing dialogue between stakeholders

Success in implementing these recommendations requires sustained commitment from all stakeholders and regular evaluation of outcomes to ensure effectiveness while preserving cultural integrity in music education.

Conclusion

This research advances understanding of how ubiquitous learning can enhance creative music arrangement skills among Thai youth through three key contributions. First, the study identified five essential components of ubiquitous learning (permanency, accessibility, immediacy, interactivity, and context-awareness) and demonstrated their specific applications in music education. These components showed strong relationships with fundamental aspects of creative music arrangement: sound crafting, musical architecture, rhythmic patterning, and emotional articulation.

Second, the theoretical framework developed integrates adaptive learning environments, collaborative music creation, continuous skill development, and cultural integration, providing a foundation for developing culturally responsive music education technologies. This framework uniquely balances technological innovation with cultural preservation, addressing a critical gap in contemporary music education.

Third, the research offers practical guidelines for educational institutions implementing ubiquitous learning technologies while maintaining cultural integrity in music education. The findings provide valuable insights for educational institutions, technology developers, and policymakers, potentially influencing future research and practice in music education technology.

While empirical validation through future studies is recommended, this theoretical framework represents a significant step toward understanding how technology can enhance music education while preserving cultural heritage. The integration of ubiquitous learning principles with creative music arrangement skills provides a model for developing effective, culturally sensitive educational innovations.

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Contact email: nattapobau@kkumail.com

Exploring Students' Experiences and Attitudes Toward Text-Generating AI in Foreign Language Learning: A Study of Japanese University Students

Harumi Kashiwagi, Kobe University, Japan
Min Kang, Kobe University, Japan

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Abstract
Advancements in generative artificial intelligence (AI) have the potential to enhance language learning. As the educational use of generative AI is still in its nascency, understanding learners' experiences and perceptions is crucial. This preliminary study used a 5-point Likert scale to explore the experiences and attitudes of 77 Japanese university students in one social sciences class and one humanities class toward incorporating text-generating AI into English learning. We found that approximately 70% of the participants had prior experience with text-generating AI. Their necessity and interest scores in acquiring AI skills averaged 4 or higher in both classes, with social science students demonstrating significantly higher levels than humanities students, suggesting a greater need for AI in careers such as data analysis. Furthermore, their interest in using AI for English learning averaged a score of 4 for humanities students and 3.8 for social science students, with no significant difference between the groups. Approximately 50–60% of the students in both classes did not use AI for English learning. Economics students demonstrated significantly higher perceived necessity of and interest in AI skills compared to their interest in using text-generating AI for English learning, indicating a gap in how students from different faculties value AI skills. As their interest levels may increase with experience, guidance on the use of AI in English learning is crucial. These findings can help tailor educational strategies to the unique needs of different student groups while integrating AI tools into English language learning.

Keywords: Generative AI, Text-Generating AI, Student Experiences, Student Interest, Speaking Practice, Foreign Language Learning

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Introduction

Advances in generative artificial intelligence (AI) carry the potential to radically transform both pedagogy and learning in the field of education. Text-generating AI tools such as ChatGPT are trained on a vast corpus of text data, enabling them to generate responses that mimic human interactions. Taking advantage of this feature, efforts are being made to apply AI to foreign language conversation practice.

In a recent study, Nakamura and Wasaki (2023) incorporated generative AI into speech learning in Japanese language education, with a focus on Japanese speech practices. To address the lack of opportunities for foreign language speaking practice, Nakazato, Nakamura, and Tobita (2023) developed a prototype system of a web application called LingoAI. This application, which uses ChatGPT and the VRM file format for 3D characters, enables voice conversations with 3D characters in English, Russian, and Japanese.

The educational use of generative AI is still in its early stages, and efforts and support measures for utilizing generative AI are beginning to be implemented. Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) has come to support the incorporation of generative AI in teaching. This initiative includes delivering lectures on the nature and limitations of generative AI (Yoshida, 2023), holding online training sessions on its use (MEXT, 2023a), and creating instructional videos to train teachers to use it (MEXT, 2023b).

Regarding the potential challenges of AI inclusion, Fujimura (2023) conducted a comparison of the latest generative AI functionalities. He surveyed current teachers and graduate students in teacher training programs to examine their intention to use generative AI, its potential for educational application, its considerations, and the necessary educational content. Ajlouni, Wahba, and Almahaireh (2023) found highly positive attitudes toward using ChatGPT as a learning tool among students at the University of Jordan, with students recognizing its potential to facilitate the learning process.

However, concerns regarding the accuracy of the data generated by ChatGPT have also been reported. Based on a sample of EFL (English as a Foreign Language) learners in Saudi Arabia, Jamshed, Alam, Al Sultan, and Banu (2024) found that while learners held positive views of the efficacy of AI-powered instruction, they also reported several serious concerns. These concerns included privacy issues, the crude nature of the technology, the lack of digital literacy among teachers and students, practical arrangements involving complex procedures and numerous tasks, expert shortages, the addictive nature of technology, and its failure to deal with the specific needs and challenges of various student groups.

As mentioned, efforts to investigate learners' use of generative AI are ongoing; however, the situation is likely to vary across countries. Owing to the rapid advancement of generative AI technology, the number of users and usage patterns among learners are expected to change over time. Conducting continuous research is important to keep pace with the progress of generative AI and explore appropriate educational content and methods.

This preliminary study aimed to investigate learners' experiences of and attitudes toward text-generating AI, explore their current situation, and identify countermeasures for the issues revealed in the survey. Our research questions were as follows:

1. Have the students ever used text-generating AI?
2. Do the students think it is necessary to acquire skills to use text-generating AI, and are they interested in acquiring the skills to utilize text-generating AI? Are there differences in students' perceived necessity of and interest in AI depending on the faculty?
3. Are the students interested in using text-generating AI to learn English? Are there differences in students' interest depending on the faculty?
4. Are there differences between students' interest in using text-generating AI to learn English and their awareness of the necessity of text-generating AI skills or their interest in acquiring skills to utilize text-generating AI?

The following sections discuss the methods adopted to conduct the study and the study findings. Subsequently, the conclusions and recommendations for future studies are presented.

Methods

Participants

The participants comprised 77 first-year students from two classes—social sciences and humanities—at a university in Japan. Table 1 presents the number of students and their majors. The students were informed of the study's purpose and the confidentiality of their data, and informed consent was obtained accordingly.

Table 1: Number of Participants and Their Majors

Class	Grade	Faculty	Number of Students
A	First year	Economics	41
B	First year	Global Human Sciences	36

Data Collection and Analysis

The questionnaire (Table 2) was distributed to the participants to gather their subjective responses about their previous experience with text-generating AI (Q1), most frequently used text-generating AI software (Q2), awareness of the necessity of text-generating AI skills (Q3), and interest in acquiring skills to utilize text-generating AI (Q4). Additionally, they were asked about their interest in using text-generating AI for English language learning (Q5) and their past experiences of using text-generating AI for learning English (Q6).

The participants were asked to choose their responses to Q1 from the two options listed in Table 2. For Q2, the participants were asked to select the most frequently used text-generating AI software from the options listed in Table 2. To account for those who had never used text-generating AI, the option "Not used" was included. The participants' responses to Q3–Q5 were scored on a 5-point Likert scale (1="Strongly Disagree"; 2="Moderately Disagree"; 3="Neutral"; 4="Moderately Agree"; and 5="Strongly Agree"). For Q6, the participants were asked to select their experiences using text-generating AI to learn English, as shown in Table 2, from which they could select multiple responses. Similar to Q2, in Q6, the option "Not used" was included for those who had never used text-generating AI.

We used the Wilcoxon rank-sum test to investigate whether any statistical differences existed between the ratings of the two classes. Additionally, the Wilcoxon signed-rank test was used to examine any statistical differences in the ratings of Q3, Q4, and Q5 within each class.

Table 2: Questionnaire Items

Items on Students' Awareness of the Necessity of and Interest in Acquiring Text-Generating AI Skills and in Using Text-Generating AI for English Language Learning
Q1. Have you ever used a text-generating AI?
1. Yes, I have used it. 2. No, I have not used it.
Q2. Which text-generating AI do you use the most? Please choose one. If you have never used a text-generating AI, please select "Not used."
1. Not used 2. ChatGPT 3. Copilot 4. Gemini (Google Bard) 5. Other (Please specify)
Q3. It is necessary to acquire the skills to use text-generating AI.
1. Strongly Disagree 2. Moderately Disagree 3. Neutral 4. Moderately Agree 5. Strongly Agree
Q4. I am interested in acquiring skills to utilize text-generating AI.
1. Strongly Disagree 2. Moderately Disagree 3. Neutral 4. Moderately Agree 5. Strongly Agree
Q5. I am interested in using text-generating AI for learning English.
1. Strongly Disagree 2. Moderately Disagree 3. Neutral 4. Moderately Agree 5. Strongly Agree
Q6. Please select the experiences you have had using text-generating AI for learning English (multiple answers allowed). If you have never used text-generating AI for learning English, please select "Not used."
1. Not used
2. English composition correction and writing practice
3. Text-based conversation practice
4. Voice-based conversation practice
5. Vocabulary learning
6. External exam preparation (TOEIC, TOEFL, etc.)
7. Other (Please specify)

Results and Discussion

We analyzed the results of the questionnaires to address each research question pertaining to the students' experiences of and attitudes toward text-generating AI. This section discusses the overall questionnaire results and observed data trends. The questionnaire response results and corresponding percentages of participant responses for each item are presented in Figures 1–4 and Tables 3 and 4.

We examined whether the participants had previously used text-generating AI via Q1, the responses to which are presented in Figure 1. According to the results, 71% of the participants in Class A (Economics) and 64% in Class B (Global Human Sciences) chose "Yes, I have used it (a text-generating AI)." As the percentages were relatively similar, these results suggested that the participants' responses were not influenced by whether they were in social sciences or humanities classes. In Japan, literacy education regarding generative AI has not yet been widely incorporated into the curriculum for elementary to high school.

Consequently, experiences with generative AI depend more on the personal engagement of individual students than on their areas of study.

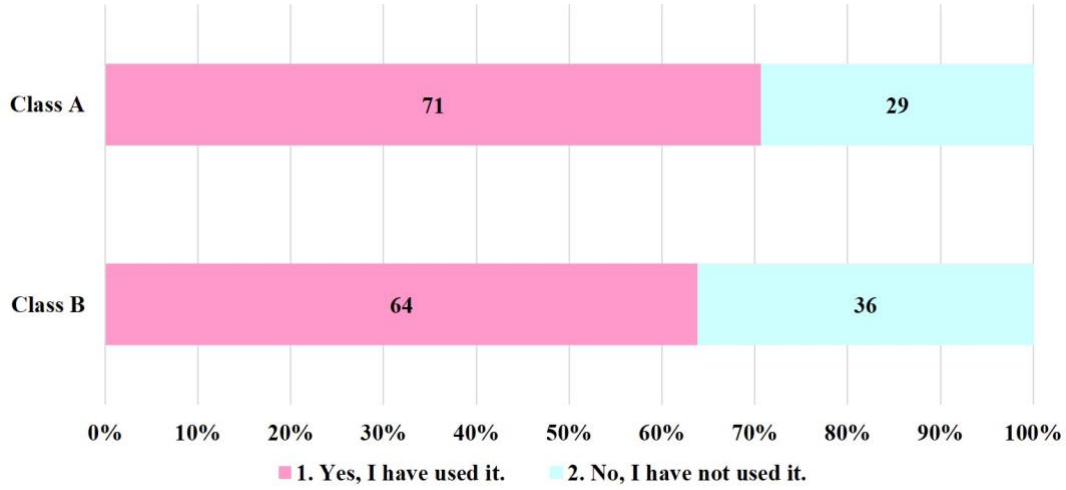

Figure 1: Corresponding Percentages of Participants' Responses to Q1

Table 3 presents the responses to Q2, which identified participants' preferred text-generating AI. Each number in this table represents the number of participants who selected each option, and the numbers in parentheses indicate the percentages within each class. We observed that slightly less than 70% of the participants in Class A and 50% of the participants in Class B used ChatGPT as their primary text-generating AI. In terms of other text-generating AIs, one student in Class A and four in Class B used Copilot, whereas only one student in Class B used Gemini. These results suggested that ChatGPT was the primary text-generating AI used by a substantial number of students.

Table 3: Results of Participants' Responses to Q2

Class	1. Not used	2. ChatGPT	3. Copilot	4. Gemini (Google Bard)	5. Other (Please specify)
Class A	12 (29.3%)	28 (68.3%)	1 (2.4%)	0 (0%)	0 (0%)
Class B	13 (36%)	18 (50%)	4 (11%)	1 (3%)	0 (0%)

Furthermore, we analyzed how participants perceived the need for text-generating AI skills in their future careers. Figure 2 presents the responses to Q3, which concerns the students' perceived need for text-generating AI skills. According to the results, 98% of the participants in Class A (Economics) strongly or moderately agreed that they would require text-generating AI skills in the future. In Class B (Global Human Sciences), 80.6% of the participants agreed with Q3. Regarding students' perceptions of the need for text-generating AI skills in their future careers, more than 80% of the participants in both classes provided positive responses.

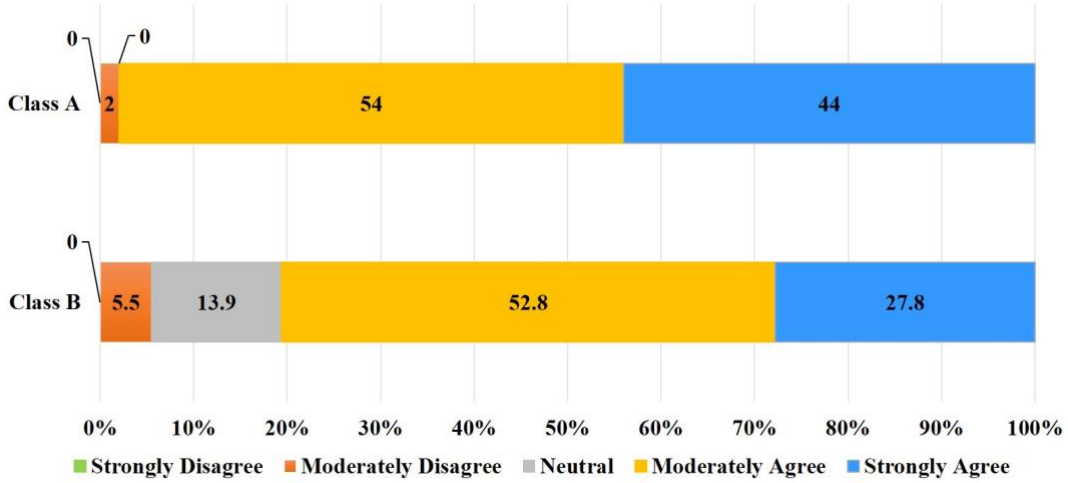

Figure 2: Percentages of Participants' Responses to Q3

Subsequently, we analyzed the participants' interest in acquiring skills to utilize text-generating AI. The percentages of the participants' responses to Q4, indicating their desire to gain text-generating AI skills, are shown in Figure 3.

According to the results, 98% of the participants in Class A (Economics) strongly or moderately agreed that they were interested in acquiring skills to utilize text-generating AI. In Class B (Global Human Sciences), 83.4% of the participants agreed with Q4. Similar to the results of Q3, more than 80% of the participants in both classes expressed a positive interest in acquiring the skills to utilize text-generating AI. However, students in Class A (Economics) appeared to have a slightly stronger interest.

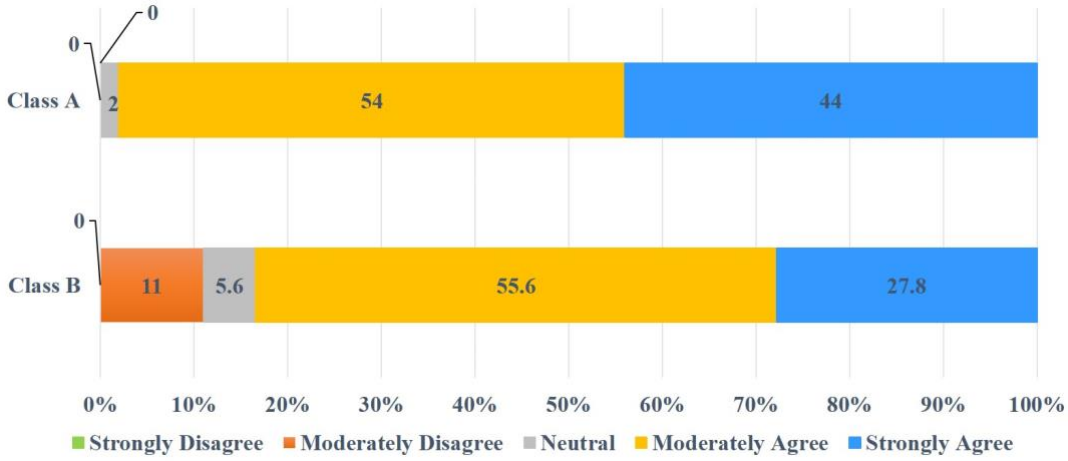

Figure 3: Percentages of Participants' Responses to Q4

Finally, we analyzed the participants' ratings of their interest in using text-generating AI to learn English. Figure 4 presents their responses to Q5, which addressed students' eagerness to use text-generating AI in English learning. According to the results, 71% of the participants in Class A (Economics) strongly or moderately agreed with Q5. In Class B (Global Human Sciences), 84% of the participants agreed with Q5. More than 70% of the participants in both classes expressed positive interest in using text-generating AI to learn English, with students in Class B (Global Human Sciences) demonstrating a slightly stronger interest.

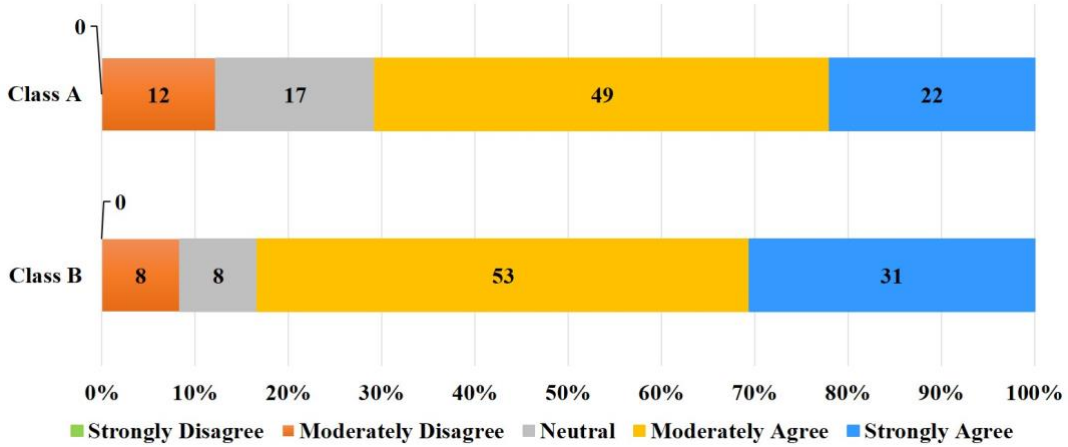

Figure 4: Percentages of Participants' Responses to Q5

Additionally, we analyzed the students' past experiences using text-generating AI to learn English based on their responses to Q6. Table 4 presents the number of participants who selected each option. Multiple responses were allowed for Q6. The percentages in parentheses indicate the proportion of each response relative to the total number of participants in each class. Options 1–7 in the table represent the following responses: (1) "Not used," (2) "English composition correction and writing practice," (3) "Text-based conversation practice," (4) "Voice-based conversation practice," (5) "Vocabulary learning," (6) "External exam preparation (TOEIC, TOEFL, etc.)," and (7) "Other (Please specify)."

According to the Q6 results, approximately 30% of the participants in both classes (34% in Class A and 28% in Class B) used text-generating AI for English composition correction and writing practice. Approximately 20% of the participants in both classes (15% in Class A and 22% in Class B) used it for vocabulary learning. Additionally, approximately 5% of the participants in both classes used text-generating AI for both text- and voice-based conversation practice. However, 50–60% of the students in both classes did not use it for learning English. These results suggested that the participants did not have sufficient experience in applying text-generating AI to English learning.

Table 4: Results of Participants' Responses to Q6

Class	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
Class A	24 (59%)	14 (34%)	1 (2%)	2 (5%)	6 (15%)	0 (0%)	0 (0%)
Class B	20 (56%)	10 (28%)	3 (8%)	2 (6%)	8 (22%)	1 (3%)	1 (3%)

Research Question 1

To address the first research question—"Have the students ever used text-generating AI?"—we examined whether the participants had previously used text-generating AI. According to the results presented in Figure 1, approximately 70% of the participants in both Class A and Class B had previously used text-generating AI. Therefore, their responses were not influenced by whether they were in social science or humanities classes. Because the educational use of generative AI is still in its early stages, students' experiences with generative AI are influenced more by their personal engagement than by their areas of study.

In Japan, literacy education regarding generative AI has not yet been widely incorporated into the curriculum from elementary to high school. Consequently, the students were expected to

have varying experiences with text-generating AI. These results highlight the need to design curricula that consider students' individual experiences with AI.

Research Question 2

The second research question was "Do the students think it is necessary to acquire skills to use text-generating AI, and are they interested in acquiring the skills to utilize text-generating AI? Are there differences in students' perceived necessity of and interest in AI depending on the faculty?" To address this, we analyzed participants' awareness of the necessity of text-generating AI skills, their interest in acquiring these skills, and how these needs and interests were perceived by the two faculties. The average scores of their responses to Q3 and Q4 were calculated using a 5-point Likert scale for each class to investigate the overall student perceptions. The average scores for both Q3 and Q4 were 4.4 for Class A and 4.0 for Class B. Given these high average scores, we concluded that many students in both classes perceived the necessity of and an interest in acquiring text-generating AI skills for their future careers.

Subsequently, the Wilcoxon rank-sum tests were conducted using the Q3 and Q4 data to determine whether statistically significant differences existed between the two classes at a significance level of 0.05. The results for Q3 revealed significant differences between Classes A and B (p=0.036). Similarly, the results for Q4 indicated significant differences between Classes A and B (p=0.043).

Therefore, the average score of the perceived necessity of and interest in acquiring text-generating AI skills was four or higher in both classes. While students in both fields recognized the importance of AI-related skills, social science students showed significantly higher levels of necessity and interest than their humanities counterparts. This indicated a strong recognition of the value of AI skills among students, particularly those in social sciences, who were more inclined to value these skills for their future careers.

Research Question 3

The third research question was "Are the students interested in using text-generating AI to learn English? Are there differences in students' interest depending on the faculty?" To address this, we analyzed whether the participants were interested in using text-generating AI for English language learning and whether any differences existed in their interests between the two faculties. Regarding their interest in the use of text-generating AI for learning English, the average scores for Q5 were 3.8 for Class A and 4.1 for Class B. This indicated that students' interest in text-generating AI for learning English was slightly higher among humanities students than social science students.

The Wilcoxon rank-sum test was conducted using Q5 data to determine whether statistically significant differences existed between the two classes at a significance level of 0.05. The results revealed no significant differences between Classes A and B (p=0.207).

Thus, students' interest in using text-generating AI to learn English was not influenced by whether they were in social science or humanities classes. According to the Q6 results in Table 4, 50–60% of the students in both classes had not yet used text-generating AI for English learning. Their level of interest may evolve as they gain more experience with the technology in the context of language learning.

Research Question 4

The fourth research question was "Are there differences between students' interest in using text-generating AI to learn English and their awareness of the necessity of text-generating AI skills or their interest in acquiring skills to utilize text-generating AI?" For this, we analyzed whether students' interest in using text-generating AI to learn English differed from their awareness of the necessity of text-generating AI skills or their interest in acquiring these skills within each faculty. Regarding students' interest in using text-generating AI for learning English, the average scores for Q5 were 3.8 for Class A and 4.1 for Class B. Regarding their awareness of the necessity of text-generating AI skills, the average scores for Q3 were 4.4 for Class A and 4.0 for Class B. The average scores for Q4, reflecting students' interest in acquiring skills to utilize text-generating AI, were also 4.4 for Class A and 4.0 for Class B.

Based on the class averages, the students in Global Human Sciences showed little difference between their interest in using text-generating AI to learn English and their awareness of the necessity of text-generating AI skills or their interest in acquiring these skills. However, Economics students had average scores of 4.4 for the necessity of AI skills and interest in acquiring these skills, whereas their interest in using text-generating AI for learning English was 3.8. Compared with the students in Global Human Sciences, Economics students appeared to have less interest in using AI for English language learning.

Subsequently, Wilcoxon signed-rank tests were conducted using the Q3, Q4, and Q5 data to determine whether statistically significant differences existed at the 0.05 level. The results revealed significant differences in Class A between Q3 and Q5 (p=0.002) and between Q4 and Q5 (p=0.000) but no significant differences in Class B between Q3 and Q5 (p=1) or between Q4 and Q5 (p=0.854).

Thus, students in Global Human Sciences recognized the importance of AI-related skills and were interested in using text-generating AI for learning English. However, Economics students demonstrated significantly higher levels of perceived necessity and interest in AI skills than their interest in using text-generating AI for English language learning. These findings underscored a potential gap in how students from different faculties perceive and value AI-related skills.

Specifically, the relatively consistent responses from Global Human Science students highlighted a recognition of the importance of AI across various contexts. Meanwhile, the significant differences in responses from Economics students suggest a need for targeted interventions to increase their interest in and engagement with AI tools for English language learning within this group. One possible approach could be to integrate activities involving the use of generative AI when working with real-world economic cases written in English. This approach could showcase the practical applications and benefits of AI in economic scenarios, thereby enhancing student motivation and participation.

Overall, these results underscore the importance of tailoring educational strategies to the unique needs and perceptions of different student groups to maximize the benefits of integrating AI tools into English language learning. By addressing these gaps, educators can better prepare students for a future in which AI competency is increasingly critical.

Findings

Although this study requires further improvement, its results revealed some critical findings regarding Japanese university students' experiences with and attitudes toward text-generating AI.

First, approximately 70% of the participants in both Economics and Global Human Science classes had previously used text-generating AI, whereas the remaining 30% had no prior experience. Therefore, students are likely to have varying experiences with text-generating AI, indicating the need to design curricula that consider students' individual experiences.

Second, while students in both fields recognized the importance of AI-related skills, social science students showed significantly higher levels of perceived necessity and interest than their humanities counterparts. Social science students may feel a greater need for text-generating AI in their future careers, particularly in areas such as data analysis. However, more detailed data and a larger survey sample are necessary to confirm this finding.

Third, the students' interest in using text-generating AI to learn English was not influenced by whether they were in social sciences or humanities classes. Additionally, 50–60% of the students in both classes had not yet used text-generating AI for English learning. Their level of interest may evolve as they gain more experience with the technology in the context of language learning. It is important to guide students on how to effectively use AI to improve their English learning.

Fourth, Economics students exhibited significantly higher levels of perceived necessity of and interest in AI skills compared with their interest in using text-generating AI for English language learning. These findings highlighted a potential gap in how students from different faculties perceive and value AI-related skills.

In summary, students recognized the importance of AI-related skills, regardless of their major fields of study. However, the ways in which text-generating AI might be used vary across faculties and individuals. Personal experiences with text-generating AI could also influence the perceived necessity of and interest in such technology. Providing guidance based on each individual's intended use could help increase their interest in text-generating AI. Offering guidelines that align with each student's goals and encourage skill enhancement may help stimulate interest in AI and motivate them to use it more actively. Furthermore, presenting specific examples and successful cases can help students better understand how to practically utilize AI.

Simultaneously, rather than simply using text-generating AI to make tasks easier, it is crucial to instill and maintain a positive and constructive attitude toward utilizing AI to enhance students' abilities. To engage students in using text-generating AI, the benefits and challenges associated with its use must be highlighted. Thus, by addressing both the practical applications and inherent challenges of text-generating AI, educators can prepare students for integration into their academic and professional lives.

Conclusions

We investigated Japanese university students' experiences with and attitudes toward text-generating AI. A questionnaire with a 5-point Likert scale was distributed to 77 Japanese

university students in two classes, yielding four primary findings. (1) Approximately 70% of the participants in both classes had previously used text-generating AI, whereas 30% had no prior experience with it, indicating that experiences with text-generating AI vary across individuals. (2) While students in both fields recognized the importance of AI-related skills, social science students showed significantly higher levels of necessity and interest. They felt a greater need for text-generating AI in their future careers than their humanities counterparts. However, more detailed data and a larger survey sample are necessary to confirm this finding. (3) Regarding interest in using text-generating AI for English language learning, no significant difference was found between the groups. Additionally, 50–60% of the students in both classes had not yet used text-generating AI for English learning; however, their level of interest may evolve with more experience with the technology. It is important to guide students on how to effectively use AI to enhance their English learning. (4) Students in Economics demonstrated significantly higher levels of perceived necessity of and interest in AI skills compared with their interest in using AI for English language learning. This highlights a potential gap in how students from different faculties perceive and value AI-related skills.

Limitations and Recommendations

The current study has certain limitations. First, the small sample size of 77 students may limit the generalizability of the results. Therefore, the survey should be expanded to include a larger number of students with diverse backgrounds. As the number of students using text-generating AI is expected to increase, longitudinal data must be collected annually from first-year university students.

Second, a significant number of the students in this study did not use text-generating AI for English learning. They were expected to have varying levels of experience with text-generating AI. Therefore, they must be guided on how to effectively use AI to enhance their English learning. Additionally, more detailed data on students' specific uses and perceptions of text-generating AI across different disciplines could provide deeper insights into their attitudes and needs.

Despite these limitations, the study offers significant insights. As a continuation of this research, we aim to foster a more positive and constructive attitude toward AI among students by addressing both the practical applications and inherent challenges of text-generating AI. Tailoring educational strategies to the unique needs and perceptions of different student groups is crucial for maximizing the benefits of integrating AI tools into English language learning. By addressing these gaps, educators can better prepare students for a future in which AI competency is becoming increasingly critical.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

I utilized generative AI and AI-assisted technologies, specifically ChatGPT-3.5 and Copilot, to help polish the sentences in my paper. However, I did not use any AI to generate information for background research, nor did I employ it during the drafting stage or in creating the outline for this paper.

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Contact email: kasiwagi@kobe-u.ac.jp

Structural Validity of the Career Decision-Making Self-Efficacy Scale for Thai Vocational Students: A Confirmatory Factor Analysis for Career Guidance Development

Chanchai Yothasoot, King Mongkut's University of Technology Thonburi, Thailand
Surapon Boonlue, King Mongkut's University of Technology Thonburi, Thailand
Saranya Chuathong, King Mongkut's University of Technology Thonburi, Thailand
Sutiwat Supaluk, King Mongkut's University of Technology Thonburi, Thailand

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Abstract
This study aims to develop a model for Career Decision-Making Self-Efficacy (CDMSE), within the context of Thai society and to examine the alignment of its confirmatory components with empirical data. The study employed Confirmatory Factor Analysis (CFA) with a sample of 508 vocational students from technical colleges in Thailand in 2024. The instrument used was an online questionnaire, Reviewed by experts in psychology. The analysis results indicate that the model demonstrates a high level of alignment with empirical data, as evidenced by the following fit indices: χ^2=258.01, df=232, P-value=0.11589, RMSEA=0.015, all of which fall within acceptable ranges. This study has both theoretical and practical implications, confirming the suitability of the CDMSE model within the context of Thai vocational students. It Serves as a crucial foundation for developing an effective career guidance system that enhances vocational students' confidence in making appropriate career choices, ultimately reducing unemployment and addressing the future shortage of skilled labor. It can be concluded that the Career Decision-Making Self-Efficacy Scale for Thai Vocational Students, this study plays a vital role in supporting the development of specialized programs to enhance vocational students' decision-making capabilities regarding career choices. It fosters a deeper understanding of career development within the context of the educational system and labor market demands. The findings from this study can be applied to the design of career guidance curricula, the formulation of education and labor policies, and national workforce planning.

Keywords: CDMSE (Career Decision-Making Self-Efficacy), CFA (Confirmatory Factor Analysis), Vocational Students, Career Guidance

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Introduction

At present, all sectors are focusing on the development of human resources to drive the economy and society, especially in the field of vocational education, which plays an important role in producing skilled workers that meet the labor market's needs. Nonetheless, vocational education continues to encounter numerous obstacles and challenges, especially concerning students' career choices. Sukardi and colleagues (2019) Vocational Secondary Education plays a crucial role in preparing students with the essential skills to participate in the labor market, either through self-employment or as permanent employees. Yoto, Y. (2016). stated the importance of vocational education in terms of preparing students with the necessary skills and abilities before entering the labor market in the form of self-employment or working in various sectors. Maskey (2019) The research revealed that a significant obstacle to pursuing technical education is society's preference for general education over vocational training. Sakdapat (2024) The educational institutions are proposed to develop curricula that reduce the gap between student performance and the labor market's needs. It is the use of teaching methods in the current and future contexts; in addition, it also promotes learning from real experience. Regarding career decision-making, the concept of self-awareness (Self-efficacy) and Bandura (1977) explained that the more reliable the source of experience, the more reliable it was. This was in line with the research of Betz and Hackett (1981). He stated that the improvement of the method of assessing confidence in one's occupation ability was the development of a tool measuring one's ability to make career choices (Career Decision-Making Self-Efficacy (CDMSE), which was developed by the Career Decision-Making Self-Efficacy (CDMSE). Taylor and Betz (1983) It is a tool containing 50 questions to assess expectations of one's abilities or important behaviors in making career choices. Betz and colleagues (1996) developed a short tool (CDMSE-SF) with 25 items for simple usage. Repi and Kurniawati (2022) mentioned Career Decision Self-Efficiency, also known as Career Decision Self-Efficiency (CDMSE), which was an important factor for students in the final stages of their educational journey. Sukpanyium and colleagues (2023) said that if students explored and analyzed their achievements and used data from others' experiences, they would increase their awareness of the need for self-management and motivation to choose their careers, enhancing the confidence to lead to their career goals. Butsitarach and colleagues (2021) Moreover, the process of identifying an individual's ability to make an informed choice of a career path is linked to professional development; therefore, some elements can be customized to fit the specific context of the educational institution. Panphet & Somanandana (2023) The ability of self-awareness and the opportunity acceptance in the labor market and career landscape profoundly impact one's ability to participate in the career decision-making process. Purnama and Ernawati (2021) The empirical findings indicated a list of highly competent measures that could accurately assess various aspects of an individual's Career Decision-Making Self-Efficacy Scale (CDMSE). Gao and Wang (2024) The findings indicated that one's ability to make career decisions was important in influencing students' educational choices and willingness to apply to higher vocational colleges. These findings suggested that students' abilities and beliefs in their abilities in the field of career decision-making were the instruments determining their choice of education. Therefore, vocational institutions and enrollment management offices must use strategies that are designed to motivate, reinforce, and guide students' self-performance in career decisions. In addition, future research should take into account the multifaceted nature of the research topic, the selection of appropriate methods, or the integration of different approaches to provide a more holistic level of explanation of the fundamental mechanisms that govern the educational decisions of vocational students. Kamarudin and colleagues (2024) These findings affirmed the necessity of the integration of

psychological paradigms in terms of the development of career readiness frameworks for students enrolled in higher education institutions in Malaysia. Omar and colleagues (2023) Increased intellectual ability has been identified as the most important predictor of a student's self-efficacy about professional development. Graduates remain committed to future aspirations by fostering critical skills, especially skills related to intellectual abilities. Khampirat (2024) Future inquiries may explore in deeper detail the complex interactions between socio-demographic variables and personal characteristics to yield a more comprehensive understanding of occupational adaptation in the Thai context. Liu et al. (2022) stated that a clearer comprehension of future skill requirements might indicate the necessity of graduate education to align with career aspirations. Dangol and colleagues (2023) There are two major indicators for choice of career—self-efficacy and career choices. Self-efficacy is such as finding information in the library about the interested occupation, managing the job interview process, and knowing the work field. Career choices are such as career advancement with a high profile and the status of the organization, that is, size, status, image, and location of the organization or company in the feasible and common places.

Regarding the importance of recognizing one's ability to make career choices, the researcher focused on self-awareness in Career Decision-Making Self-Efficacy (CDMSE) in the context of Thai society and checked the consistency of the model with empirical data. Confirmatory Factor Analysis (CFA) was used on a sample of vocational education students in Thailand. The results of this study will significantly enhance the confidence of vocational students in making the appropriate career decision by contributing to the development of an effective career guidance system. This will result in a decrease in unemployment and a future shortage of skilled workers.

Research Methodology

Research Design

This study uses quantitative research using Confirmatory Factor Analysis (CFA) to examine the consistency of Career Decision-Making Self-Efficacy Scale (CDMSE) with empirical data in the context of Thai vocational education. This approach was chosen to confirm the component structure of the CDMSE measurement form and to assess the suitability of the tool for Thai vocational education students.

Population and Sample

The population in this study is vocational education students from technical colleges in Thailand. In the 2024 academic year, the sample selection was conducted using a multi-stage random sampling method to obtain a comprehensive representation of the vocational education student population nationwide. Taking into account the proportion of students in each region, major, and grade level. The tool used in the research is the CDMSE-SF (Career Decision-Making Self-Efficacy Scale-Short Form) developed by Betz and colleagues (1996) and adapted to the context of Thai vocational education students. The measurement consists of 25 questions, divided into 5 components: 1) Self-appraisal 2) Occupational Information 3) Goal Selection 4) Career Planning 5) Problem-Solving Each question uses a five-point scale ranging from "no confidence at all" (1 Score) to "Most confident" (5 Score).

Instrument Quality Inspection

1. Content Validity: Five psychology experts assessed the consistency between the questions and the operational definition using the Index of Item-Objective Congruence (IOC).
2. Construct Validity: Use confirmatory element analysis (CFA) to verify the conformity of the measurement model with the empirical data.
3. Reliability: Cronbach's Alpha Coefficient and Composite Reliability (CR) are analyzed.

Data Collection

Data collection for the 2024 academic year will be done by coordinating with the academic department of the technical college as a sample group. The questionnaire was distributed and collected through an online system.

Data Analysis

1. Analyze the basic data with descriptive statistics, including frequency, percentage, mean, and standard deviation.
2. Review the preliminary agreement of the confirmatory element analysis: Multivariate Normality, Linearity, Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) to measure the suitability of the data., Bartlett's Test of Sphericity to check the relationship between variables.
3. Analyze the confirmatory elements with the LISREL program to verify the conformity of the measurement model with the empirical data. Based on the Conformance Index values, they include Chi-square (χ^2) and χ^2/df, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), P-value.

Results

The researcher conducted a structural accuracy analysis by confirmatory factor analysis to verify the structural measurement characteristics of Career Decision-Making Self-Efficacy Scale (CDMSE) by examining the harmony of the research model with empirical data. Second-order confirmatory Factor Analysis Structural Consistency Analysis was performed by confirmatory factor analysis to verify the structural characteristics of the five components of Career Decision-Making Self-Efficacy Scale (CDMSE). To determine whether the observed variables are sufficiently correlated to analyze the elements, as well as to explore the KMO and Bartlett's Test of Sphericity, which is a statistical test of the hypothesis that this correlation matrix is an identity matrix, to determine whether this set of data is suitable for elemental analysis. The results of the correlation coefficient analysis between the observed variables were related to the 5 components of Career Decision-Making Self-Efficacy Scale (CDMSE), a total of 25 observable variables using the Pearson correlation. The correlation coefficient was found to be from .348 to .648, with the correlation coefficient between the variables differing significantly from zero at the level of .01. Considering Bartlett's Test of Sphericity, which is a statistical value that tests the hypothesis that this correlation matrix is an identity matrix. It was found that the value was 8148.034 (p=.000), indicating that the correlation matrix between the observed variables was statistically significantly different from the identity matrix at the level of .01. In line with the results of the analysis, the Kaiser-

Meyer-Olkin Measure of Sampling Adequacy (KMO) is .974. This shows that the various variables in this set of data, there are enough correlations and are suitable for the analysis of the elements. The details are shown in Table 1.

Table 1: Correlation of Observed Variables Component of Career Decision-Making Self-Efficacy (CDMSE)

var.	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25
Y1	1																								
Y2	.612*	1																							
Y3	.569*	.628*	1																						
Y4	.531*	.593*	.584*	1																					
Y5	.543*	.536*	.554*	.605*	1																				
Y6	.556*	.527*	.490*	.525*	.516*	1																			
Y7	.459*	.402*	.439*	.422*	.444*	.502*	1																		
Y8	.487*	.478*	.502*	.437*	.510*	.478*	.503*	1																	
Y9	.522*	.495*	.515*	.503*	.533*	.516*	.511*	.589*	1																
Y10	.531*	.511*	.550*	.526*	.534*	.546*	.492*	.572*	.539*	1															
Y11	.600*	.492*	.532*	.508*	.562*	.578*	.447*	.490*	.515*	.545*	1														
Y12	.471*	.482*	.457*	.485*	.503*	.442*	.406*	.428*	.471*	.479*	.583*	1													
Y13	.490*	.569*	.571*	.588*	.492*	.479*	.466*	.447*	.482*	.547*	.558*	.538*	1												
Y14	.498*	.458*	.465*	.488*	.551*	.457*	.471*	.443*	.542*	.538*	.549*	.458*	.602*	1											
Y15	.502*	.486*	.529*	.508*	.513*	.503*	.442*	.490*	.512*	.559*	.569*	.518*	.585*	.569*	1										
Y16	.475*	.434*	.473*	.480*	.488*	.550*	.400*	.392*	.492*	.500*	.551*	.494*	.519*	.478*	.493*	1									
Y17	.568*	.509*	.546*	.554*	.510*	.559*	.428*	.451*	.535*	.550*	.629*	.481*	.564*	.528*	.559*	.495*	1								
Y18	.518*	.555*	.537*	.569*	.556*	.540*	.444*	.554*	.574*	.608*	.599*	.493*	.634*	.577*	.586*	.519*	.633*	1							
Y19	.549*	.510*	.528*	.519*	.558*	.515*	.469*	.530*	.577*	.600*	.589*	.492*	.561*	.610*	.577*	.475*	.586*	.648*	1						
Y20	.482*	.453*	.510*	.539*	.502*	.447*	.424*	.467*	.504*	.539*	.500*	.481*	.490*	.472*	.541*	.456*	.584*	.558*	.594*	1					
Y21	.544*	.460*	.536*	.518*	.532*	.565*	.466*	.528*	.501*	.538*	.531*	.439*	.540*	.486*	.531*	.530*	.563*	.600*	.630*	.594*	1				
Y22	.499*	.452*	.479*	.472*	.488*	.499*	.360*	.369*	.474*	.507*	.565*	.512*	.471*	.499*	.542*	.544*	.579*	.483*	.504*	.424*	.481*	1			
Y23	.468*	.510*	.485*	.512*	.479*	.451*	.422*	.440*	.465*	.510*	.506*	.472*	.515*	.487*	.533*	.452*	.506*	.553*	.519*	.507*	.486*	.574*	1		
Y24	.472*	.447*	.507*	.463*	.474*	.445*	.451*	.457*	.446*	.502*	.505*	.439*	.545*	.537*	.544*	.462*	.517*	.587*	.524*	.460*	.495*	.565*	.587*	1	
Y25	.458*	.427*	.464*	.485*	.513*	.421*	.348*	.368*	.409*	.492*	.438*	.458*	.421*	.465*	.468*	.474*	.458*	.512*	.464*	.458*	.493*	.601*	.492*	.600*	1
Mean	3.45	3.57	3.65	3.68	3.63	3.45	3.22	3.49	3.45	3.52	3.54	3.60	3.59	3.43	3.62	3.56	3.42	3.47	3.48	3.57	3.66	3.63	3.60	3.60	3.67
SD	1.06	1.04	1.04	1.03	1.07	1.08	1.06	1.00	0.99	1.02	1.05	1.02	1.00	1.04	1.04	1.08	1.02	1.04	1.00	0.99	1.01	1.05	1.05	1.05	1.03

KMO : Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .974
Bartlett's Test of Sphericity = 8148.034, p = .000, df = 300

The results of the structural alignment analysis of Career Decision-Making Self-Efficacy Scale (CDMSE) showed that the model was harmonized with the empirical data.

The criteria for checking the consistency of the confirmatory elements from the statistics used in the test are considered according to Table 2.

Table 2: Criteria for Checking Consistency in the Analysis of Affirmative Elements and Results of the Structural Correctness Analysis of the Elements of Career Decision-Making Self-Efficacy (CDMSE)

Fit Statistics	Criterion	Computed values	Judgment result
1. Chi-Square χ^2	p>.05	.12	Passed
2. Relative Chi-Square χ^2/df	< 2	1.11	Passed
3. Goodness of Fit Index (GFI)	≥.95	.96	Passed
4. Adjusted Goodness of Fit Index (AGFI)	≥.95	.95	Passed
5. Normed Fit Index (NFI)	≥.95	.99	Passed
6. Non-Normed Fit Index (NNFI)	≥.95	1.00	Passed
7. Comparative Fit Index (CFI)	≥.95	1.00	Passed
8. Root Mean Square Error of Approximation (RMSEA)	<.05	.015	Passed
9. Root Mean Square Residual (RMR)	<.05	.022	Passed
10. Standardized Root Mean Square Residual (SRMR)	<.05	.022	Passed

From Table 2, it is found that the Chi-square value is 258.01, which has a probability value of .12 at 232 degrees of autonomy (df=232), with a chi-square to degrees of autonomy ratio of 1.11, which is less than 2. The Adjusted Harmonized Index (AGFI) is .96 and the Adjusted Harmonized Index (AGFI) is .95. The Comparative Harmonization Index (TLI) or (NNFI) is 1.00, the Comparative Harmonization Index (CFI) is 1.00, the Mean Square Root Index of Estimation Margin (RMSEA) is .015, the Root Index of the Mean Squared of Remainder (RMR) is .022, and the Root Index of the Square of Standard Remainder (SRMR) is .022.

Table 3: Results of the First-Order Confirmatory Factor Analysis Component of Career Decision-Making Self-Efficacy (CDMSE)

Variables	**Factor loading**		**t**	**r^2**
	b (SE)	β		
First-order confirmatory Factor Analysis				
Self-Appraisal				
Y1	1.00	.74	<------>	.55
Y2	.96 (.05)	.71	17.56**	.50
Y3	1.01 (.06)	.75	16.75**	.56
Y4	1.02 (.06)	.75	16.87**	.57
Y5	1.03 (.06)	.76	16.96**	.58
Occupational Information				
Y6	1.00	.72	<------>	.51
Y7	.91 (.06)	.65	14.15**	.43
Y8	.99 (.06)	.71	15.27**	.50
Y9	1.05 (.07)	.75	16.02**	.56
Y10	1.10 (.06)	.79	16.96**	.62
Goal Selection				
Y11	1.00	.76	<------>	.58
Y12	.90 (.05)	.68	16.89**	.47
Y13	.99 (.06)	.75	17.46**	.56
Y14	.96 (.06)	.73	16.90**	.53
Y15	1.00 (.06)	.76	17.85**	.58
Y16	.90 (.06)	.68	15.76**	.47
Career Planning				
Y17	1.00	.77	<------>	.59
Y18	1.07 (.05)	.82	19.85**	.68
Y19	1.03 (.05)	.79	18.85**	.62
Y20	.97 (.06)	.74	17.53**	.55
Y21	.97 (.06)	.75	17.68**	.56
Problem-Solving				
Y22	1.00	.77	<------>	.59
Y23	1.00 (.06)	.77	17.28**	.59
Y24	1.01 (.06)	.77	17.95**	.60
Y25	.99 (.06)	.76	17.10**	.58

Table 4: Factor Loadings From the Second-Order Confirmatory Factor Analysis of the Career Decision-Making Self-Efficacy (CDMSE)

Variables	Factor loading		t	r^2
	b (SE)	β		
Second Order Confirmatory Factor Analysis				
Self-App	.71 (.04)	.95	18.04**	.91
Occu-In	.68 (.04)	.95	17.27**	.90
Goal-Sel	.73 (.04)	.96	19.16**	.93
Car-Plan	.74 (.04)	.97	19.42**	.94
Pro-Sol	.67 (.04)	.87	17.28**	.76

Chi-square=258.01 df=232 p-Value=.12 χ^2/df =1.11 GFI=.96 AGFI=.95 NFI=.99 TLI / NNFI=1.00 CFI=1.00 RMSEA=.015 RMR=.022 SRMR=.022

Table 5: The Correlation Matrix Between Latent Variables of the Career Decision-Making Self-Efficacy (CDMSE)

Correlation Matrix Between Latent Variables	Self-App	Occu-In	Goal-Sel	Car-Plan	Pro-Sol	CDMSE
Self-App	1.00					
Occu-In	.91	1.00				
Goal-Sel	.92	.92	1.00			
Car-Plan	.92	.92	.93	1.00		
Pro-Sol	.83	.83	.84	.85	1.00	
CDMSE	.95	.95	.96	.97	.87	1.00

** p < .01, The numbers in parentheses are the standard tolerances.
<------> SE and t values are not reported as they are mandatory parameters. (constrained parameter)

From Table 3, the results of the analysis of the second confirmatory component of Career Decision-Making Self-Efficacy Scale (CDMSE) are presented, which consists of the component weight value in the form of a raw score (b). Element weight in the form of a standard score (β) Standard Deviation (SE) and Prediction Coefficient (r^2).

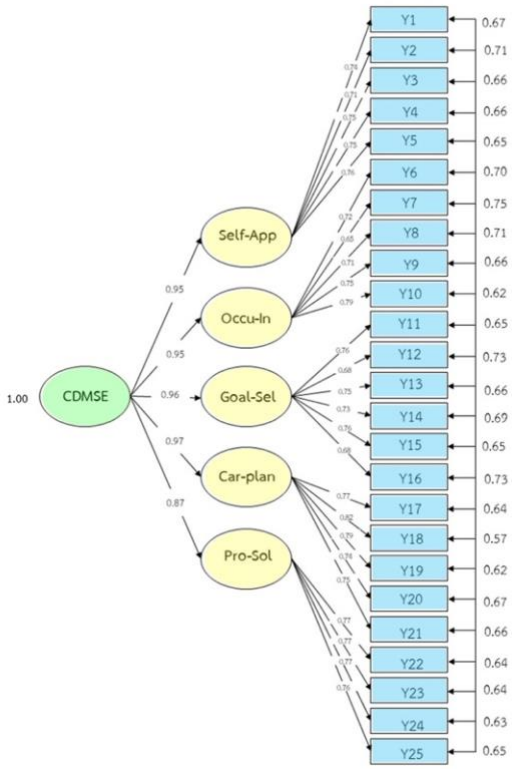
Considering the results of the analysis of the first component, which is the result of a model analysis that shows the relationship between the perception of Career Decision-Making Self-Efficacy Scale (CDMSE) and the five components: 1) career self-survey, 2) career information, 3) career goal selection, 4) career planning, and 5) career problem-solving. It was found that the component weights of all variables were statistically significant at the level of .01, indicating that all 25 variables were characterized as structural indicators of Career Decision-Making Self-Efficacy Scale (CDMSE), with the variable having component weights in the form of standard scores ranging from .65 to .82.

In conclusion, Career Decision-Making Self-Efficacy Scale (CDMSE) component indicators developed in this study are statistically significant indicators at the .01 level. All indicators have positive component weight. This means that if students have high attributes according to these indicators, it will result in a higher awareness of their ability to make the Career Decision-Making Self-Efficacy Scale (CDMSE).

Considering the results of the analysis of the second confirmatory component, which is the result of model analysis, which shows the relationship between the second component of

Career Decision-Making Self-Efficacy Scale (CDMSE) and the five components: 1) Career self-survey, 2) Career information, 3) Career goal selection, 4) Career planning, and 5) Career problem-solving. The weights in the form of standard scores ranged from .87 to .97, indicating that these five components are statistically significant components of the Career Decision-Making Self-Efficacy Scale Choices (CDMSE). In the Cognitive Measure of Career Decision-Making Self-Efficacy Scale (CDMSE), there are elements of career planning, followed by career goal selection, career self-survey, and career self-exploration. Career information and career problem-solving. Each of these elements There were variations in the composition of the Perception of Vocational Career Decision-Making Self-Efficacy Scale (CDMSE) of 94.00%, 93.00, 91.00, 90.00, and 76.00 respectively. The correlation coefficient ranges from .83 to .97, indicating that the Cognitive Component of Career Decision-Making Self-Efficacy Scale (CDMSE) in Career Self-Survey Career information, career goal selection, career planning, and career problem-solving are not independently separated. The composition analysis confirms the second component of Career Decision-Making Self-Efficacy Scale (CDMSE) as shown in Figure 1.

Figure 1: Results of the Analysis of the Second Affirmative Component of the Perception of Career Decision-Making Self-Efficacy Scale (CDMSE)



Chi-square=258.01 df=232 p-Value=.12 "χ" ^"2" "/df"=1.11 GFI=.96 AGFI=.95 NFI=.99 TLI / NNFI=1.00 CFI=1.00 RMSEA=.015 RMR=.022 SRMR=.022

Conclusion

The objective of this investigation was to examine the structural accuracy of Career Decision-Making Self-Efficacy Scale Perception Scale (CDMSE) in the context of vocational education students in Thailand. The first component's analysis, which was the result of model analysis, demonstrated the correlation between the perception of Career Decision-Making Self-Efficacy Scale (CDMSE) and 5 components, as follows: 1) Self-Appraisal, 2) Occupational Information, 3) Goal Selection, 4) Career Planning, and 5) Problem-Solving.

Regarding 25 observable variables using Pearson correlations, it was found that the correlation coefficient was significantly different from zero statistically at the level of .01, and all variables were sufficiently correlated and suitable for elemental analysis. The second confirmatory component analysis was the result of the structural correctness analysis of the components of Career Decision-Making Self-Efficacy Scale (CDMSE), consisting of the 5 components. It was very consistent with empirical data. In addition, other conformity indices held up in terms of reliability and accuracy. The results showed that the Career Decision-Making Self-Efficacy Scale (CDMSE) had good measurement properties, with the internal confidence value of each component at an acceptable level. The Affirmative Element Analysis (CFA) also supported the structural validity of Career Decision-Making Self-Efficacy Scale (CDMSE) in the context of vocational education students in Thailand. It showed that each question could measure the elements that were appropriately defined. This research's results were in line with the core concept of Bandura's (1977). The heightened reliability of experiential sources positively correlated with an increase in perceived self-efficacy. The Career Decision-Making Self-Efficacy Scale (CDMSE) in the context of vocational education students in Thailand was useful for career guidance teachers and counselors since it enabled a more precise determination of the strengths and areas for the advancement of each student. This resulted in the provision of suitable guidance and assistance. (Cui, 2024) Additionally, the inherent flexibility and adaptability of the framework enabled integration into educational and professional environments by addressing an array of diverse requirements and preferences to strengthen the confidence of vocational students in making the right career choice. Thus, it will lead to a reduction in unemployment and a shortage of skilled workers in the future. In addition, adaptability is crucial because technological advancements and shifting economic landscapes allow individuals to update their skills and knowledge continuously, especially when considering their upcoming careers in the future. While technology is constantly evolving, new imagined opportunities will emerge. Therefore, emphasizing these skills in education and training will be essential for Career Decision-Making Self-Efficacy.

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Contact email: Chanchai.yoth@kmutt.ac.th

Who's on First? Who's on Second? Getting Our Students to Home Today

Denese Wolff-Hilliard, Houston Christian University, United States
Tia Caster, Houston Christian University, United States

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Abstract
Just as baseball teams are made up of diverse players with unique skills, our classrooms are filled with students who bring different strengths and challenges to the field. First-in-family students, who make up more than half of the enrolled population in American higher-education institutions, often face unique hurdles—academic struggles, financial pressures, and social isolation—that can impact their success. Yet, with the right coaching and playbook, these students can become all-stars in their academic journey. This workshop will focus on strategies to differentiate instruction and support first-in-family students, helping them build cultural capital and a sense of belonging. Readers will learn how to identify individual student needs and create a game plan that fosters academic and social growth, ensuring every student has the chance to hit a home run in their college experience.

Keywords: First-in-Family Students, Differentiation, Differentiated Instruction, Cultural Capital, College

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Introduction

Many skills are required to create a winning team--diverse skills, strategy, and flexibility to name a few. Similarly, teaching requires some of the same skills. Each student arrives in a classroom with a set of knowledge and skills while also having gaps in understanding. Regardless of the content, some students are more prepared than others, but all students need and deserve instruction at their level. Unmet needs tend to lead to disengagement, frustration, and other academic struggles. Each student needs different coaching based on where they are at--dugout to third base. This baseball analogy will help to identify the students in the classroom and how professors can support them.

Dugout

In baseball, the players in the dugout are the ones who are in uniform but might be surprised they are on the roster. They do not necessarily have their cleats, gloves, bats, or other necessary equipment for success–they simply remember to show up. In the classroom, these tend to be the students who write their essays on their phones and are unprepared with supplies like a pencil and paper but have the trendiest attire. The foundation of content needs to be built.

English Class

Some students in this stage may face academic challenges that hinder their reading and writing performance, often falling below the class average (Kuh et al., 2006). Their lack of writing experience may be the most prominent reason that challenges this group of students. Resembling a stream-of-consciousness style that can confuse and distract readers is often how these students tend to write. They may have difficulty formulating a clear thesis statement or developing their ideas in a logical progression. Further complicating this group's writing experience is their limited understanding of the conventions of grammar and punctuation, which further complicates their success. Because this group struggles to access basic academic supplies, such as notebooks and digital devices, they may rely on non-traditional tools, such as smartphones, to write assignments. In essence, these students may experience a disconnect between their writing abilities and the educational environment.

Math Class

In a college-level math class, these students tend to count on their fingers, as they lack math proficiency and procedural fluency. They also lack confidence in themselves and their knowledge. These students tend to either keep quiet and not ask questions or draw attention to another part of themselves (e.g., making jokes to emphasize that they are funny). They may fail assignments, not bring a calculator to class, and not ask for any help.

On Deck

When a baseball player has made it on the roster, they have their uniform and other equipment, and they have some skills, they end up in the line-up and get ready to bat. These are the players who are on deck. They understand the game and are ready to play. In the classroom, this is the student who has some experience and a decent grasp of the content. They have the foundation but often will sit on the perimeter of the classroom. They are not the students who will ask questions, they are easily crushed when they get something wrong

or a poor grade, and they cannot handle any exceptions to the rules. These students not only lack confidence, but more importantly lack self-efficacy. Often these are first-in-family students who not only are struggling academically but also have little cultural capital or sense of belonging. They are questioning everything they are doing and even why they are trying this college thing.

English Class

The writings of this group typically meet assignment requirements but lack depth and critical analysis. While their writing may address key points, the work often feels superficial because they include concepts without connecting them to broader themes or real-world applications. Encouraging more detailed explanations and contextual connections is essential for improving their writing (Fernstein & Reda, 2009). Although students in this group show basic comprehension, they often struggle with depth and critical analysis that could enhance their work.

Math Class

These students tend to desire to excel or at least do well; however, they may have been convinced that they do not have a "math brain" so they cannot do well. Despite research from Van De Walle and colleagues (2023), students and teachers still tend to believe that the ability to learn and comprehend mathematics successfully is hereditary–which is a false assumption. Math professors are responsible for meeting these students where they are and providing the support they need. These students tend to follow steps exactly as they are given and cannot handle any variations to the examples given to them. This is often why they might be able to do well on homework or classwork that is exactly like the notes but freeze when the test has a different variation of the same type of problem.

Up to Bat

It is now the player's turn to bat. They have a bit more skill, they are coachable, and they have had some practice applying their skills. In the classroom, they are willing to answer some questions and realize they have knowledge gaps but might not be able to articulate them. These students will say that they are not the "strongest student" and need the biggest champion due to being belittled and crushed many times by themselves. These students may have had an extended relative attend college who can give them some input, but they still tend to be unsure of themselves.

English Class

This group demonstrates basic writing mechanics and recognizes their need for support. Low-stakes writing assignments enhance their skills and confidence. Gradual challenges and scaffolded assignments further boost their confidence. Specific feedback helps them meet assignment requirements, acknowledge strengths, and improve their writing (Eckstein & Bell, 2023). With consistent guidance and encouragement, these students can celebrate continuous improvements, which is crucial for their development.

Math Class

These students need every step outlined for them and can be heard saying, “but my other teacher showed me this way.” Once they understand one method or practice, they do not have the confidence to veer from it. This group of students needs someone to come alongside them to highlight their strengths instead of their deficiencies (Van de Walle et al., 2023). They are already aware they have shortcomings and remind themselves of them often. These students need the biggest cheerleader as they apply what they have learned to help combat their negative self-talk.

First Base

First base is the first place a baseball player gets to after they hit the ball. These athletes tend to practice regularly and listen to their coaches. They analyze what is being presented to them, and they have proven themselves while still lacking self-confidence. In the classroom, these students have some success with content but still need approval and reassurance. They rely on guidance from the instructor, and you may hear them say, “I think I know what I am doing.” These students check first, then complete.

English Class

This group of students has a solid grasp of writing fundamentals but requires ongoing support. They can follow guidelines and understand rubrics but lack the confidence to innovate. Their writing is formulaic due to hesitation to experiment. Peer review as an instructional strategy works well with the First Base student group. Implementing peer review draft workshops can help them critique their work and make independent decisions (Baker, 2016). Providing numerous opportunities for them to step outside their comfort zone will boost their confidence and encourage experimentation in their writing.

Math Class

These students tend to rely heavily on a calculator, even if they do not know how to use it. While they tend to have an increased procedural fluency and can recognize different types of problems and methods, they still need confirmation and reassurance that they arrived at the correct answer. Based on the continuum of understanding from instrumental to relational, these students have a conceptual understanding of the mathematics presented, while relational understanding is the goal for all students across all mathematics content (Van de Walle et al., 2023).

Second Base

Second base is the next place to which a baseball player progresses. They take initiative and evaluate the other team. They still need a bit of reassurance but also complain about being talked to as if they are still in the dugout. In the classroom, these students can lack courage to get started and may need motivation. They will complete and then check.

English Class

Writers at this stage have mastered the basics and focus on executing their ideas with precision. Organizing their ideas with clearer purpose and direction, they are intentionally

learning to apply grammar and vocabulary, increasing their writing skills and syntactical awareness. They exhibit strong fundamental skills and can continue to improve their organizational skills. Similar to the First Base students, this group should be encouraged to use the writing center services because of the immediate benefit they gain from working with a peer writing tutor (Zhang & Kim, 2024). Because of their lack of confidence, this student group benefits from consistent guidance and reassurance.

Math Class

These students tend to be aware of the common misconceptions but may still get them mixed up. While the former students need reassurance that they got it right, these students need reassurance they did it right. They have moved further on the continuum of understanding closer to a relational understanding (Van de Walle, 2023). This group can incorporate reasonableness into their analysis as they evaluate a problem and their answer.

Third Base

These students are one step from scoring a run for their team. They only need a bit of coaching, and they take off on their own. They have grit and perseverance, and the "I got this" mentality while creating plays and strategies for their team. In the classroom, these students are often the unofficial peer tutor. They have ingenuity and write prompts and practice problems for their peers. They finish early and accurately and need to be pushed to continue to excel and grow. These students also tend to have cultural capital and a sense of belonging.

English Class

These students are developing a voice and a recognizable writing style, allowing them to express themselves clearly and creatively. Their writing features imagery and thoughtful reflections, engaging readers with authenticity and depth. Encouraging this group to write so that each piece reflects their unique experiences and emotions is the instructor's goal, underscoring the importance of nurturing individuality in the writing process (Soiferman, 2019). This group of students may also ask to personalize the writing task, which is a sign of their growing confidence. By encouraging this personalization, the professor allows Third Base students to discover their distinct literary voices and take ownership of their writing. In this supportive atmosphere, students are empowered to explore their ideas, express their individuality, and add to their writing repertoire.

Math Class

In a math class, this type of student is confident and may see assignments, especially homework with many problems practicing the same concept, as busy work. This tends to lead to their not doing the homework but having success on tests and quizzes. When these students do complete their work, they might follow steps the instructor never showed them or come up with a way that makes sense to them (and works). This increases the need for the instructor to take a step back, consider this new method or process, and, if it works for them and allows them to arrive at the correct answer while understanding the concept, allow it. Conversely, these students may question why they must show their work if they "got the right answer" to a problem. This group of students needs to be encouraged to continue to grow by creating solutions to real-world problems that need a solution, not simply be given more work to

complete. One way to encourage this extended type of thinking is to ask the student to determine a problem that needs to be resolved that would make their lives easier or better. This makes it personal to them and therefore increases motivation to resolve it.

The Baseball Playbook: Differentiation Strategies

According to Carbaugh and colleagues (2016), differentiation includes four pillars: knowledge-centered, assessment-centered, learning-centered, and community-centered. Knowledge-centered differentiation suggests that the teacher helps students set high-achieving goals and then either provides support or challenges for students to reach their goals (Carbaugh et al., 2016). Assessment-centered differentiation involves providing frequent, timely feedback to students. The feedback then directs the instructor's teaching and students' practice (Carbaugh et al., 2016). A learner-centered classroom is unlikely without the teacher knowing the learners and their interests and building relationships with their students. Relating content to the learners' interest is one way to enhance teaching and learning. When professors build relationships with their students, the opportunity for their classroom to feel community-centered can begin (Caster, 2022). The discussion of pertinent topics along with content is one way to establish the ideal classroom environment and provide opportunities for students to build cultural capital. Another way to promote a community-centered classroom is to celebrate differences and allow students to take risks and make mistakes (Caster, 2022). This can facilitate enhanced teaching and learning (Carbaugh et al., 2016).

Education researchers Finnan and Kombe (2011) believed in nontraditional interventions to help facilitate remediation. They discussed a program in which students were taught two academic years of mathematics in one school year. The focus was not only on content but also on the students' identity, increasing their confidence, and providing a "safe and nurturing environment" (Finnan & Kombe, 2011, p. 2). While this study focused on adolescent students, this is the case for all students, especially those who struggle.

Wu (2016) compared a group of students in the United States to those in Shanghai, China, regarding math self-efficacy and investigated the effects of math professors' support of students, positive teacher-student relationships, and support provided to professors. The study showed that when math teacher support increased, student self-efficacy also increased (Wu, 2016). The students in Shanghai had much higher self-efficacy and higher math achievement (Wu, 2016). Wu (2016) also discussed how students perceived math teacher support as positively associated with student math self-efficacy in both groups of students.

Practically, differentiation could look different based on the content, student needs, physical classroom setup, and even the instructor's personality. Tiered assignments, flexible grouping, and targeted support are three ways to approach differentiation.

Tiered Assignments

The purpose of tiered assignments is to provide modified tasks based on students' readiness and skill level. As students become more proficient, the expectations increase. This requires instructors to know their students, understand each student's knowledge gaps, and use strategies to scaffold content along the way.

Flexible Grouping

Grouping students based on their various skills and abilities can allow instructors to provide focused instruction to various groups of students. For example, in a math class, if one group of students struggles with solving multi-step linear equations while another group struggles with finding roots of quadratic equations, each group can receive the instruction they need. In the next class, if someone from the first group has moved on to another topic, they can join a different group. The idea is structured flexibility with grouping based on student needs.

Targeted Support

Using data to identify students who are at risk, on target, and excelling requires instructors to make data-driven decisions. In an English course, this could look like a writer's workshop towards the beginning of the semester, where some students clearly need additional support with their outline. Targeted support allows the instructor to identify those students and offer specific office hours to address this topic or, if the university has a writing center or other academic support and resources, guide students to those resources. This is not the instructor simply telling the students to go to the writing center or get tutoring; rather, this is the professor holding specific conversations with those students, ideally in a one-on-one setting.

Game Plan

Some common obstacles for first-in-family students include financial pressures, academic preparedness (or lack of it), and cultural barriers. Some strategies our university has used to address the unique needs of first-in-family students include staff members, Student Success Specialists, who are assigned to first-year students with specific majors (e.g., Humanities majors have one Student Success Specialist, Education and Behavioral Sciences majors have a different Student Success Specialist, etc.). Additionally, all first-year students are part of the First Year Seminar (FYS) program. They are grouped by the same or similar majors, with many of the sections being taught by professors who teach within their major and have an upper-level peer mentor who is also in their major. This gives students a significant sense of belonging as they navigate their first year at the university. Within the FYS course are assignments with the specific outlined purpose of building cultural capital. For example, as a group project, students must identify a faculty or staff member to interview about growth mindset. Many groups select a professor they hope to take later in their program. Then, the group must reflect on their growth and fixed mindsets, create a presentation, and present it to the class.

Conclusion

Just like baseball coaching, effective teaching requires flexibility, understanding different players' needs, and targeting strategies. The progression from the dugout to home plate parallels the journey of first-generation students as they acquire confidence, strengthen skills, and garner cultural capital throughout their college experience. When professors recognize each student's progress, ranging from the Dugout to the Third Base, they can provide the appropriate support and challenges. By using intentional differentiation strategies, such as tiered assignments, flexible groupings, and targeted support, professors can cater to students' varying needs and provide specific guidance. Programs such as First Year Seminar and Student Success Specialists play a crucial role as supportive team members, assisting students in navigating each stage of the academic journey.

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Contact emails: dhilliard@hc.edu
tia.caster318@gmail.com

The Development of an Automated Response System Using AI Chatbot to Support and Resolving Network-Related Problems at Thai University

Sangtong Boonying, Rajamangala University of Technology Suvarnabhumi, Thailand
Suwit Somsuphaprungyot, Rajamangala University of Technology Suvarnabhumi, Thailand
Anek Putthidech, Rajamangala University of Technology Suvarnabhumi, Thailand
Amnaj Sookjam, Rajamangala University of Technology Suvarnabhumi, Thailand
Parinya Natho, Rajamangala University of Technology Suvarnabhumi, Thailand

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Abstract
This research aims to design an automated response system using an AI Chatbot to diagnose internet connectivity problems in higher education institutions. The focus is developing and implementing a system to respond to and advise university staff and faculty regarding internet connectivity issues. Users are allowed to request help troubleshooting at any moment. The system uses artificial intelligence technology to assess and manage users' data to deliver basic troubleshooting techniques, including assessing internet signals, network configuration, and fixing common errors. Methodologies have been established to evaluate the efficacy of the chatbot in enhancing user satisfaction, alleviating the burden on IT support personnel, and augmenting overall effectiveness in network troubleshooting. The assessment results produced an estimate of precision performance at 89% and a recall performance of 89%. User satisfaction surveys indicated an 85% ($\bar{X}$=4.69, S.D.=0.48) satisfaction rate among the students, faculty, and staff concerning core connectivity issues. Implementation of the project resulted in a 30% reduction in the volume of the IT helpdesk workload, allowing staff to focus on higher-priority tasks. Upon evaluating the distinct characteristics, it was determined that the quality of problem-solving ($\bar{X}$=4.75, S.D.=0.45), operational efficacy ($\bar{X}$=4.68, S.D.=0.51), and user-friendliness ($\bar{X}$=4.63, S.D.=0.48) emerged as the highest-ranked characteristics. The results indicate a significant reduction in the workload of IT support staff, a shorter average response time, and a high level of user satisfaction. This research highlights the benefits of implementing AI-powered solutions for problem-solving internet connectivity in higher education institutions. It provides valuable insights for the future development of automated support systems in Thai universities.

Keywords: Automated Response System, Artificial Intelligent, Chatbot

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Introduction

Nowadays, managing the network system at universities has been more complicated. Because of the high dependence on consistent and high-speed access to the internet, problems occur in the area of networking that cause the discontinuation of both academic and administrative functions. It is relevant at Thai universities because large-scale digital infrastructure is expanding with their service requests for fast and efficient technical support. However, traditional support for network-related issues through helpdesks has sometimes failed to meet the ever-rising inquiry requests, creating delays that slow the process. Thus making the users very dissatisfied. The research then sampled students and staff using the Internet service at the Rajamangala University of Technology Suvarnabhumi. It was found that most of the sample group advised that the university should provide faster service when the Internet is out of service. Therefore, an automated response system using AI chatbot technology offers a promising solution to enhance technical support services. AI chatbots can handle routine inquiries and network troubleshooting tasks, providing faster, more efficient solutions (Gentsch, 2019).

AI chatbots have emerged as a reliable tool to automate customer service and technical support, reducing human intervention for everyday and repetitive tasks (Shawar & Atwell, 2007). By using machine learning algorithms and natural language processing, the chatbots engage the user in a conversation-like manner in order for them to solve network problems much faster. Such systems can be configured to identify typical issues-for instance, Wi-Fi connectivity, IP address conflicts, or general slowness of the network, and walk users through some troubleshooting steps without immediate intervention by IT staff, as stated by Adamopoulou and Moussiades (2020). Thus, implementing an AI chatbot for network-related support may increase operational efficiency and improve the user experience in educational institutions.

In Thai universities, integrating AI-driven chatbots into network support services could alleviate the workload on IT departments, which are often overwhelmed with many support requests, especially during peak academic periods. A well-designed chatbot can offer 24/7 support, instantly addressing minor and critical network issues. Additionally, such systems can be continuously updated to adapt to new problems and improve performance over time (Klopfenstein et al., 2017). The real-time data generated from chatbot interactions could help IT departments analyze recurring issues, enabling proactive network infrastructure management (AbuShawar & Atwell, 2015).

This study aims to develop and implement an AI chatbot system to support and resolve network-related problems at a Thai university. Developing a system that can respond to and advise university staff and professors about internet connection problems so that users can inquire about how to solve the problems at any time. The system uses artificial intelligence technology to analyze and process user data to provide basic troubleshooting methods, such as checking internet signals, setting up networks, and fixing common errors. The focus is on improving the efficiency of IT support services, reducing response times, and enhancing user satisfaction through automated solutions. By examining the chatbot's performance in a live university setting, this research will provide insights into the benefits and limitations of AI-driven technical support in educational institutions.

Literature Review

The development of an automated response system using AI chatbots to resolve network-related issues has been of great interest in recent times, considering that there is enormous demand to ensure that IT management services function effectively and are scalable. They have generally been applied in education, healthcare, and customer service, amongst others, as they serve as a digital assistant through the return of responses upon the inquiries placed forward by the users with a quicker and more effective attendance rate. Thus, at Thai University, the application of AI chatbots has been relevant in supporting and troubleshooting network problems to enhance user experience and reduce the workload for the IT support staff. This literature review aims to debate current research and technologies dealing with AI chatbots, focusing on their role in network issue resolution, user experience, and higher education institutions.

AI Chatbots and Applications in IT Support

Along the line, AI chatbots have been researched for automated response systems, with most studies indicating the vast potential of such systems to improve customer service and support in varied industries. Equipped with natural language processing and machine learning, a chatbot can simulate human-like conversations to solve common user problems with no human intervention. It has been the backbone for AI chatbots, including understanding and responding to user queries in a much human-like fashion. Some valuable NLP techniques that have taken chatbots' performance further are sentiment analysis, entity recognition, and machine translation. Jurafsky and Martin (2021) discussed the basics of NLP and its application in developing chatbots, especially regarding understanding various user inputs and generating appropriate responses. This also calls for adapting the chatbot to understand Thai and English in a Thai university setting. Adamopoulou and Moussiades, 2020 critically reviewed various chatbot technologies, from rule-based systems to AI-powered conversational agents with good problem-solving capabilities. AI chatbots have also succeeded in IT support concerning general technical issues like connectivity problems, software debugging, and account management. Bhakta and Savarimuthu (2017) discussed how AI can automate IT helpdesk operations through chatbots to take some load off human support personnel for round-the-clock support. Problems related to internet connectivity, network speed, or logging into the Wi-Fi network are highly prevalent in big institutions like universities. Several researchers have proposed a range of AI-driven systems for the above-mentioned issues. Hsu and colleagues (2019) designed a system that could predict network failures using machine learning and automate recovery processes in real-time, which can be integrated into chatbot interfaces. Such systems allow users to receive immediate feedback on their network problems, improving response times and overall satisfaction. In particular, chatbots help detect and resolve network issues by guiding users through diagnostic steps and suggesting solutions, minimizing user downtime in academic settings.

AI Chatbots in Thai Higher Education and Challenges

Understanding user behavior and preferences is critically important in designing a university chatbot. Okonkwo and Ade-Ibijola (2020) explained that the construction of a university-based chatbot should be user-centered. For this reason, they argue that such a chatbot should be intuitive and easy to operate, capable of handling problems students most often encounter, which relate to networking, course registration, and exam schedules. This, in turn, will ensure wider adoption of the chatbot and increased satisfaction of its users. Various universities

worldwide have already started deploying AI-enabled chatbots to improve the student services they provide, specifically for IT support. For instance, the Chatbot "Pounce" is being used at Georgia State University to answer queries about admission and financial aid for students (Baker et al., 2018). While Pounce does not relate to network issues, it shows how universities can use AI chatbots to answer routine inquiries, which could be expanded to IT-related problems in Thai universities. In the Thai context, AI technology in education is on the rise, but limited research focuses on the specific application of chatbots in resolving network-related problems. Chaiyasoonthorn and colleagues (2020) also researched how AI can enhance the educational experience in Thailand, focusing on how AI technologies can do some tasks for school administrators. Very little literature has discussed using AI chatbots for network troubleshooting within universities, an area that seems promising for further research. In these circumstances, the application of AI chatbots significantly increased the performance of IT support teams by automating routine inquiries and freeing human resources to resolve higher complexity problems. On customer service and AI chatbots, a study by Xu and colleagues (2020) concludes that automatized systems reduce response time while enhancing customer satisfaction. The following research concerns university IT departments facing many complaints regarding networking, which can be handled efficiently using chatbot systems.

Despite the advantages, there are many challenges in implementing chatbots for network problem resolution at universities. The main challenge is the accuracy of the chatbot in diagnosing technical problems. In most cases, chatbots fail to diagnose complex or uncommon network issues. Yousif and colleagues (2021) discussed the limitations of chatbots in technical support and suggested using AI chatbots together with human agents for better problem resolution. Success within a Thai university environment means the technical and language challenges a chatbot system must face. The AI chatbots will be updated further because of advances in artificial intelligence, machine learning, and data analytics. Eventually, conversational AI will be improved by being context-aware and able to predict problems that can make the network more robust in problem resolution. Bock and colleagues (2020) add that in the future, an AI chatbot will be able to predict and prevent network issues from happening through analysis of large volumes of data concerning network activity. Therefore, This proactive approach will prove particularly beneficial for universities that rely heavily on a stable and reliable network infrastructure.

Research Methodology

This research aims to design, develop, and evaluate a Thai university's automated AI chatbot system for resolving network-related problems. A design and development research (DDR) approach focuses on creating an AI-based solution. The study is divided into three main phases: (1) needs assessment and problem analysis, (2) system development, and (3) system evaluation.

Phase 1: Needs Assessment and Problem Analysis

Stakeholder Interviews.

Interviews with key stakeholders (IT staff, network administrators, students, and faculty members) are conducted to gather insights into common network issues and their expectations of a chatbot system. Data from these interviews will be used to design the chatbot’s knowledge base and decision tree.

Survey Questionnaire.

A survey is distributed to students and staff to determine their common network-related problems, preferred communication channels, and willingness to use an AI chatbot. The data will guide system feature prioritization.

Phase 2: System Development

System Architecture Design.

The automated response system will be built using an *AI-based chatbot* integrated with a *Natural Language Processing (NLP)* engine. The architecture will consist of the following components: *User Interface (UI):* The front where users interact with the chatbot. *NLP Engine:* Enables the chatbot to understand user queries and generate context-appropriate responses. *Knowledge Base:* A repository of solutions to common network issues based on the data from Phase 1. And *backend integration:* Link to university network systems for real-time diagnostics and troubleshooting.

Development Tools.

The development will utilize tools such as *Python* for AI model creation, *Dialogflow* or similar chatbot interaction management frameworks, and network-related diagnostics APIs. The system will also continuously integrate machine learning algorithms to improve response accuracy based on user interactions.

Prototyping.

A chatbot prototype will be developed and tested in a controlled environment. The prototype will simulate common network problems (e.g., Wi-Fi connection failures and IP conflicts) and provide automated solutions.

Phase 3: System Evaluation

Pilot Testing.

The system will be deployed in a small-scale pilot within the university's IT helpdesk. A selected group of students and staff will use the chatbot to report network issues and receive solutions.

Usability Testing.

Usability testing will be performed to evaluate the chatbot’s interface, response accuracy, and overall effectiveness in solving network-related problems. Metrics such as *response time*, *solution accuracy*, and *user satisfaction* will be measured using questionnaires and system logs.

System Improvement.

Pilot testing and usability evaluation feedback will make the system more sophisticated. That would include fine-tuning the NLP model, increasing the knowledge base, and improving the

user interface for a better experience. Precision is an accuracy measure that describes how good a chatbot is at predicting the right intent or extracting the proper entities in its responses. This metric counts the number of responses that a chatbot flags as accurate but are accurate. High Precision: The chatbot's most accurate forecast. Low Precision: Many inaccurate forecasts or answers do not relate to the user's question in equation 1.

$$Precision = \frac{TruePrositives(TP)}{TruePrositives(TP)+FalsePrositives(FP)} \quad (1)$$

Recall quantifies how many accurate answers the chatbot can locate to user inquiries. It can be computed by counting the number of pertinent outputs the chatbot generates. High Recall means the chatbot responds to all pertinent queries the user poses. Low Recall means the chatbot does not understand user intent at all or does not identify specific pertinent inquiries shown in Equation 2.

$$Recall = \frac{TruePrositives(TP)}{TruePrositives(TP)+FalseNegatives(FN)} \quad (2)$$

Finding

The study sought to create an AI chatbot-based system to assist with and address network issues within a university in Thailand. Using chatbots as a tool to support and solve network-related problems in universities as virtual agents can be seen as a tool that helps officers and related units provide better service for solving network-related problems. An automated response system architecture will be presented in Figure 1.

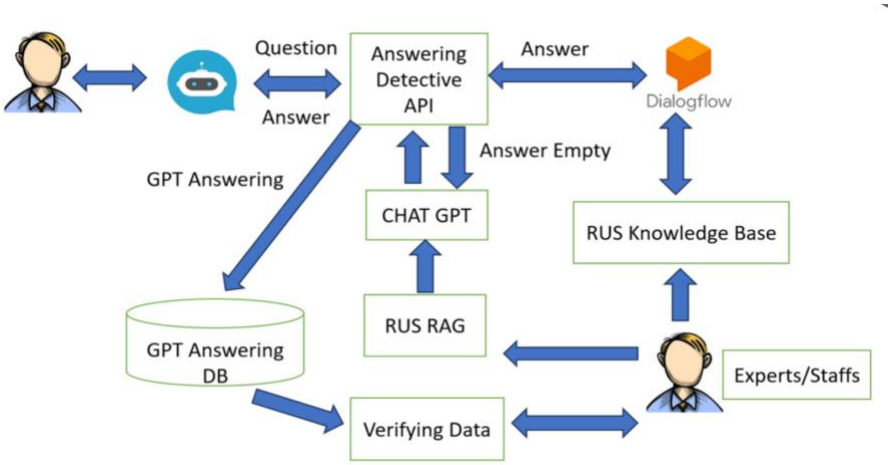


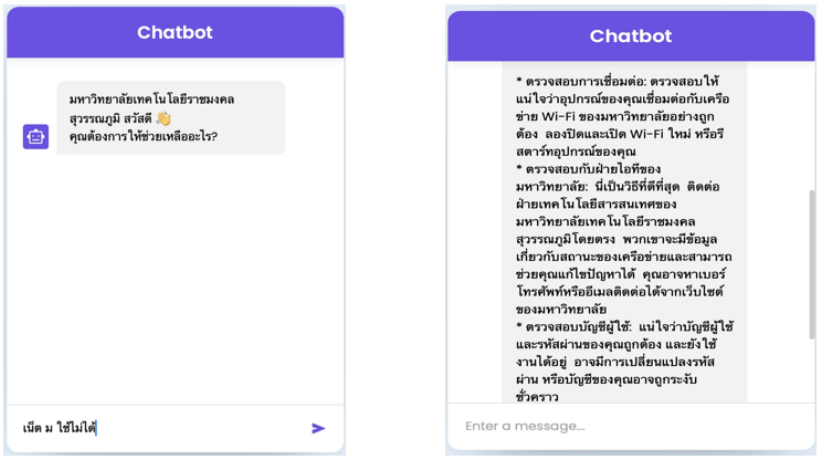
Figure 1: An Automated Response System Using AI Chatbot to Support and Resolve Network-Related Problems in Thai University

The Figure 1. Show an automated response system architecture for troubleshooting network issues in a university that combines AI-driven solutions with expert reviews to improve user satisfaction. Users can interact with an AI chatbot that acts as the first point of contact for Answering Detective API inquiries. The central authority then determines whether the user's question can be answered using pre-defined answers or if further action is required. Pre-defined answers are retrieved from the Dialogflow module linked to the RUS Knowledge Base, which stores verified answers. Suppose no pre-defined answers are available for the user's question. The question is forwarded to CHAT GPT, which can search for additional solutions to answer the user's question from (RUS RAG) and other CHAT GPT databases.

All answers retrieved from CHAT GPT's search are stored in the GPT Answering DB. However, to ensure accuracy in answering questions, the answers generated by CHAT GPT must be reviewed by experts or IT staff before being stored in the GPT Answering Database and further recorded in the RUS Knowledge Base and RUS RAG. This method allows the system to update its knowledge base to improve future answers continuously. Combining automated response generation with human expert review ensures efficient, reliable, and contextually appropriate solutions. Ultimately, it helps improve the efficiency of answering users' questions and improves the user experience.

Automated Response System Using AI Chatbot Development

An AI Chatbot-based automated response system to solve network-related problems in a university was developed using Dialogflow CX for natural language understanding and handling pre-defined responses. For complex queries, OpenAI's GPT API can be integrated with Retrieval-Augmented Generation (RAG), supported by Haystack frameworks, to retrieve relevant data from the RUS Knowledge Base. The system uses Python as the primary development language for backend processes, integrated with FastAPI for API management and MongoDB for database management. Structured and semi-structured knowledge can be stored, while ElasticSearch can be used for fast and efficient data retrieval. The system's accuracy can be assessed using precision and recall metrics to measure the relevance of the user's response. A diverse set of test cases includes both pre-defined and GPT-generated responses. Figure 2 demonstrates the functionality of an automated response system using an AI chatbot to resolve network-related issues in a Thai university.



Question from faculty staff Answer from AI Chatbot

Figure 2: Demonstrates the Primary Function of an Automated Response System Using an AI Chatbot for Resolving Network-Related Issues in a Thai University

Figure 2 shows that a user, such as a faculty staff member or student, submits a query to the chatbot regarding a network connectivity issue. The chatbot processes the query and provides detailed troubleshooting steps, including verifying device connections, resetting Wi-Fi configurations, and contacting university IT support if necessary. The response is well-structured and tailored to guide the user through resolving their issue, reflecting the system's ability to effectively combine predefined answers with user-specific assistance. Performance testing tools use COLAB to simulate user workloads to assess response time, scalability, and system stability to ensure that the system is efficient and reliable enough to effectively meet user needs in answering questions accurately and quickly. The results of performance testing will be presented as follows:

Accuracy of Issue Detection and Resolution

The chatbot has been created to tackle various network-related issues, from the simplest, such as connection establishment, to more sophisticated ones, such as network problems and troubleshooting. During the experiment, the chatbot accurately identified and fixed 78% of the most simple problems (where the network was reset, the IP provided to the user was unsuccessful, and the user could not connect to a wireless network). In terms of advanced-level troubleshooting (including but not limited to high network latency, bandwidth management, and security issues), the chatbot performed initial troubleshooting steps in 60 % of occurrences, where afterward, it advised calling in the human support teams.

Response Time

It is noted that the average response time of the chatbot to provide the first solution was 1.5 seconds, thus improving the response rate compared to physical helpdesk systems, which took 10-15 minutes on average during peak hours to give the first response. The quick response was critical in addressing issues that were likely to be familiar and which would have otherwise led to the crippling of day-to-day academic and administrative activities, thus saving students and employees a lot of time and the associated irritation.

User Satisfaction

Surveys conducted with students, faculty members, and administrative staff revealed that 85% of the users were satisfied with the chatbot’s assistance in resolving fundamental connectivity issues. Many users highlighted the convenience of receiving instant responses rather than waiting for human support. However, 15% of users preferred human assistance, particularly for more complex problems where the chatbot’s responses were limited or insufficient.

Scalability and Integration

The solution was effectively incorporated into the university's current IT infrastructure, which included network management tools and a helpdesk ticketing system. This made it possible to track outstanding situations more effectively and escalate to human help when needed. A precision performance estimate of 0.89 and a recall performance calculation of 0.89, as displayed in Figure 3, indicate that the system could manage around 500 inquiries at once.

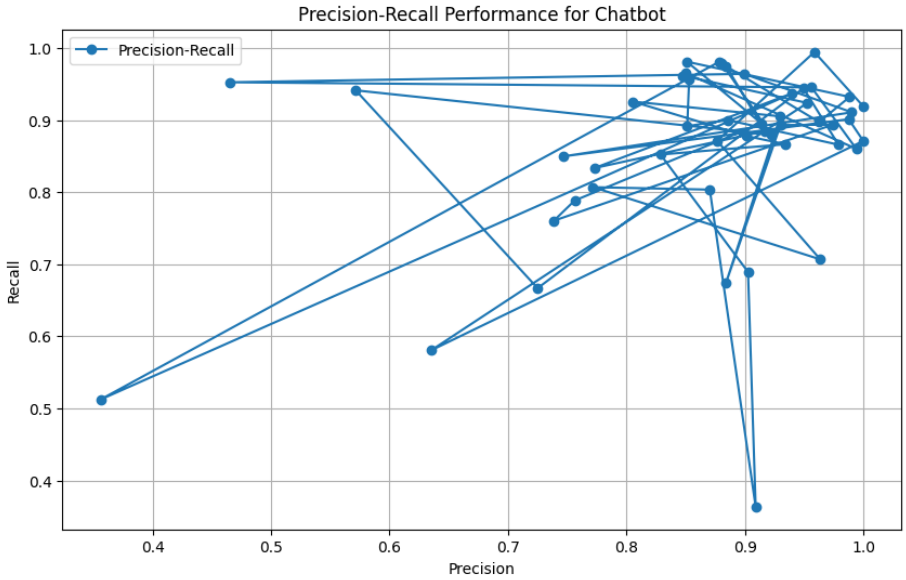


Figure 3: A Result of Precision and Recall Performance

Knowledge Base and Learning Capabilities

The AI-based interactive chat tool used a dynamic personal knowledge base, periodically populated with input from the IT professionals and system logs. Over six months, the chatbot exhibited a 20% improvement in addressing situations that had previously baffled the system, thus illustrating its ability for learning and self-improvement.

Challenges Encountered

While the chatbot performed well in handling predefined problems, it struggled with complex, non-standardized issues, requiring further refinement of its natural language processing (NLP) capabilities to improve context understanding. Additionally, users occasionally experienced frustration with the chatbot's limited conversational flexibility, especially when they did not follow predefined troubleshooting steps.

Efficiency

Implementing the AI chatbot reduced the total load carried out by the IT helpdesk personnel by 30%, correspondingly reducing human resource costs. In addition, the IT team was able to redirect their attention and efforts to more productive activities like network maintenance and infrastructure upgrading instead of carrying out basic diagnoses.

Table 1: The Survey Results

Item	$\bar{X}$	SD	Interpretation
Problem-Solving Quality	**4.75**	**0.45**	**Very high**
1. Is the system effective in solving the issues you encounter?	4.65	0.44	Very high
2. Is the time taken to solve problems by the system sufficiently fast?	4.79	0.45	Very high
3. Are the instructions for problem-solving provided by the system clear enough?	4.85	0.42	Very high
4. Do you feel the system helps reduce recurring errors or problems?	4.72	0.47	Very high
Operational Efficiency	**4.68**	**0.51**	Very high
5. Does the system perform quickly according to your needs?	4.55	0.48	Very high
6. Does the system run smoothly without frequent technical issues?	4.76	0.53	Very high
7. Is the system stable during continuous use?	4.7	0.55	Very high
8. Does the system respond to your commands promptly?	4.72	0.46	Very high
Ease of Use	**4.63**	**0.48**	Very high
9. Do you feel the system is easy to understand and use from the first time?	4.58	0.53	Very high
10. Can you quickly find the necessary information or functions without complication?	4.67	0.43	Very high
11. Is the menu or interface layout organized and convenient to use?	4.56	0.53	Very high
12. Are the usage instructions provided straightforward to follow?	4.72	0.43	Very high
Total	**4.69**	**0.48**	Very high

Table 1 shows that the survey results in the user satisfaction evaluation results show an overall average score ($\bar{X}$) of 4.69 and Standard Division (S.D.) of 0.48, indicating high satisfaction. Notably, the problem-solving quality ($\bar{X}$=4.75) received the highest scores, particularly in the clarity of instructions (4.85) and the speed of problem resolution ($\bar{X}$=4.79). Meanwhile, operational efficiency ($\bar{X}$=4.68) and ease of use ($\bar{X}$=4.63) also received good ratings. Overall, the system is highly effective in meeting users' needs.

Summary of Results

Overall, the AI chatbot displayed encouraging outcomes in managing auxiliary issues, such as network problems within the university, especially concerning more familiar and straightforward occurrences. It also showed remarkable upgrades in parameters: response time, user satisfaction, and scalability. Even though more complex issues remain a problem along with improving NLP, the system is an excellent way to alleviate the pressure on IT employees and enhance the experience of students and lecturers. Improvement and enhancement over time will further reinforce the system’s performance and flexibility to cope with emerging network challenges.

Conclusion

The development of an AI-driven chatbot for an automated feedback mechanism to tackle network-related challenges encountered in Thai universities has demonstrated remarkable improvement in user satisfaction and efficiency in technical assistance. This research aimed to create an artificial intelligence system that can be used for the everyday network issues faced by a University's students, teachers, and administrative personnel. By integrating natural language processing (NLP) and machine learning algorithms, the chatbot could deliver real-time solutions, reduce the burden on human IT staff, and improve the efficiency of troubleshooting processes. As demonstrated by the research findings, it was possible for the AI chatbot system to singlehandedly resolve many recurring technical issues with the subsistence of help-seeking behaviors. Such common problems included but were not limited to, network connection, changing the passwords, and Wi-Fi setup. User satisfaction surveys also offered customers information about the system's usability, stating that the chatbot efficiently offered solutions to frequently asked questions within the shortest time possible. In addition, the chatbot's performance continued developing with time due to its capability to learn from the users and system within the logs, hence being able to manage more complex inquiries. Moreover, the research also shows that there is a need for users to provide feedback to improve the functioning of the chatbot and to be able to use it successfully within the university network. Expanding the chatbot's capabilities for more complex technical problems should be addressed in subsequent studies, and multi-language support should be implemented in future studies to serve users who speak different languages. To sum up, this effort lays the groundwork for using artificial intelligence in academia, which aims to resolve network issues more efficiently and enhance the automation of university information technology services. The deployment of such systems is not only practicable but also essential given the current trends in technology.

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Contact email: parinya.n@rmutsb.ac.th

Learning Process in Learning Community as Paulo Freire's Learning Approach

Nur Ilma, Yogyakarta State University, Indonesia
Hiryanto, Yogyakarta State University, Indonesia
Naila Intania, Wahid Hasyim University, Indonesia

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Abstract
Learning communities are one of the effective alternative platforms in the learning process. Learning communities are formed as a place for learners and teachers to share knowledge or experience, develop creativity or skills, and as a place to discuss important information. Learning community is considered as a relevant learning method with Freire's perspective on the basis of participatory and critical education. This research aims to examine the learning process in learning communities based on Paulo Freire's concept of education. The method in this paper uses a literature approach. The literature approach is a method of writing, clarifying, and making data obtained from various written sources. Data analysis in this research is carried out by organising data that has been obtained from various literature sources from google scholar with the keywords Learning Community, Paulo Freire Learning and Liberation Education. The results of this study show that Paulo Freire's education focuses on humanist education with the aim of dehumanisation. The position of educators and students is the same as the subject of mutual dialogue in understanding the reality of life by involving students' awareness to think critically, fostering imagination in defining and sharpening students' point of view of a reality. Liberation education in learning communities can be seen from the collaborative planning process, the implementation of education by promoting dialogue and active participation, and reflective evaluation to identify achievements, challenges and opportunities for improvement.

Keywords: Learning Community, Learning Process, Paulo Freire's Method

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Introduction

As long as humans are destined to be born into the world, they are inseparable from curiosity in finding the meaning of curiosity. Treating this curiosity, a human being must look for ways to understand everything. The process of understanding everything is called learning. Throughout the life of a human being from birth to the end of life, there is no escape from the learning process. Learning is a process from not knowing to knowing something. As long as a human being is diligent in learning, it will form a better person, insight, and maturity.

Humans are indeed required to understand everything in this life. Imagine if humans do not learn, it will have a negative impact on them and even the worst scenario that occurs can create the decline of a country, because of the moral, knowledge, innovative Dand creative crisis due to the lack of literacy and interest in learning by the younger generation. These adverse impacts can be prevented by emphasising the quality of education comprehensively. Efforts to improve the quality of education are not as easy as one might think, not necessarily just changing the education curriculum. All of this must be reformed such as revamping the learning pattern of a teacher, adjusting the learning curriculum, and adapting students in the learning process.

Renewal of the quality of education must be suppressed in order to realise the goal of superior education, foster analytical thinking of teachers and students, improve students' potential abilities and character, and educate the nation's life in order to advance a nation's civilisation and dignity. Throughout life a human being will continuously need education and learning. The importance of learning from childhood, growth and development, to adulthood without limiting the context of education undertaken. Lifelong education can take place in the family environment, school environment, mass media, and social environment (Faizin et al., 2023).

In the educational setting, the process of learning and learning are two things that are closely related and cannot be separated in educational activities. Learning and learning are said to be a form of education that makes an interaction between teachers and students. Teaching and learning activities carried out in this case are directed at achieving certain goals that have been formulated before teaching is carried out. Teachers consciously plan teaching activities systematically by utilising everything for the benefit of teaching. Learning is interpreted as a process of behaviour change as a result of individual interaction with the environment. Meanwhile, learning is the process of interaction between students and educators, with learning materials, delivery methods, learning strategies, and learning resources in a learning environment. The success of the learning and learning process can be seen through the level of success in achieving educational goals. With this success, it can be said that the teacher has succeeded in teaching (Anisa et al., 2020).

The learning process has been designed through a certain curriculum and tiered is learning in formal education such as elementary school, junior high school to senior high school. In addition to formal learning, there is non-formal learning based on the orientation of the interests of students such as learning to follow organisations, communities, forums, self-development courses and other activities. It is very influential on the motoric development of students in addition to learning in formal schools alone but also participating in useful activities outside of school to add new insights.

The concept of learning independently according to Paulo Freire is known as liberation education. Freire mentions that the education system in schools is passive. While it can be improved by replacing the teacher's authority as a coordinator, dialogue as a substitute for lectures, students as participants, learning programs are arranged separately with programs that are disaggregated and conditioned into units of study (Freire, 2019, p. 67). Such learning approaches should be required in the education process. So that education is not always conventional, which only emphasises the transfer of knowledge from teacher to student. Indeed, teachers know everything and students are assumed to know nothing, teaching materials have been designed separately from students so that they do not rely on the problems being faced. Whereas in a learning community, learners on their own accord work together to learn and solve the problems they want to solve. Often the teaching material comes from the learners themselves. Although there is a mentor, it is only a facilitator who participates in learning with other learners.

Based on the above background, the learning community can be an alternative place for self-potential development for students. Therefore, researchers are interested in further examining the learning process of students in learning communities based on the concept of Paulo Freire.

Literature Review

Learning Process

The learning process is an interaction between students and their environment, so that students process information into knowledge, skills and attitudes as a result of the learning process. The learning process can be created in such a way as to facilitate students in carrying out learning activities. If the learning situation is uncomfortable or there is a disturbance, the learning process will cause the failure of the process (Hazmi, 2019).

According to Fathurrohman and Sutikno in Supradewi (2010), teaching and learning activities have the following characteristics:

1. Have a purpose.
2. There are mechanisms, procedures, steps, methods and techniques that are planned and designed to achieve the goals that have been set.
3. The focus of the material is clear, directed and well planned.
4. There is learner activity.
5. Careful and precise teacher actors.
6. There is a pattern of rules that teachers and students adhere to in their respective proportions.
7. Time limit to achieve learning objectives.
8. Evaluation of the learning process and results.

Learning Communities

Community comes from the Latin *munus*, which means the gift of giving, *cum*, and *together* between each other (Suardi, 2018, p. 1). A community is a group of individuals who have a natural relationship formed within it, bound by a common sense of belonging, beliefs and preferences (Anggraini et al., 2017). According to Rulli Nasrullah defines community as a collection of individuals formed from a group of people, socially interacting with each other

among members of the group, the existence of common needs or goals among group members, the openness of individual group members such as time (Yulliyanti, 2021).

The learning community is a place to share knowledge, experience or skills in carrying out their duties as educators. Learning communities are open to every educator in an education unit. Stakeholders can participate and even parents who care about improving the quality of education can participate. Without regard to background, experience or seniority, every teacher can learn in the learning community (Situmorang & Nurdiansyah, 2024, p. 67).

Learning community according to Susilo, Mardiani, & Widyaswari (2024, p. 3), is a form of association entity of various individuals who have the following characteristics:

1. Have certain learning needs and have the same learning goals.
2. Gather physically or virtually to exchange knowledge and experience.
3. Discuss the information shared and take certain actions together to achieve agreed goals.

Communities require interactive, dialogical and communicative relationships between several people to improve knowledge, skills and morals. To maximise the function of the learning community, it must be built systematically, gradually and functionally to become a professional community, a community that is able to make learning the pulse of all its members and drive major changes in the way of thinking, behaving, associating and seeing the world with high ideals. Seeing this, it is natural that professional learning communities are believed to be an effective vehicle for balancing the development of three forms of human intelligence, namely intellectual, emotional and spiritual intelligence. Of course, it still needs to be supported by a climate of openness, absence of domination, leadership, non-discrimination, and empathy among community members (Dimyati, 2019, p. 149).

As an educator, there are various ways to develop professional skills. One way to do this is by learning together with a learning community. There are four main objectives in building a learning community according to (Milaini et al., 2023, p. 8).

1. Educate community members by gathering and sharing information on practice-related questions and issues.
2. Facilitate interaction and collaboration between community members to initiate and sustain learning.
3. Encourage members to improve their competence through information sharing and discussion.
4. Integrate the learning gained through the community in daily work.

Education According to Paulo Friere

Paulo Friere was a revolutionary philosopher and teacher for grassroots communities. Freire envisioned an education to awaken people from dehumanisation and oppression. The formation of Friere's educational thought is inseparable from these five schools, namely personalism, existentialism, phenomenology, marxism, and Christianity (Albadi, 2022, p. 52)
The main theme of Freire's ideas basically refers to the premise that education is a ‘process of re-humanising’ or dehumanisation. Freire explains the process of dehumanisation with an analysis of people's consciousness or outlook on themselves. According to Topatimasang, Rahardjo & Fakih (2015, p. 30-32), Freire classifies human consciousness into the following categories:

1. Magical consciousness, which is the consciousness of people who are unable to recognise the link between one factor and another. In the reality of education, students dogmatically accept the truth from the teacher, without any mechanism to understand the essence of each lesson theme given.
2. Naive consciousness, which sees the human aspect as the root cause of society's problems. Ethical issues, creativity, and the need for achievement in this consciousness are considered as determinants of social change.
3. This critical consciousness sees the system and structure as the source of the problem. The critical paradigm in education is to train students to identify injustices in existing systems and structures, then be able to analyse how systems and structures work, and how to transform them. The task of critical education is to create spaces and opportunities for students to engage in a process of creating fundamentally new and better structures.

Method

The method in this paper uses a literature approach. Literature research is a research by writing, clarifying, and making data obtained from various written sources (Muhajir, 1983, p. 43). After that, it analyses the literature sources related to the focus of the study discussed. Data analysis in this research is carried out by organising data that has been obtained from various literature sources from google scholar with the keywords Learning Community, Paulo Freire Learning and Liberation Education. From the results of the data, data analysis is carried out through recording, grouping until the right research conclusions are obtained.

Results and Discussion

Paulo Friere's Education Method

The educational method initiated by Paulo Freire is a problem-facing education system. A teacher does not only position himself as an all-knowing person, while his students as people who do not know. However, the teacher here is a facilitator and learning partner. The teacher is no longer a frightening figure for students but the position of teachers and students is equal, there is no longer a limit to the subject as an educator and the object as a learner. With the same position, there will definitely be an interaction of teachers and students understanding together the various realities of life (Siswadi, 2022).

This method emphasizes the role of dialogue, participation and contextual understanding in the educational process. Contrary to traditional educational methods that often emphasize asymmetrical relationships between teachers and students so that the learning process is nothing more than a process of transferring knowledge from teachers who know everything and students who know nothing.

Liberation education does not place the teacher as the sole owner of knowledge, but rather as an individual who involves himself with students in creating relevant learning. Therefore, teachers must be able to understand the context of students' lives and facilitate them in a continuous process of critical reflection, dialogue and social action.

In the current education system, it boils down to the reality of the dichotomy of roles between teachers and students, conceptualized by Freire with the term banking of education. Bank-

style education in Harisuddin (1981) that there are customs that illustrate a state of oppressed society with the following facts:

1. Teachers teach, students learn.
2. The teacher knows everything, the student knows nothing.
3. Teachers think, students think.
4. The teacher tells stories, the students listen.
5. The teacher organizes, the students are organized.
6. The teacher chooses and carries out his/her choice, the students agree.
7. The teacher does, the student imagines himself doing through the teacher's actions.
8. The teacher sets the content of the lesson program, the student (without being asked for his opinion) must adjust to the lesson.
9. The teacher mixes his knowledge authority and professional authority to hinder students' freedom.
10. The teacher is the subject in the learning process, the students are just objects.

The scheme of bank education style will be clarified through the following chart:

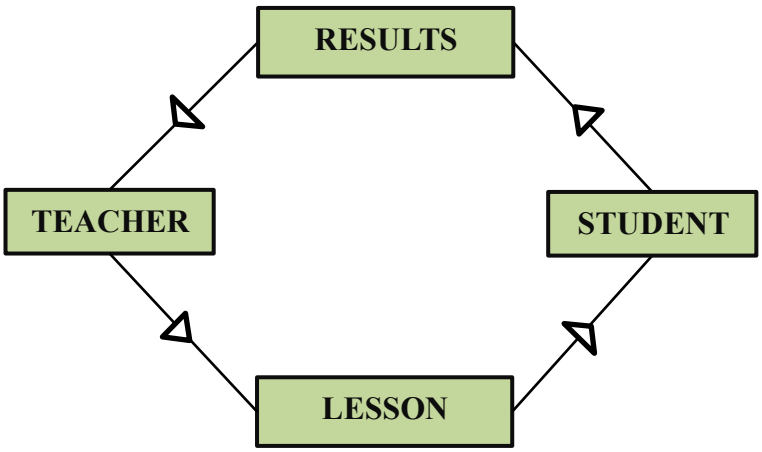

Figure 1: Bank Style Education System

According to Freire, this bank-style education positions the teacher as a giver to the students, and the students only listen, accommodate and recall the things that have been conveyed by the teacher. When the time comes, the students will be tested to find out how high their understanding of the lessons they have undergone. The results of their learning will later get a grade transcript or diploma by seeing how many grades a student gets, as well as the grade transcript he gets. The results of student development will affect the quality of teachers in teaching.

This system will make students feel pressured and uncomfortable in learning. Such an education system requires students to listen to the teacher's explanation and do the assignments again and again. This teaching method is only based on the teacher explaining the subject matter, giving assignments, competency exams and receiving the results of accumulated grades. This is done repeatedly so that the results of student development will stagnate referring to theories and grades alone the purpose of learning.

Freire assumes that education should be a tool to liberate individuals from the various oppressions they face in life. But the practice of education itself is often a reflection of the oppression of the *"educator"* and the *"oppressed."* The teacher in this case is not the main object of criticism but the education system that has placed the teacher in that definition. The

education system has given a different definition between teachers and students (Robikhah, 2018).

The position of teachers and students is the same, who are involved in a dialogue to understand the context of life such as politics, social and culture. Students are taught to analyze their own reality by questioning the structures of oppression and injustice that occur in the surrounding environment. It is not enough just to analyze and develop critical awareness but also to participate in a form of transformational action to change the situation.

Educators in Paulo Freire's view are not subjects who know everything. The role of educators is to engage students' awareness to think critically, help students develop their thinking, foster students' imagination to be able to define and provide their own point of view on things. Students are invited to get to know and analyze their own reality. Education is considered as a miniature of life, so what is taught by teachers should be related to the problems faced by students.

The main focus of liberation education to develop students' critical thinking cannot be separated from the main goal of this educational process which is to create a more just and democratic society. Every individual is truly free from oppression and has the right to develop. Education is not considered a process of knowledge transfer, but a tool that frees individuals to understand their reality, actively participating in efforts to create a better social life.

Dialogue-based education is one of the educational methods proposed by Paulo Freire. This method emphasizes an interactive approach in education. Dialogue in educational activities becomes the main foundation in the interaction formed. Teaching and learning activities are no longer a model of knowledge transmission from teacher to student. However, in dialog, teachers and students voice their thoughts and points of view and listen to each other. Both are required to participate actively. Through this dialog, a deeper understanding is expected.

Characteristics of dialog learning that need to be understood according to (Freire, 2004, p. 157).

1. Oriented on solving problems that are happening according to the context of the times. Dialogue education cannot ignore the issues that surround students, the material becomes a study of dialogue and involves students in solving it. Students are not passive individuals who only receive results and subject matter from the teacher. But students with their creativity seek and find their own subject matter.
2. Dialogical education holds the view that students are not empty vessels waiting to be filled with pre-designed values and knowledge. But students have reasoning and thinking that needs to be developed. Students' thoughts and awareness must be expressed in critical, creative manifestations on an ongoing basis in order to achieve better social change.
3. Dialogical education eliminates the essence of the relationship between teachers and students as a vertical relationship. There is no subject that liberates and the object that is liberated, both teachers and students are educational actors who act as subjects. Dialogue will not be possible when there is a dominant and dominated role. But both must be equal in a condition full of love and trust.
4. Dialogical education is conscientizing, an approach that empowers students to analyze issues and take action. When students have critical thinking and deep understanding, the next step is individual engagement in problem solving. The process of

conscientization can be done by reading, studying reality and participating in discussions. In other words, the concept of conscientization encourages students to be more involved in the world and to be responsible.

In dialog-based education, the teacher is not the only source of knowledge and is considered all right so that students must obey, but more than that. Students are still obedient to their teachers, but in this context no one is said to be the oppressor and no one is said to be the oppressed because both have an equal position. The end of the problem-facing education system is how a student has a critical awareness within himself, and is able to independently manage the information obtained, and reflect back to himself on the usefulness of knowledge and information obtained so that he is able to take an attitude towards the construction of knowledge taken in the learning process (Harisuddin, 1981).

Through the dialog process, students can sharpen their critical analysis of life issues. With their awareness, students are able to identify problems of justice and social inequality, politics and oppression. The context will be studied by students as an effort to solve their problems and prepare for healthy social participation. This process allows students to see global issues and relate them to their lives. To make it easier, it will be clarified through the following scheme:

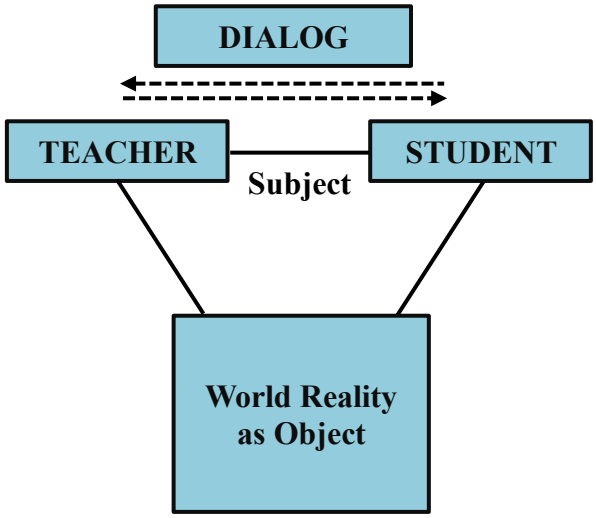

Figure 2: Paulo Freire's Dialogue Education

Community as an Alternative to Paulo Freire's Learning Model

The learning process emphasized by Paulo Freire leads to dehumanization. Through the dehumanization strategy, it is expected to be an effective learning process without any intervention for students. The learning process applied by Freire emphasizes freedom or independence in learning. The method proposed by Freire leads to humanist education. The application of this method in the learning process aims to construct an education system with the nuances and atmosphere of learning that is comfortable, joyful, without burden either by students, educators or educational institutions (Siswadi, 2022).

The learning system that is usually often done in the classroom must be updated to a relaxed atmosphere during learning and how to facilitate interaction between teachers and students. One of the steps that can be taken is to form a learning community. The formation of a learning community can be a place for students to share knowledge or experiences, develop

creativity or skills, discuss important information, and even teachers and students interact with each other as members of the community without thinking about the status of leaders or subordinates.

Learning communities are considered as one of the learning approaches as introduced by Paulo Freire, having the principles of participatory and critical education. This can be reflected in the learning process in learning communities. Based on research conducted by Yukti & Wahyono (2020) on "The Learning Process in the Joglo Tani Community". In addition, there is research conducted the Learning Community "Qaryah Thayyibah" in the Perspective of Paulo Freire's Liberation Education (Fatimah & Rahmawati, 2015). So that from the two studies, the learning process in the learning community can be described as follows:

Lesson Planning.

In an effort to design community learning, it is done by emphasizing dialogical aspects with the spirit of liberation and placing residents as subjects in learning who play an active role and have the authority to determine the policies and sustainability of learning activities. The planning of learning activities is based on the needs faced in a certain period resulting from discussions by community members. If the learning objectives are in accordance with the results they need, of course other members will find it easier to involve themselves.

The learning approach can be done with the student learning center method, meaning that learning activities take place based on the desire to learn by members. The role of the facilitator is to assist during the discussion process, such as ensuring that members give their opinions. The parties involved in the learning planning process are all components that are integrated in the friendship such as students, facilitators, managers, parents and the community. Another approach is active learning with problem-facing method. Students have full authority about the area or subject that interests them to learn. The factor that is also the focus of research is the time and implementation of learning, which is flexible depending on the needs of community members, it can be in the morning, afternoon or other times.

Learning Implementation.

The learning process is not a process of transferring knowledge from one party to another. But all learning members are given the opportunity to bring as many problems they face related to the topics and learning objectives that have been agreed upon. Neither does the facilitator provide answers to the problems found. But students will go back to find answers independently either through books, the internet and other sources. After that, all opinions are collected without worrying about the truth and errors of the results they find. The findings of the learning members are then discussed to get an understanding and agreement on the most correct answer to solve the problem. The purpose of this activity is to discover the structure of the knowledge being studied.

The role of the facilitator is to accompany the discussion and encourage the learning members to take part in the discussion. Facilitators themselves are individuals who learn and grow together with other members. The group's learning pattern is based on their local conditions, habits, experiences and knowledge. The actor's presence is to empower them by learning together anywhere (Hasdiansyah et al., 2021).

Learning Evaluation.

Evaluation is not done in the form of giving values or standards that are set, but each member of learning evaluates in the form of self-evaluating or evaluating himself. The success of learning is their ability to recognize their own talents, weaknesses and strengths after a learning process. The facilitator and the learning members conduct a dialog to question the extent of knowledge that has been learned. This is to find out the development of learning members who are still lagging behind other members. Then members who already understand will help explain so that there is no competition among learning members. Evaluation is conducted to determine the extent of their understanding in interpreting the learning process that has been carried out.

Based on the learning experience in the learning community, it was found that there was a motoric improvement in the subject being studied. As for some of the obstacles found include, the perception of members who are not good about non-formal education so that they are less serious and the absence of supporting facilities such as the internet.

Conclusion

Paulo Freire's concept of education focuses more on humanist education with the aim of dehumanization. Freire sees the teacher not as the sole owner of knowledge, but as an individual who involves himself with students in creating relevant learning. A teacher must involve students' awareness to think critically, help students develop their thinking, foster students' imagination to be able to define and provide their own point of view on a matter. The position of teachers and students are the same as subjects who dialogue with each other to understand the realities of life such as politics, social and culture. Learning communities are considered a relevant learning approach to Freire's perspective on the basis of participatory and critical education. In learning communities, each member is required to actively participate in expressing their critical abilities through dialogue so that the learning process is no longer another form of oppression as is often practiced in conventional education methods. Liberation education in learning communities can be seen in the collaborative planning process, the implementation of education by prioritizing dialogue and active participation, and reflective evaluation to identify achievements, challenges and opportunities for improvement.

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Contact email: nailaintania7@gmail.com

Development of a Digital Camera-Based Attendance System for University Students

Suwit Somsuphaprungyos, Rajamangala University of Technology Suvarnabhumi, Thailand
Anek Putthidech, Rajamangala University of Technology Suvarnabhumi, Thailand
Amnaj Sookjam, Rajamangala University of Technology Suvarnabhumi, Thailand
Sangtong Boonying, Rajamangala University of Technology Suvarnabhumi, Thailand
Nutthawat Mudpetch, Rajamangala University of Technology Suvarnabhumi, Thailand

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Abstract
This research aimed to 1) develop a process for counting class time and screening for diseases using digital camera technology, 2) develop an application for managing class time and screening for diseases, and 3) evaluate and monitor the performance of the developed system. This study involved designing a process for counting class time and screening for diseases. The study population was students from the Faculty of Business Administration and Information Technology. The sample group was students from the Digital Business Technology program at Rajamangala University of Technology Suvarnabhumi. The prototype was tested using facial recognition technology and temperature measurement to screen and record data in a cloud database. The system has a notification mechanism via the Line application for risk groups to inform those involved to prepare and respond appropriately. The research results indicated that the developed process for counting class time and screening for diseases can effectively assess those at risk of COVID-19 with high efficiency (mean=4.85, standard deviation=0.47). The accuracy testing group consisted of 30 Digital Business Technology program students. Each person was tested three times. The test results showed that the facial recognition and temperature measurement programs had an accuracy of ±0.3 degrees Celsius. Expert evaluations of the system performance also indicated high overall performance (mean=4.81, standard deviation=0.52).

Keywords: Detection Face, Digital Camera, Counting Students, Screening For Diseases

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Introduction

Higher education institutions such as universities are places where the following people, such as students, lecturers, and educational personnel, gather to perform activities such as teaching, research, registration, seminars, sports, recreation, and leisure. The variety of services depends on the nature of each activity, such as registration services, library services, meeting room reservations, appointments with academic advisors, and convenient and energy-saving services. Universities and university management development involve organizing and allocating resources and facilities to support educational services and related activities. It should keep pace with the times and adopt new technologies such as artificial intelligence, cloud computing, virtualization, and the Internet of Things as the future direction for building smart campuses. This development aims to improve teaching, management, and services to a higher level to achieve the status of "smart" educational institutions. Colleges and universities can also become smart campuses like cities, innovative businesses, and buildings.

The Faculty of Business Administration and Information Technology, Rajamangala University of Technology Suvarnabhumi, offers doctoral, master's, bachelor's, and advanced diploma programs in various fields of study. Teaching and learning management also requires the collection of class attendance scores to motivate students to gain effective scores. Currently, the system for recording class attendance and student activity participation still uses the method of calling names from a list printed on paper from the student registration system, which is slow in reading the names of students one by one, in order from the first to the last person in the class, which wastes much time.

Therefore, the researcher has the idea of applying digital camera technology to record class attendance, activity participation, and screening for COVID-19. The system will collect data on class attendance participation and participation in other activities and identify students with abnormal body temperatures, indicating they may be infected with COVID-19. The system will then send a report to relevant personnel for further action.

Review of Literature

This literature review encompasses three main areas: digital cameras, the Study of Class Attendance Behavior, Screening, and Temperature Measurement Technology. It explores the existing literature and empirical evidence surrounding these topics and identifies the potential benefits and concerns of using digital cameras in educational settings.

A Digital Camera

A digital camera, also called a digicam, is a camera that captures photographs in digital memory. Most cameras produced today are digital (Musgrove,2006), essentially replacing those that capture images on photographic film or film stock. Digital cameras are now widely incorporated into mobile devices like smartphones with the same or more capabilities and features of dedicated cameras (Cooke, 2017). High-end, high-definition dedicated cameras are still commonly used by professionals and those who desire to take higher-quality photographs (Tarrant, 2006, pp. 8-31).

Digital and digital movie cameras share an optical system, typically using a lens with a variable diaphragm to focus light onto an image-pickup device. The diaphragm and shutter

admit a controlled amount of light to the image, just as with film, but the image pickup device is electronic rather than chemical. However, unlike film cameras, digital cameras can display images on a screen immediately after being recorded and store and delete images from memory. Many digital cameras can also record moving videos with sound. Some digital cameras can crop and stitch pictures and perform other kinds of image editing (White, 2019; Zhang, 2011).

Study of Class Attendance Behavior

Study of class attendance behavior is conducted by classroom research process in which teachers are the ones who carry out the work to solve problems that occur in the classroom and use the results to improve teaching and learning or promote the development of students' learning to be better to maximize the benefits to the students Studying classroom attendance behavior, such as being late and absent, is a guideline that helps to know the learning behavior of students that affects learning achievement. The researcher teacher can choose to use data sources from both school data collection and data collection by the researcher teacher himself, such as school statistics, class attendance, grades, subjects registered, etc. Regarding research related to studying classroom attendance behavior, behavior adjustment, not attending class, and being late to class, students found that in collecting data on student attendance, the researcher used the student responsibility observation form and the attendance record book as data collection tools. These methods are suitable for a small sample group. Therefore, if you want to collect data from a large sample group, you must use tools to collect data more easily and quickly than the behavior observation method and the attendance record book. Conduct participatory action research using activities emphasizing integrated learning to study students' learning achievement. It used observation, assignment of work, project evaluation form, self-evaluation form, critique record, and mid-term test. It was found that the trainees had knowledge and understanding. They could write an integrated learning management plan comprising various teaching methods, activities integrating content and life skills knowledge, and various evaluation tools through the specified criteria. In addition, it was found that most students had scores that passed the quantitative knowledge criteria of 70 percent in terms of learning achievement, systematic thinking process skills, and analytical thinking. In terms of awareness and learning behavior, it was found that students were interested in teaching and learning activities, could answer questions, and participated in the classroom. From the above research on classroom attendance behavior, it can be concluded that regular classroom attendance affects their academic achievement. The tool used to collect classroom attendance data is in the form of notes, which is inconvenient for data collection.

Screening and Temperature Measurement Technology

Amid the outbreak of the Coronavirus Disease 2019 (COVID-19), both public and private sectors have developed technologies to assist in screening patients at risk of contracting the virus. Some of the interesting new technologies include the following:

Thermal Cameras.

Government and private organizations use thermal cameras to help scan and check employees or customers who may have a fever. These thermal cameras are the latest in thermal imaging technology using artificial intelligence, designed to detect body temperature accurately. Scanning people with high body temperatures can help identify early symptoms

of the virus. The cameras can accurately detect body temperature even when people walk and wear masks, hats, or helmets. The cameras help speed the screening process and provide audible and visual alerts when temperatures exceed normal ranges.

Body Temperature Screening System.

The body temperature measurement system screens people quickly and accurately. Its Application Programming Interface (API) is integrated with the organization's software system, making it suitable for large organizations that link employee or user data with body temperature data. This system is also suitable for patient screening services in public areas such as hospitals, train stations, bus stations, shopping malls, and large office buildings.

Thermal Camera Solution for COVID-19.

The thermal camera has high-precision body temperature detection technology and can detect up to 15 people per second from up to 3 meters. It has a built-in sensor and speaker that will immediately notify when the body temperature exceeds the specified criteria with an error value of only 0.3°C (+/-). The camera also works with other security systems, such as CCTV cameras, recording still images and videos, recording temperatures, and tracking people entering or leaving the area in real-time. This solution reduces the risk of employees contacting people infected with the disease.

µTherm FaceSense Smart Temperature Measurement Device.

Developed by the Photonics Technology Research Team of the National Electronics and Computer Technology Center (NECTEC), this device measures body temperature without contact. It can detect temperature from a person’s face up to 1.5 meters away in just 0.1 seconds, displaying the temperature as a number on the screen. If the temperature exceeds the set value, the number changes from green to red, triggering an alarm. This technology, which compensates for variables like temperature, humidity, and distance, ensures highly accurate measurements, even when individuals are wearing masks.

Methodology

The attendance recording system and screening are operated to separate groups of people at risk of infection with the new coronavirus strain 2019 (COVID-19) before entering the classroom. When a group of people enters the area, they must go through the automatic screening process using a camera to detect it by checking the information of the group of people along with the body temperature of that group. When the detection finds that the body temperature of the group of people is higher than the standard criteria for infection with the COVID-19 virus, the system will notify the information and specify the location to the relevant officers, which will consist of Security officers must separate the group of people who are at risk and notify the nurses and administrators. However, if the group of people who have passed the automatic screening system and are not found to have a body temperature exceeding the specified standard, the information will be recorded in the system that they have entered the classroom.

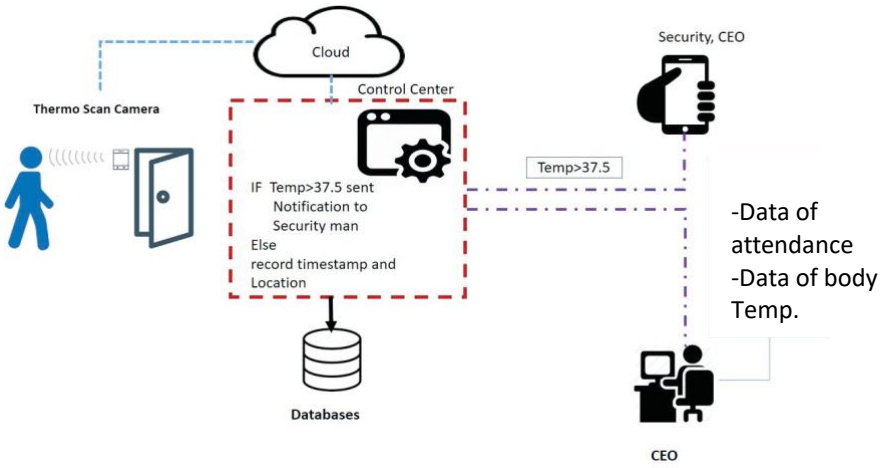

Figure 1: System Architecture

Setup

Design of screening process, module development, and equipment installation the research team designed the screening process by studying and analyzing documents and asking the needs of those involved. System requirements were designed by considering the possible and appropriate context.

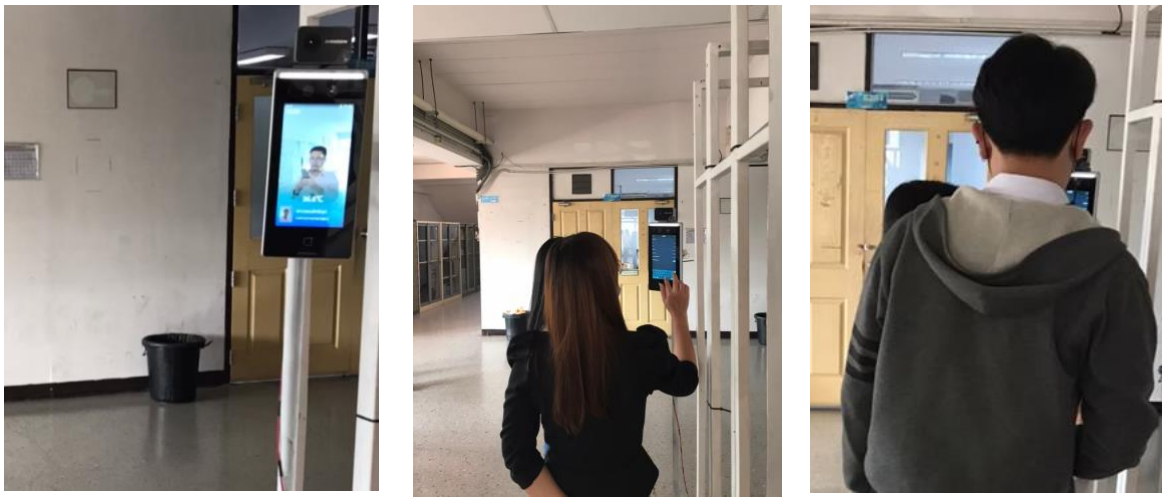

Figure 2: Setting Up a Digital Camera for Detection

From Figure 2, the camera can capture the facial structure when there is movement in front of the camera. The facial structure check data will be sent from the camera's memory database. If a person's face data is in the memory, the camera will read the person's data along with the temperature detection. The system database will be saved to the learning stage if the temperature is expected according to the conditions. The alarm system will start the process if the temperature exceeds the conditions. If the data from memory is checked and no data is found, the camera will display the message N/A (person data not found), but the temperature is still detected. If the temperature is expected according to the conditions, the data will be recorded as a person with no name details (N/A), but the temperature and time are recorded. If the temperature exceeds the conditions, the alarm system will follow the process, and the history will be recorded later.

Design and develop applications. The application is capable of reporting temperature information, risk group information, and coordinates of risk groups from the location of the face and temperature detection camera to risk groups and related persons. It is developed according to the information system development life cycle (SDLC). In developing the system application, the capabilities of the face and temperature detection camera can be used to send data to the cloud and develop a web application as a system management part, which consists of a system administrator and a report display part via the web application page. The development tools are PHP language, MySQL database, and data management, and the system performance is evaluated by information technology experts who graduated in information technology or other related fields with no lower than a master's degree or hold an academic position of no lower than an assistant professor, totaling three people.

Results

Accuracy Test Results

The test was conducted to check the accuracy of the temperature measurement system and the recognition system. The experimental group used to check the system's accuracy consisted of 30 students in the Information Systems and Business Computer Program at the Faculty of Business Administration and Information Technology, Rajamangala University of Technology Suvarnabhumi. Each participant in the test was tested three times. The temperature measurement program yielded test results with an error margin of ±0.3 degrees Celsius. The analysis results for the accuracy of temperature measurement and face recognition are presented in Table 1. The test results are acceptable in medical applications and can be used in real-world scenarios. The developed face recognition program has an average accuracy of 90%. Based on the test results, it can be concluded that the face recognition program is suitable for real-world applications. Various factors, including one influence the margin of error) The actual lighting conditions during the test did not match those when the database images were collected, 2) The camera's resolution used to develop the face recognition program, and 3) Insufficient number of databases for training purposes.

Table 1: The Analysis Results for the Accuracy of Temperature Measurement and Face Recognition

Number of testers	**Temperature measured by infrared sensor (°C)**			**Temperature measured by mercury sensor (°C)**			**Discrepancy (°C)**		
	Test-1	Test-2	Test-3	Test-1	Test-2	Test-3	Test-1	Test-2	Test-3
1	36.5	36.4	36.7	36.5	36.7	36.5	0.0	-0.3	0.2
2	36.4	36.5	36.5	36.2	36.5	36.5	0.2	0.0	0.0
3	36.5	36.6	36.7	36.5	36.7	36.7	0.0	-0.1	0.0
4	36.7	36.6	36.5	36.6	36.4	36.3	0.1	0.2	0.2
5	36.5	36.5	36.7	36.3	36.5	36.6	0.2	0.0	0.1
6	36.7	36.5	36.4	36.5	36.6	36.2	0.2	-0.1	0.2
7	36.4	36.6	36.5	36.5	36.9	36.5	-0.1	-0.3	0.0
8	36.5	36.7	36.6	36.7	36.5	36.5	-0.2	0.2	0.1
9	36.6	36.5	36.9	36.3	36.5	36.7	0.3	0.0	0.2
10	36.9	36.2	36.5	36.6	36.5	36.7	0.3	-0.3	-0.2
11	36.5	36.5	36.5	36.2	36.7	36.5	0.3	-0.2	0.0
12	36.5	36.6	36.5	36.5	36.5	36.6	0.0	0.1	-0.1

13	36.5	36.3	36.7	36.5	36.6	36.8	0.0	-0.3	-0.1
14	36.7	36.7	36.5	36.5	36.5	36.7	0.2	0.2	-0.2
15	36.5	36.5	36.7	36.7	36.2	36.5	-0.2	0.3	0.2
16	36.2	36.7	36.5	36.5	36.5	36.7	-0.3	0.2	-0.2
17	36.5	36.4	36.2	36.2	36.5	36.4	0.3	-0.1	-0.2
18	36.6	36.5	36.5	36.5	36.7	36.5	0.1	-0.2	0.0
19	36.3	36.6	36.6	36.6	36.5	36.6	-0.3	0.1	0.0
20	36.5	36.9	36.3	36.3	36.7	36.5	0.2	0.2	-0.2
21	36.5	36.5	36.7	36.7	36.5	36.5	-0.2	0.0	0.2
22	36.7	36.5	36.5	36.5	36.6	36.5	0.2	-0.1	0.0
23	36.6	36.5	36.7	36.7	36.3	36.5	-0.1	0.2	0.2
24	36.6	36.5	36.4	36.6	36.5	36.5	0.0	0.0	-0.1
25	36.2	36.5	36.5	36.3	36.5	36.7	-0.1	0.0	-0.2
26	36.6	36.7	36.6	36.7	36.5	36.3	-0.1	0.2	0.3
27	36.3	36.4	36.9	36.5	36.7	36.7	-0.2	-0.3	0.2
28	36.6	36.6	36.5	36.8	36.4	36.3	-0.2	0.2	0.2
29	36.4	36.2	36.5	36.2	36.5	36.6	0.2	-0.3	-0.1
30	36.2	36.6	36.7	36.5	36.6	36.4	-0.3	0.0	0.3

Table 2: The Efficiency of the System

Detail	**Mean**	**S.D.**
1. Functional Requirement Test	4.82	0.53
2. Functional Test	4.82	0.52
3. Usability Test	4.82	0.52
4. Security Test	4.80	0.51
Total	**4.81**	**0.52**

Conclusion

The research focuses on developing a system for recording class attendance and participation in other activities, including screening for COVID-19, using digital camera technology, and developing an application for managing class attendance and screening. The performance of the developed system was also evaluated. The system helps teachers reduce the time spent recording class times, thus saving time on calling names before starting the lesson. It also helps track and prevent the spread of the disease.

Accuracy Testing of the Digital Camera Equipment

The system was tested with 30 Digital Innovation Business students from the Faculty of Business Administration and Information Technology, Rajamangala University of Technology Suvarnabhumi, by testing, analyzing, and improving the temperature measurement program and facial recognition software.

In the experiment, each of the 30 students was tested 3 times, and the results were analyzed and summarized, identifying and fixing problems that caused inaccuracies in each round of testing to achieve the desired objectives. The temperature measurement program for the test subjects was inaccurate, with the temperature measured by the infrared sensor (°C) compared to the mercury sensor (°C) having an error of ±3°C, indicating that the temperature measurement and facial recognition program is effective and accurate, able to record class

attendance and participation in other activities, including screening people at risk of COVID-19 infection.

Application Development for Attendance Recording, Screening, and Risk Assessment. The facial recognition and temperature measurement data record attendance and screen at-risk individuals. The system records information such as when the face was detected, the measured temperature, and the risk status of viral infection. This data includes internal and external individuals who have not verified their identity. The data is then stored on the cloud system for further use in reporting and system development. The application for recording attendance and screening consists of several screens: an attendance recording screen, a display showing data upon entering a location, a screen displaying the recorded temperature when it reaches the screening threshold of 37.5°C, and a display of the date and time of entry.

Experts and users conducted tests to evaluate the system's efficiency. They were asked to use the system and complete a questionnaire assessing its performance. The evaluation focused on four aspects: functionality (Functional Requirement Test), system performance (Functional Test), usability (Usability Test), and security (Security Test).

Results of the System Evaluation

Based on expert analysis, the system’s overall performance was highly effective. The top three performance areas met the system's functional requirements, performance, and usability. Security and verification were rated slightly lower. The user analysis also rated the system as highly effective overall. The highest-rated area was usability, followed by meeting the system’s functional requirements and performance. Security and verification were rated lowest.

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Contact email: suwit.s@rmutsb.ac.th

Aesthetic Education Through Teaching Japanese Literature and Cinema at the Ho Chi Minh City University of Education in Vietnam

Thu Vân Phan, Ho Chi Minh City University of Education, Viet Nam

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Abstract
In recent years, along with the strengthening of friendship and international cooperation between Vietnam and Japan, many novels and short stories from Japanese literature have been translated and introduced to Vietnam, and well received by Vietnamese readers. In addition, Japanese cinema has gradually conquered Vietnamese audiences, through film festivals, the recognition that comes with earning international awards, as well as official screenings at domestic cinemas. The use of films adapted from Japanese literature to further promote the reception of literature among young people is also recognized as a new trend of the times. To better reflect these current trends and and promote the development of the aesthetic sense of youth in general and students at the Faculty of Literature of the Ho Chi Minh City University of Education in particular, we have developed several new subjects: *The Relationship between Literature and Cinema* (Master's Program in Foreign Literature 2016 - 2024), *Foreign Literature and Cinema* (Master's Program in Foreign Literature 2024 - 2026), while also having organized many seminars on literature - cinema, as well as introducing adaptations from Japanese literature and cinema into subjects such as *Eastern Literature* 1 - 2, *Eastern Literature Topics*, *History of Eastern Thought*, etc. Through the subjects and teaching activities, we have exposed students and Master's students to subject matter related to Japanese aesthetics, including concepts such as wabi (侘), sabi (寂), yugen (幽玄), etc.; Japanese identity expressed through literature and cinema as well as a variety of other content. This article summarizes the method of aesthetic education utilized in teaching Japanese literature and cinema at the Faculty of Literature, Ho Chi Minh City University of Education, while also emphasizing the importance of aesthetic education and proposing new approaches to aesthetic education for university students.

Keywords: Aesthetic Education, Japanese Literature, Japanese Film, Ho Chi Minh City University of Education

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Introduction

Aesthetic education for young people is always necessary, especially for Gen Z, a generation that is facing unprecedented challenges from the development of social networks, the internet and AI. Aesthetic education helps young people understand more about art, and through works of art, understand more about the world and themselves. Self-discovery through artistic experiences, especially literature and cinema, helps young people gain respect for different styles and artistic values, thereby discovering their own style and values. This is particularly important for younger individuals who sometimes don't yet know exactly who they are as it can help them to position themselves in society and define their personal identity in life. These are fundamental steps that can help a person live a more peaceful and happy life.

Currently, Vietnamese education is also aiming at the goal of aesthetic education. The document of the 13th National Congress of Delegates ~~is~~ talks about the importance of: "(…) Linking education in knowledge, ethics, aesthetics, life skills with physical education, improving the stature of Vietnamese people" (Communist Party of Vietnam, *Documents of the 13th National Congress*, vol. 1, Truth National Political Publishing House, Hanoi, 2021, pp. 136-137). Meanwhile, it can also be seen that in Vietnam's national education strategy, attention has been paid to raising 5 important issues for the comprehensive development of a person: knowledge, ethics, aesthetics, life skills and physical fitness.

In Vietnam, many scholars and educators have started to focus more on aesthetic education for students. This includes a greater awareness of the impact of the internet on the formation and development of aesthetic tastes of young people, and an emphasis on providing knowledge about traditional culture, literature and art for young people.

So why do I propose aesthetic education for students through Japanese literature and cinema?

First, because Japan is one of the few countries with a strategy in originating and popularizing concepts about aesthetics, creating influence not only in Japan but also around the world.

Second, Vietnamese youth today are very fond of, even passionate about, Japanese culture in general and Japanese literature and cinema in particular. Japanese literature is currently translated into Vietnamese with a disproportionately large number of publications, and receives special attention from the young public. Japanese films in recent years have also won many prestigious awards, including the Oscar for best foreign film, and the Oscar for best animated film. This further promotes the aesthetic reception among young people (Phan Thu Van, 2022).

Third, Vietnam and Japan have a friendly relationship. In 2023, there were many activities to celebrate the 50th anniversary of the establishment of diplomatic relations between Vietnam and Japan, and cultural and artistic exchange activities have continued to take place recently. Not only that, Vietnam and Japan also have many similarities in culture and history, such as being located in the same Kanji cultural sphere, having political and cultural exchanges since the ancient and medieval times, suffering the consequences of war, etc. All of these factors have helped facilitate the acceptance and popularity of Japanese literature, cinema and their aesthetic messages among Vietnamese youth.

The Importance of Aesthetic Education

Aesthetic education as an academic concept was clearly proposed and originated by the German philosopher, poet and historian J. C. Friedrich Von Schiller (1759 – 1805). It is generally believed that the first book on aesthetic education was Schiller's *Letters upon the Aesthetic Education of Man* written in 1793-1794. Schiller asserted that only through aesthetic education can people achieve full and harmonious development between reason and emotion, and perfect their personality, thereby promoting sustainable social development.

Since modern times, aesthetic education has become a field that intersects aesthetics, pedagogy, psychology and anthropology and has received noteworthy attention in countries such as Germany, the United States, England, China, Japan, etc.

In Japan, in 1872 under the Meiji period, the government published the Educational System "学 制", a legal document that opened the way for the modernization of education. The first person to introduce "aesthetics" was Nishi Amane (西周, 1829-1897). He translated "aesthetics" as "good aesthetics" (善美学), "good interest theory" (佳趣论), "beautiful science" (美妙学), and then carried out a systematic construction of his own aesthetic thoughts (郑子路, 2021). In 1885 - 1886, the book *A New Theory of Education* "教育新论" written by James Johonnot (1823 – 1888) and translated by Takamine Hideo (高峰秀夫,1853-1910) was published. This was the first book discussing Western education to be translated into Japanese, in which for the first time the concepts of "aesthetics", "fine arts", "aesthetics" and "aesthetic education" were used. Japanese education began to borrow Western aesthetic concepts to incorporate traditional aesthetic categories. (柏奕旻, 2020).

In Vietnam, in the *General Aesthetics* textbook, one of the first books to lay the foundation for aesthetics and aesthetic education in Vietnam, Professor Lê Ngọc Trà wrote: "The height of aesthetic ideals will help people to open their eyes and hearts, to know how to choose, to know how to direct their feelings towards true beauty, works of humanistic value from the past as well as the present, the cultural and artistic quintessence of the nation and of humanity" (Lê Ngọc Trà, 1995).

Unlike professional art education for a small number of people, aesthetic education focuses more on public and humanistic nature, and its approaches include but are not limited to art, music, literature, drama, dance, architecture, environment and other art forms.

Howard Gardner (1943 -), a modern and contemporary American psychologist, pointed out that education is undergoing a period of strong impact from postmodern consciousness and digital media networks. The impact of postmodern consciousness causes doubts about accepted beauty standards and gives rise to a desire to break the mold, creating beauty according to personal standards, while digital media networks provide too much unverified information as well as create a crowd effect that is not always reliable. Therefore, aesthetic education becomes more necessary than ever, so that each person can build a solid foundation in the process of growing up, before facing a complex reality of life.

The notion of an ideal and universal personality has been recognized for thousands of years in all cultures. The ideal universal personality is considered to be a personality with three important qualities: Truth, Goodness and Beauty.

"Truth" represents honesty, sincerity and respect for the truth.

"Goodness" is often understood as kindness, sincere thoughts. More broadly, this is the love of community, love of fellow human beings and humanity.

"Beauty" is the perception of beauty, having aesthetic sense when standing before beauty, having knowledge of beauty to evaluate what is beautiful and what is not yet or not beautiful at all, and at an even higher level is knowing how to create beauty in all areas of life.

Aesthetic education is a planned, oriented strategy to develop people with the ability to perceive, feel, and correctly evaluate aesthetic phenomena in reality and art. On that basis, learners will gradually form the ability to live, work and create according to the law of beauty.

Aesthetic education is inseparable from the general educational process. All subjects, to a greater or lesser extent, have the potential to educate young people about aesthetics. However, literature and cinema can be placed in a special position in aesthetic education, because they do not only teach about ordinary beauty, but also aim at the humanistic spirit, promote understanding and sympathy between people, or between people and the natural world. In addition, they serve to promote tolerance, empathy and arouse legitimate aspirations. In the case of Japanese literature and cinema, selecting and teaching Japanese literary and cinematic works can help students understand the core values of Japanese culture and make comparisons with Vietnamese culture, thereby being able to understand more about themselves and have a broader view of the world.

Aesthetic Education Utilized in Teaching Japanese Literature and Cinema at the Faculty of Literature

At undergraduated level, in the field of humanities and arts, aesthetics is an important subject including general courses and topics on Eastern and Western aesthetic theories. However, aesthetic education is not only within the scope of one or a few subjects, but is inherent in most subjects. All subjects that can contribute to imparting to learners sensitivity, love for nature, country, for the beauty of the soul, language style, and or the cultural and artistic values of humanity, can be considered to be suitable candidates for the use to incorporate aesthetic education.

At Ho Chi Minh City University of Education, we design the program related to Japanese Literature for undergraduate students as follows:

At the university level, there are 2 compulsory subjects related to Japanese literature:

Ancient and Pre-modern Eastern Literature (45 periods), teaching the literature~~s~~ of Eastern countries that are largely familiar to Vietnamese people, typically that of China, Japan and India. 30% of the content and duration of this program is related to early Japanese literature, including the historical process of Japanese literature from its inception to before the Meiji period, with a focus on works such as *Taketori Monogatari*, *Genji Monogatari* and Haiku poetry.

A similar proportion is dedicated to Modern and Contemporary Eastern Literature (45 periods), to teach students about Chinese, Japanese and Indian literature in the modern period. About 30% of the Modern Literature program content and duration ~~are~~ is related to Japanese

literature, including the modernization of Japanese literature from the Meiji Restoration to contemporary literature, introducing the works of Natsume Soseki, Akutagawa's short stories, Kawabata Yasunari's novels and Haruki Murakami's novels.

These are two compulsory subjects taught in the second year of university for individuals majoring in Literature and Literature Pedagogy, so after completing the compulsory program, students have an overview of Japanese literature.

In the third year, students majoring in Literature have the option to study the Japanese Literature Specialization. If students choose to study Japanese Literature Specialization, they will be introduced to additional works such as *Manyoshu*, *Stories of Old Times*, or Noh drama, etc.

In the 4th year, students majoring in Literature must choose 1 elective course, depending on the student's career orientation. For example, if the student has a career orientation related to the media, they typically choose the subject which is most closely related to cinema, namely *Film Criticism Practice*. Meanwhile students majoring in Literature Pedagogy (who are oriented to teach Literature in middle and high schools after graduation) have 1 compulsory elective course, which relates to *Topics of Eastern Literature*.

In the Film Criticism Practice course, we select a number of films directly related to literary works that students have studied in the *Ancient and Pre-modern Eastern Literature and Modern* and *Contemporary Eastern Literature* (the 2 aforementioned compulsory) courses for students to watch and learn to analyze a variety of films. These include works such as the Ghibli animation *Kaguya hime no monogatari* (2013) adapted from *Taketori Monogatari*, the movie *Rashomon* (1950) adapted from the stories *Rashomon* (羅生門) and *Yabu no naka* (藪の中) by Akutagawa Ryuunosuke, the movies *Burning* (Lee Chang Dong 2018), *Drive my car* (Ryusuke Hamaguchi, 2021) adapted from the work of the same name by Haruki Murakami, etc.

In the *Topics of Eastern Literature* course, students will study in more depth Japanese literary works from a regional comparative perspective. This might involve comparing literature written in Japanese Chinese characters with literature written in the Chinese characters of Vietnam, China and Korea; or comparing the works of Natsume Soseki with Lu Xun (China), the works of Haruki Murakami with Ho Anh Thai (Vietnam) and other regional authors.

At the graduate level, there are 2 subjects related to Japanese literature and cinema: *Japanese Poetry and Novels* and *The Relationship between Literature and Cinema* (Master's Program in Foreign Literature 2016 - 2024), *Foreign Literature and Cinema* (Master's Program in Foreign Literature 2024 - 2026).

With *Japanese Poetry and Novels*, students will study more deeply about the genres of poetry and novels especially the formation and development of movements in Japanese literature.

With *Foreign Literature and Cinema*, students will learn about the influence of Japanese literature and cinema on the world, through short stories, novels, comics, anime, etc.

Through these subjects, there are some consistent issues that we use as a connection between different subject matter:

First, it is to understand literature and cinema through some basic Japanese aesthetic categories. When studying *Genji Monogatari*, students learn about "mono no aware" (物の哀れ) - sensitivity to things, sensitivity to the ephemeral. When studying Haiku poetry, students have the opportunity to learn more about "wabi" (transient and clear beauty) and "sabi" (silent beauty of nature and aging). When studying Noh theater, students add knowledge about "yūgen" (deep grace and subtlety). These aesthetic sensibilities are the foundation of the Japanese cultural and aesthetic norms of elegance and beauty, and are also reflected in modern and contemporary literary and cinematic works.

Second, it is through these categories that students can understand more about Japanese culture and people. For example, the feeling of "mono no aware" (物の哀れ) arose in Japan and became an important feeling that dominated Japanese literature and art, closely related to the geographical conditions of the Japanese archipelago. Since ancient times, parts of Japan have often been covered in fog, so the scenery hidden in the fog gives the impression of vagueness, uncertainty and constant change. Another example is "wabi", an idea which was created by Sen no Rikyu 千利休 (1522 – 1591), a famous tea master of the Warring States period in Japan. It blends the spirit and beauty that tea pursues: rough on the outside, perfect on the inside. It was then refined by the haiku poet Matsuo Basho 松尾芭蕉 (1644 – 1694), who guided by Noh music, gradually developed the meaning of beauty. He noted that from the appearance of old objects (including people), a beauty full of time appears even when the appearance is mottled, an irresistible beauty, even when faded and blurred.

Third, it is to compare the feelings in Japanese literature with Vietnamese literature, so that students can understand the cultural differences between Japan and Vietnam, and at the same time, locate traditional cultural values. Our students/graduate students have had valuable works comparing Japanese literature with Vietnamese literature such as comparing and contrasting Inoue Yasushi's short stories with Nguyen Huy Thiep's short stories, or researching Empty Symbols in Murakami's *Kafka on the Shore* and *The Wind Erases All Marks* by Ho Anh Thai, etc. These are the first steps showing the intersection in the artistic thinking of modern and contemporary Japanese writers, at the same time showing the differences in artistic style, character building and cultural symbols. These differences are based on various cultural backgrounds and aesthetic sensibilities between writers from different cultures.

New Approaches to Aesthetic Education for University Students

In our opinion, the new aesthetic education has five notable elements and benefits:

First, it shifts the course emphasis from theoretical to practical. In the era of information explosion like today, students can easily access a treasure trove of knowledge and books, they just need a little guidance on which sources to approach, and how to process information effectively and accurately. Therefore, we believe it makes sense to reduce purely theoretical teaching hours to increase practice and discussion hours.

Second, it encourages students to share their personal aesthetic experiences, especially when approaching something completely new, beyond their previous aesthetic experience. For example, some of our students were shocked when they first read Kawabata's *Sleeping Beauty or Beauty and Sadness*, and some cannot explain why the author approached his works in that way. Our goal is to respect their aesthetic experience, rather than providing

explanations or answers right away. We then encourage them to learn more about Kawabata's other works, or read more and compare what they learn with Tanizaki's novels, and continue to discuss issues related to traditional Japanese aesthetic sensibilities.

Another example is our study of viewers' experiences of *Grave of the Fireflies*, to understand the different perspectives of Vietnamese viewers on the situation that Japanese people faced after World War II. We encourage students to record their reading/watching experiences, their views before, during and after reading/watching the work, and encourage them to keep those pages of their writing even after they have finished the course. Their reading experiences as well as their aesthetic experiences will continue to change during their time at school, as well as after they graduate.

Third, the lecturer's teaching experience, knowledge accumulation, and life experience are very important. If the lecturer does not have enough aesthetic experience and aesthetic sensitivity, he or she cannot inspire students. Therefore, in our department, we encourage lecturers to participate in cultural and artistic exchange activities in Vietnam and also abroad, creating conditions for lecturers to have the opportunity to improve and develop themselves. From there, lecturers will have more creativity and the ability to offer more inspiring lessons for students. The overall effect is to help teachers to reach and maintain higher professional standards than they otherwise might.

Fourth, we organize activities such as dramatizing literary works so that students can experience the feeling of being transformed into a character in another culture, thereby gaining empathy and deeper feelings about literature and culture. In this sense, our view is close to Hans-Georg Gadamer (1900–2002)'s aesthetic view: artistic experience is a way to increase aesthetic awareness, creating art or participating in artistic activities is a process of play or festival, stimulating joy, excitement and imagination. "Gadamer emphasizes within experience (Erfahrung) one is always participating, perhaps unwittingly, in something beyond oneself" (https://plato.stanford.edu/entries/gadamer-aesthetics/). These experiences of students also help them enrich their inner world and learn to live harmoniously in a community.

Fifth, studying and experiencing aesthetic categories does not only help students grasp concepts and identify manifestations of aesthetics in literary and artistic life. It also helps students locate differences. in culture, thereby respecting differences as well as maintaining their own cultural identity in a globalized world.

Conclusions

In short, we believe that teaching aesthetics through literature and cinema is a process of finding joy and empathy in art. It may not immediately show a specific result, but each of our efforts nevertheless plays an essential role on the journey to creating beautiful souls and useful people for society. At a time when many young people are in need of assistance when it comes to discovering their own identity and gaining deeper appreciation for literature and cinema as well as other cultures, aesthetic education arguably provides a more effective method to teach and engender within young people greater respect for other cultures as well as themselves and promote a more harmonious global existence.

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A Comprehensive Synthesis and Administrative Implementation Framework for Universal Design for Learning

Rapeephan Phaengsopha, Khon Kean University, Thailand
Saowanee Sirisooksilp, Khon Kaen University, Thailand

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Abstract
The Universal Design for Learning (UDL) framework is a powerful approach to creating inclusive educational environments that cater to the diverse needs of all learners. However, its implementation in Thailand remains limited due to varying contextual challenges. This study aims to synthesize and validate UDL components specifically tailored to the Thai educational context. A mixed-methods approach was employed, consisting of an extensive document analysis, expert focus group discussions with nine educational experts, and a subsequent validation phase through a survey of 50 educational stakeholders. The synthesis phase identified five critical UDL components, including visionary UDL leadership, stakeholder engagement, teacher professional development, flexible curriculum design, and Supportive Learning Environment. The validation results indicated a high level of appropriateness for these components, with overall mean scores above 4.7 out of 5. Additionally, comparative analysis with international UDL implementations, and technology integration assessments were conducted to further contextualize the findings. The study concludes that while the UDL framework is highly relevant for Thailand, its successful implementation requires strategic planning, particularly in technology integration and professional development. This research offers new insights by adapting global best practices in UDL to the specific needs of Thai education, contributing to the ongoing discourse on inclusive education in Southeast Asia.

Keywords: Universal Design for Learning (UDL), Inclusive Education, Thailand Education System

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Introduction

Universal Design for Learning (UDL) has emerged as a critical framework for creating inclusive educational environments, yet its implementation in Thailand faces significant challenges. While Thailand has made strides in educational reform, the country continues to struggle with providing equitable and inclusive education, particularly in accommodating diverse learner needs across urban and rural areas. Recent studies highlight persistent gaps in educational outcomes, with Bualar (2015) identifying critical barriers including inconsistent policy implementation, resource limitations, and insufficient teacher preparation, especially affecting marginalized populations. These challenges are further complicated by the urban-rural divide, where Piyaman and colleagues (2017) document significant achievement gaps and disparities in educational resources.

Previous research has established UDL's effectiveness in various educational contexts. Meta-analyses demonstrate significant positive impacts, with Almeqdad and colleagues (2023) reporting a combined effect size of 3.56 across 13 empirical studies, and King-Sears and colleagues (2022) finding moderate positive effects (g=0.43) in their analysis of 20 studies. Implementation studies in diverse settings have shown promising results, with Cook and Rao (2018) documenting successful adaptations for students with learning disabilities and Espada-Chavarria and colleagues (2023) reporting positive outcomes in higher education settings. However, Zhang and colleagues (2024) identify significant implementation challenges, including inconsistent alignment between guidelines and interventions.

Several research gaps exist in the current literature regarding UDL implementation in Thailand's specific context. Han and Lei (2024) note limited research on teacher and student perceptions in diverse cultural settings, while Rao and Meo (2016) emphasize the need for more systematic approaches to integrating UDL with standards-based instruction. Moreover, McKenzie and colleagues (2023) highlight the challenges of UDL implementation in low and middle-income countries, where contextual adaptation and capacity building are crucial yet understudied. The integration of technology within UDL frameworks presents additional challenges, as Bray and colleagues (2023) reveal that while technology effectively supports UDL's representation principle, its potential for fostering engagement and expression remains underutilized.

This study aims to address these gaps by synthesizing and validating UDL components specifically tailored to the Thai educational context. The research objectives are threefold:

(1) To identify and validate critical UDL components suitable for Thailand's educational system through expert consultation and empirical validation.
(2) To develop a comprehensive technology integration framework that addresses the urban-rural digital divide.
(3) To create a strategic implementation framework that considers Thailand's unique resource constraints and cultural context.

The study makes several significant contributions to both theory and practice. First, it provides a validated framework for UDL implementation specifically designed for the Thai context, addressing the need identified by Kantavong and colleagues (2017) for culturally responsive inclusive education practices. Second, it offers practical insights into technology integration strategies that consider resource limitations, building on Shimojo and colleagues' (2020) work on educational technology adoption in Asian contexts. Third, it develops a strategic implementation framework that balances ambitious goals with practical constraints,

addressing concerns raised by Fry and Bi (2013) regarding the challenges of educational reform in Thailand. Finally, the study contributes to the broader discourse on UDL adaptation in developing educational systems, providing valuable insights for other Southeast Asian countries facing similar challenges in creating inclusive, technology-enhanced learning environments.

Literature Review

Universal Design for Learning (UDL): Theoretical Framework and Global Implementation

Universal Design for Learning (UDL) has emerged as a transformative educational framework aimed at creating inclusive learning environments that accommodate diverse learner needs (CAST, 2024b). The framework, grounded in neuroscience research, emphasizes three core principles: multiple means of engagement, representation, and action & expression (Capp, 2017; Al-Azawei et al., 2016). Recent meta-analyses demonstrate UDL's significant impact on educational outcomes, with Almeqdad and colleagues (2023) reporting a combined effect size of 3.56 across 13 empirical studies, while King-Sears and colleagues (2022) found moderate positive effects (g=0.43) in their analysis of 20 studies. The theoretical foundations of UDL have evolved significantly since its inception. Smith and colleagues (2019) identified key developments in UDL research, highlighting the need for more rigorous implementation criteria and measurement tools. This aligns with findings from Al-Azawei and colleagues (2016), who analyzed peer-reviewed papers from 2012 to 2015, revealing positive outcomes in learner engagement and academic performance across various educational contexts. Rao and colleagues (2014) further emphasized UDL's effectiveness in both K-12 and post-secondary settings, though noting inconsistencies in implementation approaches. Global implementation of UDL reveals varying degrees of success and challenges. Studies from developed nations demonstrate more established practices, with Cook and Rao (2018) highlighting successful adaptations for students with learning disabilities. Espada-Chavarria and colleagues (2023) documented positive outcomes in higher education settings, particularly in improving student motivation and comprehension through blended teaching methods. However, Zhang and colleagues (2024) identified significant challenges in UDL implementation, including inconsistent alignment between guidelines and interventions, and limited theoretical foundation in many UDL-based practices. Research gaps persist in understanding UDL's effectiveness across different cultural contexts. Han and Lei (2024) noted limited research on teacher and student perceptions in diverse settings, while Rao and Meo (2016) emphasized the need for more systematic approaches to integrating UDL with standards-based instruction. Lambert and colleagues (2023) argued for viewing UDL as a dynamic thinking process rather than a rigid checklist, suggesting the importance of context-sensitive implementation strategies. International comparative studies reveal significant variations in UDL adoption. McKenzie and colleagues (2023) examined UDL implementation in low- and middle-income countries, highlighting the need for contextual adaptation and capacity building. Ainscow (2020) emphasized the importance of systemic change and leadership support in successful UDL implementation, while Piticari (2023) demonstrated positive effects on student motivation in mainstream schools. These findings underscore the necessity of considering local educational contexts and resources when implementing UDL frameworks. Recent developments in UDL research have also highlighted the importance of professional development and teacher preparation. Craig and colleagues (2019) found significant improvements in teachers' UDL implementation following intensive training programs. Similarly, Rusconi and Squillaci (2023) identified

positive impacts of UDL training on teacher competencies, particularly in mainstream and special education contexts. However, they also noted gaps in research regarding the characteristics that influence training success and its effects on teacher self-efficacy and collaboration.

Technology Integration in Universal Design for Learning

The integration of technology within UDL frameworks represents a critical development in creating accessible and inclusive learning environments. Bray and colleagues (2023) conducted a systematic review revealing that while technology effectively supports UDL's representation principle, its potential for fostering engagement and expression remains underutilized. This finding aligns with research by Nieves and colleagues (2019), who demonstrated the effectiveness of technology-enhanced UDL implementation through Massive Open Online Courses (MOOCs). The COVID-19 pandemic has accelerated technology adoption in education, highlighting both opportunities and challenges. Basham and colleagues (2020) emphasized technology's role in supporting UDL implementation during emergency remote learning, while noting the need for systematic approaches to educational redesign. The Global Education Monitoring Report (2023) identified significant disparities in digital access and infrastructure across Southeast Asia, particularly affecting rural and marginalized communities. Research gaps exist in understanding effective technology integration across different educational contexts. McKenzie and colleagues (2023) highlighted challenges in low- and middle-income countries, where limited technological infrastructure affects UDL implementation. Shimojo and colleagues (2020) demonstrated positive outcomes from combining Information and Communication Technology (ICT) with UDL principles in Japanese classrooms, though noting the slower progress compared to other developed nations. Professional development emerges as a critical factor in successful technology integration. Craig and colleagues (2019) found that targeted training programs significantly improved teachers' ability to implement technology-enhanced UDL strategies. Rusconi and Squillaci (2023) emphasized the importance of continuous professional development in supporting teachers' technological competencies and adaptive teaching strategies. The use of assistive technologies and digital tools presents both opportunities and challenges. Carrington and colleagues (2020) explored how technology supports UDL implementation for students with autism spectrum disorders, while Bettini and colleagues (2014) emphasized the importance of providing adequate technological resources and support for special educators. However, studies by Paul and colleagues (2022) and Kelly and colleagues (2022) identified ongoing challenges in ensuring equitable access to technology and appropriate support systems.

Contextual Factors in Thai Educational System

The implementation of UDL in Thailand's educational system faces unique challenges shaped by cultural, institutional, and policy contexts. Bualar (2015) identified several critical barriers, including inconsistent policy implementation, resource limitations, and insufficient teacher preparation, particularly affecting rural areas and marginalized populations. These challenges are compounded by the complex interplay of traditional teaching methods and modern educational reforms. Research by Kantavong and colleagues (2017) provided valuable insights through a comparative study of inclusive education practices in Thailand and Indonesia. Their findings revealed that Thai teachers experience higher levels of exhaustion despite receiving more institutional support, highlighting systemic challenges in implementation. Piyaman and colleagues (2017) further documented significant achievement

gaps between urban and rural schools, emphasizing the need for targeted interventions and support systems. The administrative context plays a crucial role in UDL implementation. Nomnian and Arphattananon (2018) examined school administrators' competencies, identifying five key areas essential for effective English language teaching and learning. Wongsirasawat and colleagues (2019) developed role indicators for administrators to enhance learning management efficiency, while emphasizing the importance of professional development and stakeholder engagement. Historical analysis by Fry and Bi (2013) traced the evolution of educational reforms in Thailand, revealing persistent challenges in implementation and outcomes. Wallapha and colleagues (2014) explored alternative education approaches, demonstrating potential pathways for addressing diverse learning needs within the Thai context. Assalihee and Boonsuk (2022) highlighted specific challenges in adapting teaching methods to local cultural contexts, particularly in Thailand's Deep South. Recent policy developments and initiatives show promising directions but also reveal ongoing challenges. Fry (2018) documented the growth of alternative education models in Thailand, highlighting their potential for supporting diverse learning needs. However, studies by Paul and colleagues (2022) and Finkelstein and colleagues (2019) identified continuing gaps in inclusive practices and teacher preparation, suggesting the need for more comprehensive approaches to educational reform.

Research Methodology

This study employed a comprehensive mixed-methods approach to synthesize and validate Universal Design for Learning (UDL) components within the context of Thailand's education system. The research was conducted in two primary phases: synthesis and validation. These phases were designed to ensure the development of a robust and contextually relevant UDL framework for Thailand, considering both local educational challenges and global best practices.

Research Design

The research design employed a mixed-methods approach, integrating both qualitative and quantitative methodologies to thoroughly examine the Universal Design for Learning (UDL) components from multiple perspectives. It was structured into two main phases: the first phase focused on synthesizing UDL components through an extensive document review, framework analysis, and contextual evaluation tailored to Thailand’s educational system, supplemented by expert focus group discussions to refine the components for local relevance. The second phase validated the synthesized components using quantitative methods, where a survey instrument was distributed to educational experts to assess the appropriateness, feasibility, and overall effectiveness of each component within the Thai educational context.

Phase 1: *Synthesis of UDL Components*

Document Analysis.

The initial phase involved an extensive document analysis to identify, extract, and synthesize UDL components relevant to the Thai educational context. This process included:

- Literature Review: A systematic review of academic publications, policy documents, and reports related to UDL was conducted. The review focused on identifying key UDL principles and components that have been successfully implemented in various

international contexts. This step ensured that the synthesized components were grounded in established research and best practices.

- Framework Analysis: Existing UDL frameworks from leading educational institutions and global organizations were analyzed to extract core components. This analysis provided a foundational structure for developing a UDL model tailored to the needs of Thai students and educators.
- Contextual Analysis: An examination of Thailand's educational policies, curriculum standards, and current inclusive education practices was undertaken. This analysis ensured that the synthesized UDL components would be both relevant and feasible within the Thai educational system.

Expert Focus Group Discussions.

To refine the synthesized components and ensure their contextual relevance, focus group discussions were conducted with educational experts. The focus groups consisted of:

- Participants**:** A purposive sample of nine educational experts with extensive experience in UDL, inclusive education, and Thai educational policy. These experts included academic researchers, policy advisors, and experienced educators.
- Discussion Topics: The discussions focused on the applicability, adaptability, and potential challenges of implementing the synthesized UDL components in Thailand. Participants were encouraged to provide insights and suggest modifications to enhance the components' relevance to the local context.
- Data Collection and Analysis: The discussions were recorded and transcribed, with key themes and suggestions identified through thematic analysis. The feedback was then used to refine the UDL components before moving to the validation phase.

Phase 2: ***Validation of Synthesized Components***

The second phase of the study involved validating the synthesized UDL components through quantitative methods. This phase aimed to assess the appropriateness and feasibility of the components for implementation in Thai educational settings.

Survey Instrument Development.

A survey instrument was developed to quantitatively assess the appropriateness of the synthesized UDL components. The survey included:

- Questionnaire Design: The questionnaire was designed to measure expert opinions on the relevance, clarity, feasibility, and overall appropriateness of each UDL component. The Likert scale was used, with responses ranging from 1 (strongly disagree) to 5 (strongly agree).
- Pilot Testing: The survey instrument was pilot-tested with a small group of educators to ensure clarity and reliability. Based on the feedback, minor adjustments were made to the wording and structure of the questions.

Data Collection.

The validated survey instrument was distributed to a broader group of educational experts across Thailand. The experts included school administrators, curriculum developers, and university faculty members with expertise in UDL and inclusive education.

- Sampling Method: A purposive sampling method was used to select participants who had significant experience with UDL or who were involved in inclusive education initiatives in Thailand.
- Response Rate: A total of 50 completed surveys were collected, representing a diverse cross-section of Thailand's educational landscape.

Data Analysis.

The collected survey data were analyzed using descriptive statistics, including mean scores and standard deviations, to determine the overall appropriateness of each UDL component.

- Statistical Analysis: Descriptive statistics were calculated for each UDL component, allowing for a clear comparison of how each was perceived by the expert participants. The mean scores provided insight into the components' relative strengths and potential areas for improvement.
- Interpretation: The analysis highlighted which components were most highly rated and which required further refinement. This informed the final recommendations for UDL implementation in Thailand.

Comparative Analysis with International UDL Implementations

The comparative analysis placed the validated Universal Design for Learning (UDL) components within a global context by comparing them to implementations in countries such as the United States, Finland, and Japan. International UDL frameworks served as benchmarks to evaluate the alignment of Thai components with global best practices. The analysis also highlighted unique adaptations necessary to address Thailand's specific educational challenges, offering insights into how contextual factors influence UDL implementation and identifying strategies for effective adaptation in diverse settings.

Technology Integration

The analysis of technology integration explored the role of digital tools and platforms in supporting Universal Design for Learning (UDL) within Thai schools. Data were collected through surveys and secondary analysis to assess the availability and effectiveness of existing technologies in fostering UDL principles. The findings highlighted significant gaps, particularly in rural and underserved areas, prompting recommendations for targeted improvements to enhance technology access and utilization. These improvements aim to ensure equitable and effective support for UDL implementation across diverse educational settings in Thailand.

Scenario Analysis

The scenario analysis explored potential trajectories for Universal Design for Learning (UDL) implementation in Thailand under varying conditions, focusing on different levels of technology adoption and funding availability. Four distinct scenarios were developed to reflect these variables, providing a framework for understanding the diverse pathways UDL implementation could take. Each scenario's potential outcomes were systematically assessed, offering valuable insights for strategic planning and highlighting the critical factors necessary for ensuring effective and sustainable implementation within Thailand's unique educational context.

Research Results

This section presents the findings from the synthesis and validation of Universal Design for Learning (UDL) components within the context of Thailand's education system. Additionally, it includes comparative analysis with international UDL implementations, technology integration, and future scenario analysis.

Synthesis of Universal Learning Management Components in Thailand

The synthesis phase involved an in-depth analysis of existing literature, frameworks, and expert opinions. The following components were identified as critical to the successful implementation of UDL in Thailand:

Table 1: Synthesized UDL Components in the Thai Educational Context

UDL Component	**Description**
visionary UDL leadership	Establishing a clear and inclusive vision for education that addresses the diverse needs of all students.
Stakeholder Engagement	Involving teachers, students, parents, and community members in the decision-making process.
Teacher Professional Development	Continuous training and support for teachers to effectively implement UDL in their classrooms.
Flexible Curriculum Design	Developing adaptable curricula that accommodate diverse learning styles and abilities.
Diverse Assessment Methods	Implementing varied assessment strategies to cater to different learning needs and to provide equitable evaluation.
Supportive Learning Environment	Creating a conducive environment for learning through technology integration and flexible classroom setups.

Validation of UDL Components for the Thai Educational Context

The synthesized components were validated through expert surveys and quantitative analysis. The results indicated a high level of appropriateness across all components, suggesting their suitability for effective implementation in Thailand's education system.

Table 2: Validation Results of UDL Components in the Thai Educational Context

UDL Component	**Mean Score**	**Standard Deviation (SD)**	**Appropriateness Level**
visionary UDL leadership	4.67	0.50	Very High
Stakeholder Engagement	4.56	0.53	Very High
Teacher Professional Development	4.73	0.48	Very High
Flexible Curriculum Design	4.89	0.33	Very High
Supportive Learning Environment	4.79	0.44	Very High
Overall Mean	4.73	0.46	Very High

The results in Table 2 demonstrate the high level of appropriateness for each UDL component, emphasizing their readiness for implementation within Thailand's education system. As shown in Figure 1, these components have been visualized to further highlight their validation results.

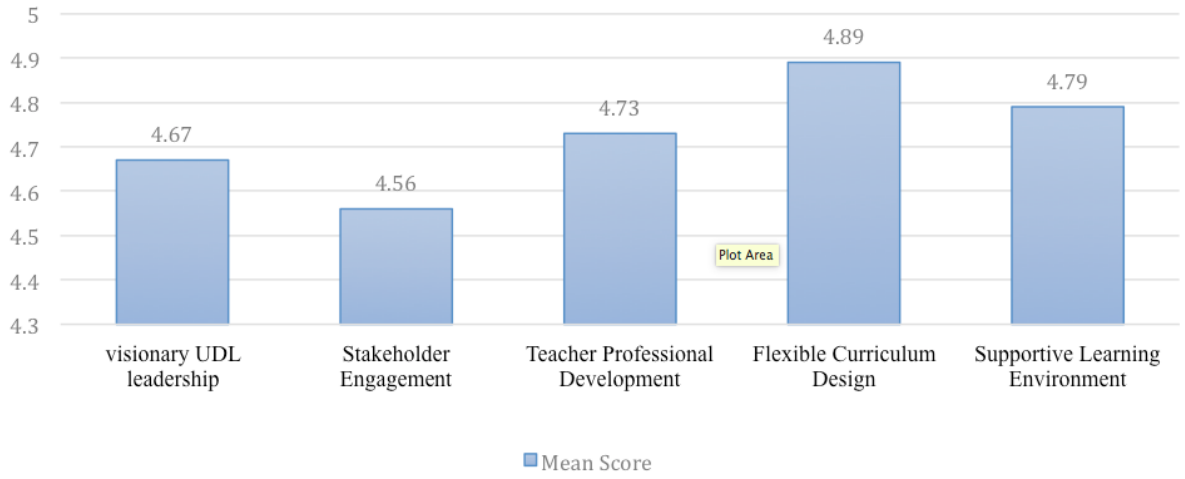

Figure 1: Validation Results of UDL Components in the Thai Educational Context

Comparative Analysis With International UDL Implementations

To provide a broader context, the Thai UDL components were compared with implementations in other countries, highlighting both similarities and differences. This comparison emphasizes the global relevance of the synthesized components and identifies potential areas for improvement.

Table 3: Comparative Analysis of UDL Components

UDL Component	Thailand	United States	Finland	Japan	Global Best Practices
visionary UDL leadership	Clear, Inclusive	Established	Strong	Emerging	Vision statements aligned with inclusivity and accessibility across countries.
Stakeholder Engagement	Developing	Advanced	Moderate	Strong	High levels of community and parental involvement are crucial.
Teacher Professional Development	Ongoing	Extensive	Structured	Continuous	Emphasis on continuous, practical training in UDL principles.
Flexible Curriculum Design	In Progress	Well-developed	Adaptive	Standard	Curriculum flexibility is a key factor in successful UDL implementation.
Supportive Learning Environment	Emerging	Strong	Tech-enhanced	Developing	Technology integration is a common feature across successful UDL environments.

Technology Integration in UDL

The integration of technology in UDL is essential for creating a modern and inclusive learning environment. This analysis explores the current status of technology use in Thai education and suggests potential improvements.

Table 4: Technology Integration in UDL

Technology	**Application in UDL**	**Current Status in Thailand**	**Potential Improvements**
Assistive Technologies	Supports diverse learning needs through adaptive tools.	Limited availability	Increased access and training required.
Learning Management Systems	Facilitates flexible curriculum and diverse assessments.	Widely implemented	Enhanced user interface and analytics.
Interactive Learning Tools	Encourages student engagement and participation.	Emerging use	Greater integration into daily lessons.
Digital Content Platforms	Provides access to a variety of learning materials.	Growing use in urban areas	Expansion to rural schools needed.

Scenario Analysis

Future scenarios were developed to explore how UDL might be implemented under different conditions, such as varying levels of technology adoption and funding. This analysis provides a dynamic understanding of the potential evolution of UDL in Thailand.

Table 5: Scenario Analysis of UDL Implementation

Scenario	**Key Features**	**Potential Outcomes**
High Tech, High Funding	Extensive technology use, substantial investment in professional development.	Rapid improvement in UDL implementation, high student engagement.
Low Tech, High Funding	Limited technology use, focus on human resources and curriculum redesign.	Steady progress, focus on teacher-student interactions.
High Tech, Low Funding	Reliance on existing technologies, limited teacher training.	Uneven implementation, possible disparities between schools.
Low Tech, Low Funding	Minimal investment, focus on basic UDL principles and low-cost solutions.	Slow progress, possible challenges in achieving inclusive education.

Discussion

Synthesis and Validation of UDL

The synthesis and validation of UDL components for Thailand's educational context revealed five critical elements, all receiving remarkably high validation scores (mean > 4.7 out of 5) from educational experts. visionary UDL leadership (mean=4.67, SD=0.50) and flexible curriculum design (mean=4.89, SD=0.33) emerged as particularly crucial elements, aligning with global best practices while addressing local needs. This strong validation suggests these components effectively bridge the gap between international UDL principles and Thailand's specific educational challenges. These findings both support and extend previous research in several ways. Our results align with Smith and colleagues' (2019) emphasis on rigorous implementation criteria while adding specific contextual considerations for Thailand. The high validation scores for stakeholder engagement (mean=4.56, SD=0.53) support Kantavong and colleagues' (2017) findings on the importance of community involvement in Thai education, though our framework provides a more comprehensive approach to engagement. Additionally, our identification of organizational culture as a critical component extends beyond Wongsirasawat and colleagues' (2019) findings on administrative roles, emphasizing the need for systemic cultural transformation. The results particularly resonate with recent studies on UDL implementation in diverse cultural contexts. For instance, our findings support McKenzie and colleagues' (2023) emphasis on contextual adaptation in low and middle-income countries, while providing specific strategies for the Thai context. The high validation scores for teacher professional development (mean=4.73, SD=0.48) align with Rusconi and Squillaci's (2023) findings on the importance of teacher training, though our results suggest additional considerations specific to Thai educational settings. However, some findings diverge from previous research. While Al-Azawei and colleagues (2016) found varying levels of UDL compliance across different educational contexts, our study revealed consistently high validation scores across all components, suggesting strong expert consensus on their relevance to Thailand. This difference might be attributed to our focused approach on contextual adaptation and the comprehensive nature of our validation process. The study's strength lies in its mixed-methods approach and robust validation process. However, limitations include the focus on expert opinions rather than direct classroom implementation data. As Han and Lei (2024) noted, there remains limited research on teacher and student perceptions in diverse settings, suggesting the need for further investigation of these perspectives in the Thai context.

Technology Integration Framework

The analysis of technology integration reveals significant disparities between urban and rural areas in Thailand, particularly in access to assistive technologies and digital learning platforms. The findings indicate that while learning management systems are widely implemented, other essential technologies remain underutilized, creating a critical challenge for equitable UDL implementation. These results both support and extend previous research findings. The observed urban-rural divide aligns with the Global Education Monitoring Report's (2023) findings on digital disparities in Southeast Asia. Our findings also support Bray and colleagues' (2023) observations about technology's role in UDL implementation while providing specific insights into Thailand's unique challenges. The results particularly resonate with Shimojo and colleagues' (2020) findings on the gradual adoption of educational technology in Asian contexts, though our study reveals more pronounced disparities in the Thai context.

While Basham and colleagues (2020) emphasized technology's role in supporting UDL during emergency remote learning, our findings suggest the need for more sustainable, context-specific approaches. This aligns with Craig and colleagues' (2019) emphasis on targeted training programs, though our results indicate additional considerations for resource-limited settings. Our findings extend Carrington and colleagues' (2020) work on technology support for diverse learners, highlighting specific challenges in the Thai context. The results also build upon Paul and colleagues' (2022) and Kelly and colleagues' (2022) findings regarding equitable access challenges, providing concrete recommendations for the Thai educational system. The study contributes to understanding technology integration challenges in developing contexts, though several limitations exist. The focus on current technology status may not fully capture rapid technological changes, and the analysis might benefit from longitudinal data on technology adoption patterns.

Strategic Implementation Framework

The scenario analysis reveals that successful UDL implementation in Thailand requires a carefully balanced approach considering both technological and human resource factors. The high-tech, high-funding scenario shows promise for rapid improvement, but the low-tech, high-funding scenario may be more realistic for immediate implementation, given current resource constraints. These findings align with but also extend previous research. They support Bualar's (2015) identification of critical barriers in Thai inclusive education while providing specific strategic pathways for implementation. The results also complement Piyaman and colleagues' (2017) emphasis on human resource development, though suggesting a more nuanced approach to implementation. Our framework builds upon Fry and Bi's (2013) analysis of educational reforms in Thailand, offering concrete strategies for addressing persistent challenges. The findings also extend Wallapha and colleagues' (2014) work on alternative education approaches, providing a structured implementation pathway that considers diverse educational needs. The results particularly resonate with recent international research. Our strategic framework aligns with Ainscow's (2020) emphasis on systemic change and leadership support while addressing Thailand's specific contextual challenges. The findings also support Lambert and colleagues' (2023) argument for viewing UDL as a dynamic process rather than a rigid framework, though providing more specific guidelines for the Thai context. However, some findings diverge from previous research. While Espada-Chavarria and colleagues (2023) emphasized technology-first approaches in higher education, our results suggest that human capital development should be prioritized in the initial phases of UDL implementation in Thailand. This difference might be attributed to the unique challenges and resources available in the Thai educational system.

Implications and Future Directions

This research has significant implications for educational policy, practice, and future research in Thailand's implementation of Universal Design for Learning (UDL). The validated UDL components provide a foundation for systemic change in Thai education, suggesting the need for comprehensive policy reforms that support inclusive educational practices. The findings particularly underscore the importance of addressing the urban-rural divide in technology access, as highlighted by the Global Education Monitoring Report (2023), and the need for sustained professional development programs aligned with Rusconi and Squillaci's (2023) recommendations. The scenario analysis implies that policymakers should consider a phased implementation approach, initially focusing on human resource development while gradually building technological infrastructure. This aligns with McKenzie and colleagues' (2023)

observations about UDL implementation in low- and middle-income countries while addressing Thailand's specific contextual challenges. Furthermore, the high validation scores for organizational culture and stakeholder engagement suggest the need for comprehensive community involvement in UDL implementation, supporting Kantavong and colleagues' (2017) findings on the importance of community participation in Thai inclusive education.

Recommendations

Recommendations for Research Implementation

Based on this study's findings and limitations, several key recommendations emerge for future research endeavors. First, longitudinal studies should be conducted to examine the practical implementation of the validated UDL components in diverse Thai educational settings. This addresses Han and Lei's (2024) identified gap regarding the need for more comprehensive implementation research across different cultural contexts. Such studies should particularly focus on tracking the effectiveness of UDL components across urban and rural schools, measuring both quantitative outcomes and qualitative experiences of stakeholders. Second, research should investigate the development and validation of culturally appropriate assessment tools for measuring UDL implementation fidelity, addressing Zhang and colleagues' (2024) concerns about inconsistent implementation measures. Third, comparative studies examining UDL implementation across different Southeast Asian countries would provide valuable insights into regional adaptation strategies, building on McKenzie and colleagues' (2023) work on UDL in developing contexts. Additionally, research should explore cost-effective technology integration models suitable for resource-limited settings, extending Bray and colleagues' (2023) findings while addressing Thailand's specific technological challenges.

Recommendations for Educational Practice

For educational practitioners and administrators, several practical recommendations emerge from this study's findings. First, schools should prioritize the development of comprehensive professional development programs that focus on UDL implementation, aligned with Craig and colleagues' (2019) findings on the effectiveness of targeted training programs. These programs should emphasize practical application strategies while considering local resource constraints. Second, educational institutions should establish clear frameworks for stakeholder engagement, following Kantavong and colleagues' (2017) emphasis on community involvement in Thai education. This includes developing structured approaches for involving parents, community members, and local organizations in UDL implementation.
The study also recommends a phased approach to technology integration, starting with basic infrastructure development and gradually expanding to more advanced applications. This aligns with Shimojo and colleagues' (2020) observations about the gradual adoption of educational technology in Asian contexts. Schools should focus on building robust support systems for teachers, including mentoring programs and professional learning communities, as suggested by Rusconi and Squillaci (2023). Additionally, administrators should work to create inclusive organizational cultures that support UDL implementation, addressing Wongsirasawat and colleagues' (2019) findings on the importance of administrative leadership in educational innovation.

Special attention should be paid to developing flexible curriculum designs that accommodate diverse learning needs while maintaining alignment with Thai educational standards. This

recommendation builds on Espada-Chavarria and colleagues' (2023) work on effective UDL strategies in higher education while considering Thailand's specific educational context. Finally, schools should establish systematic monitoring and evaluation processes to track the effectiveness of UDL implementation, incorporating both quantitative and qualitative measures of success.

Conclusions

This comprehensive study of Universal Design for Learning (UDL) implementation in Thailand's educational system yields significant theoretical and practical contributions to the field of inclusive education. Through rigorous mixed-methods research, including expert validation, comparative analysis, and scenario planning, the study has identified and validated five critical UDL components specifically tailored to the Thai context, with all components receiving remarkably high validation scores (mean>4.7 out of 5). The research particularly highlights the crucial role of flexible curriculum design (mean=4.89) and supportive learning environments (mean=4.85) in successful UDL implementation while also revealing significant urban-rural disparities in technology access and integration. These findings contribute to both theoretical understanding and practical implementation strategies, offering valuable insights for policymakers and educational leaders working to implement UDL principles in developing educational systems. The study opens several important avenues for future research, including longitudinal implementation studies, investigation of cost-effective technology integration strategies, and development of sustainable professional development models. These conclusions not only advance our understanding of UDL adaptation in Thai education but also provide valuable insights for other developing educational systems in Southeast Asia, particularly in addressing the challenges of creating inclusive, technology-enhanced learning environments within resource constraints.

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Moderating Effects of Cognitive Load and Learning Engagement on Self-Regulated Learning Motivation and Academic Achievement

Wen-Liang Chang, National Taipei University of Technology, Taiwan
Ming-Hsiu Tsai, National Taipei University of Technology, Taiwan
Cheng-Hung Weng, National Taipei University of Technology, Taiwan
Hung-Che Cheng, New Taipei Municipal Tur Ya Kar Elementary & Junior High School, Taiwan

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Abstract
This study aims to explore the moderating effects of increased cognitive load and learning participation on the relationship between autonomous learning motivation and academic achievement. The research subjects were seventh-grade students from a junior high school in New Taipei City, undergoing a six-week teaching intervention. The participants received a teaching intervention that incorporated increased cognitive load before and during classes. Data were collected using the Autonomous Learning Motivation Scale, Cognitive Load Scale, Learning Participation Scale, and Academic Achievement Test, and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results showed that: (1) autonomous learning motivation significantly positively predicted academic achievement; (2) increased cognitive load had a significant positive moderating effect on the relationship between autonomous learning motivation and academic achievement; (3) learning participation had a significant positive moderating effect on the relationship between autonomous learning motivation and academic achievement. These findings highlight the importance of increased cognitive load and learning participation. It is suggested that teachers should focus on providing learning scaffolds, guiding students to engage in higher-level cognitive processing, and creating an interactive and engaging learning environment to enhance students' autonomous learning motivation and academic achievement.

Keywords: Autonomous Learning Motivation, Germane Cognitive Load, Learning Participation, Academic Achievement

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Introduction

With the advancement of technology and developments in the field of education, digital learning environments have become an important medium for teaching. How to enhance students' learning motivation in digital learning environments and thus promote academic achievement is a significant issue in current educational research. Previous studies have shown that learning motivation is a key factor affecting academic achievement (Brown, 2022; Lazzari, 2023; Nugraheni et al., 2022). At the same time, cognitive load and learning participation also play important moderating roles in the learning process (Kalyuga, 2011; Kirschner et al., 2009; Paas & Van Merriënboer, 1994; Renkl & Atkinson, 2003; Van Merriënboer et al., 2006). However, empirical research on the relationship between learning motivation, cognitive load, learning participation, and academic achievement, especially in digital learning environments, is still limited.

Although existing studies have explored the impact of learning motivation on academic achievement (Cerasoli et al., 2014; Kriegbaum et al., 2018; Lazowski & Hulleman, 2016; Mayer, 2014; Ryan & Deci, 2020), the role of cognitive load and learning participation as moderating variables in digital learning environments has not received sufficient attention and research. Therefore, this study attempts to build on previous research to explore the relationships between autonomous learning motivation, increased cognitive load, learning participation, and academic achievement, with the aim of expanding the relevant research field and providing new perspectives and bases for optimizing digital learning environments.

Learning motivation refers to an individual's psychological tendency to become interested in learning activities and willing to invest time and effort, which is an important factor driving learning behavior and influencing learning outcomes (Ryan & Deci, 2020). Self-Determination Theory (SDT) divides motivation into intrinsic motivation and extrinsic motivation, emphasizing that individuals will generate high-quality intrinsic motivation when their basic psychological needs for autonomy, competence, and relatedness are satisfied, thereby enhancing learning engagement and performance (Ryan & Deci, 2017). Numerous empirical studies support the view of Self-Determination Theory, finding a significant positive relationship between intrinsic motivation and academic achievement (Cerasoli et al., 2014; Lazowski & Hulleman, 2016; Taylor et al., 2014). For example, a meta-analysis by Cerasoli and colleagues (2014) found that the average correlation coefficient between intrinsic motivation and academic performance was 0.27, while the correlation coefficient for extrinsic motivation was only 0.14. Additionally, intrinsic motivation has been found to predict variables such as learning satisfaction, persistence, and creativity (Howard et al., 2021; Jeno et al., 2019).

However, the rich information and complex interactions in digital learning environments may place higher demands on students' cognitive processing, leading to additional cognitive load (Kalyuga, 2011; Mayer, 2014). Cognitive Load Theory (CLT) posits that learners' working memory is affected by intrinsic cognitive load, extraneous cognitive load, and germane cognitive load (Sweller, 2010). Intrinsic cognitive load stems from the complexity of the learning material itself, extraneous cognitive load arises from flaws in instructional design, and germane cognitive load is associated with the mental effort learners invest in the learning process (Leppink et al., 2013). While an appropriate cognitive load can facilitate learning, excessive cognitive load can interfere with learning (Paas & Van Merriënboer, 2020). For instance, Chen and Wu (2012) found that students' extraneous cognitive load increased significantly when faced with complex multimedia learning materials, resulting in decreased

learning performance. Similarly, Lin and Chen (2017) found that when the intrinsic complexity of learning tasks exceeded students' ability levels, it triggered a higher intrinsic cognitive load, thereby affecting learning outcomes.

Given this, it is hoped that the teaching design context in this study can provide appropriate germane cognitive load in line with the current textbook structure to enhance learning outcomes.

Learning participation refers to the degree of students' engagement in the learning process, including behavioral engagement, emotional engagement, cognitive engagement, and agentic engagement (Fredricks et al., 2004). Behavioral engagement refers to students' participation and effort in learning activities, emotional engagement refers to students' interest and value recognition in learning, and cognitive engagement refers to students' thinking and strategy use regarding learning content (Reeve, 2013). Higher levels of learning participation are considered important mediating variables between learning motivation and academic achievement (Jang et al., 2016; Reeve & Lee, 2014). For example, Jang and colleagues (2016) found that teacher support for students' autonomy significantly enhanced students' learning participation, thereby promoting academic performance. Similarly, Reeve and Lee (2014) found that students' learning participation at the beginning of the semester could predict academic performance at the end of the semester, and improved academic performance further reinforced students' learning participation, creating a positive cycle. In this teaching design context, appropriate guiding activities are introduced in response to different levels of participation, aiming to enhance learning participation before and during the course, thus improving academic achievement.

Literature Review

Autonomous learning motivation, increased cognitive load, and learning participation are three important research themes in the field of educational psychology and form the theoretical basis for this study. These three themes reveal key factors influencing students' learning processes and outcomes from motivational, cognitive, and behavioral perspectives. This paper will systematically review the theoretical foundations, current research status, and future prospects of these three themes to provide an integrated perspective for understanding the complex mechanisms of student learning.

Autonomous Learning Motivation

Autonomous learning motivation refers to the drive for students to voluntarily and continuously invest time and effort in the learning process (Ryan & Deci, 2017). Self-Determination Theory (SDT) is an important theoretical framework for explaining autonomous learning motivation (Deci & Ryan, 1985; Ryan & Deci, 2000). The theory posits that humans have three basic psychological needs: autonomy, competence, and relatedness. When the learning environment satisfies these needs, students exhibit higher autonomous learning motivation (Ryan & Deci, 2020).

Numerous empirical studies support the hypotheses of the Self-Determination Theory. For example, Jang and colleagues (2016) used experience sampling to examine high school student's classroom learning motivation and found that teachers' autonomy-supportive behaviors significantly predicted students' autonomous learning motivation, influencing their classroom engagement and learning performance. Similarly, a meta-analysis by Patall and

colleagues (2022) found that teachers' provision of choices, rationales, and empathy - autonomy-supportive behaviors - was significantly positively correlated with students' autonomous learning motivation (r=.31). However, effectively enhancing students' autonomous learning motivation in educational practice remains challenging. On one hand, students of different ages and cultural backgrounds may have different needs for autonomy support (Chirkov, 2009; Reeve et al., 2020). For example, Reeve and colleagues (2020) found that compared to Western countries, students in Asian countries are more inclined to accept teachers' guidance and control. On the other hand, while supporting students' autonomy, teachers also need to provide appropriate structure and guidance to help students construct knowledge and skills (Jang et al., 2010; Sierens et al., 2009). For example, Sierens and colleagues (2009) found that the interaction effect between teachers' autonomy support and structure was most beneficial for enhancing students' learning motivation when the two were moderately combined.

Future research can further explore how teachers implement autonomy support in different subjects and teaching stages and how to integrate autonomy support with other teaching strategies (such as competence support and relatedness support) to create the optimal learning environment (Jang et al., 2016; Stroet et al., 2013). Additionally, exploring the relationship between students' personal characteristics (such as achievement goal orientation and attribution style) and autonomous learning motivation can help implement personalized teaching interventions (Dompnier et al., 2015; Kusurkar et al., 2013).

In summary, autonomous learning motivation, as a high-quality type of motivation, can promote the depth and breadth of learning by guiding students to engage more in cognitive processes directly related to learning content. In digital learning environments, it is worth exploring how to meet students' needs for autonomy, competence, and relatedness through task design and instructional interactions, thereby enhancing their autonomous learning motivation. Accordingly, this study proposes the following hypothesis:

Hypothesis 1: Autonomous learning motivation positively predicts academic achievement.

Germane Cognitive Load

Increased cognitive load refers to the cognitive processing that learners engage in to deeply understand learning materials, which has a positive impact on learning (Sweller et al., 2019). According to Cognitive Load Theory, there are three types of cognitive load in the learning process: intrinsic cognitive load, extraneous cognitive load, and germane cognitive load (Sweller, 2010). Intrinsic cognitive load arises from the complexity of the learning material itself, extraneous cognitive load comes from unnecessary instructional design, and germane cognitive load stems from learners' active cognitive processing for knowledge construction (Sweller et al., 2019).

CLT emphasizes that instructional design should reduce extraneous cognitive load while promoting germane cognitive load to optimize learning outcomes (Kalyuga, 2011). For instance, van Merriënboer and Sweller (2005) proposed four instructional design principles to reduce extraneous load and increase germane load: the goal-free effect, worked example effect, completion problem effect, and inductive problem-solving effect. The effectiveness of these principles has been supported by numerous empirical studies (Renkl, 2014; van Gog & Rummel, 2010).

However, whether students can benefit from germane cognitive load depends on their prior knowledge level. According to the expertise reversal effect, instructional designs that are effective for novices may have negative impacts on more advanced learners (Kalyuga, 2007). For instance, for students who already have relevant knowledge, too much guidance and examples may interfere with their knowledge integration and deep processing (Kalyuga & Renkl, 2010). Therefore, teachers need to adjust instructional design based on students' expertise levels to provide optimal cognitive load for students of different levels (Kalyuga & Singh, 2016).

Future research can further explore the specific forms and measurement methods of germane cognitive load and its application strategies in different subjects and learning stages (de Jong, 2010; Leppink et al., 2014). Additionally, researchers are also calling for attention to learners' subjective experiences of cognitive load and the relationship between subjective and objective measures (Klepsch & Seufert, 2020; Seufert, 2020). Integrating subjective and objective measures can help comprehensively understand the mechanisms of cognitive load and provide more precise guidance for instructional practice.

To reduce ineffective load and increase the effective load, the principles for designing digital learning materials include the goal-free effect, worked example effect, completion effect, split-attention effect, redundancy effect, expertise reversal effect, and transient information effect (International Cognitive Load Theory Workshop).

According to Cognitive Load Theory, germane cognitive load can be further divided into elaborative load, example-based load, variability load, explanatory load, goal-oriented load, and interactive load (Kalyuga, 2011). These types of germane load should be selected and designed based on learning content and goals to optimize learning outcomes while balancing intrinsic, extraneous, and germane cognitive load to avoid overall cognitive overload (Van Merriënboer & Sweller, 2005).

Based on the aforementioned literature, this study proposes the following hypothesis:

Hypothesis 2: Germane cognitive load positively moderates the relationship between autonomous learning motivation and academic achievement. That is, when students invest more germane cognitive load, the positive correlation between autonomous learning motivation and academic achievement is stronger.

Learning Participation

Learning participation refers to the degree of students' engagement in the learning process, including behavioral, emotional, cognitive, and agentic dimensions (Fredricks et al., 2004). Behavioral participation refers to students' effort and involvement in learning activities, emotional participation refers to students' interest and value recognition in learning, cognitive participation refers to students' thinking and strategy use regarding learning content, and agentic participation refers to students' proactive efforts to enhance and improve the learning process (Reeve, 2013). Higher levels of learning participation are considered important mediating variables between learning motivation and academic achievement (Jang et al., 2016; Reeve & Lee, 2014).

For example, Chiu (2021) found that providing timely encouragement and support in flipped classrooms significantly enhanced students' learning motivation and self-efficacy. Pan and

colleagues (2019) also showed that giving students successful experiences, such as guiding them to complete pre-learning tasks, can promote positive emotional experiences.

Erbil (2020) pointed out that using interactive teaching strategies like group discussions and role-playing in flipped classrooms can significantly increase students' classroom participation. Turan and Goktas (2018) found that guiding students to think actively and express their views before class can promote their active participation in classroom discussions.

Steen-Utheim and Foldnes (2018) showed that encouraging students to ask questions, think deeply, and reflect in flipped classrooms can enhance their critical thinking and metacognitive abilities. Låg and Sæle (2019) found that guiding students to summarize principles and connect knowledge can lead to more meaningful learning.

Hew and colleagues (2020) pointed out that giving students opportunities to evaluate and provide feedback in flipped classrooms can increase their sense of ownership and participation. Ng (2018) emphasized that establishing democratic and equal teacher-student relationships and creating a fair learning environment can promote students' active participation in the learning process.

Further exploration shows that factors influencing students' learning participation include personal and environmental aspects. At the personal level, students' self-efficacy, goal orientation, and attribution style significantly affect learning participation (Ames, 1992; Bandura, 1997; Dweck & Leggett, 1988). For example, Schunk and DiBenedetto (2016) showed that when students believe they can complete learning tasks and attribute learning outcomes to their efforts, they display higher learning engagement. At the environmental level, teachers' instructional practices, peer relationships, and school climate significantly influence students' learning participation (Furrer & Skinner, 2003; Jang et al., 2010; Wang & Eccles, 2013). For instance, Reeve (2006) found that teachers who provide choices and support autonomy significantly increase students' classroom engagement. Recent theories of learning participation further expand its content, proposing the concept of agentic engagement, which emphasizes students' active creation and optimization of their learning environment to meet their learning needs (Reeve, 2013; Reeve & Tseng, 2011). For example, Matos and colleagues (2018) found that when students actively seek teachers' help and feedback and express their ideas and suggestions, their learning experiences are more positive and learning outcomes more ideal.

Although learning participation is crucial for students' development, enhancing it remains challenging. In the digital age, students face more distractions and temptations, making it important for educators to focus on maintaining focus and engagement in technology-rich environments (Bergdahl et al., 2020). Additionally, the measurement and intervention of learning participation face methodological limitations, requiring diversified research designs, such as combining self-reports, behavioral observations, and physiological indicators to deeply understand the mechanisms and influencing factors of participation (Azevedo, 2015; Sinatra et al., 2015).

In summary, recent studies further support the application of learning participation theories in flipped classrooms and provide more empirical evidence. This study will incorporate these recent research findings in designing and practicing to enhance students' participation from multiple dimensions for better teaching outcomes.

Based on the above, learning participation can be seen as an important process through which learning motivation affects academic achievement. However, there is still insufficient empirical support for the moderating role of learning participation in this relationship. Therefore, this study proposes the following hypothesis:

Hypothesis 3: Learning participation positively moderates the relationship between autonomous learning motivation and academic achievement. That is, when students exhibit higher learning participation, the positive correlation between autonomous learning motivation and academic achievement is stronger.

Research Methodology

Research Subjects

The study targets seventh-grade students from a junior high school in New Taipei City, using purposive sampling to select two classes totaling 60 students. The students received instructional designs incorporating scaffolds and increased cognitive load. The pre-test scores of the two classes showed no significant difference based on their previous semester's science grades.

Research Instruments

(a) Autonomous Learning Motivation Scale: The "Learning Motivation Scale" developed by Ryan and Deci (2000) includes subscales for intrinsic motivation, identified regulation, external regulation, and motivation, with a total of 9 items. This study uses only the intrinsic motivation subscale, with a Likert 5-point scale (1 = strongly disagree, 5 = strongly agree). Higher scores indicate stronger autonomous learning motivation. The Cronbach's α value for internal consistency in this study's sample is 0.89.

(b) Cognitive Load Scale: The "Multidimensional Cognitive Load Scale" by Leppink and colleagues (2013) was adapted to create the "Germane Cognitive Load Scale," which includes four dimensions: elaborative load, example-based load, variability load, and explanatory load, with a total of 12 items. Higher scores indicate a higher perceived germane cognitive load. The Cronbach's α value for internal consistency in this study's sample is 0.90.

(c) Learning Participation Scale: The "Four-Dimensional Learning Participation Scale" by Reeve and Tseng (2011) includes behavioral, emotional, cognitive, and agentic participation, with a total of 24 items. Higher scores indicate higher levels of learning participation. The Cronbach's α value for internal consistency in this study's sample is 0.87.

Instructional Design

The experimental group received a four-week instructional intervention. The content was based on the seventh-grade science unit "Biological Evolution."

The instructional goals include exploring the relationship between fossils and evolution, understanding the types and formation of fossils, analyzing fossil evidence for evolution, and understanding core concepts of biological evolution theories.

The instructional design mainly follows the principles of Cognitive Load Theory and scaffolding theory. Before the class, teachers provided conceptual scaffolds such as reading prompts and key points to guide students in previewing key concepts. During the class, procedural scaffolds such as demonstrating evolutionary reasoning and providing thinking frameworks were used to help students solve problems. Teachers also incorporated tasks such as variation exercises and reflective questions to induce students' engagement in elaborative and higher-order cognitive processing related to learning content, aiming to construct more comprehensive knowledge structures.

Data Analysis

This study used SmartPLS 3 for Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis. PLS-SEM is preferred over Covariance-Based Structural Equation Modeling (CB-SEM) for its higher statistical power when dealing with small samples and non-normal data, and it is suitable for both theory validation and development (Hair et al., 2019).

Analysis steps include evaluating the reliability and validity of the measurement model, evaluating the explanatory power of the structural model, and testing the significance of path coefficients and moderating effects. The reliability of latent variables is assessed using composite reliability (CR), convergent validity using average variance extracted (AVE), and discriminant validity using the Fornell-Larcker criterion. The explanatory power of the structural model is evaluated using R^2, and the effect size of predictor variables using f^2. Bootstrapping is used to test the significance of path coefficients, and the two-stage approach is used to analyze moderating effects.

Results

1. *Measurement Model Analysis*

Table 1 shows that the composite reliability of the latent variables ranges from 0.89 to 0.92, exceeding the threshold of 0.70 (Hair et al., 2019). The AVE ranges from 0.65 to 0.72, exceeding the standard of 0.50, indicating good convergent validity. Additionally, the square root of the AVE of each variable is greater than its correlations with other variables, meeting the Fornell-Larcker criterion and supporting discriminant validity. Overall, the measurement model is reliable and valid.

2. *Structural Model Analysis*

The R^2 for academic achievement as the dependent variable is 0.45, indicating moderate explanatory power of the model. Regarding the research hypotheses, autonomous learning motivation has a significant positive impact on academic achievement ($\beta=0.32$, $t=3.81$, $p < 0.001$), with a medium effect size ($f^2=0.15$), supporting Hypothesis 1.

Table 1: Summary of Measurement Model Analysis

Latent Variables	CR	AVE	Autonomous Learning Motivation	Cognitive Load Increase	Learning Participation	Learning Achievement
Autonomous Learning Motivation	0.92	0.72	(.85)	-	-	-
Cognitive Load Increase	0.91	0.68	0.56	(.82)	-	-
Learning Participation	0.90	0.65	0.61	0.53	(.81)	-
Learning Achievement	0.89	0.67	0.63	0.58	0.67	(.82)

Note. The diagonal elements represent the square root of AVE; the off-diagonal elements represent correlations among variables.

As shown in Figures 1 and Figures 2, the interaction terms between germane cognitive load and autonomous motivation significantly affect academic achievement (moderating effect=6.872>1.96), supporting Hypothesis 2. This indicates that germane cognitive load can enhance the moderating effect of autonomous motivation on achievement.

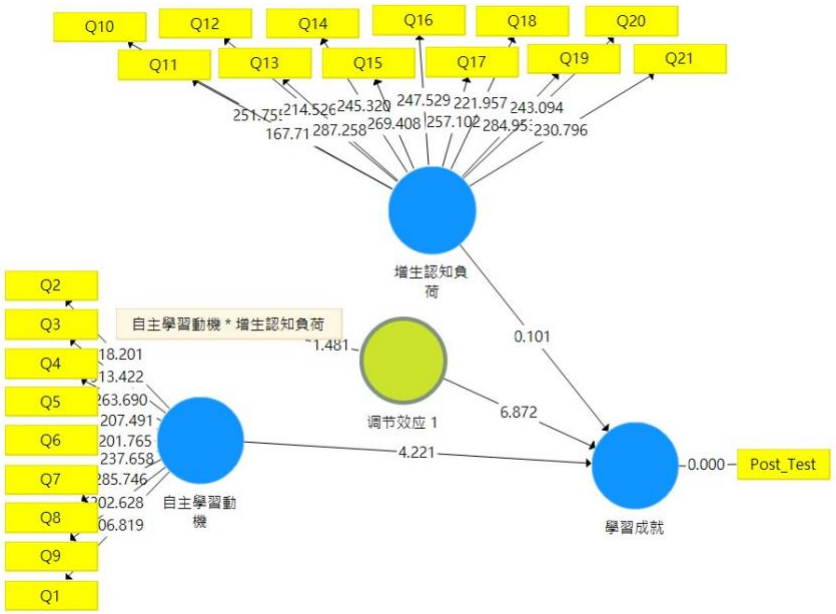

Figure 1: PLS-SEM Results of Germane Cognitive Load Regulation Analysis

Similarly, the interaction terms between learning participation and autonomous motivation significantly affect academic achievement (moderating effect=3.703>1.96), supporting Hypothesis 3. This indicates that learning participation can strengthen the positive impact of autonomous motivation on achievement.

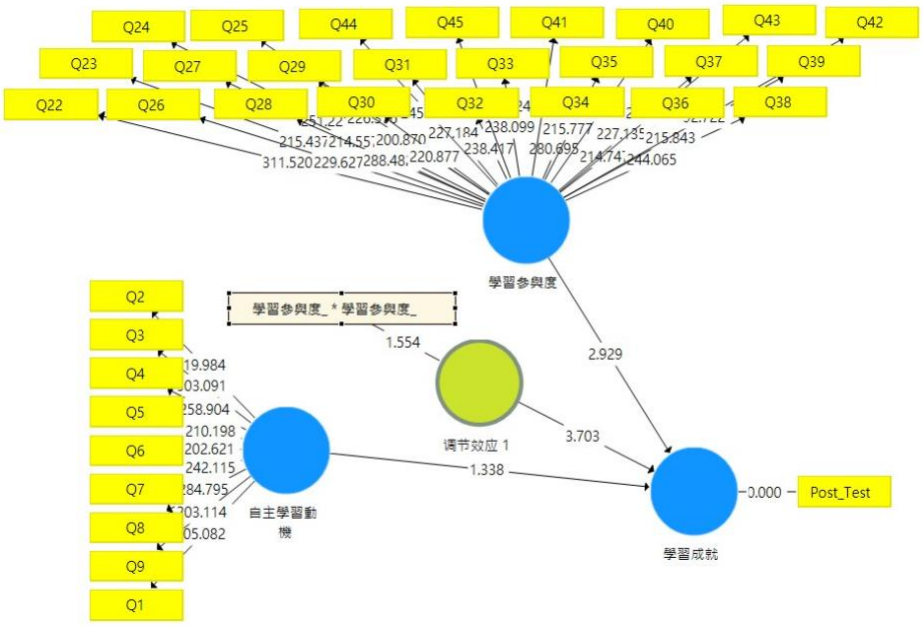

Figure 2: PLS-SEM Learning Engagement Moderates Analysis Results

Discussion

1. *Impact of Autonomous Learning Motivation on Academic Achievement*

This study found that autonomous learning motivation significantly positively predicts academic achievement, consistent with previous research (Jeno et al., 2019; Lin, 2021). This suggests that when students engage in learning based on intrinsic interest and value recognition, they are more likely to adopt deeper cognitive strategies and invest more effort, resulting in better academic performance. This finding supports the view of Self-Determination Theory, which posits that autonomous learning motivation benefits cognitive development and academic progress.

2. *Moderating Effect of Germane Cognitive Load*

This study further examined the role of germane cognitive load in the relationship between autonomous learning motivation and achievement. The results show that germane cognitive load moderates this relationship, with higher levels of germane cognitive load enhancing the positive impact of autonomous motivation on achievement. This finding echoes the main assertions of Cognitive Load Theory, which emphasizes that instructional design should reduce extraneous load, manage intrinsic load, and promote germane load to guide students into higher-order cognitive processing and genuinely enhance learning (Kalyuga, 2011; Sweller et al., 2019).

It is important to note that germane cognitive load is not about quantitative accumulation but qualitative improvement. As Seufert (2018) noted, not all forms of cognitive investment bring positive effects; only cognitive efforts closely related to learning goals and capable of inducing conceptual reorganization can be considered a true germane load. Therefore, teachers should design tasks that not only control the total load but also focus on inducing higher-order cognitive processes like reflection, reasoning, and knowledge integration.

3. *Moderating Effect of Learning Participation*

This study also found that higher levels of learning participation strengthen the positive correlation between autonomous learning motivation and academic achievement. In other words, students with high autonomous motivation who exhibit active learning behaviors and invest more cognitive and emotional resources are more likely to achieve positive learning outcomes. This finding partially supports Reeve's (2012) view that participation should encompass both quantitative and qualitative aspects, with behavioral involvement alone being insufficient; emotional recognition and cognitive strategies must also be integrated to truly enhance learning.

For educational practice, teachers should provide engaging task contexts that meet students' needs for autonomy, competence, and relatedness, thereby enhancing their autonomous learning motivation. At the same time, creating supportive teacher-student interactions and peer cooperation atmospheres, encouraging idea expression, and providing constructive feedback can guide students to achieve higher-quality engagement across behavioral, emotional, and cognitive dimensions, thereby enhancing the impact of learning motivation on academic achievement.

4. *Contributions*

This study makes several important contributions to the field of educational psychology. First, it empirically validates the moderating roles of germane cognitive load and learning participation in the relationship between autonomous learning motivation and academic achievement, extending the existing research on these constructs. The findings highlight the importance of considering cognitive and behavioral factors alongside motivational ones in optimizing learning outcomes.

Second, the study presents a detailed instructional design model incorporating scaffolding and germane cognitive load principles in science education. This model provides a practical framework for teachers to create learning environments that support students' autonomy, guide them into higher-order thinking, and foster active participation. The effectiveness of this model, as demonstrated by the study's results, offers valuable insights for instructional practice.

Third, by focusing on junior high school students and the subject of science, this study helps fill a gap in the literature, as much of the prior research on cognitive load and learning participation has been conducted with older students or in other domains. The findings suggest that these principles are applicable and beneficial across a wider range of educational contexts than previously established.

Finally, the study's use of PLS-SEM analysis represents a methodological contribution, demonstrating the value of this approach for handling complex relationships between latent variables in educational research. The combination of theoretical grounding and rigorous empirical testing employed in this study serves as a model for future investigations in this area.

Conclusion and Recommendations

This study investigated the moderating roles of germane cognitive load and learning participation in the relationship between autonomous learning motivation and academic achievement among junior high school students. The findings support that autonomous learning motivation significantly positively predicts academic achievement, and that higher levels of germane cognitive load and learning participation enhance this effect.

These results reinforce the empirical foundations of Cognitive Load Theory and Self-Determination Theory, highlighting that instructional design should balance cognitive load, motivational processes, and engagement quality. Through a four-week teaching intervention, this study presented a teaching model incorporating scaffolding and germane cognitive load in science education.

By providing conceptual and procedural scaffolds, teachers guided students into inquiry contexts, focusing on core concepts and mastering key strategies. Simultaneously, through variation exercises and reflective tasks, teachers induced students to invest in more elaborative and integrative cognitive resources, creating potential development spaces for students.

This study's findings offer several insights for designing digital learning environments and fostering motivation in teaching. Firstly, teachers should carefully evaluate the cognitive load of digital materials, providing appropriate scaffolding to help students focus on key points and master essential strategies. Secondly, teachers should design task contexts that guide students into higher-order cognitive processing through analogy, reflection, and knowledge integration. Furthermore, teachers should create collaborative learning and peer feedback mechanisms to stimulate students' active participation in behavioral, emotional, and cognitive dimensions, fully enhancing the motivational impact on learning outcomes. Lastly, for students of different achievement levels, instructional design should provide necessary support while ensuring equal opportunities for high-standard learning, aiming to achieve the ideal of both equity and excellence in education.

Although this study has preliminarily validated the effectiveness of instructional designs incorporating germane load, there are still some limitations worth exploring in future research. Firstly, this study focused only on junior high school students and the field of science; future studies could expand to different age groups and subjects to examine the cross-context applicability of this model. Secondly, this study focused on students' cognitive and motivational performances, while social interactions and environmental contexts may also influence students' perceptions of load and learning engagement, which deserve further consideration. Moreover, as germane load is essentially a psychological investment state that is difficult to measure directly, future studies could use qualitative data such as interviews and think-aloud protocols to explore students' cognitive processes in different instructional activities in more detail. Lastly, this study adopted a quasi-experimental design, which can establish preliminary causal relationships between variables; however, the complexity of educational contexts makes it challenging to control for all confounding factors. Future studies could use longitudinal tracking designs to comprehensively explore the long-term interactions between instructional, individual, and contextual factors.

In summary, facing the rapid changes in learning modes in the digital age, guiding students to appropriately invest cognitive resources in rich information contexts, enhancing learning

motivation and engagement, and ultimately optimizing learning outcomes are urgent issues for educators. This study integrates theories and empirical evidence to provide clues for instructional practice. Only by supporting students to exceed their current cognitive levels through appropriate guidance and engaging them in meaningful cognitive processing, while stimulating high-quality engagement in behavioral, emotional, and cognitive dimensions, can we truly realize the potential of every unique learner. The journey of teaching and learning begins with appropriate design, based on students' needs, and continuously improves in dynamic balance.

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Contact email: mhtsai@tykjh.ntpc.edu.tw

Preserving Modern Local Skills: A Case Study of Embroiderers in Chiang Mai, Thailand

Pathitta Nirunpornputta, Bangkok University, Thailand

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Abstract
The paper contributes to developing local embroidery skills in Northern Thailand (Chiang Mai) on the interplay between traditional and modern practices. This paper is qualitative research with a practice-based method that combines in-depth interviews, participant observation, and autoethnography to examine how local cultural skills have adapted to contemporary demands through a case study of local embroiders. In the past, embroiderers in Chiang Mai specialised in traditional Lan Na design patterns for local garments (Lan Na is a specific place in Northern Thailand). However, as the demand for conventional clothing declined, numerous local garment factories were forced to close. Embroiderers, therefore, started shifting their focus from traditional patterns to modern designs, raising a critical question about the preservation of local skills *"If local practitioners (embroiders) no longer engage with traditional designs, is it still valuable to preserve these local cultural skills?"* In conclusion, the research presents 'an explanation of how local embroidery practices have evolved', highlighting the perspectives of key stakeholders such as academics, local designers, and those who are involved with local embroiders. The findings emphasise the complex dynamics of cultural preservation in the face of changing social needs and contribute to broader discussions on the value of preserving local skills in a modern context.

Keywords: Safeguarding Cultural Heritage, Northern Thailand, Heritage Textiles, Buddhism

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Introduction

This study proposes to explore how traditional embroidery has changed in nature in the Lan Na Kingdom (Northern Thailand) and what that change has come to mean for cultural preservation today. The study is grounded in traditional craft skills in Chiang Mai province in northern Thailand, specifically in the San Kamphaeng district, well-known for local artisan production and manufacturing, from traditional umbrellas and pottery to signature textiles in silk and cotton.

Traditional Embroidery and Lan Na Design

The Lan Na embroidery designs, created by local embroiderers, reflected the kingdom's identity and heritage. They were generally used on traditional garments and deeply woven into the fabric of local life and daily routines. Historically, San Kamphaeng district was a major hub for artisans and local factories, therefore, the district is a key location setting for this study.

During the 1980s and 1990s, San Kamphaeng was bustling with embroidery workshops and both large and small garment factories, producing pieces rooted in the characteristic Lan Na design tradition, especially for tourists and visitors. This industry shaped the lives of many artisans, passing down skills through generations.

However, as seen from today's situation (in 2024), the demand for local traditional clothes has considerably declined. With fewer people purchasing these items, local garment factories have had to close, deeply impacting embroiderers who specialised in these traditional designs, forcing embroiderers to adapt their skills to survive.

Shifts in Demand and Skills Adaptation

This decline in demand for traditional clothing has forced embroiderers to rethink their craft. Local embroiderers in San Kamphaeng have shifted from creating traditional designs to working with more modern, and contemporary patterns. This raises an important question for cultural preservation: *if the local practitioners are no longer creating traditional designs, do their skills still represent something worth preserving?*

Literature Review

Lan Na Textiles

Over seven centuries, whether under self-governance or external rule by Siam or Burma, the Lan Na people have maintained much of their distinct cultural identity (Prangwatthanakun & Naenna, 1990). This identity is evident in their religion, architecture, and the unique practices that define Lan Na culture (Conway, 2002). Lan Na heritage textiles have represented an important ingredient of this culture (Prangwatthanakun & Naenna, 1990) and are symbolically associated with the blending of social and religious traditions within it (Conway, 2002).

In addition, dress and textiles played a significant role in tributes and gift exchanges between the Lan Na courts and neighbouring courts, including those in the Shan States, Luang

Prabang, Sibsong Pan Na, China, Burma, and Siam. These exchanges served as symbols of loyalty and mutual acknowledgment (Conway, 2002).

More recently, according to Singhanan (2015), Lan Na textiles remained a staple in Northern Thailand, with traditional tube skirts (Sin or Sarong) still worn by Lan Na women for temple visits and special occasions. Textile shops and galleries, offering both cotton and silk, are concentrated in Chiang Mai's Mueang district, including areas like Waroros Market, Tha Pae Road, Nimmanhaemin Road, Charoenrat Road, Watgate, and Robinson department store. Additionally, districts like Mae Chaem, San Kamphaeng, and Chom Thong are home to numerous textile shops and factories, where cotton and silk fabrics are sold by the yard.

Sarong of San Kamphaeng District

According to Chainan (2023), who researched the Sarong (โสร่ง, traditional tube skirt) in San Kamphaeng district which has a signature weaving pattern known as "San Kamphaeng", named after the district, which has been used for over 100 years.

Furthermore, when HM Queen Sirikit visited San Kamphaeng district, she was intrigued by silk gowns and ordered that Miss Thailand, who was going to participate in the Miss Universe pageant that year, wear silk gowns from San Kamphaeng in a ready-to-wear sarong for the contest. As a result, silk gowns became famous worldwide at that time, and it was considered a very prosperous era for silk gowns from San Kamphaeng. From Chainan's research (2023), it was also found that few still make sarongs, which have been incorporated. A group was created to operate various activities, including the Chalermrach Cultural Centre and the San Kamphaeng Silk Museum. The group works to build strong unity and develop itself, such as taking training courses offered by government agencies, which are available to university students, school students, or individuals wishing to study or visit the wisdom of the San Kamphaeng district. Nevertheless, research on the San Kamphaeng Sarong presented a lack of design development and a limited ability to produce various items made from local fabric, resulting in a decline in demand for local weaving textiles.

Traditional Embroidery

Numerous studies conducted on traditional Thai weaving textiles but for embroidery, there are still limited studies. However, there are some studies dealing with minor ethnic groups, for example, the Hmong or Akha hill tribes. In Thai "Pha Pak (ผ้าปัก)" is the term for embroidered fabric, for example, the Hmong or Akha hill tribes. In Thai "Pha Pak (ผ้าปัก)" is the term for embroidered fabric. When searching for data about Pha Pak, usually information comes from the government sector. For instance, the Sustainable Arts and Crafts Institute of Thailand (SACIT) has conducted research and documented the Hmong tribe's embroidery, as well as the development of new designs, such as "Pha Pak Kor Luang" (ผ้าปักกอหลวง), which originates from local hill tribes.

Moreover, Thai embroidery has been part of royal artisan techniques, as seen in embroidery art templates of nature and landscapes for fabric embroidery, by the Foundation for the Promotion of Supplementary Occupations and Related Techniques (SUPPORT) of Her Majesty Queen Sirikit of Thailand (2007).

The concept of comparison between handicraft and digital craft replacement had been seen from Devi and colleagues' (2019) research which is based in India, comparing digital embroidery with traditional hand embroidery. They highlighted the complexity of the embroidery process, from interpreting designs to meeting the production demands of embroidery machines. Despite this complexity, the results that can be achieved with digital embroidery are often well worth it, offering something unique that cannot be achieved by other means. Hand embroidery, valued for its complexity and the hours of effort involved, commonly tends to be more expensive because so much time is taken.

The Role of Fashion Designers

From the research of Nirunpornputta (2022), my own PhD research, when focusing on how fashion designers have worked on preserving heritage textiles, they shared the same perspective on how to conserve traditional textiles. Fashion designers used fashion design approaches whereby the textiles are seen as one kind of fabric, a 'raw material' for creating modern clothes, or contemporary clothes following global trends.

Additionally, they considered that 'preservation' was counter to sustainable developments. They considered the design before preservation when working on traditional textiles. Similarly, the fashion designers said in Nirunpornputta (2022)'s research that they considered those textiles as a material, a type of textile before concentrating on the value or the story behind those textiles. Moreover, they made a difference between meanings of 'heritage textiles' and 'traditional textiles': the first are those textiles which they are kept and appear untouchable while the latter is textiles that they can use in their fashion design as they believed traditional textiles made from heritage skill approaches are suitable for contemporary design. Lastly, the pricing of both heritage textiles and traditional textiles are matter of interest. Therefore, fashion designers must consider their business before preserving heritage textiles in their ways, though they propose to support local communities.

Research Methods

Since Crouch and Pearce (2012) suggested that observation is a fundamental method in social research and a crucial tool for ethnographers, the primary method used in this fieldwork was participant observation. This involved living in Northern Thailand, engaging with local practitioners and communities, and actively participating in ongoing social activities. Using a practice-based research method allowed me to actively participate in the environment I was studying. I used autoethnography to reflect on my own experiences within this cultural setting. Additionally, autoethnography allows for the identification of the relationship between insiders and outsiders (Ellis & Adams, 2014).

I also conducted in-depth interviews with embroiderers, academics, and local designers, combined with participant observations of the embroidery work itself. In-depth interviews can vary in their level of structure, and informal discussion during the interview allows the researcher to identify and explore new questions and topics (Sugarman & Sulmasy, 2001).

The interviews for this research were face-to-face. Shuy (2002) recommended that face-to-face interviewing of practitioners is advisable as it tends to provide a more valid outcome. Additionally, Shuy (2002) suggested that such conversations should incorporate open-ended questions, as these are less likely to influence the answers and are particularly suitable for exploring complex issues.

This combination of approaches enabled this study to adopt a holistic approach to local embroidery to understand both the emotional and technical dimensions of embroiderers' experiences in adapting their craft.

Collecting Data

The Field Research in Chiang Mai

The data collection was conducted in May 2004. There were three main interviewees during data collection: Singhanan, a Lan Na historian and expert; Fongkam, the head and founder of Baan Phu Ka, a local embroidery community in San Kamphaeng district, Chiang Mai; and lastly, Assistant Professor Thianchai Aksrondit, an academic lecturer, a local designer at Chiang Mai University who focuses on local cultural heritage preservation.

For observations and interviews, I visited a village in San Kamphaeng district, Chiang Mai, as Singhanan said there is one village in this district that is well-known for local embroidery. Singhanan took me to the village and introduced me to Fongkam. We visited Fongkam's house, where she was embroidering clothes she had ordered from a local brand (Images 1, 2). The design patterns for the embroidery were created by the designer and owner of the brand. They are modern designs, but some elements are simple local patterns that have been widely used as part of local textiles in Lan Na. Nevertheless, the designer rearranged the elements and brought them together into one garment (Image 3).

Image 1: Fongkam Was Working on Aksrondit's Project and Image 2: Fongkam Community's Work for One Local Brand by Dr Pathitta Nirunpornputta (2024)

Image 3: Embroidery Details Made by Fongkam's Community and Designed by One Local Brand by Dr Pathitta Nirunpornputta (2024)

Singhanan and I also saw Aksrondit's works, as he has been involved in local embroidery preservation and began working on and developing projects with Fongkam's community. I later interviewed Aksrondit to collect data about his lectures and design projects with his students, focusing on local embroidery. He also explained how he started providing assignments for his students and how he encourages local embroiderers to improve their skills, trying to use old techniques and local patterns for different purposes. He started the project as textile art pieces related to Buddhism and Lan Na culture, with his students designing the art pieces alongside Aksrondit (Images 4, 5).

Image 4 and 5: Aksrondit and His Students' Design Works Embroidered by Fongkam's Community by Dr Pathitta Nirunpornputta (2024)

Aksrondit also mentioned the exhibition (Images 6, 7) he and his students worked on together to present the embroidery artworks created in collaboration with the Baan Phu Ka local embroidery community. He aimed to encourage local artisans to take an interest in local embroidery, just as they have in weaving. Traditional weaving has been a focus for both local communities and academics for a long time. However, local embroidery has received limited

attention, which he believes should be preserved. He sees it as another opportunity for local artisans to acquire an additional skill, alongside weaving. Singhanan agreed with Aksrondit and added that, having met various groups of people across the Lan Na Kingdom who work with Lan Na textiles—whether textile experts, academics, textile artists, or weavers—she rarely saw anyone mentioned local embroidery. However, she had seen some textiles, including embroidery, in temples, which is similar to what Aksrondit mentioned about seeing embroidered textiles in temples.

On the other hand, Fongkam said her community survives on orders from local brands that use local embroidery with modern designs. She explained that the community has not worked with local embroidery patterns for a long time, except for the work with Aksrondit and his students. She believes modern design is key to helping her community stay employed. However, if there are orders requiring local patterns, the community needs them to be shown, as the younger generations have not seen them before. She recalled the local patterns she used to make, such as the San Kamphaeng pattern, which featured simple dots like an asterisk symbol (*) and lines that decorated collars and shirt plackets. These designs were originally made for local people and later for tourists and visitors.

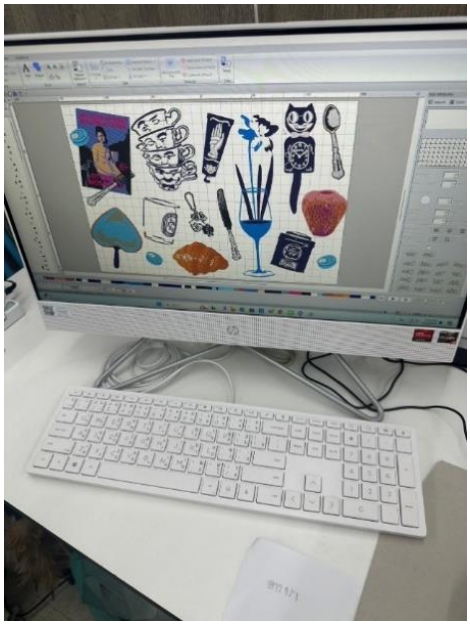
Image 6 and 7: Aksrondit and His Students' Exhibition
by Aksrondit (2024)

Singhanan also mentioned that people have seen embroidery in local markets and consider this skill is made for commercial garments, as many hill tribes across the Lan Na Kingdom create embroidery for their textiles and commercial purposes. I visited local markets with Singhanan and also found embroidered textiles. However, Singhanan explained that most of them are made by hill tribe people, called Pha Naka (ผ้านากา) who live along the borders between Thailand and Myanmar (Image 8).

Image 8: Pha Naka (ผ้านาคา) I Found From a Local Market in Chiang Mai
by Dr Pathitta Nirunpornputta (2024)

Design Practice – Reflecting While Gaining Experience on Embroidery

I gained experience working with digital embroiderers based in Bangkok and a local hand embroiderer based in San Kamphaeng district, Chiang Mai. The data mainly focused on gaining experience with local embroiderers in San Kamphaeng district. However, I used the modern design I had worked on with the digital embroiderer earlier, which allowed me to compare experiences working on embroidery using different approaches.



Images 9 and 10: Working on Digital Embroidery
by Dr Pathitta Nirunpornputta (2024)

As seen in Images 9 and 10, digital embroidery can produce precise designs on a digital screen. I used Adobe Photoshop and Illustrator to create each element and learned how to use

a machine and programme specifically for Brother's embroidery machine with digital embroidery.

I designed a tablecloth based on my concept of whimsical objects that I like, laying them out on the table and transforming objects from my bedroom into graphics for embroidery using Adobe Photoshop and Illustrator. The design was then transformed into pre-embroidery artworks using the PE-DESIGN 11 programme, which is specialised for digital embroidery machines.

The workshop used a BROTHER PR680W machine, which was limited to six colours per run. Markings for plates in each block of the pattern were assisted by embroiderers, while I marked each plate four times to achieve the desired size of approximately 100 x 100 centimetres. Each block was switched to a different thread colour, rather than each motif in the programme.

To correct minor errors related to slipping marks on each plate that caused inexact alignment, I added extra details to fill the gaps and complete the work. The tablecloth was sewn with another cloth for the other side and decorated with small lining for additional decoration.

For the experiment with local hand embroidery, I spent more time creating this piece compared to the digital embroidery one. The digital embroidery took time only when designing on Adobe Photoshop and Illustrator, while the embroidery machine took around one hour to finish one block of the frame. However, for hand embroidery, I had to spend more time drawing all the elements using a pencil and preparing all the yarns for Fongkam. Although I used the same design, I transferred patterns onto the fabric by using pencil drawings and a light board to allow me to see the patterns through the front of the fabric.

According to Fongkam, she preferred me to draw all the patterns on the fabric and prepare the yarns for embroidery. The colours I selected were based on my design, but I allowed her to use yarns selected according to her design perspective. Fongkam used her sense of colour to create the artwork on the fabric I gave her. From my view, as Aksrondit said, when he first worked with local embroiderers, he also let them use their aesthetics and sense of colour to work on his design. They used genuine, vibrant colours, just as they would normally use for their local textiles. Later, he had to select colours according to trends to guide them, as he wanted to create a more modern design. As a result, as seen in Image 13, the final work created by Fongkam is vibrant and colourful.

Image 11,12,13: Working on Local Hand-Embroidery Techniques
by Dr Pathitta Nirunpornputta (2024)

Findings

Traditional vs. Modern Perspectives

Through these conversations and observations, I found a range of perspectives on preservation. Academics, local designer, a local practitioner are concerned that moving away from traditional designs means losing touch with Chiang Mai's heritage. They worry that if modern designs take precedence, future generations may no longer recognise the distinct styles of Lan Na embroidery. Nevertheless, the head of the local embroidery community also argued that modern adaptations are necessary to keep embroidery alive and relevant. By evolving with current tastes and markets, these skills can remain economically viable, allowing artisans to make a living from their craft.

Key Voices From the Community

One example comes from an embroiderer (the head of the embroidery community) I interviewed, who expressed a sense of loss about moving away from traditional patterns. She described these designs as her 'cultural roots,' something deeply personal that is now fading.

There are only a few projects relating to traditional embroidery patterns, with far fewer orders compared to modern embroidery designs created for commercial purposes. She also added that modern patterns allowed her and members of the community to be part of making garments that appeal to younger generations, drawing them into the art of embroidery in a way that traditional designs might not. These contrasting views highlight a dynamic tension between honouring heritage and adapting to survive – a balance that embroiderers are constantly negotiating.

Experiment – Comparing Handicraft and Digital Embroidery

To deepen my understanding of the value of local hand skills, I conducted a comparative experiment using the same design with both handicraft and digital embroidery techniques. The goal was to assess not just the visual outcome but also the intangible qualities each method contributes, such as the time, effort, and personal touch involved in traditional hand embroidery. This experiment revealed distinct contrasts. Handicraft embroidery, though time-

intensive, presented a sense of texture, warmth, and uniqueness that digital embroidery could not replicate. Each stitch by hand carried a sense of personal investment from the artisan, adding a unique character that reflected their skill and connection to the craft.

In contrast, digital embroidery, while precise and efficient, lacked this level of personal expression. The findings underscore the meaning and value that local hand skills bring—not just as a visual outcome but as an embodiment of cultural heritage and individual artistry.

Implications for Preservation

This study brings us to a complex understanding of preservation. In today's globalised, rapidly changing world, preserving skills does not necessarily mean keeping things exactly as they were. Instead, it may mean allowing skills to evolve so they can be sustained. What does this mean for local embroiderers? To 'preserve' may mean recognising both the value in traditional forms and modern adaptations that sustain them. This approach respects the continuity of the craft and the necessity of change.

Conclusion

The main question of the study, *"If local practitioners (embroiderers) no longer engage with traditional designs, is it still valuable to preserve these local cultural skills?",* the case of Chiang Mai's embroidery, from the head of the embroiderer village to academics and experts, this study suggests that local skills should be viewed as living, evolving elements of culture. Embroiderers will continue working as local embroiderers as long as their skills allow them to earn greater profits. Safeguarding, in this sense, is not about freezing a skill in time but about keeping it viable and meaningful. By embracing both traditional and modern elements, we can help these skills endure in a way that resonates with today's world.

Acknowledgments

This study is a case study that mainly focuses on local embroidery in San Kamphaeng district and reflects my experiences from working on design, as well as both digital and hand embroidery. The study aims to understand the value of hand embroidery and how to preserve these local techniques, should they be considered worth preservative. Consequently, future researchers could expand further research on the value of preserving local traditional crafts, as this study is limited to one specific location.

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Enhancing Critical Thinking Through Reading in a Controlled Environment: A Study Using the BookRoll Tool

Panadda Jaiboonlue, Bansomdejchaopraya Rajabhat University, Thailand
Wasan Na Chai, National Electronics and Computer Technology Center, Thailand
Nattapol Kritsutikul, National Electronics and Computer Technology Center, Thailand

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Abstract
Critical thinking is a vital skill in many aspects of a person's activities, particularly in education, where it enables students to analyze, reason, plan, and self-evaluate. This paper propose a controlled environment designed to train critical thinking through reading, helping students understand logical connections between sentences. This controlled environment is designed for learner's activities to assign several kinds of annotations including logical statement type, keyword and logical linking between sentences to the proper writing text by self-analysis under the supervision of coaches. By engaging in these activities, students can learn to recognize logical expressions and persuasive strategies in writing, gain insight into the author's cognitive processes, and apply these insights to improve their writing abilities. We enhanced the features of BookRoll, an e-book system developed by Kyoto University, to increase its efficiency and better support the tracking of students' reading behaviors. The system records various activities, including time spent on each page, highlighting keywords within sentences, and identifying logical connections between sentences, among other metrics. From experiments, the results showed that the environment helps to increase learning performance. The average precision and recall scores from tagging of the participants using this feature were higher than the participants not using the tool for 0.15 and 0.22, respectively. Moreover, the participants showed significant growth in thinking skills in terms of more correct analysis and critical thinking after using the tool. These results indicated that the thought analysis tool improved users' abilities to become more strategic planners and create more persuasive writing.

Keywords: Critical Thinking, Enhancing Learning, Reading Analysis

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Introduction

Learning is a critical process for acquiring both knowledge and skills. One approach to learning, independent learning, involves learners taking initiative in acquiring knowledge or skills through their own efforts, fostering inquiry and critical evaluation. This method is particularly well-suited for self-development during free time, offering learners the opportunity to enhance their thinking and analytical processes through active engagement. Independent learning also provides the flexibility for learners to explore areas of personal interest in knowledge and skill development. However, unstructured or excessive freedom in this process can lead to challenges, such as misunderstanding, the acquisition of incorrect information, or reliance on outdated theories. To mitigate these risks, interventions such as guidance and the setting of boundaries are essential to ensure that learners remain on a productive path of improvement.

The acquisition of knowledge and skills involves distinct learning methods. When learning new knowledge, common approaches include reading and listening, which aid in memorization and understanding. However, acquiring skills requires continuous practice and guidance from experienced individuals. Among various skills, thinking stands out as the most complex and ambiguous to acquire, given the unique cognitive differences among individuals. Thinking skills, though abstract in nature, manifest in practical applications such as decision-making, argument formation, and the use of logic in both speaking and writing. Writing, especially academic writing, provides the clearest expression of thinking skills, as it demonstrates logical reasoning through a structured and intricate thinking process.

One widely applied technique for skill acquisition is learning by example (LBE), which has shown notable success across various applications (Atkinson et al., 2000). In LBE, examples serve as models that possess desirable characteristics, allowing learners to analyze, imitate, or even improve upon them. By extracting these characteristics from exemplary models, learners can develop their own skills. In the context of academic logic and systematic thought, learning thinking skills should involve the study of high-quality, published academic articles, which provide clear examples of logical relationships and thought processes.

This study emphasizes the development of critical thinking skills by analyzing logical relationships within academic writing, focusing on content analysis rather than technical language. To support learners in building these skills, we propose a controlled reading environment using structured activities designed to help students examine both content and logical relationships in academic articles. The BookRoll tool serves as the primary platform for this approach, aiming to enhance learners' cognitive processes by guiding them through the analysis of sample articles and fostering critical thinking. Although learners engage in self-directed learning, expert guidance is provided to define the scope, monitor progress, and offer feedback throughout the process.

The remainder of this paper is structured as follows: Section 2 describes the design of the tool and presents the framework for creating a reading environment that supports the development of critical thinking. This section also discusses the inclusion of behavioral monitoring features through the log system. Section 3 covers the experimental setup, results, and analysis of the outcomes, providing insights into how the tool impacts learners' progress. Finally, Section 4 concludes the study with a summary of findings and recommendations for future improvements to the tool and learning framework. This research demonstrates how integrating a structured reading environment with real-time monitoring can enhance the

development of critical thinking skills, providing valuable insights for both learners and educators.

Methodology

This section presents the design of learner activities and the development of additional features to control the e-reading environment, aimed at enhancing critical thinking skills through article reading. The feature is developed from the conceptual analysis framework developed by W. Na Chai (2017) and is designed to assist users in analyzing written articles by identifying logical statements, contextual relationships, and key concepts. The control the e-reading environment is designed as illustrated in Figure 1.

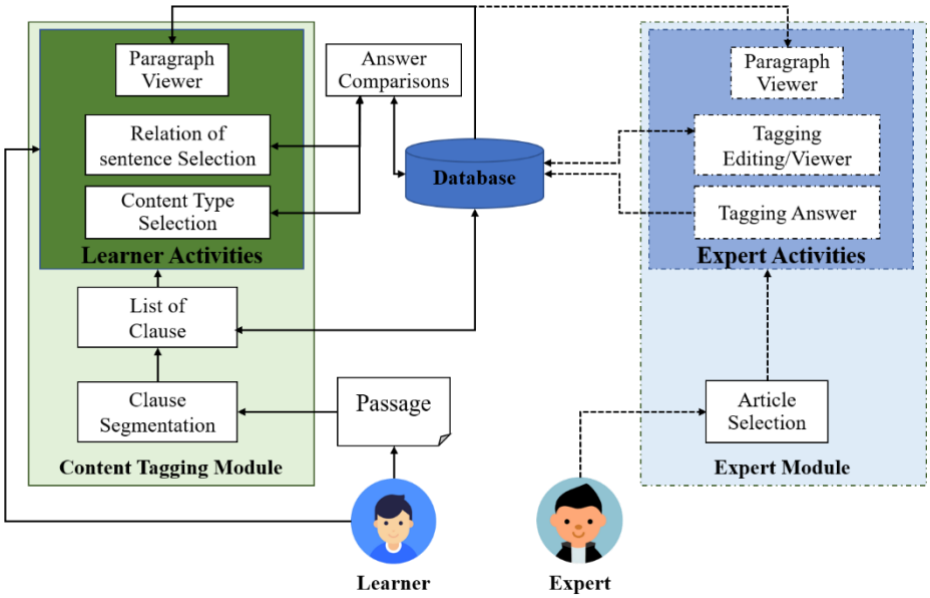

Figure 1: An Overview of the Controlled Environment Thought Analysis Tool via Reading

The main goal is to help learners analyze the structure of a written article through reading. In addition to practicing analyzing the structure of a written article, learners will be able to discover implicit logical structures within sentences and understand how authors use these strategies to persuade readers. It is expected that learners will develop greater analytical awareness through the analysis process in this controlled environment. Key features of the activities include keyword highlights, content-type tagging, and sentence linking. These activities create an environment that directs the student's analysis of clarifying logical connections in the text, which in turn practices analyzing each section of the reading. The analysis process requires learners to break down the text into individual sentences, highlighting keywords in each sentence to identify the sentence's context. This includes recognizing the main ideas, logical categories of the text, and connections to other sentences, utilizing the add-on features developed in the BookRoll system. By engaging in this process, learners will conduct a detailed analysis of the text and gain valuable insights into the structure of effective writing, allowing them to identify gaps in the author's analytical thinking and apply these insights to improve their writing.

The controlled reading process in this analysis environment is comprised of three key components: BookRoll (an e-book reader), a reading activity module, and a storage system that records activities for analysis and ensures learning accuracy. Instructors can track learner

reading behaviors and review their annotations, providing feedback that guides students without giving away the correct answers, thus helping them avoid misconceptions. This integration of user-driven analysis and expert guidance promotes the development of both metacognitive awareness and critical thinking skills in writing.

BookRoll

BookRoll, an innovative digital e-book reader developed by researchers at Kyoto University, enhances interactive learning and student engagement by supporting active learning, self-regulation, and personalized study experiences. One of its key features is its ability to track and analyze detailed reading behaviors such as page views, time spent on each page, and the use of annotations. This data-driven approach provides educators with actionable insights into student engagement and comprehension, allowing for timely, targeted interventions to improve learning outcomes. Our collaboration with Kyoto University focuses on using BookRoll in the education field and improving its features to better support these learning objectives.

In addition to tracking reading behaviors, BookRoll promotes active learning by enabling students to annotate texts, highlight key concepts, and add personalized notes, fostering deeper comprehension and critical thinking. Integrated with Kyoto University's Learning Management System (LMS), BookRoll allows instructors to monitor student progress in real-time, supporting personalized learning pathways. Its flexibility in accommodating various file formats, including PDFs, enables the use of diverse teaching materials across disciplines. By engaging with digital texts through BookRoll, students also develop metacognitive skills, gaining greater awareness of their own learning processes and improving their academic performance.

Reading Feature

Keyword Highlights.

For each sentence, learners are asked to provide keyword(s) they believe represent the core concept of the sentence. Learners can highlight the term that appeared in the sentence context using a highlighting feature. The number of keywords assigned is limited to 1 to 3 per sentence, and the chosen terms can be either single words or compound words.

This function is designed to encourage learners to analyze and identify the most significant terms that represent the sentence's key concepts, helping them recognize the importance of selecting contextually appropriate terms.

Content Type of Statement Selection.

This function provides a list of logical types for annotating clauses within sentences. Each clause carries a specific idea, often conveying the writer's reasoning, making it a concise summary of the intended content. In the previous version of the tool (Na Chai, 2017), numerous logical types were included, derived from comprehensive writing guidelines, expert analysis, practical writing experience, and feedback from publication reviews. However, users reported that the large number of types and overlapping categories led to confusion and difficulty during selection.

In response to this feedback, the list has been reviewed and refined to focus on the essential concepts of logical statements. The pre-defined content types have been carefully designed to encompass the ideal structures for logical expression in academic writing. This version organizes the types into a two-level hierarchical structure, as in Table 1, ensuring clarity and ease of use for effective annotation.

Table 1: A List of Content Type for Annotation and Their Definition

Content Type		**Definition**
Categories	**Subcategories**	
Declarations	• Declaration of Fact	Statements that convey factual information
	• Declaration of Opinion	Statements that express opinions
	• Giving Details	Statements that provide specific details about core terms of other statements
Emphasis and Contradiction	• Emphasizing	Statements that are restated to emphasize their significance
	• Contradicting Part	Statements that express contradictions to other statements
Examples and Demonstrations	• Giving Example	Statements presenting actual cases or instances related to other statements
	• Giving Demonstration	Statements demonstrating circumstances described in other statements
Causal and Temporal Relationships	• Cause Part	Statements explaining the cause of an event or incident
	• Effect Part	Statements describing the effect or result of a cause
	• Prior Part	Statements describing events that occur before a continuous event/incident
	• Following Part	Statements describing events that follow a continuous event/incident
Conditional and Result Statements	• Condition Part	Statements explaining the condition that triggers an event or incident
	• Result Part	Statements describing the result triggered by fulfilling the condition

Users must assign one of these types to each sentence, with only the subcategories available for annotation. By applying these types, learners are guided to uncover the author's implicit methods and strategies for persuading readers through sentence connections. This process

enables learners to recognize patterns in writing style and explore the underlying logic more deeply, rather than focusing solely on the content's surface.

Sentence Linking.

The relationship between sentences reflects the author's flow of ideas and thought processes within their work. From analyzing well-written published articles, we observe that most sentences are connected to form a coherent and logical network, enhancing the persuasiveness of the text. Readers are thus expected to learn how to express these logical relationships through exposure to effective writing.

Each sentence type, such as cause and effect, often exhibits logical links with others. Learners are tasked with identifying these connections by analyzing the relationships between sentences. They are required to align and assign sentence links using sentence IDs, irrespective of the statement types initially assigned. If a sentence introduces a new concept unrelated to any previous sentences, learners are permitted to assign 'none' to indicate the absence of any prior connections. This exercise fosters deeper engagement with the structure of academic writing and promotes critical thinking by encouraging learners to explore the logical interplay between ideas.

Data Storage

The Log Palette plays a crucial role in the BookRoll system, operating within the Learning and Evidence Analytics Framework (LEAF). It functions as a learning analytics dashboard, collecting and visualizing data based on students' interactions with digital learning materials. BookRoll, an eBook reader, captures key behaviors—such as page views, bookmarks, notes, and time spent on specific sections—enabling both students and educators to reflect on learning patterns. This analytical approach facilitates evidence-based education by helping instructors adapt teaching strategies and gain insights into student engagement and progress (Majumdar et al., 2021; Ogata et al., 2018).

To further promote critical thinking through reading, three key features have been integrated into the system: Keyword Highlights, Content Type Selection, and Sentence Linking. These additions provide deeper insight into students' cognitive processes, allowing instructors to monitor reading behavior more precisely and assess the development of analytical skills.

These features enrich the analytical capacity of the BookRoll system, fostering reflective reading habits and supporting the development of students' analytical thinking through interactive and evidence-based learning as shown in Table 2.

Table 2: Data of Interactions From Learners in Using Tools

Key Design Element	Log Record
General Interactions	• Page viewed
	• Time spent per page
Learner-Highlighted Keywords	• Keyword identified
	• Sentence number
	• Timestamp
Content Type Assignment	• Selected content type
	• Sentence number
	• Timestamp
Sentence Relations	• Related sentence connections
	• Sentence number
	• Timestamp

Evaluation and Discussion

Experiment Setting

To evaluate the effectiveness of the proposed tool, an experiment was conducted comparing learners' thinking processes in independent learning both with and without the tool. The goal was to assess how the tool influences learners' analytical skills by examining differences between unaided learning and tool-supported learning.

The participants consisted of 42 Thai graduate students from a computer science and information technology department. They were randomly divided into 2 groups, with 21 participants per group:

- Group 1: Participants learned without using the tool.
- Group 2: Participants were provided with the tool from the beginning.

Each group was required to select academic articles from a curated pool assembled by a team of experts. The articles were sourced from IEEE Xplore (2015–2022) and selected for their readability and high-quality presentation of logical relationships and expressions. Only articles unanimously agreed upon by all three experts were included in the pool, which ultimately contained 43 papers within the field of computer science and information technology.

Participants were instructed to independently select three articles from the designated pool. They then examined the introduction sections of the chosen articles, using the provided tool to tag each clause according to content type and logical relationships. Throughout this process, an expert offered guidance on interpreting the logical structure of the clauses and provided feedback on tagging decisions. After analyzing each article, participants were required to take a break of at least one hour to mitigate fatigue and minimize cognitive overload.

For the evaluation, the participants' assigned tags—both for content type and clause relationships—were compared against a gold standard created by the expert team. The following metrics were used to assess performance:

- Precision: The proportion of correct tags out of all tags assigned by the participant.

- Recall: The proportion of correct tags relative to the total number of clauses in the article.
- F-Measure: A harmonic mean of precision and recall, calculated as:

$$F1 = 2 * \frac{precision * recall}{precision + recall} \quad (1)$$

This study yielded insights into the extent to which the controlled environment fosters logical reasoning and analytical skills by comparing participants' performance across different learning conditions. Quantitative metrics, including precision, recall, and F-measure, were employed to evaluate participants' accuracy and consistency in identifying and tagging logical structures within academic writing.

Experimental Result and Discussion

The average precision and recall results for the first group (without the controlled environment) and the second group (with the controlled environment), across different tasks content type tagging, relation assignment, and overall performance are presented in Figure 2. These findings illustrate how the controlled environment influences the accuracy and consistency of participants' analytical performance.

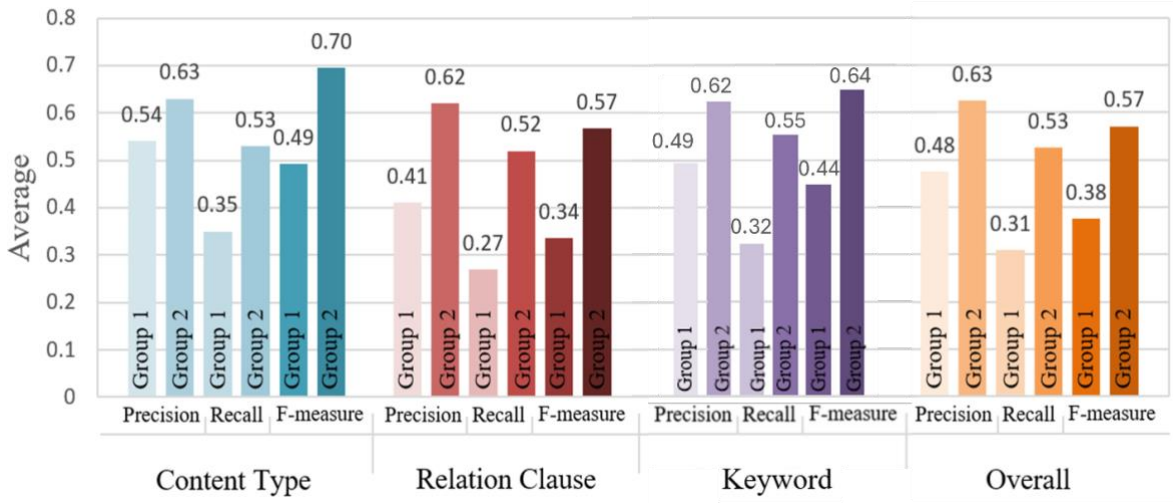

Figure 2: Comparison of Average Results in Precision and Recall Between Participants With Tool and Without Tool

Figure 2 clearly illustrates that the precision, recall, and F-measure scores of the second group (using the controlled environment) surpass those of the first group (not using the controlled environment) in both content type tagging and clause relation identification. Overall, participants who worked within the controlled environment attained higher average precision, recall, and F-measure scores, with improvements of 0.15 and 0.22, respectively. These findings suggest that identifying clause relations poses greater challenges and is more prone to errors than assigning content types, given that understanding clause relations requires a comprehensive interpretation of the entire expression, whereas content type tagging focuses on individual clauses. The controlled environment significantly boosted recall scores by offering an automated clause segmentation feature, which helped increase participants' awareness and reduce the likelihood of omitting clauses. The results also show that the number of correctly identified clauses grew from the second paper onward, even

when participants were no longer using the controlled environment. This pattern implies that the environment helped participants develop a clearer understanding of how to separate clauses and recognize the logical content embedded within them.

In addition, response accuracy improved over time. From post-test interviews, participants indicated that the controlled environment was particularly beneficial for novice learners and those striving to master analytical processes. They emphasized that it serves as a platform to practice critical thinking skills. Through tagging, participants could examine well-written article samples, thereby gaining insights into various writing styles and developing transferable skills for their own academic writing.

Experts interviewed during the experiment noted a marked acceleration in skill development among participants who utilized the controlled environment. They reported a steady reduction in the time required to tag content types and clause relations, alongside a growing sense of confidence among participants as the experiment advanced. Experts further recommended incorporating a visual graph of clause relations derived from the tagged data. Such visualization would explicitly demonstrate the network of logical connections, enabling learners to better grasp and replicate the reasoning process through a more empirical and visually oriented approach.

Conclusion and Future Work

This paper introduces a controlled environment designed to support learning and enhance cognitive processes through the analysis of high-quality examples. The environment provides a structured approach for examining thought processes embedded in academic articles, which often contain complex logical expressions. It guides users in annotating each clause with specific content types (e.g., fact declaration, reason provision, and conditional statements) and identifying relationships between clauses. The objective of this annotation process is to help learners recognize thinking patterns from exemplars and develop their analytical skills.

The experimental findings indicate that the controlled environment significantly improved participants' tagging precision and recall, both in content type selection and clause relation identification. The increase in accuracy between those who used the environment and those who did not was statistically significant. Moreover, the environment bolstered participants' understanding of the importance of analytical and critical thinking skills.

In future work, we plan to visualize the annotated content types and clause relationships as a "network of thoughts," offering an empirical representation of logical connections. We also aim to introduce additional features that utilize the tagged data to suggest logical expressions for academic writing. Another key development will focus on expert involvement, wherein experts will select, tag, or edit articles within the environment, thereby further enhancing its usability and accuracy.

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Enhancing Interdisciplinary Critical Thinking Skills in Higher Education With Improved Content Selection and Syllabus Sequencing Presented by Relationship Mapping

Zhaotong Li, Nanyang Technological University, Singapore
Bohao Ma, Nanyang Technological University, Singapore
Seng Chee Tan, Nanyang Technological University, Singapore
Seyed Mehdi Zahraei, Australian Maritime College–University of Tasmania, Australia
Chee Chong Teo, Nanyang Technological University, Singapore

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Abstract
This paper presents an integrated teaching approach aimed at enhancing interdisciplinary critical thinking (CT) skills in higher education by improving content selection and syllabus sequencing. The approach is grounded in Cognitive Load Theory (CLT), which states that course content is biologically secondary knowledge and should be selected and sequenced in an organized manner to minimize cognitive load, allowing students to better grasp interdisciplinary connections. Based on the CLT, the approach proposes that the content and syllabus should be sequenced through three primary stages, including Core Domain, Complementary Domains, and Exogenous Domains. A key feature of this approach is the use of Relationship Mapping (RM), a visual-based tool that helps students understand and apply interdisciplinary relationships within the course material. RM is used to enhance the presentation of topic sequencing and lecture summaries, while students are required to design and develop RM in their assignments to support understanding and answer visualization. The effectiveness of this approach was tested using the Mann-Whitney U test with survey results from students taking a final-year undergraduate course on Intermodal Transportation, a senior year undergraduate course. The experimental group demonstrated significant improvement in analytical skills, self-efficacy, self-regulation, and out-of-the-box thinking compared to the control group. However, no significant gains were observed in evaluative reasoning, interpretation, inference, creative self-concept, and personal identity, suggesting areas for further refinement. This study contributes to the existing literature by providing a novel method for enhancing interdisciplinary CT in higher education, particularly with mapping tools like RM.

Keywords: Interdisciplinary Critical Thinking, Content Selection and Syllabus Sequencing, Relationship Mapping

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Introduction

As outlined in the Delphi Report (Facione, 1990a), critical thinking (CT) is defined as the purposeful, self-regulatory process that involves interpretation, analysis, evaluation, and inference, along with the explanation of the evidential, conceptual, methodological, criteriological, or contextual factors that form the basis of judgment. CT encompasses a range of skills and dispositions essential not only for achieving academic success but also for equipping students to handle complex real-world challenges (Puig et al., 2019). It is recognized as one of the most vital cognitive skills for students (Din, 2020). Numerous studies have highlighted employers' concerns that university graduates may lack adequate CT development (Hart Research, 2018; OECD, 2022). Therefore, the adoption of effective pedagogical strategies to enhance student's CT is imperative.

Given the various definitions and characteristics of CT, this paper seeks to focus on enhancing the interdisciplinary thinking component of CT in higher education, aiming to better equip students with the ability to adapt to change and make sound decisions when confronted with complex problems in both academic and professional settings (Abrami et al., 2008; Calma & Davies, 2021). Interdisciplinary thinking involves the ability to integrate knowledge from diverse disciplines (Spelt et al., 2009). With the increasing need for graduates to collaborate across various fields, interdisciplinary education has gained significant attention in the existing literature (Lindvig et al., 2019). Interdisciplinary CT refers to CT skills specifically applied within interdisciplinary contexts. By evaluating issues from an interdisciplinary perspective, there is considerable potential for improving CT, particularly in the interpretation of information (Bassachs et al., 2020).

In this research, an integrated approach has been developed for content selection and syllabus sequencing in higher education courses, with a primary focus on cultivating interdisciplinary CT within the subject matter. The approach centers on grouping topics that are strategically sequenced and introduced in stages. As the course advances, students gain a deeper understanding of the progressively constructed interdisciplinary "big picture", thereby enhancing their interdisciplinary CT skills. The content selection and syllabus design are grounded in Cognitive Load Theory proposed by (Sweller, 1988), which emphasizes minimizing the cognitive load on students' working memory. This reduction in cognitive load allows students to more effectively grasp the interconnections between disciplines and apply these skills in problem-solving scenarios (Leppink & Duvivier, 2016). A key component of the integrated approach is the use of a visual-based mapping tool known as Relationship Mapping (RM) (Teo et al., 2023). RM is consistently employed in the classroom to illustrate the interdisciplinary and systemic relationships among selected topics. Students also utilize RM in problem-solving exercises to generate ideas and establish connections between interdisciplinary factors or concepts.

The remainder of this paper is structured as follows. The next section outlines the integrated approach, encompassing content selection, syllabus sequencing, RM, and the relevant literature. Section 3 presents the methodology, including the application of the integrated approach in an authentic classroom setting and the survey conducted. Section 4 provides a discussion of the findings, with concluding remarks presented in Section 5.

Integrated Approach & Literature Review

This section outlines the development of the integrated approach and reviews the related literature.

Content Selection and Syllabus Sequencing

The approach developed aims to enhance interdisciplinary CT, focusing on the integration of knowledge across diverse disciplines rather than merely accumulating information, which is characteristic of a multidisciplinary approach (Spelt et al., 2015). The goal is to establish effective content selection and syllabus sequencing in higher education courses to strengthen students' ability to connect distinct disciplines and integrate relevant knowledge and skills, which equips students to address complex problems (Gao et al., 2020).

Syllabus design plays a crucial role in fostering CT (Bean & Melzer, 2021). The literature on effective syllabus design often emphasizes the alignment of learning objectives, assessments, and instructional methods (Kandlbinder, 2020; Wagner et al., 2023; Wiggins & McTighe, 2007). Among various approaches, content selection and syllabus sequencing are foundational because they ensure a logical progression of knowledge, which is essential for facilitating comprehension and retention (Chi, 2009).

In the proposed approach of this study, the course content is organized and presented sequentially through three primary stages: (1) the *Core Domain*, which encompasses the foundational knowledge essential for comprehending the subject matter, including key theories, methodologies, and concepts; (2) the *Complementary Domains*, which cover related disciplines or sub-disciplines within the broader framework of the Core Domain; and (3) the *Exogenous Domains*, which, while less directly connected to the Core Domain, exert significant interdisciplinary influence. For instance, in the context of Intermodal Transportation, the Core Domain pertains to the efficient movement of primarily containerized goods using multiple modes of transport. The Complementary Domains address areas such as product management, focusing on the types of goods transported, and production management. The Exogenous Domains explore the impact of technological innovations, environmental regulations, and social responsibility. As the course progresses through these stages, the connections between the Core Domain and the other domains are highlighted to emphasize interdisciplinary relevance and a holistic view.

Sequencing the syllabus involves more than merely arranging topics in order; it focuses on reinforcing the connections between them, especially the interdisciplinary relationships as the course advances through different domains. The proposed syllabus sequencing is designed to align with the natural cognitive process involved in problem-solving. When addressing challenges within a specialized area, individuals typically begin by considering the most relevant factors, or "control variables" (Core Domain), that are directly related to the field. Subsequently, they examine less directly related factors, or "less controllable" elements (Complementary Domains), that may still prove useful, before moving on to broader and external influences (Exogenous Domains). The sequencing strategy in our approach follows a bottom-up methodology, beginning with problem-solving at the most immediate level to allow for a more customized solution before exploring other aspects of the issue. This method enables students to concentrate on specific concepts within the Core Domain before integrating these ideas into a broader, more comprehensive framework as they tackle complex problems.

Another key rationale for this sequence lies in the necessity of establishing a solid foundation of subject-specific knowledge (Core Domain) before integrating it with interdisciplinary areas (Complementary and Exogenous Domains). Cognitive Load Theory supports this strategy by highlighting the constraints of working memory on individuals' cognitive capabilities (Paas et al., 2003; Sweller, 2011). This theory emphasizes the critical role that working memory plays in effective instruction, making it a fundamental consideration in content selection and syllabus sequencing (Venkat et al., 2020). Cognitive Load Theory advocates for reducing unnecessary information complexity and cognitive burden, ensuring that all new information is effectively organized and processed within the limitations of working memory, which interacts with knowledge stored in long-term memory (Caskurlu et al., 2021; Owens & Sweller, 2008). The proposed content selection and syllabus sequencing align with these principles, aiding students in acquiring new knowledge by building on their existing knowledge base stored in long-term memory, thereby alleviating the demands on working memory, and consequently promoting better knowledge acquisition and retention in higher education.

Relationship Mapping

Visual-based mapping refers to the graphical structuring and virtual display of information, functioning as a vital educational tool (Choudhari et al., 2021). It begins with a central theme from which related concepts are connected, forming hierarchical and relational linkages. These two-dimensional visual structures encourage creativity and flexibility in logical reasoning, providing a contrast to the traditional linear approach of note-taking (Groffman & Wolfe, 2019). Key examples of mapping tools include mind mapping and concept mapping (Davies, 2011). Mind mapping focuses on an image-cantered diagram where related ideas or sub-topics radiate outward from a core theme, fostering a creative and fluid exploration of content within a domain (Eppler, 2006). On the other hand, concept mapping arranges ideas hierarchically to show meaningful relationships between them, thereby improving the clarity and organization of thought (Watson, 1989).

RM distinguishes itself from other mapping tools by emphasizing problem-solving within the interdisciplinary CT framework. Although RM shares the basic principle of creating "linkages" between ideas, concepts, or variables, it is particularly focused on highlighting the interdependencies between problem factors, which can be illustrated as either cause-and-effect links (single-headed arrows) or mutual dependencies (double-headed arrows). Unlike concept maps, RM does not impose a strict hierarchical structure, and unlike mind maps, it does not extend concepts from a single central idea. Instead, RM is centred on domains, expanding the map progressively across interdisciplinary areas. The method of content selection and syllabus sequencing in this study’s syllabus design is closely aligned with RM’s domain-focused methodology, enhancing students' comprehension of the material and their interdisciplinary CT skills. Moreover, RM's domain-based mapping approach is designed to be more straightforward, with the development of the map being introduced to students incrementally as the syllabus progresses. This straightforwardness reduces the instructional time needed to teach the mapping technique, addressing issues noted by Machado and Carvalho (2020), where students often find it challenging to draw connections in concept maps and may be discouraged by the time-intensive nature of mastering and applying this method.

Literature Gap and Objectives

Implementing effective and sustainable pedagogical strategies in higher education is crucial for helping students develop and apply CT skills in everyday situations (Salinas-Navarro et al., 2024). As a result, the literature has introduced a range of teaching methods designed to improve students' CT skills, including written tasks, group activities, inquiries, problem-solving exercises, case studies, oral presentations, and feedback (Bezanilla et al., 2019). Among these approaches, written assignments, group discussions and projects, oral presentations, and debates have been widely adopted in interdisciplinary curricula (Aslan & Aybek, 2020; Cowden & Santiago, 2016; Khan & Wells, 2023; Oudenampsen et al., 2023). These methods are particularly effective because they offer structured guidance and instruction from educators, which helps students develop and refine CT skills, including judgment and reflection (Alsaleh, 2020). However, challenges such as technical difficulties, increased workloads for both teachers and students, and students' lack of self-motivation for active participation hinder the broader adoption of these methods in interdisciplinary settings, thereby limiting the enhancement of students' CT skills (Nichat et al., 2023; Vu, 2023). In contrast, mapping as a tool for improving interdisciplinary CT has received relatively little attention. This highlights a gap in the literature regarding the impact of mapping tools, such as RM, on enhancing students' interdisciplinary CT skills in higher education.

To address this gap, this study aims to design and evaluate the impact of an integrated teaching strategy that incorporates enhanced content selection and syllabus sequencing using RM, with the goal of fostering students' interdisciplinary CT skills in higher education. The study distinguishes itself from existing literature in several ways. Firstly, it applies Cognitive Load Theory to optimize the selection and sequencing of content within interdisciplinary courses at the higher education level. Moreover, it develops a teaching methodology that combines content selection and syllabus sequencing with RM to effectively enhance interdisciplinary CT skills. Further, it explores broader applications of RM, focusing on its effectiveness in complex and interdisciplinary scenarios.

Methodology

Intervention and Participants

To assess the effectiveness of the proposed approach, it was implemented in the final-year undergraduate course Intermodal Transportation, a senior year undergraduate course that focuses on a specialized area of freight transport. It is part of the Maritime Studies program at Nanyang Technological University, Singapore. By adopting the integrated approach, the course content was revised, the syllabus was restructured, and RM was utilized to present the material in a way that more effectively enhances students' interdisciplinary CT when engaging with real-life case studies and assignments.

The pre-intervention syllabus for Intermodal Transportation focused on topics related to the hardware, operations, and management of freight transportation across different modes, with particular emphasis on the movement of marine containers. These topics formed the Core Domain of the course. The redesigned syllabus introduced new topics that explore the interconnections with other closely related factors and decision-making processes, specifically those concerning transportation nodes (e.g., location and distance) and the materials or products being transported (e.g., inventory management). These additions are followed by discussions on other important, though less directly related, aspects that affect

transportation decisions, including production, product sourcing, and sales/marketing, which collectively form the Complementary Domains. Finally, the syllabus covers the Exogenous Domains, which include environmental considerations (e.g., carbon footprint and regulations), government policies, social factors, and technological advancements. Due to the fixed number of class hours, the addition of new topics required the removal of certain existing ones. This intervention allowed for the identification of topics that could be omitted, primarily those related to transport equipment, which students are likely to learn more effectively through industry experience.

The RM was gradually introduced in alignment with the syllabus, serving both as a teaching aid and a problem-solving tool. Students were provided with opportunities to apply RM in problem-solving tasks during class discussions. Additionally, the intervention included a design-based take-home assignment, requiring students to develop a transportation plan for the international shipment of consumer goods with varying characteristics. A hypothetical company, along with its key features such as sales profile and strategic plans, was provided as the context. Given the open-ended nature of the problem, students were expected to state their assumptions to support their arguments and were encouraged to conduct independent research to substantiate their recommendations. The assessment was guided by rubrics derived from the California Critical Thinking Skills Test (CCTST) (Facione, 1990b). These rubrics were adapted to be observable and measurable, ensuring clarity and ease of understanding for students. The rubrics assessed four key areas: Interpretation and Analysis of the Problem, Recommendations, Limitations, and Overall Reasoning.

The effectiveness of the integrated approach was assessed by measuring and comparing student performances between an experimental group and a comparison group. Logistical constraints required these groups to be enrolled in different semesters, making a simultaneous experimental design impractical. Conducting the experimental group after the comparison group provided additional preparation time for the intervention. It is not expected that the order of the groups would impact the findings. Both groups comprised final-year Maritime Studies students who completed the same curriculum and met identical admission criteria, ensuring a consistent level of academic proficiency and inherent experimental control.

Survey

A survey was administered to both the comparison and experimental groups at the end of the course. The survey measured nine CT constructs identified from the literature, including analytical skills, evaluative reasoning, interpretation, inference, creative mindset, creative self-concept, creative personal identity, self-efficacy in CT, self-regulation, and out-of-the-box thinking (Dyck et al., 2012; Facione, 1992; Gelerstein et al., 2016; Stupple et al., 2017).

Analytical skill involves the ability to grasp the meaning and importance of statements and concepts and to determine how they are inferentially related (Facione, 1990a). Evaluative reasoning focuses on the ability to assess the credibility and relevance of statements, as well as to justify the logical connections between them (Facione, 1990a). Interpretation refers to the skill of clarifying and demonstrating an understanding of information, while inference pertains to drawing logically sound and defensible conclusions (Bellaera et al., 2021; Facione, 1990a). Self-efficacy in CT is defined as an individual's belief in their competence in CT (Stupple et al., 2017). Self-regulation encompasses the readiness and ability to consciously oversee one's cognitive processes, reflect on reasoning, perform self-assessments, and take corrective measures when necessary (Dyck et al., 2012). Thinking

outside the box involves the inclination to surpass conventional thinking patterns (Tsui, 2008). Additionally, two creativity-related constructs are considered, which are creative self-concept and creative personal identity. Creative self-concept refers to how individuals perceive their creativity, while creative personal identity reflects the degree to which creativity is viewed as a central aspect of one's self-concept (Karwowski, 2016; Lebuda et al., 2020). Confidence in and beliefs about one's creativity can have a positive impact on CT (Álvarez-Huerta et al., 2022). Table 1 outlines samples of the survey questions and corresponding literature sources. All responses were recorded on a five-point Likert scale, with 1 representing strong disagreement, 3 indicating neutrality, and 5 signifying strong agreement.

Table 1: Survey Questions

Construct	Samples of measurement items	References
Analytical skill	Total of 4 questions. *Sample: I identify causal relationships among the components in the information given.*	(Teo et al., 2023)
Evaluative reasoning	Total of 4 questions. *Sample: I evaluate the credibility of every detail in the information given.*	(Sosu, 2013)
Interpretation	Total of 3 questions. *Sample: I identify which elements are important for solving a problem.*	(Gelerstein et al., 2016)
Inference	Total of 4 questions. *Sample: I identify what additional information is needed to decide between two contradicting opinions.*	(Gelerstein et al., 2016)
Self-efficacy	Total of 3 questions. *Sample: It is useful in improving my confidence in identifying what is important in solving logistics problems.*	(Dyck et al., 2012)
Self-regulation	Total of 4 questions. *Sample: I think critically/creatively about the procedures needed for effective logistics management.*	
Think-out-of-the-box	Total of 4 questions. *Sample: I analyze logistics management problems from different perspectives.*	
Creative self-concept	Total of 5 questions. *Sample: I am good at proposing original solutions to problems.*	(Karwowski et al., 2013)
Creative personal identity	Total of 5 questions. *Sample: Being clever, original, and inventive are characteristics which are important to me.*	(Karwowski et al., 2013)

The survey participants were selected through convenience sampling, comprising all students from both the comparison and experimental groups. These participants were intended to represent university students, particularly those with fundamental knowledge of their major

and a general understanding of interdisciplinary studies. To ensure the quality of responses, students were required to record their start and finish times during the survey. Responses were considered invalid if they lacked start/end times or if the survey was completed in less than 3 minutes. In the comparison group, 47 responses were collected with 39 deemed valid for data analysis. In the experimental group, 53 responses were obtained with 51 qualifying for analysis.

Results and Discussion

The reliability and validity of the survey's measurement model were first evaluated for each group. The omega values for all constructs are above 0.7, with only one marginally below the threshold (0.691 for *Inference*). Therefore, the model's internal consistency is justified (Hayes & Coutts, 2020). Composite reliability for each construct was also calculated, with values exceeding 0.7, except for one instance (0.697 for *Inference*), confirming the reliability of the measurement model (Hair et al., 2019). Convergent validity was assessed through the average variance extracted, and all statistics were found to be above the recommended threshold of 0.50 (Hair et al., 2019). The heterotrait-monotrait (HTMT) ratios between each pair of constructs for both groups, all of which are below the recommended threshold of 0.9, thereby confirming the discriminant validity of the model (Henseler et al., 2015). Table 2 presents the descriptive statistics. An increase in mean values across all constructs is noted in the experimental group compared to the comparison group. According to existing literature, a two-sample t-test is appropriate for comparing the means of two independent samples (i.e., the comparison and experimental groups) if the normality assumption is satisfied, as indicated by the Shapiro-Wilk test. If this assumption is violated, the Mann-Whitney U test is recommended instead (Rochon et al., 2012). In this study, the normality assumption was not met, prompting the use of the Mann-Whitney U test to further substantiate the approach's effectiveness. The results, detailed in Table 4, reveal significant improvements in analytical skill, self-efficacy, self-regulation, and out-of-the-box thinking, while no significant differences were observed in the other constructs.

Table 2: Comparison on Survey Results

	Mean (S.D.)		Mean difference	Mann-Whitney U test	
	C(n=31)	E(n=38)	E - C	*p-value*	Effect size[a]
Analytical skill	3.58 (0.696)	3.84 (0.571)	0.261*	0.064	0.213
Evaluative reasoning	3.39 (0.824)	3.59 (0.787)	0.205	0.218	0.109
Interpretation	3.56 (0.757)	3.65 (0.605)	0.090	0.488	0.005
Inference	3.81 (0.654)	3.99 (0.526)	0.181	0.246	0.095
Creative self-concept	3.45 (0.660)	3.58 (0.661)	0.127	0.241	0.098
Creative personal identity	3.12 (0.875)	0.15 (0.873)	0.026	0.529	0.009
Self-efficacy	3.76 (0.546)	4.12 (0.474)	0.36***	0.002	0.346
Self-regulation	3.29 (0.786)	3.67 (0.624)	0.391*	0.057	0.220
Think-out-of-the-box	3.32 (0.823)	3.71 (0.591)	0.388**	0.039	0.244

Note: E: Experiment group. C: Comparison group. *, **, ***: Significance at 0.10, 0.05, 0.01 level. [a]: Rank biserial correlation.

The improvement in students' analytical skills aligns with the objective of the integrated approach, as the interdisciplinary CT process underlying this method helps clarify the inferential connections between different disciplines (Davies, 2011). This enhancement was also likely supported by the content selection and syllabus sequencing, which follows RM's systematic process of establishing and inferring interdisciplinary relationships. Moreover, the inclusion of a design-based assignment allowed students to utilize RM and interdisciplinary CT skills to address open-ended, real-world problems, which not only strengthened their confidence in their thinking abilities but also enhanced their self-efficacy. The observed improvement in self-regulation can be attributed to the focus on a mapping process that is consistent with the content selection and syllabus sequencing across disciplinary domains. This approach, by reducing cognitive load, may have encouraged students to consciously evaluate their cognitive processes. Additionally, the emphasis on interdisciplinary CT likely promoted deeper reflection on their reasoning and self-assessment, particularly when creating linkages in the maps. The intervention also provided concrete evidence of learning outcomes and conceptual understanding, which likely contributed to enhanced self-regulation in students' learning processes (Chularut & DeBacker, 2004). Furthermore, the interdisciplinary content, combined with CT fostered by RM, encouraged students to explore various innovative solutions, thereby improving their ability to think outside the box.

Conclusion

This study introduced a teaching approach that integrates content selection and syllabus sequencing, presented through RM. By leveraging Cognitive Load Theory, this integrated approach helps students in higher education enhance their interdisciplinary CT by minimizing

unnecessary information complexity within the constraints of working memory, and by promoting a bottom-up thinking pattern (i.e., starting with the Core Domain, followed by Complementary and Exogenous Domains). The approach has been shown to effectively improve certain CT dispositions, including analytical skill, self-efficacy, self-regulation, and think out-of-the-box. However, other CT dispositions, such as evaluative reasoning, interpretation, inference, creative self-concept, and creative personal identity, require further refinement of the approach to achieve significant improvement.

This integrated approach makes a notable contribution to the existing literature by addressing the gap concerning the lack of studies on the impact of mapping tools in enhancing students' interdisciplinary CT, particularly in higher education. Additionally, it provides a theoretical foundation for using RM to structure content selection and syllabus sequencing in an interdisciplinary learning context.

However, there are some limitations to this study. First, the sample size is relatively small. Although the study met the requirements for the Mann-Whitney U test, future research should aim to gather data from a larger participant pool to yield more robust insights under normal conditions. Second, the approach was tested only on similar samples (i.e., undergraduate students from two cohorts of the same course). Future studies should apply the approach to more diverse samples (e.g., varying ages, institutions, majors, and courses) to validate its effectiveness in different contexts. This would allow for further refinement of the approach based on both quantitative (e.g., surveys) and qualitative (e.g., interviews and assignments) data. Finally, future research should incorporate the suggested improvements to the current approach (e.g., e-learning modules, critical evaluations of existing RM, and the development of individual RM) to test the effectiveness of these enhancements. This would help establish the approach as a more comprehensive intervention for enhancing interdisciplinary thinking in higher education.

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Contact email: teocc@ntu.edu.sg

Perception of Pre-service Teachers Towards Practicing Value-Based Techno-Pedagogical Content Knowledge (VTPCK Model)

Suprita Kumari Sinha, Gautam Buddha University, India
V. K. Shanwal, National Council of Educational Research & Training, India

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Abstract
Human values are vital to promoting education. Moral and social values like humanity, honesty, compassion, equality, and culture are important in schools. Indian culture is rich with values and traditions that have been followed since immemorial. Indians are known for peace and *Vasudhaiv Kutumbakam* (all people on earth are family). For years a moral decline has been observed in children which makes them diverted from the purpose of education. In 2015, the government of India adopted Agenda 2030 for sustainable development, and since the impact initiation can be observed. The human personality is incomplete without the essence of moral and social values. The sense of decision-making, code of conduct, and character-building make us unique and superior to computers and AI. The National Education Policy 2020 (India) recommends the central role of teachers in practicing and extending the legacy of Vedas (sacred texts), rich in human values to their students. This research investigates pre-service teachers' perceptions of the Value-based Techno-Pedagogical Content Knowledge (VTPCK) model and its effectiveness in integrating values, technology, pedagogy, and content in teacher education. Using a quasi-experimental design, the study assesses the impact of VTPCK workshops on teaching competency and moral value integration among pre-service teachers. The results indicate significant improvement in pedagogical strategies and value-driven teaching practices, emphasizing the model's relevance in modern teacher training programs.

Keywords: Values, Technology, Pedagogy, Content Knowledge, Teachers

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Introduction

One of the most pressing issues of our time is the decline in moral values among our youth. In the past, the majority of teenagers exhibited moral principles and grace. The majority of the young people were then taught decency, propriety, honesty, consideration, courtesy, respect, and righteousness at an early age. From an ethical perspective, human behavior can be classified as morally right or wrong, good or bad, or immoral. The prevailing moral norm in our society always guides these decisions. Morality is not a rule that our fellow humans force upon us. It is a law that we can comprehend and decide to follow since we can see that it makes sense. In general, morality is the absence of vices like hatred, jealousy, greed, lying, etc., as well as honesty of character and fairness of attitude. A value-based society is created when individuals work together harmoniously, play a healthy synthesis, and recognize when differentiation is appropriate. However, as the majority of the younger generation gradually disregards these ethics, these moral values are gradually eroding over time. Young people today spend more time on their phones, chatting, and using Facebook and WhatsApp than they did with their elders, who once instilled moral values in them. They discuss important topics like politics and corruption, but they themselves don't have time for the visitors, a true celebration of the festival, or showing respect for their elderly grandparents. the educational institutions such as the family, school, club, etc.

The Indian Knowledge System states that among many other values, students should be taught gratitude, honesty, sharing, empathy, compassion, cooperation, respect, truthfulness, equality, culture, enterprise, fearlessness, contribution, faith, health, benevolence, oneness, humility, zeal, courage, and humanism.

> One common factor that can change the course of events and help the educational system move past its current state of rigidity and aimlessness is to become a moderate, flexible, multidisciplinary, creative, and expertise-focused system that can produce competent, creative, talented, employable, and moral students. The teacher is this typical component. (Kasturirangan, 2020)

The National Education Policy (NEP) 2020 emphasizes teachers' critical role in transforming education by integrating values, pedagogy, and technology. A collaborative, constructivist approach to learning with value-rich content, a multidisciplinary and integrated approach, extensive use of technology, and ongoing improvement of teachers' pedagogical skills are all recommended by India's National Education Policy 2020.

In this context, the VTPCK model offers a framework for training teachers to embed moral values into pedagogical practices using technology. This study aims to evaluate the perceptions of pre-service teachers toward the VTPCK model and its influence on their teaching competencies.

Literature Reviews

Research on TPACK promoting the ICT instructional process for teachers with interactive whiteboard instruction implementation was carried out by *Koh, and Divararan* (2013) from Nanyang Technological University in Singapore. For pre-service teachers to integrate ICT with content subjects and IWB, this study aimed to create instructional materials for their TPACK development. These materials included tutor modeling, hands-on exploration, and group-based design. The pre-service teacher developed TPACK with the help of GBD experiences. *Miguel-*

Revilla (2020) and colleagues from the University of Valladolid, Spain, have jointly carried out a study on evaluating social studies teachers' digital competency using the TPACK-21 model. A crucial component of pre-service teacher preparation today is educators' digital competency. Therefore, 21st-century competencies were considered in addition to TPACK. Data collection and analysis were conducted using a quantitative approach and the TPACK-21 questionnaire. Study participants included two-year social studies and secondary education candidates. After evaluating seven factors, the results showed that the TPACK and Questionnaire 21 were adequate for making positive progress. The suggested PK and conceptual orientation of instruction have proven beneficial. *Atun and Irmita* (2018) studied the impact of the TPACK approach on social skills and science literacy at Yogyakarta University in Indonesia. The population was s, and a quasi-experimental design was examined. TPACK: An Emerging Research and Development of Tool for Teachers and Educators was the subject of a study in 2011 by *Baran* and colleagues from British University. The TPACK construct was defined in this study, along with several ongoing research and development projects that make use of the framework. It was determined that TPACK improves the ability to design and test powerful technology approaches and provides clarity to any project being developed. Pre-service teachers' TPACK was investigated by *Karaca* (2015) of Marmare University in Istanbul based on a number of factors, including gender, grade level, graduation school type, technology ownership, etc. 142 pre-service teachers from the Department of Computer Education and Technologies were included in the study. As a result, this study offered insightful information to help teachers better integrate technology beginning with their undergraduate degrees. A study conducted by *Das Mitra* (2021) of Gobardanga Hindu College in West Bengal examined the potential for TPACK to be implemented in India's two-year pre-and in-service teacher education program. The study's goal was to determine how widely TPACK is being used in teacher education. It was determined that a mixed-method study that included interview tool analysis of books, journals, and documents was legitimate. A study on creating TPACK for Animal Physiology lessons for pre-service teachers was carried out by *Pusparini* (2017) and two other Bandung researchers. Soloman 4-group, an experimental group. *Kaur* (2020) investigated the role of internationalization of moral identity and religiosity as effective predictors of prosocial behavior. For the study, 400 adult females were recruited. The tool serves as a prosocial behavior personality battery, moral identity inventory, and religiousness questionnaire. ANOVA was used to analyze the data, and the results showed that more religious people have higher levels of social responsibility, empathy, and perspective-taking skills, all of which combined to have an impact on moral reasoning. A study by *Ghorai, Khan, and Mohakud* (2021) examined the impact of family background-related variables on moral education in higher secondary students in West Bengal, India. These factors included family types, caste, occupation, income, and guardian educational qualifications. A test created by B was used to assess moral values in a study involving 444 students. M. Benjamin. SPSS version 2.1 was used to analyze the data using mean, SD, T-test, and ANOVA. In the case of the family background factors mentioned, the result was significant. Together, *Ribeiro* (2020) and four other researchers from Brazil and other nations have conducted research on the topic I found reprehensible: Medical students encounter troubling moral quandaries. The purpose of this study is to examine the nature of moral quandaries, students' emotional reactions to them, and how these dilemmas affect their professional growth. Through interviews, a cross-sectional qualitative study was conducted.

India faces a decline in moral values among youth, as reflected in increasing cases of juvenile delinquency and unethical behaviour. While previous efforts and from the literature reviews to instill values in education have yielded limited results, there remains a need for innovative teacher training models that integrate value-based education with modern pedagogical and

technological tools. The VTPCK model addresses this gap by offering a structured approach to teacher education.

Research Objectives

RO_1: To design and implement a workshop based on the VTPCK model for pre-service teachers.
RO_2: To study the perceptions of pre-service teachers on the VTPCK model post-workshop.

Research Hypothesis

H_1: The VTPCK model will positively influence pre-service teachers' ability to integrate moral values into teaching practices.

Research Methodology

A quasi-experimental design was employed, complemented by a survey to collect qualitative and quantitative data. The study involved 38 pre-service teachers enrolled in a Bachelor of Education program in Delhi, India. Participants were selected through random sampling. The research tools were used to gather information pre and post-intervention, i.e., the 5-day workshop on the VTPCK model. The tool was a *self-made VTPCK* questionnaire with 45 items across seven categories, measuring value-based technological, pedagogical, and content knowledge. A *Moral Values Scale* (MVS) to assess the integration of moral values in teaching practices. An achievement test and *Follow-up interviews* were taken to gather qualitative insights into participants' experiences with the VTPCK model.

Data Collection

1. *Pre-Test*: Participants completed the VTPCK Tool and MVS and achievement pre-test before the workshop.
2. *Workshop Implementation*: A five-day workshop introduced the VTPCK framework, covering topics such as Value-based pedagogical skills, Technological tools for teaching, and integrating moral values into content delivery. The workshop was followed by a simulation class activity.
3. *Post-Test*: Participants retook the VTPCK Tool and MVS and achievement post-test after the workshop.
4. *Follow-Up Interviews*: Semi-structured interviews captured participants' perceptions and reflections.

Data Analysis

Quantitative data were analyzed using paired t-tests and descriptive statistics to measure pre- and post-workshop differences. Qualitative data from interviews were thematically analyzed to identify recurring perceptions and challenges.

Table 1: Table Showing Comparison of Means of Achievement Scores of Students Pre and Post-workshop

Comparison of Means of achievement test scores of Experimental group pre and post-intervention					
GROUPS	N	MEAN	S.D.	t-value	significance at 0.05 level
PRE TEST EXPERIMENTAL	20	38			
POST TEST EXPERIMENTAL	18	32	6.687	2.8	significant

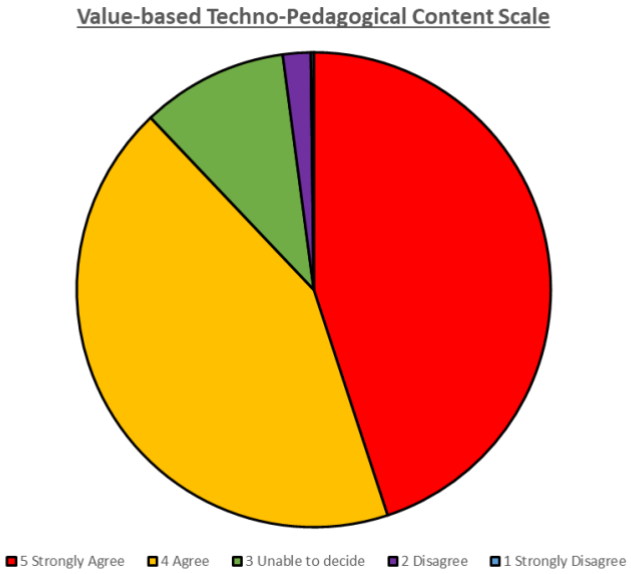

Figure 1: Total Percentage of Views of Pre-service Teachers on Value-Based Techno-Pedagogical Content Skills Under All 7 Categories

Table 2: Table Showing the Result of the Pre-service Teachers on the Moral Value Scale

Strongly Obligated	Weakly Obligated	Not Obligated
72%	17%	11%

Results

1. *Improvement in Competencies*: Participants demonstrated significant improvement in value-based teaching strategies, technological integration, and pedagogical skills ($p < 0.05$).
2. *Positive Perceptions*: 85% of participants agreed that the VTPCK model enhanced their ability to integrate moral values in teaching. 78% reported increased confidence in using technology for content delivery.
3. *Qualitative Insights*: Participants appreciated the emphasis on values such as empathy, equality, and truthfulness. The Challenges included the initial unfamiliarity with some technological tools and the need for ongoing support.

Conclusion

This study demonstrates the VTPCK model's potential to revolutionize teacher education by integrating moral values, technology, and pedagogy. The model equips pre-service teachers with the competencies required to meet modern educational challenges while fostering a value-driven teaching culture. Youth moral values are eroding, as evidenced by the rise in juvenile delinquency and unethical behavior. There is still a need for creative teacher training models that combine value-based education with contemporary pedagogical and technological tools, even though prior attempts and literature reviews to instill values in education have produced mixed results. This gap is filled by the VTPCK model, which provides an organized method of teacher preparation. Future research should explore longitudinal impacts and scalability across diverse educational settings.

Discussion and Future Suggestions

The findings support the efficacy of the VTPCK model in fostering holistic teacher development. By combining moral values with technological and pedagogical skills, the model addresses contemporary educational needs. The significant improvements observed in participants' competencies align with previous studies emphasizing value-based education's transformative potential. The challenges in the implementation of this model were the resource constraints, such as limited access to advanced technological tools and resistance to change among participants accustomed to traditional teaching methods. The suggestions for the future are:

1. We should Integrate the VTPCK model into teacher training curricula nationwide as per the results found, it is an effective model and can be one of the models for future eras.
2. To Provide continuous professional development programs to support teachers adopting value-based pedagogies.
3. To Develop digital repositories of value-based content for easier access.

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A Comparative Study on Enhancing the Accuracy of Chinese Speech-to-Text in Instructional Videos Using Large Language Models

Chih Chang Yang, National Taiwan Normal University, Taiwan
Tzren-Ru Chou, National Taiwan Normal University, Taiwan
Shu Wei Liu, National Taiwan University of Science and Technology, Taiwan

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Abstract
With the rapid development of speech recognition technology, Chinese speech-to-text (STT) systems play an important role in the production of subtitles and are often used in instructional videos. However, due to the complexity of the Chinese language and the large number of homophones, there is still significant room for improvement in the accuracy of existing STT systems. In this study, we proposed two optimization methods based on large language models (LLM), including language model-assisted editing and fine-tuned language model-assisted text editing, to improve the accuracy of Chinese STT, and verified them by producing subtitles for instructional videos in various domains and calculating the Levenshtein distance between two strings with dynamic programming. The results indicated that the fine-tuned language model-assisted text editing approach is significantly better than the language model-assisted editing approach in terms of text accuracy, and it can generate fine-tuning strategies for specific language characteristics to recognize language nuances more efficiently, thus significantly improving the accuracy of Chinese speech-to-text systems.

Keywords: Speech-to-Text (STT), Large Language Models (LLM), Instructional Videos, Fine-Tuned Language Models, Levenshtein Distance

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Introduction

In the modern era of increasingly prevalent digital education, Speech-to-Text (STT) technology has become a core tool for producing subtitles for instructional videos. However, due to the numerous homophones and complex grammatical structures in the Chinese language, existing STT systems still have significant room for improvement in accuracy (Chen et al., 2021; Zhang et al., 2018). Even advanced systems with multilingual recognition capabilities, such as OpenAI's Whisper and Google Cloud Speech-to-Text, perform suboptimally in handling Chinese, particularly in recognizing semantic differences (OpenAI, 2022; Wang, 2021).

The accuracy of subtitles in instructional videos directly affects learners' understanding of the content; incorrect word recognition may lead to misunderstandings of the learning material (Maraza-Quispe et al., 2022). Therefore, improving the accuracy of STT technology in Chinese environments has become an urgent issue to address. With the rise of Large Language Models (LLMs), which have the ability to understand textual content and make judgments, significant time can be saved on manual transcription (Brown et al., 2020; OpenAI, 2022). Although LLMs can handle tasks such as text organization, error detection, and correction, they still have limitations when dealing with homophones and specialized terminology (Maraza-Quispe et al., 2022).

With the opening up of the fine-tuning functionality in LLMs, models can be optimized for cognitive abilities on specific data (OpenAI, 2023). After fine-tuning, the model can select and identify the correct words based on context; we believe it has the potential to improve the recognition of homophones and specialized terminology (Raffel et al., 2020).

Based on this, this study aims to explore and compare two Chinese STT optimization methods based on LLMs: language model-assisted editing (LMAE) and fine-tuned language model-assisted text editing. To compare the accuracy of the two processing methods, we use the Levenshtein distance calculated using dynamic programming algorithms to compute the minimum edit distance between strings, which measures the minimum number of edit operations required to transform one string into another—including insertion, deletion, and substitution of single characters—for* evaluation purposes (Che et al., 2017; Yujian & Bo, 2007).

Research Methodology

We first selected a sample of 60 Chinese instructional videos from higher education in fields such as humanities and social sciences, natural sciences, and engineering technology to simulate real-world application scenarios. Subsequently, we used existing STT systems (e.g., OpenAI Whisper) to generate the initial subtitles. Then, we employed a Large Language Model (LLM) to perform text organization, error detection, and correction on the initial subtitles; this process constitutes the language model-assisted editing.

Next, for the fine-tuned language model-assisted text editing, we collected commonly used Chinese homophones and compiled various homophone tables or documents. We utilized the ChatGPT-4 multimodal model to identify and organize this information into the dialogue format required for fine-tuning, in JSONL format.

False	True	False	True
部份	部分	暴燥	暴躁
濱臨	瀕臨	報怨	抱怨
布署	部署	必須品	必需品
藐小	渺小	評擊	抨擊
姆指	拇指	夢靨	夢魘
脈博	脈搏	漫延	蔓延
電錶	電表	煩燥	煩躁
砥勵	砥礪	復建	復健

Homophones refer to Chinese characters that have identical phonetic forms but completely different character forms and meanings. For example, “部屬” (subordinates) and “部署” (deployment) are pronounced the same, but the former refers to personnel arrangements, while the latter refers to the arrangement of matters.

Figure1: Corrections of Common Homophones


```
{
  "messages": [
    {
      "role": "user",
      "content": "修正以下的錯別字 部份"
    },
    {
      "role": "assistant",
      "content": "部分"
    }
  ]
},
{
  "messages": [
    {
      "role": "user",
      "content": "修正以下的錯別字 濱臨"
    },
    {
      "role": "assistant",
      "content": "瀕臨"
    }
```


Figure 2: JSONL File in Dialogue Format Required for Fine-Tuning

Using the organized JSONL file, we fine-tuned the ChatGPT-4o-mini model. Subsequently, we used the fine-tuned language model to assist in text editing, performing text organization, error detection, and correction on the initial subtitles.

To evaluate the results, we calculated the Levenshtein distance using dynamic programming algorithms to compute the minimum edit distance between strings. We first compared the shortest distances between each method and the expert-approved standard examples.

To calculate the minimum edit distance between two strings A and B using dynamic programming:

$$dp[i][j] = \min \begin{cases} dp[i-1][j] + 1 & \text{(deletion)} \\ dp[i][j-1] + 1 & \text{(insertion)} \\ dp[i-1][j-1] + \delta(A[i-1], B[j-1]) & \text{(substitution)} \end{cases}$$

Where:

$$\delta(A[i-1], B[j-1]) = \begin{cases} 0 & \text{if } A[i-1] = B[j-1] \\ 1 & \text{if } A[i-1] \neq B[j-1] \end{cases}$$

Initialization:

$$dp[i][0] = i, \quad dp[0][j] = j$$

Final result:

$$\text{Levenshtein Distance} = dp[m][n]$$

Figure 3: Levenshtein Distance Calculation Formula

A Levenshtein distance value closer to zero indicates fewer changes, signifying a closer match to the expert-approved standard examples. To assess the statistical significance of these results, we chose to use an independent samples t-test for statistical analysis.

Results

We conducted an accuracy evaluation of two methods: fine-tuned language model-assisted text editing and language model-assisted editing. An independent samples t-test was used to compare the accuracy differences between the two datasets. The results showed a significant difference between the two groups (t=2.65544, p=.004507). This indicates that the fine-tuned language model performs significantly better in Chinese speech-to-text tasks than the general language model-assisted editing method.

In calculating the relevant statistical data, the mean edit distance of the fine-tuned language model-assisted text editing group was lower (M=674.2), while that of the language model-assisted editing group was higher (M=858.53). This suggests that the fine-tuned language model more effectively handled challenges such as homophones and specialized terminology, significantly reducing instances of erroneous transcription.

Table 1: Descriptive Statistics and t-Test Results for Two Treatment Groups

Group	N	M	SD	t	*p*
language model-assisted editing	60	858.53	171.04	2.66	.005*
fine-tuned language model-assisted text editing	60	674.2	118.08		

*$p < .05$

Conclusion

This study successfully demonstrated the effectiveness of fine-tuned language models in improving the accuracy of subtitles in Chinese instructional videos. Through our collected dataset of homophones and fine-tuning, the fine-tuned model exhibited higher language understanding and text generation capabilities, effectively overcoming the shortcomings of existing STT systems in accurately recognizing homophones.

The research results indicate that the fine-tuned language model can significantly reduce the error rate in the subtitle production process, further enhancing the quality and efficiency of subtitles in instructional videos. This study provides an alternative solution for improving the accuracy of Chinese speech-to-text technology and lays a foundation for subsequent applications in a wider range of educational contexts.

Future work will focus on expanding the fine-tuning dataset on a larger scale, targeting specialized terminology in various professional fields to further enhance the model's adaptability to diverse language scenarios. We will also explore how to apply this technology to other languages and domains, promoting the comprehensive development of speech recognition technology.

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Integrating Innovative Technologies in Mechanical Engineering Education: Case Study of an Arduino-Powered Robotic Arm for Quality Assurance in Automotive Manufacturing

Suzilawati Muhamud-Kayat, Universiti Teknologi MARA (UiTM), Malaysia
Mohd Hazri Mohd Rusli, Universiti Teknologi MARA (UiTM), Malaysia
Danish Afdal Azman, Universiti Teknologi MARA (UiTM), Malaysia
Joshua Goh, Pyrocell Sdn. Bhd. Malaysia

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Abstract
Integrating innovative technologies in mechanical engineering education is crucial for equipping students with the skills and knowledge required in modern industrial environments. This research presents the design, implementation, and assessment of an educational framework that incorporates Computer-Aided Design (CAD) and Simulation Software, Additive Manufacturing (3D Printing), Robotics and Automation, Mechatronics and Embedded Systems, with a specific focus on an Arduino-powered robotic arm for automated precision inspection in automotive manufacturing. The problem addressed was the existing gap in hands-on educational experiences that connect theoretical knowledge with practical applications, particularly in the context of quality assurance in manufacturing. The study explores the development of a robotic arm system designed to inspect Checking Fixture Jigs (CF-Jigs) used in automotive production, using Arduino as a cost-effective, open-source platform. This system was integrated into the curriculum to provide students with real-world experience in design, prototyping, and automation. The objectives included enhancing students' understanding of CAD modeling, 3D printing, and robotics while addressing the industry's need for efficient, accurate quality assurance tools. The methodology involved student-led projects, where students needed to design and implement the robotic arm, simulate its operations using CAD software, and produce physical prototypes through 3D printing. The system's performance was then evaluated in a simulated manufacturing environment. Findings indicated that this approach could improve students' technical skills and prepare them for challenges in modern manufacturing. Future work will focus on refining the educational framework, incorporating advanced technologies like machine learning, and expanding its application to broader engineering disciplines.

Keywords: Computer-Aided Design (CAD), Simulation Software, Additive Manufacturing, Robotics, Mechatronics and Embedded Systems

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Introduction

The rapid advancement of Industry 4.0 technologies, such as automation, robotics, and additive manufacturing, has redefined the competencies required of mechanical engineers (Smith & Brown, 2021). In modern industrial environments, mechanical engineering curricula must evolve to meet industry needs. However, traditional curricula often fail to provide adequate hands-on experience in these areas (Patel & Sharma, 2020). Quality assurance (QA) in automotive manufacturing is a critical area where robotics and IoT technologies play a pivotal role. Integrating these technologies into education prepares students for emerging challenges and equips them with practical skills. To address this gap, this study presents an educational framework incorporating innovative tools and techniques, with an Arduino-powered robotic arm designed for quality assurance in automotive manufacturing. The initiative aligns with Industry 4.0 principles and aims to equip students with practical skills relevant to contemporary industrial challenges (Smith & Brown, 2021).

Research Background

Quality assurance is pivotal in automotive manufacturing, where precision and accuracy are paramount. Checking Fixture Jigs (CF-Jigs) plays a crucial role in verifying the dimensional accuracy of components (Patel & Sharma, 2020). Despite their importance, engineering curricula often overlook practical training in quality assurance and robotics, leaving graduates unprepared for industry demands (Johnson, 2019). This gap highlights the need for integrating innovative educational methods that connect theoretical knowledge with practical applications (Kumar & Gupta, 2021). The Arduino platform provides an ideal foundation for introducing students to automation and robotics because of its cost-effectiveness and open-source flexibility (Al-Hamadi & Al-Salti, 2021). The automotive sector heavily relies on precision in manufacturing processes, with CF-Jigs ensuring dimensional accuracy (Kumar & Gupta, 2021). Integrating Arduino into the curriculum provides students with valuable hands-on experience in CAD, mechatronics, and automation. This integration bridges the gap between academic knowledge and industrial requirements, equipping graduates with skills essential for meeting the demands of contemporary manufacturing environments (Wang & Zhou, 2019).

Research Objectives

The primary objectives of this study are:

1. To develop an Arduino-powered robotic arm framework for teaching quality assurance and automation in mechanical engineering education.
2. To enhance students' hands-on learning experience by integrating CAD, robotics, and automation technologies.
3. To assess the effectiveness of project-based learning in bridging the gap between academic knowledge and industrial applications.

Methodology

Educational Framework Design

The educational framework was meticulously designed to provide a comprehensive and immersive learning experience, emphasizing hands-on skills and practical applications in

alignment with Industry 4.0 principles. The framework was designed to provide hands-on learning through four key components as listed in Table 1.

Table 1: Key Components for Framework Design

Key Components	**Description**
CAD and Simulation	Students used CAD software to design the robotic arm and simulated its movements to optimize performance and identify potential improvements (Chandra & Patel, 2019).
Additive Manufacturing (3D Printing)	Robotic arm components were fabricated using 3D printing, ensuring cost-effective production and customization (Al-Hamadi & Al-Salti, 2021).
Robotics and Automation	Arduino served as the control platform, integrating sensors and actuators to automate quality assurance tasks such as defect detection (Lee & Park, 2020).
Embedded Systems	Students programmed the robotic arm to inspect Checking Fixture Jigs (CF-Jigs), applying practical knowledge of automation and control systems to real-world scenarios (Li & Tan, 2022).

Implementation Process

The implementation process was carried out in five key phases to develop the robotic arm and ensure its effectiveness in quality assurance tasks. This structured process allowed students to apply theoretical knowledge to real-world challenges while gaining practical experience in design, manufacturing, and automation. The five key phases for the implementation process are tabulated in Table 2.

Table 2: Five Key Phases for the Implementation Process

Key Phase	Description
Phase 1: Conceptualization	Students began by analyzing quality assurance requirements and defining the specifications for the robotic arm. This phase involved understanding industry needs and brainstorming solutions to address them effectively
Phase 2: Design and Simulation	Using CAD software, students designed the robotic arm and simulated its movements. This step helped identify and address potential design flaws, ensuring the arm's functionality and efficiency before physical production.
Phase 3: Prototyping	The robotic arm's components were manufactured using 3D printing. After fabrication, the parts were assembled into a functional prototype, providing students with hands-on experience in prototyping and assembly.
Phase 4: Programming and Integration	Students programmed the robotic arm using Arduino to perform quality assurance tasks such as dimensional measurements and defect detection. Sensors and actuators were integrated to enhance the arm's capabilities, ensuring precision and reliability.
Phase 5: Testing and Evaluation	The final phase involved testing the robotic arm in a simulated manufacturing environment. Students evaluated its accuracy, reliability, and performance, making necessary adjustments to improve its operation.

Assessment Methods

The educational framework was evaluated using two main methods: rubrics and demonstrations. These approaches provided a comprehensive assessment, covering the technical, collaborative, and practical aspects.

Rubric.

The critical project components, including CAD design, programming accuracy, system functionality, and teamwork were evaluated using a structured rubric. CAD designs were assessed for clarity, precision, and optimization, while programming accuracy was judged on the effectiveness and reliability of the Arduino code. System functionality focused on the robotic arm's ability to perform tasks such as defect detection and dimensional measurement. Teamwork was also evaluated based on collaboration, communication, and problem-solving efforts. Each criterion was rated on a 5-point scale to provide clear and measurable feedback.

Demonstrations.

Each team presented their robotic arm in a live demonstration, showcasing its functionality and explaining design choices. The robotic arm's performance in quality assurance, defect detection, and dimensional accuracy was observed and evaluated. Faculty and industry professionals assessed the presentations on innovation, practicality, and technical execution, ensuring a well-rounded evaluation of the project's success.

These assessment methods provided a comprehensive overview of the framework's impact, combining objective performance metrics with student reflections and live evaluations to ensure a thorough review of both learning and application.

Results and Discussion

The robotic arm demonstrated an impressive accuracy rate of 95% in inspecting Checking Fixture Jigs (CF-Jigs) for both dimensional errors and surface defects. Figure 1 illustrates the 3D printing process for fabricating the robotic arm components. This additive manufacturing approach provided a cost-effective and efficient method for producing complex parts, allowing for rapid prototyping and refinement of the robotic arm's design. The 3D printing enabled the development of customized components, ensuring they met the specifications for the system's functionality.

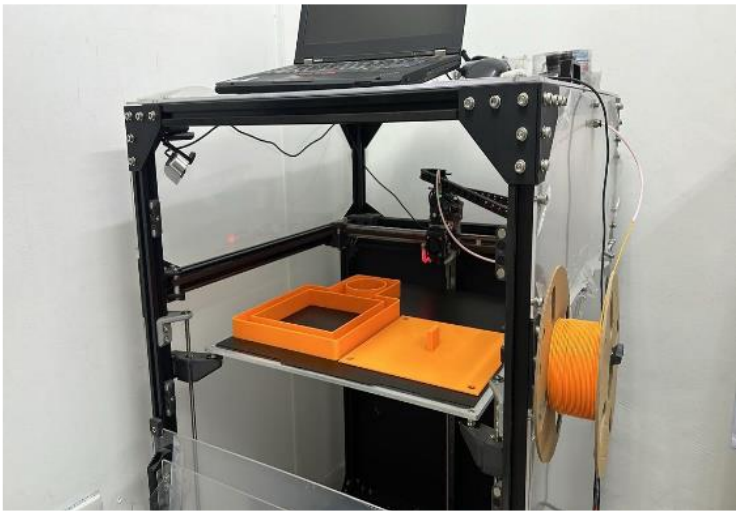

Figure 1: 3D Printing Process

Figure 2 shows the final prototype of the robotic arm, highlighting key mechanical and electronic components, such as the Arduino platform, sensors, and actuators. The design modularity allows for easy adjustments and upgrades, offering flexibility in adapting the system to various manufacturing requirements. The system also benefits from both affordability and ease of maintenance by using Arduino, a cost-effective and open-source platform.

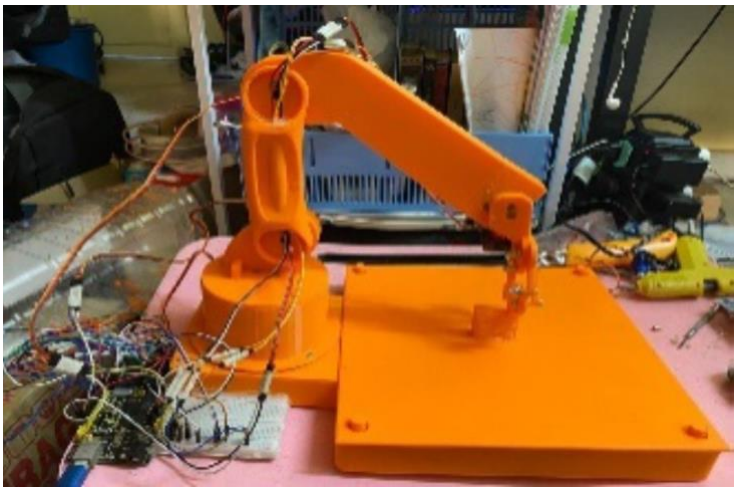

Figure 2: The Final Prototype of the Robotic Arm System

The combination of 3D printing for component fabrication and a modular design for system integration contributed to the robotic arm's high performance, offering a practical and affordable solution for quality inspections in industrial settings.

Conclusion

This study highlights the significant impact of incorporating innovative technologies into mechanical engineering education. The Arduino-powered robotic arm project was crucial in offering students valuable hands-on learning experiences that deepened their comprehension of theoretical concepts and also showcased how these concepts are applied in real-world industrial environments. By combining theoretical knowledge with practical application,

students gained a more profound understanding of engineering principles, while enhancing their problem-solving abilities and technical skills.

Future research will aim to refine this framework by integrating machine learning techniques to forecast potential defects, thereby boosting the system's efficiency and reliability. Furthermore, this approach will be extended to other engineering disciplines, allowing for a wider application of these technologies. This will foster a more comprehensive understanding of the role of innovative technologies in modern engineering education and practice.

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Contact email: suzilawati6191@uitm.edu.my

Understanding the Effectiveness of Clustered vs Semester-Based Classes on Computer Engineering Students' Academic Performance in Cebu Institute of Technology - University

Jundith D. Alterado, Cebu Institute of Technology - University, Philippines
Johnalyn L. Figueras, Cebu Institute of Technology - University, Philippines

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Abstract
This study aims to understand and compare the effectiveness of clustered and semester-based classes on student performance in higher education institutions, specifically for Computer Engineering students at Cebu Institute of Technology University. It focuses on academic proficiency, knowledge application, retention, collaboration, and logical thinking. A survey was conducted with 98 respondents who have experienced both clustered and semester-based classes to measure these areas. Using a within-subject research design, the study conducts a comparative analysis with a paired, one-tailed t-test. Additionally, the study will use a linear regression model to determine the significance of the two approaches that influence the students overall academic performance. The results reveal that students perform better in semester-based classes, as indicated by a negative t-statistic and a p-value well below the threshold for statistical significance. Furthermore, the regression analysis confirms that semester-based classes have a more substantial impact on academic performance. These findings suggest that semester-based classes are more effective in enhancing student performance, which could inform future course design and teaching strategies in Cebu Institute of Technology—University.

Keywords: Clustered, Semester-Based, Student Performance, Comparative Analysis, Within-Subject Research Design

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Introduction

Education plays a pivotal role in shaping students' academic and professional futures. As educational institutions continually seek ways to enhance learning outcomes, the structure of academic programs becomes a crucial area of exploration. One such structural variation is the difference between the traditional semester-based system and the clustered-based system, which have distinct impacts on how students engage with course content and manage their academic workload.

The semester-based system and the clustered-based system are the two different academic models used at the Cebu Institute of Technology University (CIT-U). This study seeks to understand how these two systems influence students' academic performance. The semester-based system at Cebu Institute of Technology - University spans 18 weeks, with students typically taking 8 subjects per week. This structure allows students a longer period to absorb the course content and engage with a broad array of subjects. However, the burden of managing multiple subjects at once can be overwhelming, especially for students who struggle with time management and balancing academic demands. While under the clustered-based system, which was implemented in response to the COVID-19 epidemic, students usually take four subjects each week and shorten the academic calendar to nine weeks. This system emerged as a result of the sudden transition to online education, where the traditional face-to-face teaching methods were no longer viable. The pandemic forced institutions to adapt to pure online learning, which introduced significant challenges for both students and faculty. One of the most prominent challenges was the strain in balancing the workload. Faculty members had to quickly shift from delivering traditional classroom lectures to preparing online modules and digital learning materials, a transition that often led to an increased workload in terms of content preparation and delivery. Similarly, students were faced with the challenge of adjusting to a completely new mode of learning, dealing with the complexities of online learning platforms, and managing the compressed nature of the clustered schedule. In response to these challenges, the clustered-based system was introduced as a more focused and intensive approach to learning, with the aim of reducing the number of subjects students had to manage at any given time. By grouping related subjects into blocks and offering them in a concentrated, shorter period, the clustered model was designed to mitigate some of the strain caused by the sudden shift to online education.

Research Goals and Objectives

The purpose of this study is to examine the aspects in which CIT-U students evaluate their academic performance differently in these two educational systems; specifically, it seeks to compare the academic proficiency, knowledge application, retention, collaboration, and improvement in logical thinking between students participating in both the semester-based and clustered-based systems. Furthermore, this study will look at how the students view both systems and how the way the course is delivered affects their learning, time management, and general academic performance. Accordingly, this study seeks to address several key research objectives. It aims to determine whether significant differences exist in computer engineering students' academic performance, knowledge application, retention, teamwork, and logical reasoning between clustered and semester-based systems. Additionally, it seeks to identify which approach produces better results in terms of perceived academic proficiency, knowledge application, retention, collaboration, and the enhancement of logical thinking skills. The study also examines whether these different approaches influence students' overall academic performance across these metrics. Furthermore, it explores which system students

believe better equips them to tackle future academic and professional challenges. By achieving these research objectives, this study will provide valuable insights into how different educational structures impact students' academic performance. It will also contribute to the ongoing discussion of optimizing learning environments in response to the challenges posed by the COVID-19 pandemic and the shift to online education. Ultimately, the findings may inform curriculum design and strategies for improving student outcomes in both the semester-based and clustered-based systems at CIT-U.

Methodology

This section presents the research methodology used to examine and compare the impact of clustered and semester-based class systems on the academic performance of computer engineering students at Cebu Institute of Technology University (CIT-U).

The study utilized a within-subject research design, enabling a direct comparison of students' performance in both clustered and semester-based systems. This design was chosen because it minimizes individual differences by evaluating the same group of students under both academic setups. As a result, any observed differences in performance can be attributed to the class structure rather than variations in individual capabilities.

Research Respondents and Data Collection

The study sample comprised 98 computer engineering students at CIT-U who had experienced both the clustered and semester-based systems. Purposive sampling was employed to ensure participants had enrolled in both types of classes during their academic tenure. To qualify for the study, participants needed to have completed at least one semester in each system, ensuring they had adequate exposure to both environments.

Table 1: Cebu Institute of Technology
– University Computer Engineering Students Who Took Part in The Survey

Year Level	Respondents
3rd Year	50
4th Year	159
Total	209
Sample Size (>30%)	98

The participants, all computer engineering students from Cebu Institute of Technology University in Cebu City, Philippines, had prior experience with computer programming as part of their academic curriculum. This prerequisite ensured that their responses were informed by firsthand exposure to the subject. In total, 209 respondents took part in the survey.

The survey recruited participants through convenience sampling, using official university platforms like the Learning Management System (LMS) and social media to ensure wide accessibility and participation. Data were collected through a structured questionnaire that transformed qualitative insights into quantitative values using a Likert scale. The survey questionnaire focused on students' perceptions of their academic performance across several key areas. It assessed academic proficiency by evaluating students' understanding of core computer engineering concepts, their confidence in meeting assignment and project deadlines, and their preparedness for major exams. It examined the application of knowledge

by exploring how effectively students applied their learning in practical and academic scenarios, with an emphasis on real-world relevance. Knowledge retention was measured by evaluating students' ability to recall and use course material from both systems based on academic performance-related questions. The survey also investigated collaboration and peer interaction by exploring students' experiences with group work and collaborative learning, which are critical components of engineering education. Finally, it evaluated logical thinking and problem-solving by determining how each system influenced the development of students' reasoning and problem-solving abilities.

Data Analysis

The data collected will be analyzed using a combination of statistical methods. A paired one-tailed t-test will be employed to compare students' performance across key metrics in the clustered and semester-based systems. This test will determine if there is a statistically significant difference in academic performance between the two systems, with the null hypothesis asserting no difference and the alternative hypothesis suggesting a significant difference. Descriptive statistics, including mean, median, and standard deviation, will summarize students' performance in both systems, offering insights into central tendencies and variability in outcomes. Additionally, a linear regression analysis will be conducted to assess the impact of the class system (clustered vs. semester-based) on overall academic performance. This model will help determine if the class system is a significant predictor of students' perceived academic success.

Results and Discussion

The results of this study provide valuable insights into the comparative effectiveness of clustered and semester-based class systems on the academic performance of Computer Engineering students at Cebu Institute of Technology University (CIT-U). This section presents an in-depth analysis of the collected data, highlighting trends, patterns, and key findings across various performance metrics, including academic proficiency, knowledge application, retention, collaboration, and problem-solving skills.

The results of the paired two-tailed t-test comparing the clustered and semester-based systems across various academic performance metrics revealed statistically significant differences in favor of the semester-based system.

Table 2: Paired Two-Sample t-Test for Perceived Academic Proficiency Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.5850	4.0068
Observations	98	98
Degrees of Freedom (df)	97	
t-Statistic	-4.7201	
p-Value (One-Tailed)	3.97×10^{-6}	
Critical t-Value (One-Tailed)	1.6607	

For academic proficiency, the semester system yielded a higher mean score (4.0068) compared to the clustered system (3.5850). The calculated t-statistic of -4.7201 exceeded the critical value of 1.6607 (one-tailed), with a p-value of 3.97×10^{-6}, indicating a significant difference between the two systems.

Table 3: Paired Two-Sample t-Test for Perceived Application of Knowledge Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.4286	3.8878
Observations	98	98
Degrees of Freedom (df)	97	
t-Statistic	-5.3382	
p-Value (One-Tailed)	3.08×10^{-6}	
Critical t-Value (One-Tailed)	1.6607	

In terms of application of knowledge, the semester system also outperformed the clustered system, with mean scores of 3.8878 and 3.4286, respectively. The t-statistic was -5.3382, with a p-value of 3.08×10^{-7}, further confirming the statistical significance of this difference.

Table 4: Paired Two-Sample t-Test for Perceived Knowledge Retention Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.1939	3.6735
Observations	98	98
Degrees of Freedom (df)	97	
t-Statistic	-5.7358	
p-Value (One-Tailed)	5.51×10^{-8}	
Critical t-Value (One-Tailed)	1.6607	

For knowledge retention, the semester system (mean=3.6735) again showed higher scores than the clustered system (mean=3.1939). The t-statistic of -5.7358 and a p-value of 5.51×10^{-8} reaffirmed that the observed difference was significant.

Table 5: Paired Two-Sample t-Test for Perceived Collaboration Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.2653	4.1122
Observations	98	98
Degrees of Freedom (df)	97	
t Stat	-7.7101	
p-Value (One-Tailed)	5.51E-12	
Critical t-Value (One-Tailed)	1.6607	

The mean collaboration score was 3.27 for the cluster setup and 4.11 for the semester setup. The calculated t-statistic of -7.71 exceeded the critical t-value of 1.66, while the p-value of 5.51E-12 was significantly below the 0.05 threshold. These findings indicate a statistically significant difference in collaboration, with the semester setup demonstrating a clear advantage.

Table 6: Paired Two-Sample t-Test for Perceived Improvement in Logical Thinking Between Clustered and Semester-Based Models

Statistic	Cluster	Semester
Mean	3.5816	4.000
Observations	98	98
Degrees of Freedom (df)	97	
t Stat	-4.2106	
p-Value (One-Tailed)	2.85E-05	
Critical t-Value (One-Tailed)	1.6607	

The mean for improvement in logical thinking score was 3.58 for the cluster setup and 4.00 for the semester setup. Similarly, the calculated t-statistic of -4.21 exceeded the critical t-value of 1.66, and the p-value of 2.85E-05 was far below the 0.05 threshold. These results indicate a statistically significant difference in logical thinking, with the semester setup showing a clear advantage.

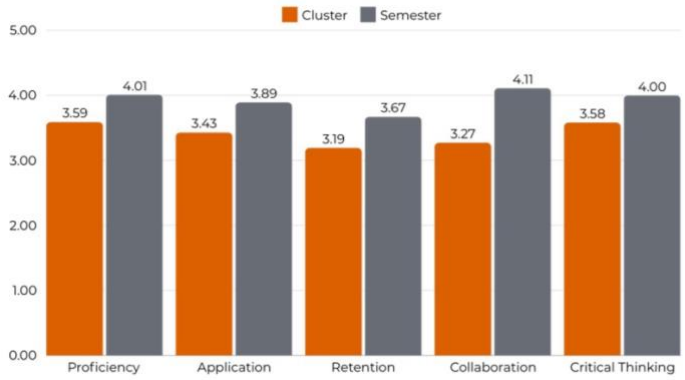

Figure 1: Overall Academic Performance Between Cluster and Semester-Based Models

The data above strongly indicates that students favor the regular semester-based system over the clustering system in all measured aspects. This suggests that the semester-based system may be better suited to fostering academic proficiency, knowledge application, retention, collaboration, and critical thinking. Institutions might consider adopting or emphasizing semester-based structures to maximize student outcomes.

Table 7: Paired Two-Sample t-Test for Overall Perceived Academic Performance

Statistic	Cluster	Semester
Mean	3.4606414	3.95626822
Observations	98	98
Degrees of Freedom (df)	97	
t Stat	-6.5803924	
p-Value (One-Tailed)	1.1974E-09	
Critical t-Value (One-Tailed)	1.6607	

Furthermore, the statistical evidence provided by the t-test aligns with the tabulated data analysis, which demonstrated the semester-based system's superiority across all five key points. Notably, collaboration showed the largest difference in average scores (4.11 vs. 3.27), emphasizing that the semester-based system fosters greater peer interaction and teamwork among students. The semester-based system’s consistent advantage in knowledge retention

and critical thinking plays a pivotal role in its superior overall academic performance, demonstrating its effectiveness in promoting deeper learning and analytical skills.

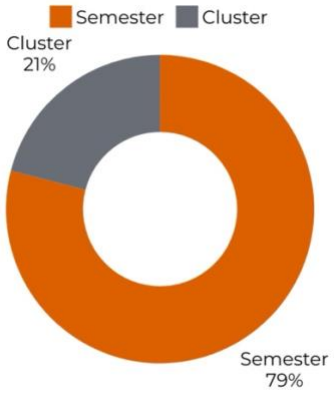

Figure 2: Students' Preferred Educational Model for Future Preparedness

The figure above summarizes the distribution of responses regarding students' preferred system between the cluster-based and semester-based approaches. The semester-based system is perceived by most students (79%) as the more effective setup for preparing them for academic and professional success. This aligns with earlier analyses indicating that the semester system is seen as superior in fostering skills such as academic proficiency, knowledge retention, and collaboration. The cluster-based system, despite being the preference of 21% of respondents, is viewed by a smaller group as more beneficial in preparing for future challenges. This may indicate a preference for the perceived flexibility or structure of the cluster-based approach, even though it scores lower in terms of academic performance metrics. The results suggest that the semester-based system is overwhelmingly favored by students (79%) when considering its potential to better prepare them for future academic and professional challenges. This aligns with the earlier findings showing that the semester-based system leads to stronger academic outcomes. Therefore, while students may have personal preferences for different structures, the semester system is likely more effective in equipping them for future success.

Table 8: Correlation Analysis Between Semester and Cluster Approaches

Metric	Correlation Value	Interpretation
Semester vs. Cluster	0.42	Positively Moderate Correlation

The correlation value of 0.42 indicates a positively moderate relationship between the semester and cluster setups in terms of their effect on academic performance. This suggests that while related, other factors might influence the students' perceived academic performance.

Table 9: Regression Analysis Summary

Metric	Value	Interpretation
Regression Equation	y=2.97+0.496×Class Setup	Academic Performance increases by 0.496 points with the class setup approach.
R Square	0.17	17% of the variance in academic performance is explained by the class setup approach.
Adjusted R Square	0.1666	Slightly adjusted for the sample size; consistent with R Square.
F-statistic	39.98	Overall regression model is statistically significant.
P-value	< 0.0001	Strong evidence against the null hypothesis, indicating significance.

The fitted regression model shows that the class setup approach significantly impacts academic performance, accounting for 17% of the variance. The positive coefficient of 0.496 suggests that shifting to a more semester-oriented approach can enhance academic outcomes.

Conclusion

The findings of this study reveal a significant difference in the academic performance and preparedness of students between the cluster-based and semester-based systems. Results from the paired t-tests indicate that students in the semester-based system consistently outperformed those in the cluster-based system in terms of academic proficiency and application of knowledge. The semester-based system demonstrated higher mean scores and statistically significant p-values, highlighting its effectiveness in fostering better academic outcomes. Furthermore, the survey responses corroborate these findings, with 79% of respondents indicating that the semester-based system better prepares them for the future. These results suggest that the semester-based system provides a more conducive learning environment for sustained engagement, deeper understanding, and application of knowledge, ultimately equipping students with the skills and competencies needed for future challenges. This study underscores the importance of structured, consistent class schedules in enhancing students' academic and practical readiness. Institutions may consider these findings to refine their curriculum design and class scheduling to maximize student success.

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Critical English Writing Skills in Thai Education: Assessing 11th Grade Proficiency and Digital Solutions

Atichon Worasan, Khon Kaen University, Thailand
Parama Kwangmuang, Khon Kaen University, Thailand

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Abstract
Critical English writing skills are essential for academic success and global competitiveness, yet Thai students often struggle in this area. This study aimed to assess the critical English writing skills of 11th grade Thai students, explore teaching challenges, and evaluate the potential of digital platforms in enhancing these skills. The research employed a comprehensive secondary analysis approach, examining data from national standardized tests (O-NET), international assessments (TOEFL iBT, IELTS), and academic literature spanning 2019-2023. The study encompassed all 77 Thai provinces, ensuring a representative national sample. Findings revealed that 80% of 11th grade Thai students possess only basic to intermediate writing skills (CEFR levels A1-B1), with significant disparities across regions and school types. Analysis identified key challenges in teaching critical writing, including large class sizes, limited individual feedback time, and insufficient focus on higher-order thinking skills. The study also uncovered a growing trend in digital tool adoption, with online writing platforms and grammar checkers being widely used, while emerging technologies like AI writing assistants show promising potential. This research contributes novel insights by providing a comprehensive, nationwide assessment of critical English writing skills in Thailand, linking proficiency levels to specific teaching challenges and technological solutions. The findings highlight the urgent need for targeted interventions to develop higher-order writing skills and suggest that strategic integration of digital platforms could significantly enhance writing instruction in the Thai educational context. These results have important implications for educational policy, teacher training programs, and the development of culturally tailored digital learning tools.

Keywords: Critical English Writing, Thai Secondary Education, Digital Learning Platforms, Writing Proficiency Assessment, Educational Technology Integration

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Introduction

Critical English writing skills have become increasingly vital for academic success and global competitiveness in the 21st century, particularly in non-English speaking countries like Thailand. However, Thai secondary school students face significant challenges in developing these essential skills, creating a concerning gap between current capabilities and the demands of higher education and international workforce requirements. This issue is particularly pronounced among 11th grade students, who stand at the crucial transition point between secondary education and higher learning. Recent standardized test results and international assessments indicate that Thai students consistently underperform in critical English writing compared to their regional counterparts, highlighting an urgent need for comprehensive investigation and intervention.

Previous research has illuminated various aspects of this challenge in the Thai educational context. Chaijaroen and colleagues (2012) revealed a fundamental weakness in Thai students' critical thinking potential, demonstrating that while basic language skills were adequately developed, higher-order thinking skills essential for critical writing showed considerable deficiencies. This finding was further substantiated by Nomnian and Arphattananon (2018), who identified systemic issues in Thai government schools affecting English language teaching effectiveness, particularly emphasizing the crucial role of strategic thinking and management leadership. The complexity of these challenges was further explored by Tongpoon-Patanasorn (2018), who found that integrated approaches combining technology with expert assessment yielded better results than single-method approaches in developing technical vocabulary and writing skills.

The teaching challenges in this context have been well-documented through various studies. Viriya and colleagues (2012) identified significant concerns regarding teaching materials and assessment methods, while Costley and Lange (2016) highlighted the negative correlation between social presence and critical thinking in asynchronous learning environments. More recent research by Marleni (2020) demonstrated the potential of technological writing features in enhancing students' writing skills, particularly when combined with traditional pedagogical approaches. This technological dimension has gained further significance with studies by Kim (2023) and Dja'far and Hamidah (2024), which revealed positive outcomes in cognitive, affective, and linguistic factors through AI-assisted instruction, while also noting the importance of maintaining a balance between technological and human feedback.

Despite this growing body of research, significant gaps remain in our understanding of critical English writing skill development among Thai secondary students. While individual studies have examined specific aspects of the problem, there lacks a comprehensive, nationwide assessment that simultaneously considers proficiency levels, teaching challenges, and technological solutions. As highlighted by Peck and Kavanagh (2024), there is a particular need for better preparation in providing writing feedback, while Yang (2022) emphasized the importance of intelligent text semantic analysis in writing correction. Furthermore, Utami and colleagues (2023) identified significant challenges in adapting technological tools to specific educational contexts and student needs, suggesting a need for more targeted research in the Thai context.

To address these gaps, this study aims to achieve three primary objectives:

(1) to assess the current proficiency levels of critical English writing skills among 11th grade Thai students across all 77 provinces, utilizing standardized test data and international assessment metrics.
(2) to identify and analyze the key challenges faced in teaching critical English writing skills in Thai secondary schools, considering both pedagogical and systemic factors.
(3) to evaluate the potential of digital platforms in enhancing critical English writing instruction, examining current adoption rates, effectiveness, and future possibilities.

This research makes several significant contributions to the field of English language education in Thailand. First, it provides the first comprehensive, nationwide assessment of critical English writing skills among 11th grade students, offering detailed insights into proficiency levels across different regions and school types. Second, it establishes a clear connection between student proficiency levels and specific teaching challenges, supported by quantitative severity ratings that can inform policy priorities. Third, it offers a detailed analysis of digital platform potential in the Thai educational context, including adoption rates and effectiveness metrics for various technological tools. These contributions are particularly timely given the increasing importance of digital literacy and the growing role of technology in education. The findings provide valuable insights for educational policymakers, teacher training programs, and developers of educational technology, potentially influencing the future direction of English language education in Thailand and similar educational contexts.

Literature Review

The increasing importance of critical English writing skills in today's globalized world has become a crucial concern in the Thai educational context, particularly for secondary school students preparing for higher education and future careers. This comprehensive review examines the current state of research regarding critical English writing skills among Thai 11th grade students, focusing on proficiency levels, teaching challenges, and the potential of digital platforms in addressing these issues.

Current State of Critical English Writing Skills in Thailand

The current state of English writing proficiency among Thai secondary students presents significant challenges that require systematic attention. Chaijaroen and colleagues' (2012) foundational study revealed critical deficiencies in higher-order thinking skills, despite adequate basic language development. This finding is particularly significant as it highlights the disconnect between fundamental language acquisition and advanced writing capabilities. Building on this, Nomnian and Arphattananon (2018) provided a comprehensive analysis of systemic issues in Thai government schools, emphasizing that successful language programs require not just teaching expertise but also strategic management and stakeholder involvement. The research landscape was further enriched by Tongpoon-Patanasorn's (2018) investigation into technical vocabulary development, which demonstrated that integrated technological and expert assessment approaches yielded superior results compared to traditional single-method teaching. This integration of technology and expert assessment has proven particularly effective in developing students' writing capabilities. Wiriyakarun's (2018) subsequent research reinforced these findings, establishing a clear correlation between vocabulary knowledge and academic achievement in Thai EFL learners. The effectiveness of combined teaching approaches was further validated by Phosa's (2020) research on blended

learning methods, which demonstrated significant improvements in writing performance when traditional and digital methods were strategically integrated. These studies collectively indicate that while Thai students often possess basic language skills, the development of critical writing abilities requires a more nuanced and multi-faceted approach that combines traditional pedagogy with modern technological tools.

Teaching Challenges and Pedagogical Approaches

The challenges facing English writing instruction in Thai contexts reveal complex interconnections between pedagogical, technological, and cultural factors. Viriya and colleagues' (2012) evaluation of university-level English courses uncovered a paradoxical situation where general teaching satisfaction coexisted with significant concerns about teaching materials and assessment methods. This finding was further complicated by Costley and Lange's (2016) research, which identified the potentially negative relationship between social presence and critical thinking in online learning environments. The temporal aspect of language acquisition was reconceptualized by Norrman (2024), emphasizing the crucial role of continuous development and interaction in language learning. This perspective gained additional support from Tran-Duong's (2023) research on media literacy's impact on online learning outcomes. Marleni's (2020) investigation into technological writing features provided crucial insights into how digital tools can enhance traditional teaching methods, while Kim's (2023) research on AI technology-based learning tools revealed both the potential benefits and risks of technological integration. The importance of balanced instruction was further emphasized by Dja'far and Hamidah (2024), who demonstrated that while AI-assisted instruction can significantly improve writing skills, maintaining an appropriate balance between technological and human feedback remains crucial. These studies collectively suggest that effective writing instruction requires a carefully calibrated approach that integrates traditional teaching methods with modern technological tools while remaining mindful of the specific challenges and opportunities presented by the Thai educational context.

Digital Platforms and Technology Integration

The role of digital platforms in enhancing critical writing skills has emerged as a central focus of recent research, with studies revealing both opportunities and challenges. Liu and colleagues' (2024) systematic review of TECLL studies provided comprehensive evidence of technology's positive impact on language achievement across different contexts. This was complemented by Wale and Kassahun's (2024) research, which specifically demonstrated how AI writing technologies can improve various aspects of writing proficiency. The practical applications of these technologies were further explored through Zhao and colleagues' (2024) evaluation of Wordtune and AlShaikh and colleagues' (2024) examination of AI-powered educational video platforms. Pitychoutis's (2024) focused investigation of AI chatbots in EFL writing instruction revealed significant improvements in both writing quality and student engagement, findings that were corroborated by Polakova and Klimova's (2024) research on chatbot implementation. The effectiveness of integrated technological approaches was further supported by Williams and Beam's (2019) comprehensive review and Arioua's (2023) study, both of which demonstrated that combining multiple digital tools leads to better outcomes in writing instruction. These studies collectively suggest that while individual digital tools can be effective, the most significant improvements in writing skills occur when multiple technological resources are strategically integrated into a comprehensive instructional approach.

Theoretical Framework and Learning Approaches

The theoretical underpinning of critical writing skill development has evolved significantly over recent years. Lantolf and Aljaafreh's (1996) foundational work on second language learning in the zone of proximal development remains relevant, emphasizing the non-linear nature of language development. This framework has been successfully adapted to digital environments, as demonstrated by Hwang and colleagues (2021) in their study of social regulation-based online learning, and further supported by Svihla and colleagues (2009) in their investigation of interactive learning assessments. Recent theoretical developments have expanded our understanding of writing skill development. Langum and Sullivan (2020) explored the relationship between academic writing, scholarly identity, and multilingualism, providing insights into the complex nature of writing skill development. Their findings were complemented by Reddy and colleagues (2018), who investigated academic stress factors affecting language learning performance. Additionally, Preiss and colleagues (2013) examined the correlation between argumentative writing and critical thinking in higher education, finding significant gender differences and educational correlates that inform pedagogical approaches.

Research Gaps and Future Directions

Despite substantial research in critical English writing development, significant gaps remain that warrant further investigation in the Thai educational context. Peck and Kavanagh's (2024) research highlighted crucial gaps in writing feedback preparation, particularly in how teachers are trained to provide effective feedback in different learning contexts. This finding was complemented by Yang's (2022) work on intelligent text semantic analysis, which revealed opportunities for more sophisticated approaches to writing assessment and correction. The comprehensive bibliometric analysis conducted by Dong and colleagues (2024) identified emerging trends toward technology integration and personalized learning, suggesting new directions for research and practice. The practical application of digital tools in writing instruction, while showing promise, still faces significant challenges. Chuchuen's (2021) research on online diaries provided valuable insights into specific digital tool applications, while Sianipar and Gultom's (2022) investigation of Google Classroom demonstrated the potential of mainstream educational platforms. However, Utami and colleagues' (2023) study of AI technology in academic writing highlighted persistent challenges in adapting these tools to specific educational contexts, particularly in Thailand. These gaps suggest several key areas for future research: the development of culturally sensitive digital tools, the integration of AI-powered writing assistance in Thai educational contexts, and the creation of more effective feedback mechanisms for large class sizes. Additionally, research is needed to better understand how to bridge the gap between basic language proficiency and advanced critical writing skills, particularly in the context of Thai secondary education.

Cultural and Identity Factors in Writing Development

The role of cultural and identity factors in writing development presents complex challenges specific to the Thai educational context. Building on Langum and Sullivan's (2020) work on scholarly identity and multilingualism, the research reveals how Thai students' cultural background influences their approach to critical writing. This understanding is crucial when considering Nomnian and Arphattananon's (2018) findings regarding systemic issues in Thai government schools, as cultural factors significantly impact how students engage with

English writing instruction. The research by Costley and Lange (2016) on social presence in learning environments takes on additional significance when viewed through a cultural lens, particularly in how Thai students navigate between their native cultural expression and the requirements of academic English writing. The effectiveness of technological integration, as demonstrated by Marleni (2020), must also be considered within this cultural context, as students' cultural backgrounds influence how they interact with digital learning tools. Kim's (2023) research on AI technology-based learning tools gains additional relevance when considering how these tools can be adapted to support culturally sensitive writing instruction. This cultural dimension is further emphasized in Dja'far and Hamidah's (2024) findings regarding the balance between technological and human feedback, suggesting that effective writing instruction must consider both cultural norms and individual identity development in the Thai educational context.

Research Methodology

This study employed a comprehensive secondary research approach to address the research objectives related to critical English writing skills among 11th grade students in Thailand, challenges faced in teaching these skills, and the potential of digital platforms in enhancing them. The methodology was designed to ensure a holistic understanding of the current landscape and to provide evidence-based recommendations for future interventions.

Data Collection

The research utilized a wide range of secondary data sources to gather comprehensive information. These sources included national standardized tests (O-NET), TOEFL iBT Writing scores, and IELTS Academic Writing scores for Thai students over a five-year period from 2019 to 2023. Additionally, the study incorporated data from 25 peer-reviewed academic journals published between 2019 and 2023, 10 government reports on education in Thailand, and 5 international comparative studies on English language teaching. To gain insights into digital tool implementation, 30 case studies of schools using digital tools in English classrooms were analyzed, along with an examination of 15 existing digital platforms used globally for teaching critical writing.

Data Analysis

The analysis of the collected data involved both quantitative and qualitative methods. Quantitative analysis was applied to the standardized test scores and other numerical data to determine proficiency levels, regional comparisons, and gender differences. This included calculating mean scores, standard deviations, and percentages for various aspects of writing skills and student demographics.

Qualitative analysis was conducted on the academic journals, government reports, and international studies. This involved thematic analysis to identify recurring patterns and themes related to challenges in teaching critical English writing skills. The severity of these challenges was assessed based on the frequency and emphasis of issues in the analyzed documents.

For the digital tool utilization aspect, a mixed-method approach was employed. Quantitative analysis was used to determine adoption rates and perceived effectiveness of various digital

tools, while qualitative analysis of case studies provided insights into the implementation and impact of these tools in educational settings.

Framework and Criteria

The Common European Framework of Reference for Languages (CEFR) was used as the primary assessment criteria for evaluating students' English proficiency levels. This internationally recognized framework provided a standardized measure for comparing skills across different aspects of language proficiency.

Geographical Scope

The study encompassed data from all 77 provinces of Thailand, ensuring a comprehensive representation of the country's educational landscape. This wide geographical coverage allowed for meaningful regional comparisons and the identification of disparities in critical English writing skills across different areas of the country.

This methodology enabled a thorough exploration of the research objectives, providing a solid foundation for understanding the current state of critical English writing skills in Thailand, the challenges in teaching these skills, and the potential of digital platforms in addressing these issues. The multi-faceted approach to data collection and analysis ensured that both broad trends and detailed insights were captured, leading to well-informed recommendations for future interventions and platform development in the Thai educational context.

Research Results

This study aimed to assess the critical English writing skills of 11th grade students in Thailand, explore the challenges in teaching these skills, and identify the potential of digital platforms in enhancing them. The research was conducted through extensive analysis of existing data from national and international standardized tests, academic literature, government reports, and case studies of digital tool implementation in educational settings.

1. Assessment of Current Student Proficiency Levels

The analysis of national standardized test data (O-NET), TOEFL iBT, and IELTS Academic writing scores for Thai students over the past five years (2019-2023) revealed the following:

Table 1: Distribution of CEFR Levels Among 11th Grade Thai Students in Critical English Writing Skills

CEFR Level	Percentage of Students	Description
C2	0.5%	Mastery
C1	2.5%	Advanced
B2	12%	Upper Intermediate
B1	25%	Intermediate
A2	35%	Elementary
A1	20%	Beginner
Pre-A1	5%	Absolute Beginner

Table 1 illustrates the distribution of critical English writing proficiency levels among 11th grade Thai students based on the Common European Framework of Reference for Languages (CEFR). The data indicates that a significant majority of students (80%) fall within the A1 to B1 levels, suggesting a predominance of basic to intermediate writing skills. Only 15% of students demonstrate upper-intermediate to advanced proficiency (B2 to C2 levels), highlighting a clear need for improvement in higher-level writing skills.

A more detailed analysis of specific writing skill components yielded the following results:

Table 2: Proficiency Levels of 11th Grade Thai Students Across Various Aspects of Critical English Writing Skills

Skill Aspect	Mean Score (0-10)	Standard Deviation	Proficiency Level
Grammar and Vocabulary	7.8	1.2	High
Sentence Structure	7.2	1.3	High
Coherence and Organization	6.5	1.5	Moderate
Idea Development	5.9	1.7	Moderate
Critical Analysis	5.3	1.9	Low to Moderate
Argumentation	5.1	2.0	Low to Moderate
Creative Thinking	4.8	2.1	Low
Overall Critical Writing	6.2	1.6	Moderate

Table 2 reveals a clear pattern in the proficiency levels across different aspects of critical English writing skills. Students demonstrate stronger performance in foundational language skills such as grammar, vocabulary, and sentence structure. However, there is a noticeable

decline in proficiency as the skills become more complex, with critical analysis, argumentation, and creative thinking showing the lowest scores. This pattern suggests that while basic language skills are being effectively taught, there is a significant gap in the development of higher-order thinking skills essential for critical writing.

The analysis of regional data from all 77 provinces in Thailand revealed significant disparities:

Table 3: Regional Comparison of Critical English Writing Skills Among 11th Grade Thai Students

Region	**Mean Score**	**Standard Deviation**
Bangkok Metropolitan	7.1	1.4
Central	6.5	1.5
Northern	6.0	1.6
Northeastern	5.7	1.7
Southern	5.9	1.6
Eastern	6.3	1.5
Western	6.1	1.6

Table 3 highlights significant regional disparities in critical English writing skills. The Bangkok Metropolitan area consistently outperforms other regions, while the Northeastern region shows the lowest average scores. This disparity likely reflects differences in educational resources, exposure to English, and socio-economic factors across regions.

Further analysis of the data revealed gender-based differences and variations based on school types:

Table 4: Gender Comparison of Critical English Writing Skills Among 11th Grade Thai Students

Gender	**Mean Score**	**Standard Deviation**
Female	6.6	1.5
Male	5.8	1.7

Table 5: Comparison of Critical English Writing Skills Among 11th Grade Thai Students by School Type

School Type	**Mean Score**	**Standard Deviation**
Public Schools	5.9	1.7
Private Schools	6.8	1.4
International Schools	8.2	1.1

Tables 4 and 5 indicate that female students generally outperform male students in critical English writing skills, and there is a clear hierarchy in performance based on school type, with international schools significantly outperforming both private and public schools.

2. Challenges in Teaching Critical English Writing Skills

An analysis of 25 peer-reviewed academic journals (2019-2023), 10 government reports on education in Thailand, and 5 international comparative studies on English language teaching revealed several key challenges:

Table 6: Major Challenges in Teaching Critical English Writing Skills

Rank	Challenge	Severity (1-10)
1	Large class sizes	8.7
2	Limited time for individual feedback	8.5
3	Students' low motivation for writing	8.2
4	Lack of critical thinking skills in students	8.0
5	Insufficient teacher training in critical writing pedagogy	7.8
6	Limited access to quality teaching materials	7.5
7	Difficulty in assessing critical writing skills	7.3
8	Cultural barriers to expressing critical opinions	7.0
9	Pressure to teach to standardized tests	6.8
10	Language interference from Thai	6.5

Table 6 outlines the major challenges in teaching critical English writing skills, as identified through literature analysis. The severity ratings are based on the frequency and emphasis of these issues in the analyzed documents. Large class sizes and limited time for individual feedback emerge as the most significant challenges, reflecting systemic issues in the Thai education system.

3. Digital Tool Utilization and Potential

Analysis of 30 case studies on schools implementing digital tools and 15 existing digital platforms used globally for teaching critical writing revealed:

Table 7: Current Utilization of Digital Tools for Teaching Critical English Writing Skills

Digital Tool Category	Adoption Rate	Perceived Effectiveness (1-10)	Main Purpose
Online writing platforms	68%	7.8	Collaborative writing, peer review
Grammar and style checkers	62%	7.2	Error correction, language improvement
Plagiarism detection software	55%	8.5	Academic integrity, source citation
Digital portfolios	42%	7.5	Progress tracking, self-reflection
Mind-mapping tools	38%	7.0	Idea organization, essay planning
Virtual reality environments	12%	6.5	Immersive writing experiences
AI writing assistants	10%	6.2	Personalized feedback, writing suggestions

Table 7 shows the adoption rates and perceived effectiveness of various digital tools in teaching critical English writing skills. The data suggests that while some tools like online writing platforms and grammar checkers are widely adopted, emerging technologies such as AI writing assistants and virtual reality environments are still in the early stages of adoption. Interestingly, plagiarism detection software, despite its lower adoption rate, is perceived as highly effective, indicating its crucial role in maintaining academic integrity.

These findings provide a comprehensive overview of the current state of critical English writing skills among Thai 11th grade students, the challenges in teaching these skills, and the potential of digital platforms to address these challenges. The results highlight the need for targeted interventions, particularly in developing higher-order thinking skills and leveraging technology to enhance writing instruction in the Thai educational context.

Discussions

Assessment of Current Student Proficiency Levels

The findings regarding current student proficiency levels reveal a concerning pattern in the development of critical English writing skills among Thai 11th grade students. The distribution of CEFR levels, showing 80% of students at basic to intermediate levels (A1-B1), with only 15% achieving upper-intermediate to advanced proficiency (B2-C2), indicates a significant challenge in developing higher-order writing skills. This pattern is particularly evident in the detailed analysis of specific writing components, where students demonstrate stronger performance in fundamental skills (grammar: 7.8/10, vocabulary: 7.8/10) but show marked weakness in critical analysis (5.3/10) and argumentation (5.1/10). The substantial

regional disparities, with Bangkok Metropolitan area (mean score 7.1) significantly outperforming other regions, particularly the Northeastern region (5.7), highlight the impact of socio-economic factors and educational resource distribution on writing proficiency.

These findings both align with and extend previous research in significant ways. The observed challenges in critical thinking and writing abilities support Chaijaroen and colleagues' (2012) findings regarding underdeveloped higher-order thinking skills among Thai students. However, our study provides a more granular analysis of this deficit across different writing components. The gender disparity in performance (female mean: 6.6, male: 5.8) aligns with Preiss and colleagues' (2013) findings on gender differences in argumentative writing, though our study reveals a wider gap in the Thai context. The significant variation in performance across school types (international schools: 8.2, private: 6.8, public: 5.9) supports Nomnian and Arphattananon's (2018) findings regarding systemic issues in Thai government schools. A limitation of this aspect of our study is the reliance on standardized test scores, which may not fully capture the nuanced aspects of writing skill development in authentic contexts.

These findings have significant implications for educational policy and practice in Thailand. The clear hierarchy in skill proficiency suggests the need for targeted interventions to develop higher-order writing skills while maintaining strong fundamental language instruction. Future research should investigate the specific factors contributing to regional and gender disparities, particularly focusing on successful practices in high-performing schools and regions. Additionally, longitudinal studies tracking student progress across different CEFR levels could provide valuable insights into effective skill development strategies.

Challenges in Teaching Critical English Writing Skills

The analysis of teaching challenges reveals multifaceted obstacles in developing critical English writing skills. Large class sizes (severity rating 8.7/10) and limited time for individual feedback (8.5/10) emerge as the most significant challenges, followed by students' low motivation (8.2/10) and lack of critical thinking skills (8.0/10). The high severity ratings for insufficient teacher training (7.8/10) and limited access to quality teaching materials (7.5/10) indicate systemic issues in the educational infrastructure. Cultural barriers to expressing critical opinions (7.0/10) present a unique challenge in the Thai context.

These findings show interesting parallels and contrasts with existing literature. The identification of large class sizes as the primary challenge aligns with Viriya and colleagues' (2012) evaluation of English courses, though our study quantifies the severity more precisely. The challenge of limited individual feedback time supports Costley and Lange's (2016) findings regarding social presence in learning environments, while adding new insights into the specific impact on writing skill development. Our findings on cultural barriers extend Langum and Sullivan's (2020) work on scholarly identity and multilingualism, particularly in the Asian context. An unexpected finding was the relatively lower severity rating for language interference from Thai (6.5/10), contrasting with previous studies that emphasized first language interference as a major obstacle.

The implications of these findings suggest the need for a comprehensive approach to addressing teaching challenges. Future research should explore innovative solutions for providing effective feedback in large classes, potentially through peer review systems or

automated tools. The cultural aspects of critical writing instruction in Thai contexts warrant further investigation, particularly in developing culturally sensitive approaches that encourage critical expression while respecting local values.

Digital Tool Utilization and Potential

The analysis of digital tool implementation reveals both promising trends and significant opportunities for improvement. Online writing platforms show the highest adoption rate (68%) with strong perceived effectiveness (7.8/10), while emerging technologies like AI writing assistants show lower adoption (10%) but maintain moderate effectiveness ratings (6.2/10). The high effectiveness rating of plagiarism detection software (8.5/10) despite moderate adoption (55%) suggests untapped potential in academic integrity tools.

These findings both support and expand upon recent research in educational technology. The success of online writing platforms aligns with Liu and colleagues' (2024) findings on technology-enhanced cooperative language learning, while our study provides specific metrics for the Thai context. The cautious adoption of AI writing assistants' contrasts with Kim's (2023) predominantly positive findings, suggesting implementation challenges specific to Thai educational settings. Our results on digital portfolios (42% adoption, 7.5/10 effectiveness) support Williams and Beam's (2019) findings on the benefits of integrated approaches, while highlighting room for increased adoption.

Looking forward, these findings suggest several directions for digital tool integration in Thai education. The gap between adoption rates and perceived effectiveness indicates potential for expanded implementation of successful tools. Future research should investigate the factors influencing successful digital tool adoption, particularly focusing on emerging technologies like AI writing assistants and virtual reality environments. Additionally, studies examining the long-term impact of digital tool integration on critical writing development could provide valuable insights for educational technology policy.

Limitations and Recommendations

Limitations of the Study

The present study, while comprehensive in its scope and methodology, encountered several limitations that should be considered when interpreting its findings. Primarily, the reliance on standardized test scores (O-NET, TOEFL iBT, and IELTS) as measures of writing proficiency may not fully capture the nuanced aspects of students' critical writing abilities in authentic contexts. While these assessments provide valuable quantitative data, they might not reflect students' actual writing performance in real-world situations. Additionally, the secondary research approach, though extensive, limited the ability to gather direct insights from current students and teachers regarding their immediate experiences and challenges. The study's timeframe (2019-2023) also coincided with significant global disruptions in education due to the COVID-19 pandemic, which may have influenced both teaching practices and student performance in ways that could not be fully isolated in the analysis. Furthermore, while the study covered all 77 provinces in Thailand, the varying quality and availability of data across regions may have impacted the comprehensiveness of regional comparisons.

Recommendations for Educational Practice

Based on the study's findings, several key recommendations emerge for improving critical English writing instruction in Thai secondary schools. First, educational institutions should prioritize the reduction of class sizes or implement split-group teaching strategies to address the primary challenge of large class sizes (severity rating 8.7/10). This could be achieved through the strategic allocation of resources and the implementation of rotating small-group instruction periods. Second, schools should develop systematic approaches to provide more individualized feedback, potentially through the integration of peer review systems and digital feedback tools, addressing the challenge of limited feedback time (8.5/10). Third, teacher training programs should be enhanced to focus specifically on critical writing instruction methodologies and the effective integration of digital tools, addressing the identified gap in teacher preparation (7.8/10).

Recommendations for Technology Integration

The study's findings regarding digital tool utilization suggest several specific recommendations for technology integration. Educational institutions should prioritize the expansion of online writing platform implementation, building on the current 68% adoption rate and high effectiveness rating (7.8/10). A structured approach to technology integration should be developed, beginning with widely adopted tools like grammar checkers (62% adoption) and gradually incorporating emerging technologies. Special attention should be paid to the potential of AI writing assistants, which despite low current adoption (10%) show promising effectiveness ratings (6.2/10). Institutions should develop clear guidelines for the balanced use of these tools, ensuring they supplement rather than replace traditional teaching methods.

Recommendations for Policy Development

Policy recommendations emerge at both institutional and national levels. At the national level, education authorities should consider developing standardized guidelines for critical writing instruction that account for regional disparities and cultural contexts. Funding allocations should prioritize reducing resource gaps between regions, particularly addressing the significant performance differences between the Bangkok Metropolitan area (mean score 7.1) and other regions, especially the Northeastern region (5.7). Educational policies should be revised to place greater emphasis on higher-order thinking skills and critical writing development, moving beyond the current focus on basic language skills as evidenced by the proficiency distribution findings.

Recommendations for Future Research

Future research should address several identified gaps and emerging questions. Longitudinal studies tracking student progress across CEFR levels would provide valuable insights into skill development patterns over time. More detailed investigations into the effectiveness of specific digital tools in the Thai context are needed, particularly regarding emerging technologies like AI writing assistants and virtual reality environments. Research should also explore the impact of cultural factors on critical writing development and how these can be effectively addressed in teaching methodologies. Additionally, studies examining successful practices in high-performing schools and regions could provide valuable insights for improving outcomes across the country.

These recommendations collectively aim to address the complex challenges identified in the study while building on existing strengths in the Thai educational system. Implementation should be approached systematically, with careful consideration of local contexts and resource availability. Regular monitoring and evaluation of implemented changes will be crucial for ensuring their effectiveness and making necessary adjustments over time.

Conclusion

This comprehensive study of critical English writing skills among 11th grade Thai students has revealed significant insights into the current state of English language education in Thailand. The findings demonstrate a clear hierarchy in writing proficiency, with 80% of students performing at basic to intermediate levels (CEFR A1-B1), highlighting a crucial need for targeted interventions in higher-order writing skills development. The identification of significant challenges, particularly large class sizes (severity 8.7/10) and limited feedback time (8.5/10), points to systemic issues that require immediate attention from educational policymakers. The analysis of digital tool utilization reveals promising opportunities, with online writing platforms showing high adoption rates (68%) and effectiveness (7.8/10), while emerging technologies like AI writing assistants, despite lower current adoption (10%), demonstrate potential for future implementation. These findings contribute to the field by providing the first comprehensive nationwide assessment of critical English writing skills in Thailand, establishing clear connections between proficiency levels and teaching challenges, and offering detailed insights into the potential of digital platforms in addressing these challenges. The results suggest that improving critical English writing skills among Thai students requires a multi-faceted approach that combines targeted pedagogical interventions, systemic reforms to address teaching challenges, and strategic integration of digital tools, while considering regional disparities and cultural contexts. These insights have significant implications for educational policy, teacher training programs, and the development of culturally tailored digital learning tools, potentially influencing the future direction of English language education in Thailand and similar educational contexts.

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Exploring Decision-Making Skills With the ChatGPT-Enhanced Decision Tree Interactive Learning Model

Yanli Miao, King Mongkut's Institute of Technology Ladkrabang, Thailand
Kanyarat Sriwisathiyakun, King Mongkut's Institute of Technology Ladkrabang, Thailand
Thanin Ratanaolarn, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
This study explores the impact of the ChatGPT-enhanced Decision Tree Learning Model on the decision-making skills of Chinese international students. By integrating artificial intelligence with traditional decision tree methods, the model offers an interactive, personalized learning experience to help students navigate complex decision-making scenarios. The study involved 80 students from a university in Thailand, who were randomly assigned to either the experimental group using the ChatGPT model or the control group using traditional teaching methods. A pre-test and post-test design, along with self-assessment tools, were used to evaluate students' decision-making skills. The results showed significant improvements in the experimental group in terms of systematic thinking, autonomous adaptability, and feedback-driven optimization. These findings support the effectiveness of AI-driven models in enhancing key decision-making skills and are consistent with existing research on the role of technology in skill development. The study concludes that the ChatGPT-enhanced model is a valuable tool for developing decision-making abilities in international students, but further research is needed with extended interventions and diverse samples to explore its long-term impact and broader applicability.

Keywords: Decision-Making Skills, ChatGPT, Decision Tree International Students

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Introduction

With globalization advancing, international education has become a key pathway for Chinese students to grow and learn. However, in unfamiliar cultural and academic environments, developing decision-making skills poses a significant challenge. These skills are critical for academic success and future career development. Arslan and Kılınç (2019) highlight that sound decisions enhance personal success and contribute to societal progress, while Samancı and Mazlumoğlu (2023) emphasize that past decisions shape our present lives. In education, decision-making skills directly impact academic performance, with Ross (1981) identifying knowledge, emotion, and skills as the foundation of wise, empathetic decisions.

Educational technology, particularly AI tools like ChatGPT, offers new opportunities to strengthen these skills. Through interactive, personalized feedback, AI supports students in tackling complex problems. A study on Chinese international students' demand for the ChatGPT-enhanced Decision Tree Learning Model (Miao et al., 2024) found strong interest in improving cultural sensitivity, adaptability, and confidence while highlighting lesser emphasis on systematic analysis and diverse values. The study recommends integrating AI, cultural training, and confidence-building programs to enhance decision-making in dynamic contexts.

Decision trees provide a visual structure for analyzing multi-factor decisions, improving transparency and reducing information overload (Priyanka & Kumar, 2020). Combining ChatGPT with decision trees enhances accuracy, adaptability, and personalized feedback (Chiesa-Estomba et al., 2024), making it highly effective in education, law, and medicine (Guo & Wang, 2024; Zhou, 2023).

In this context, this study explores whether the ChatGPT-enhanced Decision Tree Learning Model can effectively improve decision-making skills among Chinese international students. By merging the logical clarity of decision trees with ChatGPT's interactive intelligence, this model offers a dynamic, tailored learning experience. Thus, the research question is: Will the ChatGPT-enhanced Decision Tree Learning Model improve the decision-making skills of Chinese international students?

Literature Review

Theoretical Framework

The ChatGPT-enhanced decision tree learning model integrates constructivist learning theory, systematic decision theory, and AI-driven personalized learning to create a dynamic, tailored framework for improving decision-making skills. Grounded in constructivism, the model supports learners in actively constructing knowledge through interactive problem-solving scenarios, with ChatGPT providing personalized cases and real-time feedback to refine decision strategies (Jayasinghe, 2024). Systematic decision theory enhances logical analysis and visualization of outcomes, using decision trees to simplify complex problems, weigh solutions, and promote fairness in diverse learning contexts (Lehto et al., 2021). AI further personalizes learning by dynamically adjusting content, simulating immersive decision scenarios, and using data-driven optimization to refine feedback mechanisms and learning paths (Song et al., 2024). This integrated approach empowers learners to confidently navigate complex decisions, combining active knowledge construction with logical rigor and adaptive

feedback, offering a robust foundation for decision-making skill development in intelligent education systems.

The ChatGPT-Enhanced Decision Tree Learning Model

The ChatGPT-enhanced decision tree learning model integrates NLP and decision tree analysis to develop learners' decision-making and logical thinking skills through cultural sensitivity, personalized learning, and data-driven optimization. The learning process consists of the following five stages: Step 1: Needs Analysis and Scenario Design: Through an initial assessment, ChatGPT identifies the learner's decision-making abilities and cultural background, then designs customized learning scenarios and tasks based on the needs analysis. Step 2: Scenario Task Guidance: ChatGPT guides the learner through case scenarios, such as cross-cultural team collaboration or complex business problems, using the structured pathways of decision trees to analyze issues step-by-step and select optimal solutions. Step 3: Real-Time Interaction and Feedback: At each decision point, the learner receives real-time feedback from ChatGPT, including analyses of the strengths and weaknesses of their choices and suggestions for improvement, enhancing the learning process. Step 4: Reflection and Optimization: After completing the decision pathway, the system summarizes the learner's performance, analyzes errors, and provides supplementary learning materials to help the learner continuously refine their decision-making skills through repeated practice. Step 5: Evaluation: The system generates a comprehensive evaluation report covering the quality of the learner's decision pathways, cultural adaptability, and improvements in problem-solving abilities.

Decision-Making Skills

Decision-making skills refer to an individual's ability to effectively analyze information, balance multiple demands, solve problems, and make rational choices in complex academic, social, and cultural environments. Their assessment can be structured around three core dimensions: Systematic Thinking, which involves comprehensively analyzing information and developing logical, feasible solutions (Kahneman & Tversky, 2013); Autonomous Adaptability, which refers to the ability to flexibly respond to challenges and adjust decisions in dynamic and uncertain environments (de Bruin et al., 2007); and Feedback-Driven Optimization, which emphasizes reflecting on and utilizing feedback to continuously improve decision quality. These dimensions comprehensively encompass pre-decision information analysis, in-decision adjustments, and post-decision optimization, aligning with the dynamic and holistic nature of the decision-making process (Kealey & Protheroe, 1996; Kolb, 2014). The theoretical foundation includes Prospect Theory, Self-Efficacy Theory, and Experiential Learning Theory. Methods such as situational simulations, dynamic case analyses, and action-reflection journals can scientifically evaluate international students' decision-making skills, providing practical guidance for cross-cultural adaptation and academic success.

Method

Experiment Design

This study employed a pretest-posttest randomized experimental design, also known as a pretest-posttest control group design. A total of 80 students were randomly assigned to either the experimental group or the control group, with the experiment lasting six weeks. The experimental group learned using the ChatGPT-Decision-Making Tree Model, while the

control group followed traditional teaching methods. All participants completed a pretest before the intervention and a posttest afterward to evaluate the impact of the ChatGPT-Decision-Making Tree Model on students' decision-making skills.

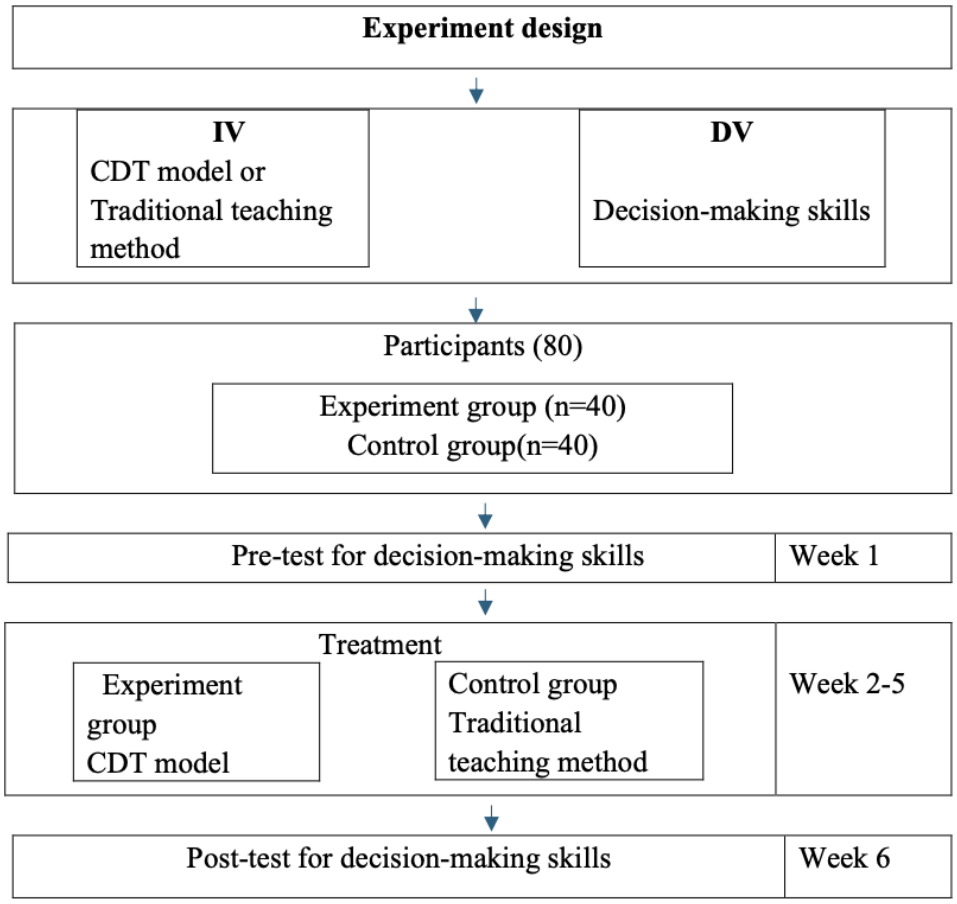

Figure 1: Experiment Design

Participants

This study randomly selected a sample of 80 Chinese international students from King Mongkut's Institute of Technology Ladkrabang (KMITL) in Thailand. Participants were divided into two groups: 40 in the experimental group and 40 in the control group. The sample included students from various academic disciplines, such as Educational Technology, Educational Management, Business Administration, and Interior Design, ensuring representativeness across different decision-making contexts.

Table 1: Participant Information

Demographic Aspects	Number		Percentage	
	Experiment	Control	Experiment	Control
Gender				
Male	23	24	28.7	30.0
Female	17	16	21.2	20.0
Age				
18-25	1	0	1.25	0
26-30	22	24	27.5	30
31& above	17	16	21.2	20
Academic level				
Undergraduate	1	0	1.25	0
Master	22	24	27.5	30
PhD	17	16	21.2	20
Familiarity with AI tools				
Familiar	29	28	36.2	70.0
Unfamiliar	11	12	13.7	15.0

Instruments

This decision-making skills assessment tool uses a quantitative questionnaire to evaluate students' performance across three core dimensions: systematic thinking, autonomous adaptability, and feedback-driven optimization. Each dimension consists of 5 statement items, totaling 15 items. Participants rate themselves on a 5-point Likert scale (ranging from Strongly Disagree to Strongly Agree), with higher scores indicating stronger skills in that dimension. The tool was reviewed by three educational technology experts and two psychology experts for Item-Objective Congruence (IOC), with all items achieving an IOC index range of 0.8–1.0, indicating strong content validity. It is deemed suitable for assessing decision-making skills in this study.

Result

Table 2: Group Statistics

	Group	N	Mean	SD	Error
Pretest	Control	40	52.95	4.58	0.72
	Experiment	40	52.18	4.98	0.79
posttest	Control	40	55.20	5.22	0.82
	Experiment	40	58.53	5.34	0.85

Table 2 shows that the pre-test mean scores of the control group (52.95) and the experimental group (52.18) were similar, indicating no significant initial differences. However, in the post-test phase, the experimental group's mean score (58.53) was notably higher than the control group's (55.20), suggesting that the intervention positively impacted the experimental group's learning outcomes.

Table 3: Independent Sample Test

		Levene's test		t-test for equality of mean						95%	
pretest	Equal variances assumed	F	Sig	t	df	one-tailed	two-tailed	Mean Difference	Error	Lower	Upper
	Equal variances not assumed	1.08	0.30	0.73	78	0.24	0.47	0.78	1.07	-1.35	2.90
posttest	Equal variances assumed		0.86	0.73	77.4	0.24	0.47	0.78	1.07	-1.35	2.90
	Equal variances not assumed	0.32	0.86	-2,82	78	0.00	0.00	-3.33	1.18	-5.68	-0.97

Table 3 presents the results of the independent samples t-test comparing the control and experimental groups during the pre-test and post-test phases. In the pre-test, Levene's test confirmed the equality of variances assumption ($F=1.08$, $p=0.30$). The t-test showed no significant difference in mean scores between the groups ($t=0.73$, $df=78$, $p=0.47$), with a mean difference of 0.78 (95% CI: -1.35 to 2.90). In the post-test, the equal variances assumption was also satisfied ($F=0.32$, $p=0.86$). However, the t-test revealed that the experimental group's mean score was significantly higher than the control group's ($t=-2.82$, $df=78$, $p < 0.01$). The mean difference was -3.33, with a 95% confidence interval of [-5.68, -0.97]. These findings demonstrate the significant positive impact of the intervention on the experimental group.

Table 4: Independent Sample Effect Sizes

		Standardizer	Point Estimate	95% confidence interval	
				lower	upper
pretest	Cohen's d	4.77	0.16	-0.28	0.60
	Hedges' g	4.82	0.16	-0.28	0.60
	Glass's delta	4.98	0.17	-0.28	0.59
posttest	Cohen's d	5.28	-0.63	-1.08	-0.18
	Hedges' g	5.33	-0.62	-1.07	-0.18
	Glass's delta	5.34	-0.62	-1.08	-0.16

Table 4 summarizes the effect sizes for the independent samples' comparison between the experimental and control groups in the pre-test and post-test phases, using three standardized metrics: Cohen's d, Hedges' g, and Glass's delta. In the pre-test, all effect sizes were small (Cohen's $d=0.16$, Hedges' $g=0.16$, Glass's delta=0.17) with 95% confidence intervals ranging from approximately -0.28 to 0.60, indicating negligible differences between the groups. In the post-test, the effect sizes increased to medium levels (Cohen's $d=-0.63$, Hedges' $g=-0.62$, Glass's delta=-0.62), with 95% confidence intervals from approximately -1.08 to -0.16, suggesting a significant positive impact of the intervention on the experimental group. The consistency across metrics reinforces the validity of the observed improvements.

Discussion

The results of this study indicate that the ChatGPT-enhanced Decision Tree Learning Model significantly improved the decision-making skills of Chinese international students. This was evidenced by the significant differences between the experimental and control groups in the post-test phase and a moderate effect size. These findings align with existing research, which highlights the role of advanced technological tools in facilitating key skill development (Ellikkal & Rajamohan, 2024).

In this study, the significant impact of the intervention on systematic thinking supports the efficacy of AI learning models in assisting students in analyzing complex problems and formulating structured solutions. Kahneman and Tversky (2013) emphasize the importance of systematic thinking in decision-making. The ChatGPT model's ability to simulate various scenarios and provide structured feedback likely contributed to the improvement in systematic thinking among the experimental group. This finding is consistent with Djunaidi, who found that structured problem-solving tools enhance students' analytical capabilities (Djunaidi, 2022).

Autonomous adaptability was another key area of improvement. The experimental group demonstrated a better ability to adjust their decision-making in changing environments, suggesting that interactive AI systems can foster greater adaptability. Individuals with higher adaptability are more likely to succeed in dynamic environments (Endres, 2018). The ChatGPT-enhanced model offered a safe environment for students to practice adaptive strategies, highlighting adaptability's role in international students' success (Miah et al., 2024).

The post-test results also highlighted the importance of feedback-driven optimization in decision-making. The experimental group exhibited an ability to effectively utilize feedback to refine their decisions, a critical skill in cross-cultural adaptation (Liu et al., 2024). Kolb's (2014) experiential learning theory supports this view, emphasizing that feedback and reflection are key to skill development. The interactive feedback loop provided by ChatGPT likely contributed to this improvement, which is in line with Xi's (2020) findings that reflective feedback processes significantly enhance decision-making quality (Donovan et al., 2015).

Conclusion

The ChatGPT-enhanced Decision Tree Learning Model is a powerful tool for improving the decision-making skills of Chinese international students. By addressing critical dimensions such as systematic thinking, autonomous adaptability, and feedback-driven optimization, the model offers a comprehensive approach to fostering skills essential for academic and social success in global contexts. These findings underscore the potential of AI-driven educational interventions to transform skill development in diverse student populations.

Limitations and Future Research Directions

While the results are promising, the study has limitations. The six-week intervention may not fully capture the long-term impact of the ChatGPT-enhanced model. Future studies could explore extended interventions and incorporate larger, more diverse samples to enhance generalizability. Additionally, qualitative methods, such as interviews or focus groups, could

provide deeper insights into how students perceive and apply the decision-making skills learned through the model.

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The Learning Model in the Metaverse for Promoting Collaborative Learning on the Thai MOOC Platform

Chutiwat Suwatthipong, Sukhothai Thammathirat Open University, Thailand
Thanathnuth Chatpakkarattana, Sukhothai Thammathirat Open University, Thailand
Suchart Saenpich, Sukhothai Thammathirat Open University, Thailand

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Abstract
This study has two primary objectives: 1) to explore the components and learning models within the metaverse that promote collaborative learning on the Thai MOOC platform, and 2) to develop and refine this metaverse-based learning model. The study identified four key components of the metaverse: 1) People, 2) Learning Strategies, 3) Media, and 4) Technology. The learning process is structured into four stages: 1) Preparation and Immersion, 2) Mission/Quest, 3) Assessment, and 4) Repetition/Reflection. Evaluation results indicate that the learning model is highly suitable for enhancing collaborative learning on the Thai MOOC platform, with an overall mean score of 4.43 and a standard deviation of 0.53. The components and learning stages received the highest appropriateness ratings, each with a mean score of 4.57 and standard deviations of 0.49 and 0.51, respectively. Among the components, Media was rated the most appropriate, with a mean score of 4.71 and a standard deviation of 0.49. The People and Technology components were equally rated, each with a mean score of 4.57 and a standard deviation of 0.53. For the learning stages, Preparation and Immersion, Mission/Quest, and Assessment all received equally high ratings, each with a mean score of 4.57 and a standard deviation of 0.53, except for Repetition/Reflection, which had a standard deviation of 0.79.

Keywords: Metaverse, Collaborative Learning, Thai MOOC, Learning Model

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Introduction

Metaverse is a virtual community that seamlessly integrates environments and various elements through technologies such as the Internet of Things (IoT), Augmented Reality (AR), and Virtual Reality (VR). It plays a crucial role in transforming communication, society, and learning patterns. Users can create avatars as their representatives to interact with the environment and objects through 3D computer graphics, allowing abstract concepts to be visualized, making it easier to understand content related to science, social sciences, and the environment. Additionally, it can simulate high-risk or unlikely real-world scenarios for skill training and mastery. Importantly, the Metaverse also creates virtual classrooms that connect learners from around the world, promoting cross-cultural education and effective international collaborative learning (Na Songkhla, 2022).

Thai MOOC is a platform that supports the delivery of open online education (Thailand Massive Open Online Course), under the supervision of the Thailand Cyber University Project. Its objective is to provide Thai citizens with access to high-quality learning opportunities, allowing them to learn for free and access educational resources anytime and anywhere through online learning. The platform aims to promote lifelong learning among the Thai population (Thailand Cyber University Project, 2021).

As mentioned, this has led to the idea of integrating the Metaverse with the Thai MOOC platform as a key approach to enhancing online learning in Thailand. The focus is on studying the components and learning models within the Metaverse that are suitable for creating a virtual learning environment that fosters interaction and collaborative learning among students. Additionally, the learning model will be developed by integrating AR, VR, and IoT technologies with the course content on the Thai MOOC platform to make learning more engaging, easily accessible, and responsive to the lifelong learning needs of Thai citizens. This integration will help create an effective learning experience, promote knowledge exchange, and develop essential skills through collaborative activities in virtual spaces. This aligns with the goal of Thai MOOC to be an open and high-quality online learning resource accessible to all.

Key Components for Utilizing the Metaverse in Education

Based on the review of related documents and research, several scholars have studied the use of the metaverse for education. The summary of their findings is presented in Table 1 below.

Table 1: Summary of Key Components for Utilizing the Metaverse in Education

Component	Author					Article
	Lee, H.; Woo, D.; Yu, S.(2022)	Díaz, J. E. M., Saldaña, C. A. D., & Ávila, C. A. R. (2020)	Hirsh-Pasek, K. et al (2022)	Woong Suh and Seongjin Ahn (2022)	Mustafa, B. (2022)	
1.Virtual classrooms or learning environments	/	/	/	/	/	/
2. 3D simulations or models for experiential learning	/	/	/	/	/	/
3. VR AR MR XR or 360 degree	/	/	/	/	/	/
4. Social and collaborative tools	/	/	/	/	/	/
5. Virtual teachers	-	/	/	/	/	/
6. Digital content and resources	/	/	/	/	/	/
7. Virtual assessment and evaluation	/	-	-	-	/	-
8. Tracking and Analytics System	-	/	-	-	/	-
9. Integration with traditional classroom	/	/	/	-	/	/
10. Accessibility	-	/	/	/	/	/

From Table 1, the researcher summarized the essential components for utilizing the metaverse in education into eight key elements: 1) Virtual classrooms or learning environments, 2) 3D simulations or models for experiential learning, 3) Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Extended Reality (XR), or 360-degree content, 4) Social and collaborative tools for communication and teamwork, 5) Virtual teachers, 6) Digital content and learning resources, 7) Integration with traditional classroom instruction, and 8) Accessibility to accommodate learners with diverse skills and devices.

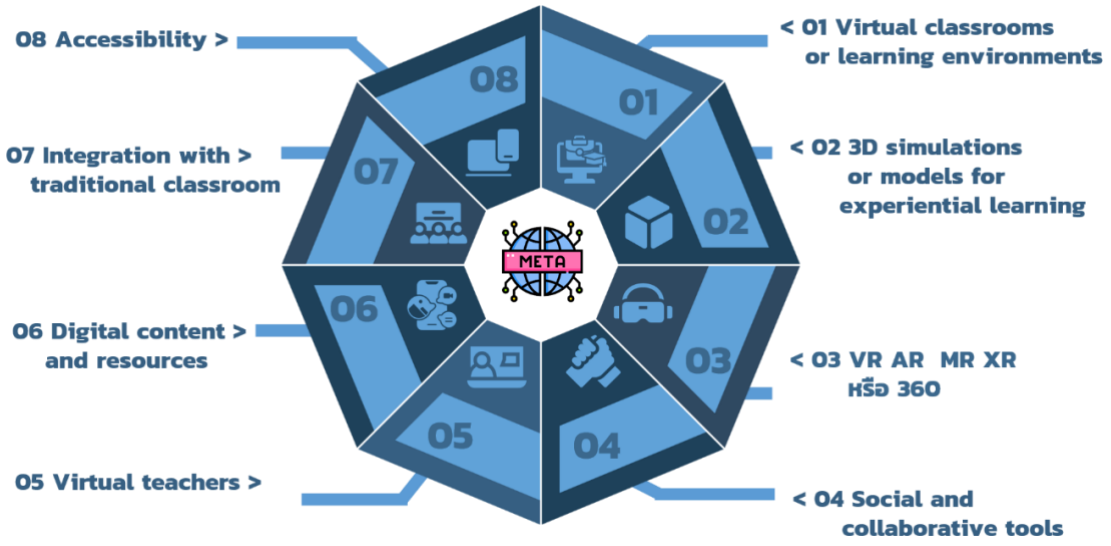

Figure 1: The Eight Components of the Metaverse
for Promoting Collaborative Learning on the Thai MOOC Platform

Based on the figure, the author provides explanations for each of the eight components as follows:

1. Virtual classrooms or learning environments: These are digital spaces where learners and educators can interact, communicate, and learn together in a remote or online setting. These environments typically include features such as video conferencing, document sharing, and interactive tools that engage learners with the content and foster collaboration.
2. 3D simulations or models for experiential learning: These are computer-generated 3D representations of real-world environments or objects that enhance experiential learning. Simulations and models can be used to mimic real-life scenarios, allowing learners to experience and interact with situations in a safe and controlled environment. This is particularly useful in fields like medicine, nursing, engineering, and architecture, where such experiences might be difficult, impossible, or unsafe in the real world.
3. Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Extended Reality (XR), or 360-degree:
   - Virtual Reality (VR) is a computer-generated 3D environment that users can interact with using devices like headsets with screens and handheld controllers. Learners are fully immersed in a simulated environment, and their actions in the virtual world reflect their movements in the real world.
   - Augmented Reality (AR) is a technology that overlays digital information—such as graphics, text, or audio—onto a user's view of the real world, which can be experienced through devices like smartphones, tablets, or special AR glasses.
   - Mixed Reality (MR) combines elements of VR and AR, integrating virtual objects into the real world seamlessly, allowing interaction with digital content to create a more realistic experience.
   - Extended Reality (XR) is an umbrella term that encompasses all forms of virtual technologies, including VR, AR, and MR, designed to provide immersive and interactive experiences for learners.
   - 360-degree media is technology that allows learners to explore environments or objects from a 360-degree perspective and can be used in combination with VR, AR, or MR to create a more realistic learning experience.
4. Social and collaborative tools: These are software applications that support social learning and collaboration by facilitating communication and teamwork among learners. They allow multiple participants to work together on projects or tasks in real-time, regardless of location. Examples include social media platforms like Facebook, Twitter, and LinkedIn; online discussion boards for knowledge sharing; project management tools such as Trello, Asana, and Basecamp; video conferencing platforms like Zoom, Meet, and Teams; and cloud file-sharing services like Dropbox, Google Drive, and OneDrive, which allow learners to share files and collaborate.
5. Virtual teachers: These refer to educators who use technology to conduct teaching activities, such as video conferencing, online platforms, and other digital tools, to teach learners remotely. Also known as online or digital teachers, virtual teachers employ a variety of methods, including live online classes, prerecorded videos, and interactive learning activities.
6. Digital content and resources: These include any type of information or educational media that is created, stored, and distributed in digital form. It can include diverse types of content such as text, images, videos, audio, and interactive media. Examples of digital content and resources include online articles, blog posts, e-books, digital textbooks, online courses (MOOCs), digital images, videos, audio files, interactive simulations, VR/AR games, online databases, and research resources. Digital content and resources can be accessed and used via various digital devices, such as computers, smartphones, and tablets.

7. Integration with traditional classroom: This refers to incorporating digital content and resources with traditional teaching methods to enhance and support the learning process. It includes various strategies and techniques, such as using interactive simulations or videos to augment instruction, leveraging online resources, digital textbooks, or educational games to complement traditional lessons.
8. Accessibility: This involves designing and developing systems with accessibility in mind, such as using clear and simple language, providing alternative text for images, using headings and lists for content organization, and ensuring easy navigation. It also includes designing responsive interfaces compatible with various devices and screen sizes, adding captions to videos, and using contrasting colors and large font sizes for readability. These considerations ensure that learners with diverse skills and devices can access and participate effectively.

A synthesis of studies on metaverse-based learning demonstrates among other things the transformative potential of metaverse across various domains, economics, learning outcomes, and engagement. Danylec and colleagues (2022) have found that the training of metaverse would cut the expenses and time by 95% for train drivers with real-time automated assessments. Also, the efficiency of the latter rises by 93%. Pigultong (2022) found cognitive gains among students with internet access were uneven, with Wi-Fi users having the highest improvement. Among the factors Almarzouqi and colleagues (2022) discovered that metaverse users inter alia must be satisfied with the service, they should also have sufficient awareness, and they must be technologically compatible to allow stakeholders to stratify the most optimal integration strategies. Kim and colleagues (2022) argued that the user-friendly design and attractive experiences will rise up the intention of using metaverse platforms among higher education students that will possibly transform the university model. Jeong and colleagues (2022) besides other fields, pointed out the integration of the metaverse with learning management systems as one of the regions, where it can be useful in education, local governance, and workforce development, also significantly contributing to the validation of student learning histories. Chen and colleagues (2022) thus checked the metaverse research to main domains including service-oriented and technology-oriented and also did the layering of its architecture. The results, the metaverse's capacity, bring out the learning process, bridge digital divides, and innovate educational ecosystems, offering great pieces of advice for future development and application.

Based on the review of related documents and studies, the researcher identified that the form of the metaverse to be applied in education can be divided into different "spaces." In this study, the "spaces" are divided into six distinct spaces based on usage characteristics: 1) Lobby Space, 2) Learning Space 3) Lab Space 4) Architecture Space 5) Show Space and 6) Joy Space (Café Space). Each of these spaces has different forms and usage characteristics, as described below.

1. Lobby Space: This is the initial space that users enter in the system. It serves as a location with guides or media for system use. Users can meet and make appointments here before moving to other spaces within the system. It includes discussion boards or announcements from system administrators or instructors, providing important information that learners and users need to be aware of.
2. Learning Space: This is the area designated for learning and includes classrooms of three sizes: 1) Small - accommodates up to 30 learners or users, 2) Medium - accommodates 31 to 100 learners, and 3) Large - accommodates over 100 learners. The classrooms are

arranged with tables and different spaces to promote learning, including group table setups to facilitate knowledge sharing and group discussions.

3. Lab Space: This space is designed for learning in a laboratory setting relevant to specific subjects and courses. Examples include nursing labs, physics, chemistry, or biology experiment labs. It uses media like VR, AR, MR, or XR to help learners have an experience as close to reality as possible.
4. Architecture Space: This learning space contains architecture related to specific subjects, allowing learners to visualize objects as close to reality as possible. Examples include the architecture of Wat Mahathat or Wat Chaiwatthanaram in Ayutthaya province.
5. Show Space: This space is intended for displaying the works of students and academics in the Thai MOOC project. Exhibitions are scheduled on a weekly or monthly basis and include art exhibits or exhibitions for both public and private sectors.
6. Joy Space (Café Space): This is a space for knowledge exchange, or a coffee corner, allowing instructors, learners, and general users to converse and share their experiences in learning on the ThaiMOOC platform. It also provides advice on career development, further studies, credit transfers, and applying acquired knowledge in daily life. This space is divided into smaller rooms, with five rooms accommodating up to 6 people and another five rooms accommodating 7 to 10 people.

Figure 2: The Six Types of Space Arrangements Within the Metaverse to Promote Collaborative Learning on the Thai MOOC Platform

Subsequently, the author conducted brainstorming sessions with nine experts in instructional design, metaverse applications, and content development regarding the "Model of Learning in the Metaverse" to promote collaborative learning on the Thai MOOC platform. The findings were categorized into three main points: 1) Components of the Metaverse, 2) Learning Process in the Metaverse, and 3) Concerns and Recommendations from the Experts.

1. Components of the Metaverse
    1) User Access to the Metaverse: Accessibility for users to enter and interact within the metaverse.
    2) Selection of Appropriate Platforms and Technology: Choosing suitable platforms and technologies for effective learning.
    3) Learner Motivation and Readiness: Learners are motivated, specific in their interest to learn, and have readiness in terms of accessibility.

4) Content and Subject Matter: Content should focus on subjects that have an impact on society and can expand collective knowledge.
5) Preparing Learners and Personnel: Prepare instructional designers and other personnel to support and expand learning through the ThaiMOOC platform. Most learners have some online learning experience, but preparation is needed for those new to the ThaiMOOC platform.
6) Instructor Assessment Skills: Instructors must have the skills to assess collaborative learning and teamwork among learners, designing evaluation processes to be conducted online. In some cases, practical assessments may need to be separated and conducted in a blended manner.
7) Adjust Visual and Language Elements: Remove arrows pointing to different components, and adjust symbols and icons to better align with the content, such as instructional strategies, tasks, and their implementation.
8) Task Assignments and Scheduling: Include a schedule of activities, duration of system use, and both synchronous and asynchronous collaboration formats.
9) Using Media and Technology for Collaboration: Use media and technology to support learners in working together, ensuring effective connectivity between technologies.
10) Implementing DNA (Device, Network, Application): Design the platform using DNA (Device, Network, Application) to ensure users are fully prepared and can access and use the platform seamlessly.
11) Use of Coins or Tokens for Rewards: Implementing a system of coins, tokens, or points as rewards for completing activities to motivate learners.
12) User-Friendly System Design: Design the system, content, and navigation so that users can easily access and use the system without confusion or losing their way.

2. Learning Process in the Metaverse
1) Orientation, Guidance, Preparation: Design effective orientations, guidance, preparation, immersion, and familiarization processes.
2) Readiness for Learning: Prepare learners with suitable equipment and ensure accessibility for learning.
3) Enhancing Learning Spaces: Adjust different learning spaces to create a more defined learning environment and set clear tasks with distinct starting and ending points that align with the various spaces.
4) Add English Terms in Processes: Include English terms in the learning process, such as "Formative Assessment" and "Summative Assessment," with additional explanations.
5) Examples of Reflective Practices: Provide examples of different ways to reflect on learning.

3. Concerns and Recommendations From Experts
1) Promote Events and Environment Design: Encourage the creation of events, such as simulations and learning activities with famous figures or influencers, to make the metaverse an integral part of users' lives. Design environments that make the metaverse feel like another social space that users interact with daily.
2) Platform Investment and Development: Consider why learners would want to spend time together on the platform, potentially including notification systems, creative outputs, and synchronized simulations. Setting shared tasks for target groups will be a key factor in ensuring the successful development of the metaverse.

3) Examples from Thai Studies: For a subject like Thai Studies, creating a metaverse where actors, influencers, or experts teach history, architecture, and art could increase interest in the metaverse.
4) Support and Funding from Universities: Support from universities through funding and promotion can help make the metaverse known, engaging, and foster greater interest, leading to increased participation and awareness.
5) Creating an Engaging Metaverse: Develop the metaverse to be beneficial and interesting to users, which will be another factor that promotes the effective use of the metaverse as part of the learning process.
6) Balanced Use of the Metaverse: Experts recommend that the use of the metaverse should be balanced. Excessive time spent by learners in the metaverse could have negative long-term effects on their well-being.

Based on the information provided, the author proposed a model of learning in the metaverse to promote collaborative learning on the Thai MOOC platform. This model includes components of the metaverse and the learning process within the metaverse, as detailed below.

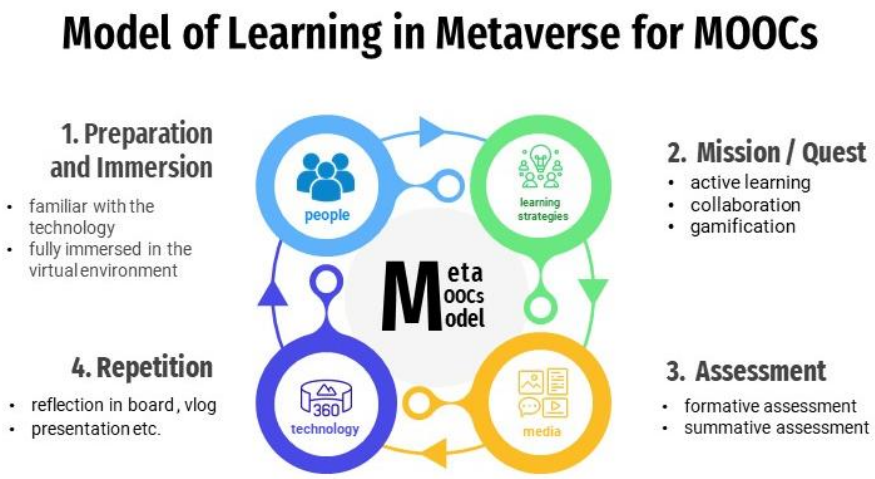

Figure 3: Model of Learning in Metaverse for MOOCs

Components of the Metaverse to Promote Collaborative Learning on the Thai MOOC Platform. The components of the metaverse include: 1) People, 2) Learning Strategies, 3) Media, and 4) Technology.

1. People: This includes instructors, instructional designers, learners, system administrators, system developers, and technical support personnel, all of whom need to be equipped with the necessary hardware and software to utilize metaverse technology effectively.
    1.1 Instructor: Responsible for delivering knowledge and experiences through various media, providing guidance, consulting, and assessing learners.
    1.2 Instructional Designer: Responsible for designing learning activities and creating an environment that facilitates learning.
    1.3 Learner: Learners must be prepared to access the internet and use metaverse technology to complete learning missions/quests, undergo assessment, and apply their knowledge through reflection.
    1.4 Administrator: Responsible for managing servers and ensuring the metaverse operates smoothly.

1.5 Developer: Develops learning environments in the metaverse and various media as defined and designed by instructors and instructional designers.
1.6 Technician Support: Provides guidance and support to personnel in using the technology.

2. Learning Strategies: These are methods and processes used to effectively manage learning through various instructional techniques. Learners can self-direct their learning, with instructors or instructional designers creating and facilitating learning activities that respond to different instructional formats—online, blended, and supplementary. Appropriate teaching methods and techniques are applied, such as Active Learning, Collaborative Learning, Gamification, Role-playing, and Simulation.
3. Media: The means used to convey content, information, knowledge, experiences, and messages from the instructor to the learner, enabling learning through various forms of media such as text, still images, animations, video clips, sound, multimedia, 360-degree images, 3D media or learning models, Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and Extended Reality (XR).
4. Technology: Refers to tools that support instructional management, communication, learning management systems, and learning assessment. Examples include virtual classrooms or learning environments, social and collaborative tools to promote teamwork, social media like Facebook, Twitter, and LinkedIn, project management tools like Trello, Asana, and Basecamp, video conferencing platforms like Zoom, Meet, and Teams, and cloud file-sharing services like Dropbox, Google Drive, and OneDrive.

Learning Process in the Metaverse to Promote Collaborative Learning on the Thai MOOC Platform. The learning process in the metaverse consists of four steps: 1) Preparation and Immersion, 2) Mission/Quest, 3) Assessment, and 4) Repetition/Reflection. Each step is detailed as follows:

1. Preparation and Immersion: Learners should familiarize themselves with the technology and interfaces before entering the metaverse. This allows them to fully immerse themselves in the virtual environment to gain the maximum benefit from the metaverse experience.
2. Mission/Quest: Refers to tasks assigned to learners that must be completed to achieve goals within the virtual environment. These missions are designed to encourage learner participation and interaction, reflecting different scenarios. Missions play a key role in developing learners' knowledge and skills, often used in conjunction with instructional strategies like Active Learning, Collaborative Learning, and Gamification. Learners complete missions within the virtual spaces where instructors have designed the learning activities.
3. Assessment: Assessment should align with the learning objectives of the learners. It is divided into Formative Assessment—used to provide feedback, support, and opportunities for learners to review and make improvements—and Summative Assessment, which is conducted at the end of the learning process to evaluate knowledge and skills. Instructors can use technology to support assessment, such as automated grading, real-time interaction, and feedback for learners.
4. Repetition/Reflection: Learners review and reflect on their learning, expressing their understanding through various formats like journal entries, blogs, infographics, video vlogs, or other presentation formats. They can share and communicate their experiences through different forms of media.

Results and Discussion

Subsequently, the researcher presented The Learning Model in the Metaverse for Promoting Collaborative Learning on the Thai MOOC Platform to experts for evaluation. The results of the evaluation are shown in Table 2.

Table 2: Evaluation of the Learning Model in the Metaverse for Collaborative Learning on the Thai MOOC Platform

Evaluation Items	Mean	SD	Appropriateness Level
Components of the Metaverse			
1) People	4.57	0.53	very high
2) Learning Strategies	4.43	0.79	high
3) Media	4.71	0.49	very high
4) Technology	4.57	0.53	very high
Average	4.57	0.49	very high
The learning process			
1) Preparation and Immersion	4.57	0.53	very high
2) Mission / Quest	4.57	0.53	very high
3) Assessment	4.57	0.53	very high
4) Repetition/Reflection	4.57	0.79	very high
Average	4.57	0.51	very high
Overall Average	**4.43**	**0.53**	high

The overall evaluation of the learning model in the metaverse to promote collaborative learning on the Thai MOOC platform found that it was appropriate at a high level, with a mean of 4.43 and a standard deviation of 0.53. The average ratings for the components of the metaverse and the learning process in the metaverse were rated as very high, both with a mean of 4.57 and standard deviations of 0.49 and 0.51, respectively.

In considering the components of the metaverse, the media component was rated the highest in appropriateness, with a mean of 4.71 and a standard deviation of 0.49, indicating a very high level of appropriateness. This was followed by the People and technology components, both rated equally at a very high level, with a mean of 4.57 and a standard deviation of 0.53.

Regarding the learning process in the metaverse, all steps—including Preparation and Immersion, Mission/Quest, and Assessment—were rated equally at a very high level, with a mean of 4.57 and a standard deviation of 0.53 for each. The Repetition/Reflection step had a mean of 4.57 with a standard deviation of 0.79, also indicating a very high level of appropriateness.

The feedback from instructional designers highlights the importance of developing interactive and engaging learning spaces within the Metaverse, aligning with research that demonstrates how immersive technologies such as VR and AR can promote collaborative skills through realistic simulated environments (Kim et al., 2022; Hirsh-Pasek et al., 2022). Studies have shown that the Metaverse provides opportunities for learners to practice teamwork and critical thinking in a structured way, making learning experiences more impactful (Jeong et al., 2022). Additionally, researchers emphasize the integration of appropriate assessment tools within the Metaverse to ensure comprehensive evaluation of both knowledge and teamwork skills (Danylec et al., 2022; Pigultong, 2022). This feedback

from instructional designers reflects a future trend in education that leverages virtual technologies to create sustainable learning experiences, in line with the skills required for the 21st century.

Conclusion

This study indicated that the integration of the metaverse into the Thai MOOC platform significantly enhanced collaborative learning in immersive technologies such as VR, AR, and interactive 3D environments. The proposed learning model covered structured stages of preparation and immersion, mission/quest, assessment, and repetition/reflection, highly rated for effectiveness in fostering engagement and teamwork. The six specified virtual spaces further facilitate different learning interactions, from formal instruction to informal discussions and exhibitions. Expert assessments confirm the model's appropriateness, and media provides a much-needed enhancement in learning. However, ensuring accessibility, user engagement strategies, and institutional support guarantees that there are several concerns to be faced before its long-term success is ensured. This study, in the end, epitomizes the dimensions of metaverse that could revolutionize online education by making learning dynamic, collaborative, and adaptive to 21st-century digital advancement.

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The Experiences of Classmates Surrounding Incidents of 'Vomiting' in Schools: An Investigation Using Scenario-Based Retrospective Among University Students

Maho Komura, Gifu University, Japan
Takashi Sano, Chukyo University, Japan
Mako Momoda, Hyogo Institute for Traumatic Stress, Japan

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Abstract
In school life, the majority of classroom and other group activities take place. When an injury or illness occurs, it is necessary to give guidance and consideration not only to the injured or ill, but also to students other than the injured or ill. The purpose of this study is to focus on the frequent occurrence of vomiting at school and to determine how classmates other than the student who vomited might feel and attempt to act. A questionnaire survey of 246 university students was conducted on a fictitious case using the recall method. Most elementary school students were averse to vomiting and often left the scene, whereas middle school students tended to express concern for the vomiting student and actively try to assist him or her. The emotions and behaviors toward injury and illness differed between elementary school students and junior high school students. It was suggested that appropriate instruction differed depending on the development of the student. Appropriate guidance should be considered for each of these differences.

Keywords: Injury or Illness Occurs, Vomiting, Classmates' Perceptions, Instructional Considerations

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Introduction

School life and educational activities, where children learn and experience, are based on a safe and secure environment (Ministry of Education, Culture, Sports, Science and Technology, 2019). One of the most important areas of school health and safety is response to injuries and illnesses during school educational activities. In the event of an injury or illness at school, each school prepares a crisis management manual and conducts training and drills with the aim of ensuring a smooth and appropriate response by teachers and staff in the event of a hazard under school management. In preparing the manuals, schools are required to specifically consider crisis management responses in three stages (before, during, and after the crisis) according to the school's actual situation, based on materials such as "School Crisis Management Manual Preparation Guide" (Ministry of Education, Culture, Sports, Science and Technology, 2018) and "Safety Education at Schools to Foster 'Ability to Live'" published by the Ministry of Education, Culture, Sports, Science, and Technology (Ministry of Education, Culture, Sports, Science and Technology, 2019). We believe that clearly stating the points to keep in mind and their specific contents will lead to useful guidelines in all educational settings throughout the country. In particular, detailed procedures for the disposal of vomit and soiled materials are provided for teachers to follow in order to prevent infectious diseases (DICT Logistical Support Team, Japanese Society of Environmental Infection Control, 2024. In fact, a case of norovirus gastroenteritis has been reported, in which vomitus was considered to be the source of infection, and appropriate treatment is required (Kimura et al., 2012; Shinkawa et al., 2004).

The Importance of Guidance and Special Considerations for Classmates When an Injury or Illness Occurs

However, the majority of classroom and other group activities in a school setting require guidance and special considerations: both the affected in cases of illness and injury, as well as other students.

It is noted that the main motivation for injured children to return to school is to be reunited with friends (Jones et al., 2022). A major injury or illness at school (e.g., vomiting) may be a negative experience for the injured or ill person that attracts the attention of others, and anxiety about negative feelings from friends may be considered. Therefore, it is necessary to provide appropriate guidance to classmates so that the injured child can return to the group without resistance.

Thus, in the event of an injury or illness, teachers do not only deal with the injured or ill child themselves, but they must also make special consideration toward the psychological burden on other students. Existing manuals for dealing with injuries and illnesses include items such as "first aid for the injured and illness" and "cooperation between teaching staff and medical institutions" as well as "response for other students." However, the guidance and special consideration to be provided to other students and how to proceed in dealing with them are currently left to the discretion of each teacher as tacit knowledge. When considering classroom management and psychological care for students after the occurrence of an injury or illness, clarification of the points and specific details of guidance and special consideration for students other than the injured or ill student is important. Considering that injuries and illnesses during group activities can occur in any area or school, guidance and special consideration for students other than those who are injured or ill at the time of an injury or illness is an essential perspective.

Therefore, the guidance and special consideration for students other than those who are injured or illness needs sufficient clarification, including in manuals and reference materials prepared to guide it. It is noted that an interview survey of school nurse teachers analyzed elementary and junior high school students' expressions regarding their own complaints of injury and illness (Kamezaki & Ogitsu, 2018). They noted that expressions regarding injury and illness differed between elementary and junior high school students, and that the responses of school nurse teachers were characterized differently depending on school level. Specifically, elementary school nurse teachers responded in a manner that elicited the children's understanding, while the junior high school nurse teachers made the students think and elicited understanding and coping methods for the symptoms and other problems (Kamezaki & Ogitsu, 2018). Thus, the guidance required of teachers will conceivably differ depending on how students perceive the injury or illness. Therefore, clarifying how students feel and try to act in situations where injuries or illnesses of classmates occur during group activities is necessary to consider the appropriate guidance and special consideration to provide.

Purpose of This Study

Based on the above, this study conducted two major surveys among college students. The primary focus was on the second survey, in which participants were presented with hypothetical scenarios of injuries and illnesses that could occur in school settings. They were asked to respond to these scenarios as if they were elementary or junior high school students. The first survey, which was supplementary, asked students about injuries and illnesses they had experienced during group activities in elementary and junior high school. Both surveys relied on the university students' recollections. Although it would be preferable to ask elementary and junior high school students, asking them about their experiences directly related to their current school life would be psychologically burdensome. Despite its limitations, advantages to targeting college students exist. For instance, the large number of subjects is suitable for analyzing general trends, and university students who have been out of compulsory education for several years can look back on their elementary and junior high school days calmly and are likely to be able to objectively evaluate the situation at that time (Watanabe, 2010). Therefore, this study conducts a survey of university students and exploratively examines the feelings and behaviors of students during the occurrence of injuries and illnesses in group situations.

Methods

Preliminary Investigation

A total of five elementary school teachers were interviewed for the purpose of creating a fictitious case study of possible injuries and illnesses in a school setting. The questionnaire for this survey was developed by collecting examples of guidance and special consideration for students other than the injured or ill student at the time of the injury or illness.

Main Fieldwork

Participants

A total of 342 university students from two universities in the Tokai region of Japan were the study surveyed. A total of 246 valid responses were received, with a mean age of 20.3 years. In July 2023, a request for survey cooperation was made in a class taught by the second author. The survey was conducted using a Google Forms questionnaire, which was completed in the form of a web-based response.

Measures

(1) Basic Attributes
Respondents were asked for gender and age as basic attributes.

(2) Experience in Injury/Illness Outbreak Scenarios
Respondents were asked whether they had experienced any outbreaks of injuries or illnesses experienced in elementary or junior high school settings.

(3) Virtual Casualty Occurrence Scenarios
We set up hypothetical situations of commonly occurring injuries and illnesses in a school setting, referring to a preliminary survey. Specifically, we made the following statement: “You are a classmate of A in the second grade of elementary school. One day, while listening to the teacher in class, A vomited.” “You are a classmate of C in the eighth grade in middle school. One day, while listening to the teacher in class, C vomited.” “You are a classmate of B in the sixth grade of elementary school. One day, while listening to the teacher in class B wet himself.” The respondents were asked to respond by writing freely about how they felt and what actions they thought they would take in response to the event. This paper analyzes the results of a hypothetical injury/illness occurrence scene task for vomiting scenes (A and C).

Data Analysis

The data from free descriptions were categorized using the categorization technique based on the KJ method (Kawakita, 1967) with public health nurses, who were both involved in this study as practitioners. The KJ method is a categorization technique devised by Jiro Kawakita, which aims to discover how meaningful connections can be made from heterogeneous data, or to generate new ideas. Labels with similar content in participants’ free-text responses were grouped into small groups to generate subcategories (Kawakita, 2017).

Human Subjects Approval Statement

Approval was granted by "the Ethical Review of Research Involving Human Subjects" by the Ethical Review Committee of the Graduate School of Sport Sciences of Chukyo University. (No.: 2023-009).

Results

1) Elementary School, Case of Vomiting

About "How do you feel"?

First, free-text responses to the question "How do you feel?" were labeled, resulting in 261 labels. The classification of these 261 labels using the aforementioned analysis method is summarized in Table 4. As shown in Table 3, a total of 21 minor, 10 medium, and four large groups were extracted. Of the 261 labels, 255 were classified into these groups, while the remaining six were deemed unclassifiable. Next, the results of our analysis for each large group are outlined in Table 4. Minor, medium, and large groups are denoted by {}, <>, and [], respectively.

Table 1: Elementary School Vomiting Scene (feeling)

large groups	medium groups	Minor groups	Total(n)	(%)
[Negative]	<Disgust>	{Unpleasant}	24	(9.4)
		{Dirty, disgusting}	56	(22.0)
		{Disdain}	2	(0.8)
	<Fear and Anxiety>	{Anxiety, fear, and confusion}	8	(3.1)
		{Complaints of poor physical condition}	25	(9.8)
	<Uncomfortable>	{Awkward/Embarrassing}	5	(2.0)
		{Increase psychological distance}	6	(2.4)
		{Wanting to leave, Not wanting to see}	9	(3.5)
[Empathy and Assistance-oriented]	<Compassion>	{Assistance-oriented}	3	(1.2)
		{Concern}	46	(18.0)
	<Empathy/Sympathy>	{Sympathy/Compassion}	8	(3.1)
[Others]	<Interesting>	{Interesting}	2	(0.8)
	<Surprise>	{Surprise}	41	(16.1)
	<Doubt>	{Doubt}	4	(1.6)
	<Nothing in Particular>	{Description of facts}	2	(0.8)
		{Nothing in particular}	1	(0.4)
[Ambivalence]	<Ambivalence>	{Concern, Wanting to leave}	1	(0.4)
		{Concern, Dirty}	7	(2.7)
		{Concern, fear}	2	(0.8)
		{Concern, Compassion}	2	(0.8)
		{Concern, Feeling sick yourself}	1	(0.4)

About "What behavior do you feel like engaging in"?

Next, free-text responses to the question "What behavior do you feel like engaging in?" were labeled, resulting in 261 labels. The classification of 247 of these labels, based on the aforementioned analysis method, is summarized in Table 4. We extracted 22 minor groups, 14 medium groups, and five major groups. All 247 labels were classified into these groups, with none deemed unclassifiable. Minor, medium, and large groups are denoted by {}, <>, and [], respectively.

Table 2: Elementary School Vomiting Scene (behavior)

large groups	medium groups	Minor groups	Total(n)	(%)
[Assistance behavior]	<Concern and Cuddling>	{Approaching and Concern}	13	(5.3)
	<Requests to teachers, etc.>	{Calling teachers and friends}	33	(13.3)
		{Following teachers' instructions}	21	(8.5)
	<Coping Behavior>	{Helping with cleaning, etc.}	13	(5.3)
		{Accompanying to the nurse's office, etc.}	2	(0.8)
		{Instructing classmates}	1	(0.4)
[Don't Get Involved]	<Looking on>	{Watch and do nothing}	17	(6.9)
		{Watch from afar}	5	(2.0)
		{Wait and stay restrained}	6	(2.4)
		{Can't do anything}	19	(6.5)
	<Physical avoidance>	{Leaving}	84	(34.0)
		{Not looking}	12	(4.9)
	Psychological avoidance	{Increase psychological distance}	2	(0.8)
Actions that could Negatively Impact Others	<Teasing>	{Being noisy}	6	(2.4)
		{Laughing}	2	(0.8)
	<Expressing Dislike>	{Expressing Dislike}	1	(0.4)
	<Ambivalent Behavior>	{Concern and Teasing}	1	(0.4)
[Impact on Self]	<Own Physical Condition>	{Impact on Own Physical Condition}	2	(0.8)
	<Crying, Confusion>	{Crying, Confusion}	2	(0.8)
[Others]	<Verification>	{Aware of Situation}	3	(1.2)
	<Talking with Friends>	{Talking with Friends}	1	(0.4)
	<Washing Hands>	{Washing Hands}	1	(0.4)

2) Junior High School, Case of Vomiting

About "How do you feel"?

We labeled the free-response statements to the question "Huw do you feel?" and created 244 labels. The results of the classification of the 244 labels according to the aforementioned analysis method are reported in Table 6; 18 minor, 10 medium, and four large groups were extracted. A total of 241 labels belonged to these groups, and the remaining three labels were deemed unclassifiable. Minor, medium, and large groups are denoted by {}, <>, and [], respectively.

Table 3: Junior High School Vomiting Scene (feeling)

large groups	medium groups	Minor groups	Total(n)	(%)
[Negative Emotion]	<Disgust>	{Disgusting/smelly}	12	(5.0)
		{Annoying}	3	(1.2)
	<Anxiety>	{Anxiety}	2	(0.8)
		{Anxiety about infectious diseases}	3	(1.2)
		{Complaints of poor physical health}	6	(2.5)
	<Uncomfortable>	{Confused}	4	(1.6)
		{Increase psychological distance}	2	(0.8)
		{Embarrassed}	2	(0.8)
[Empathy and Assistance-oriented]	<Compassion>	{Assistance-oriented}	10	(4.1)
	<Concern>	{Attending to feelings}	5	(2.0)
		{Concern}	137	(56.7)
		{Imagining reasons for vomiting}	10	(4.1)
	<Regret>	{Wish I had noticed the illness}	1	(0.4)
	<Empathy>	{I think it can't be helped}	4	(1.6)
		{Empathy}	8	(3.3)
[Others]	<Surprise>	{Surprise}	20	(8.2)
	<Indifference>	{Don't worry/Thinking nothing of it}	8	(3.3)
[Ambivalence]	<Ambivalent>	{Disgust and concern}	4	(1.6)

About "What behavior do you feel like engaging in"?

Next, free-text responses to the question, "What behavior do you feel like engaging in?" were labeled, which resulted in 267 labels. The results of the classification of the 267 labels according to the aforementioned analysis method are reported in Table 7; a total of 24 minor, 13 medium, and five large groups were extracted. A total of 264 labels belonged to these groups, and the remaining three labels were deemed unclassifiable. Minor, medium, and large groups are denoted by {}, <>, and [], respectively.

Table 4: Junior High School Vomiting Scene (behavior)

large groups	medium groups	Minor groups	Total(n)	(%)
[Assistance behavior]	<Concern and Cuddling>	{Concern}	24	(9.0)
		{Specific behaviors related to the person}	10	(37.9)
	<Requests to the teacher>	{Calling the teacher}	71	(26.9)
		{Following the teacher's instructions}	21	(8.0)
	<Coping behavior>	{cleaning/tidying up}	59	(22.3)
		{accompanying to the nurse's office, etc.}	19	(7.2)
		{instructing students around them}	3	(1.1)
	<Post-lesson involvement>	{teaching the lesson}	1	(0.4)
		{talking to the students afterwards}	1	(0.4)
	<Conflicted>	{Want to escape but help}	1	(0.4)
	<Lie>	[Pretend to help]	1	(0.4)
[Don't Get Involved]	<Looking On>	{Watch from afar}	5	(1.9)
		{Do nothing}	12	(4.5)
		{Can't do anything}	3	(1.1)
	<Avoidance>	{Not looking}	2	(0.8)
		{Leaving}	21	(8.0)
		{Increase psychological distance}	1	(0.4)
	<Inattention>	{Not caring}	1	(0.4)
		{Referring to actions they should take}	1	(0.4)
[Actions that could Negatively Impact Others]	<Teasing>	{Tease}	1	(0.4)
	<Spreading Information>	{Communicating to Third Parties}	1	(0.4)
[Impact on Self]	<Own Physical Condition>	{Negative impact on own physical condition}	1	(0.4)
[Others]	<According to the surrounding situation>	{According to the other students' state}	2	(0.8)
		{According to distance}	2	(0.8)

When we categorized the free responses to the question "How do you feel?", we found that the major response categories were the same for both second-grade elementary school students and second-grade junior high school students: [Negative], [Empathy/Assistance-oriented], [Others], and [Ambivalent]. However, the frequency of responses differed between the two groups. For the elementary school students, the most common category was [Negative], with 135 responses (52.9%), of which 82 (32.1%) indicated "Dislike." In contrast, junior high school students most frequently selected [Empathy/Assistance-oriented], with 175 responses (72.6%), particularly "Worry," which was the most common at 152 responses (63.1%).

Similarly, the major categories for the question “What behavior do you feel like engaging in?” were the same for both groups: [Assistance behavior], [Not getting involved], [Behavior that could negatively influence others], [Influence on self], and [Other]. The elementary school students most often chose [Not getting involved], with 145 responses (58.7%), especially [Physical avoidance], which accounted for 96 responses (39.3%). On the other hand, 211 responses (79.9%) from the junior high school students fell into the [Assistance behavior] category, with [Request to teachers] (92 responses, 34.8%) and [Coping behavior] (81 responses, 30.7%) being particularly frequent.

These findings indicate that the feelings and potential actions of students in situations where injury or illness occurs differ significantly depending on the school level. Specifically, many elementary school students have an aversion to vomiting and often choose to leave the area, while junior high school students are more likely to express concern for students who vomit, actively trying to help them. Additionally, although the number was small, the category of “behavior that may negatively influence others” was present in both elementary and junior high school groups. In the elementary school group, this category included <Teasing>, <Expressing disgust>, and <Ambivalent behavior>, while in the middle school group, it included <Teasing> and <Spreading information>.

Discussion

The purpose of this study was to determine the experiences of non-injured children during an outbreak of vomiting in a group setting, as well as their emotions and behaviors during the outbreak.

Points to Keep in Mind on How to Support Teachers During an Outbreak of Vomiting

We discuss the responses to the hypothetical injury/illness occurrence scenario. The feelings and behaviors of assumed second grade elementary school and second grade junior high school student students were classified partially differently depending on the school type.

Specifically, many elementary school children have an aversion to vomiting and often opt to leave the area. Junior high school students were more likely to express concern for students who vomited, thus indicating that they were more likely to actively try to help students who had vomited. From the above, we believe that, in addition to dealing with the injured or illness person themselves, elementary schools should first provide guidance and support that is attuned to the negative feelings, such as aversion, of the children around them. Furthermore, many of the children were not involved in the behavior, and many tried to leave the scene. If a person chooses not to be involved with an affected child with negative feelings toward them, a risk arises that they may continue to have such negative feelings. While aversion to and anxiety about vomiting are understandable, appropriate guidance and support are needed to prevent surrounding students from feeling aversion to or anxiety about a child who vomits. In junior high schools, guidance and support need to be provided to reassure concerned students by appropriately informing them of the situation of the injured or ill person and the factors that caused the injury or illness, and appropriate responses promoted while respecting the feelings of the students around them who actively try to take supportive actions. In the event of an outbreak of vomiting, the response manual and other manuals state that other students must be removed from the classroom to prevent secondary infections such as infectious gastroenteritis (Sendai City Board of Education, 2013). It is assumed that some students may have difficulty evacuating the room because they are worried about students

who have vomited. We believe that support that leads to psychological reassurance, such as explaining the situation to surrounding students, while respecting the privacy and feelings of the injured or ill person, needs to be provided.

In addition, a few responses from both elementary and junior high schools indicated behaviors that could have a negative impact on others, such as Teasing, which we consider important in considering points to keep in mind when teaching. Igarashi (2010) reports that a student who has difficulty controlling urination due to a congenital disease had to defecate in class, after which some other students expressed attitudes and comments that could be construed as name-calling and bullying (Igarashi, 2010). Whether an injury or illness experience becomes a negative experience or a funny story in adulthood depends largely on the relationship between teachers and children (Fukuda et al., 2022). It is important for teachers not only to respond to the occurrence of an injury or illness, but also to continue to provide guidance after the event, taking great care not to cause inappropriate language or behavior in the surrounding children.

Limitation

This study has the following limitations. First, this study was based on the analysis of college students' recollections. Therefore, the feelings and possible actions of elementary and junior high school students may differ from those of actual elementary and junior high school students in situations where injuries and illnesses occur. For example, in junior high school students, whether they engage in prosocial behavior is determined based on their relationship with others (Nishimura et al., 2018). Therefore, the results of this questionnaire survey may differ from what students actually say and do in actual junior high school situations. In the future, elementary and junior high school students themselves and their teachers should be surveyed, and the actual situation scrutinized using various research methods such as observation and interview survey. In addition, when considering instructional responses to students other than those who are injured or ill, it is important to take individual circumstances and the reality of the classroom into account as part of classroom management and student guidance. In actual educational practice, various other factors such as the relationships between teachers and students, friendships, and classroom climate are also involved in complex ways. A survey encompassing diverse perspectives is desirable in the future.

Conclusions

From the results of the virtual scene, the emotions and behaviors toward injury and illness differed between elementary school students and junior high school students. It was suggested that appropriate instruction differed depending on the development of the student. Most elementary school students were reluctant to vomit and often left the scene. On the other hand, middle school students were more concerned about students who vomited and tended to actively try to help students who had vomited. Appropriate guidance should be considered for each of these differences.

It is important to understand the feelings that classmates feel in injury/illness outbreak situations and to provide appropriate guidance to avoid negative feelings toward the injured person.

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Contact email: komura.maho@gmail.com

The Value of Cross-Cultural Design Learning on Interior Design Education

July Hidayat, University of Pelita Harapan, Indonesia
Bambang Tutuka Adi Nugroho, University of Pelita Harapan, Indonesia

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Official Conference Proceedings

Abstract
Globalization and cross-country migration due to education, work, and tourism have increased cross-cultural interactions between various countries. These cross-cultural interactions occasionally create diaspora communities of families from countries with different cultural backgrounds. Advances in transportation, information, and communication technology also make it easier for people from different cultural backgrounds to interact with each other. Facing this situation, education in design colleges needs to equip students to meet the needs of user groups from different cultural backgrounds through cross-cultural design. This study aims to understand the value of cross-cultural design learning. This study uses a case study research method. The case study is about ten cross-cultural interior designs belonging to mixed Japanese and Chinese families, which ten students designed. The things analyzed are (1) how to dialogue differences between Japanese and Chinese cultures, (2) how to represent the dialogue between the two cultures in a hybrid design, and (3) the values learned from the resulting hybrid designs. The results of creating hybrid designs are lessons on thinking in a middle way, having an open attitude, tolerance, respect, and prioritizing dialogue between cultural differences.

Keywords: Value, Cross-Cultural, Design, Education

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Introduction

The background of the study consists of national and international conditions. Indonesia has a national condition as an archipelagic country with 17,508 islands (Law Number 6 of 1996 concerning Indonesian Waters). It encompasses 1.340 ethnic groups (Central Statistical Agency Census, 2010), which makes Indonesian society a pluralistic society that lives with cultural differences. In terms of international conditions, Indonesia displays advances in transportation, communication, and information technology so that people from different countries and nations in various corners of the world can interact with each other and migrate for work, education, or social interaction. Jakarta, the capital city of the Republic of Indonesia, is a cultural "melting pot" where Indonesian citizens from various ethnic groups and foreign citizens from various countries and nations interact and influence each other with different cultural backgrounds.

This cross-cultural interaction sometimes results in marriages and families with different cultural backgrounds. In this case, art education, including design education, must educate prospective designers to be aware of and appreciate differences. Cross-cultural interactions and activities that influence each other intensively between different cultures can produce new cultures that are mixed and hybrid. Furthermore, design education, in this case, interior design education, must educate students to be creative in producing hybrid design innovations due to cultural dialogues that vary from the backgrounds of the occupants of the living space. This study aims to (1) study the value of cross-cultural design in general and cross-cultural interior design of living spaces, specifically, and (2) teach these values to students taking design education in general and interior design education in particular.

The research uses a case study research method, and the analysis variables are derived from the experiential learning theory. The case study research method can serve the research needs to obtain specific knowledge, namely the value of cross-cultural interior design education seen from a specific context. In addition, it also provides the ability to capture the reality of the learning process of value systems derived from cross-cultural design education in the Department of Interior Design at the University of Pelita Harapan.

Cross-cultural design education uses an experiential learning approach that provides design experience with real clients, aiming to provide students with a simulation of the complexity of problems and the actual process of designing living spaces when dealing with family clients from different cultural backgrounds, where students must unite the differences in views, opinions, preferences and needs of clients. The case study is a lesson in interior design of a living space from a cross-cultural family consisting of a Japanese husband and a Chinese wife living in Jakarta. The group consisted of ten students aspiring to be prospective home interior designers. The problems to be answered are (1) how to dialogue Japanese and Chinese cultures into a cross-cultural system that is the background of the design of a Japanese-Chinese family home, (2) how to represent the results of this dialogue into a cross-cultural design that is mixed and hybrid, (3) learning the value of design hybridity, (4) how students can gain life lessons from the value of this cross-cultural design.

Methods

The case study research was preceded by the development of a theory, in this case, the theory of experiential learning, from a social psychologist, David Allen Kolb. The theory of experiential learning (Kolb, 2014) states that effective lessons are obtained from four stages

in the learning process, namely, (a) concrete experience, learning through direct experience; (b) reflective observation: reflecting on experience; (c) abstract conceptualization: learning from experience, (d) active experimentation: testing results or practicing learning outcomes. After developing the theory and obtaining the analysis variables, the next step is to collect case study data using the Korean cultural literature study method and observation and interviews of users from Korean and Japanese cultural backgrounds. The data collected relates to the profile, cultural background, needs, desires, and flow of activity of users. From these data, perceptions of the user's cultural background are produced. Then, the user's cultural background is analyzed to produce programs, concepts, and design implementations. The design results are re-analyzed to reflect the Korean and Japanese cultural values represented by ten design results. The next step is to evaluate ten alternative design solutions created by ten students based on the criteria of fulfilling the needs and representing the identity of Korean and Japanese cultural values. During the design process to evaluation, the values learned by students from cross-cultural design lessons are analyzed, and how they learn them through direct experience designing clients from different cultural backgrounds is studied. The stages of the research are described by the method as follows:

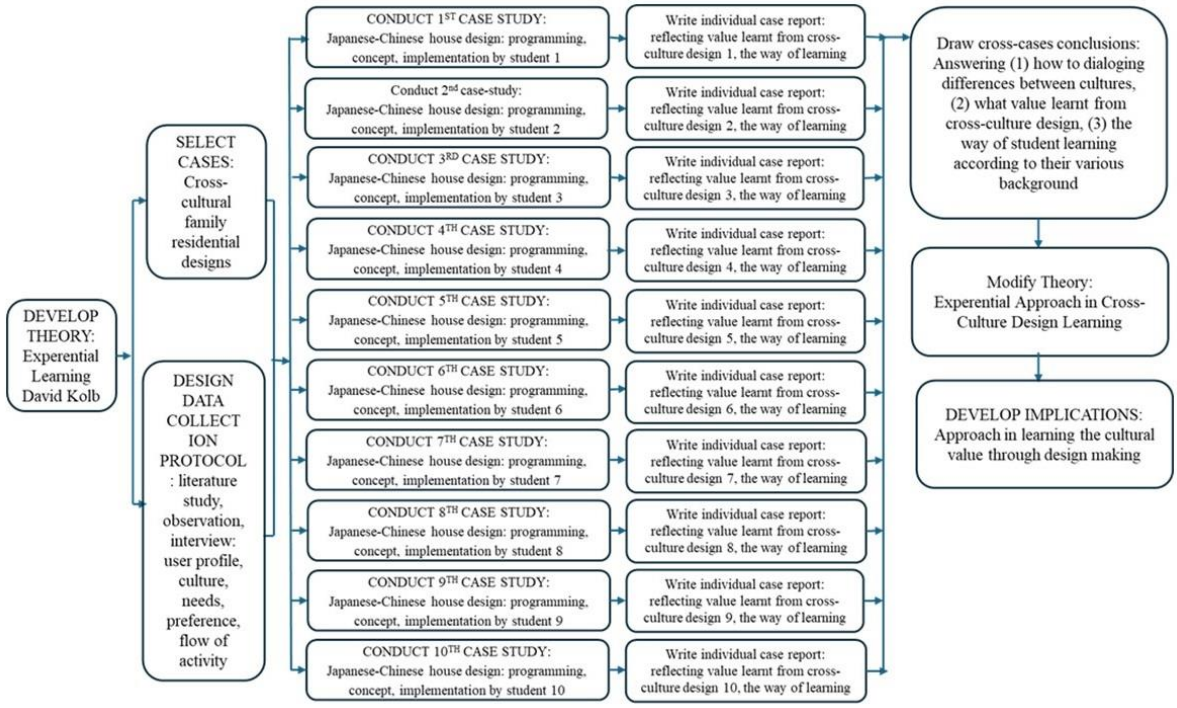

Figure 1: Case Study Research Method
(Adapted From Case-Study Research Model of Robert K. Yin, 2018)

Result

Concrete Experience in Designing Cross-Cultural Residence

Ten students learned to design the interior of a family living space with a Japanese-Chinese cross-cultural background. They conducted interviews, analyzed needs, identified design problems, and created programming, concepts, and design implementation. This design activity resulted in ten interior design cases with a Japanese-Chinese cross-cultural theme. Their designs combined the Japanese aesthetics of wabi-sabi and the Chinese aesthetics of the yin and yang balance duality. From the Japanese aesthetics of wabi-sabi, the value learned is

that beauty comes from simplicity and imperfection. It obtained the value of imperfection by applying natural elements that experience growth and change and asymmetric layout structures. Natural elements are applied, among others, by providing spaces open to the inner courtyard or back garden. When plants in the garden grow from shoots, become significant, but then wither, or from not yet flowering, flowering, then falling, it is a representation of change and, at the same time, imperfection. The beauty from imperfection comes from accepting things or elements that are as they are and run according to the laws of nature. As for the Chinese culture, it brought to light the duality of the balance of yin and yang, where two different or even opposing characters are present together in one space. These two design elements that have different images or design characters or shapes or materials or lighting and colors, when combined harmoniously, actually produce an interesting design and are varied and exciting.

Figure 2: The Study of Implementation of Japanese Aesthetics *Wabi Sabi*
(Source: Meisya Kwee, Residential Interior Design Studio, Interior Design Department, Faculty of Design, UPH, 2024)

In addition to the differences, Japanese and Chinese cultures have similarities in their outlook on life, which is related to naturalism. This view believes that humans are part of nature, so humans must maintain the sustainability of the natural environment and live side by side with nature in a harmonious, balanced sense. In the design of living spaces, intervening spaces between outdoor and indoor spaces and using natural materials are prerequisites for health and physical and psychological comfort. Indoor and/or backyard gardens provide access to natural lighting and ventilation for health and access to views to relieve stress. Using natural materials is non-toxic and provides psychological comfort because it brings humans closer to the texture and color of nature. Through the experience of designing living spaces for real clients with cross-cultural backgrounds, students learn to combine two different cultures, which have values of similarities and differences.

Figure 3: The Study of Implementation of Chinese Aesthetics: The Duality of Yin Yang Balance Concept. (Source: Kathleen Florencia, Residential Interior Design Studio, Interior Design Department, Faculty of Design, UPH, 2024)

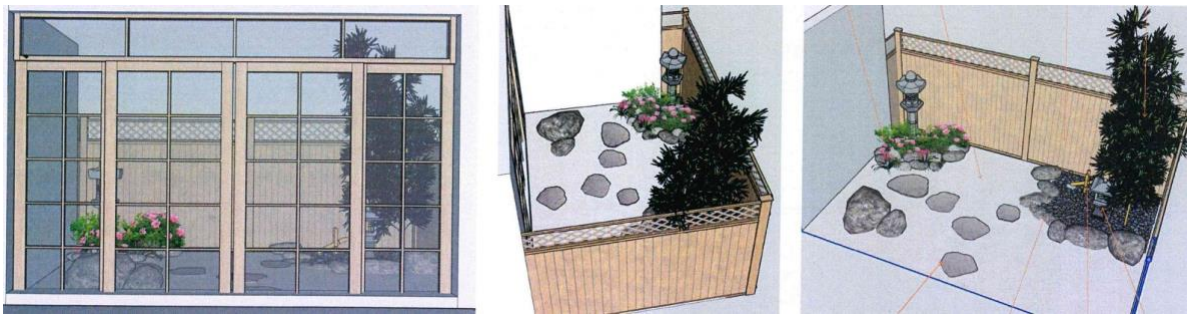

Figure 4: The Study of Implementation of Naturalism Ideology
(Source: Jacqueline Johan, Residential Interior Design Studio, Interior Design Department, Faculty of Design, UPH, 2024)

Reflective Observation

After finishing the design, we interviewed each student about the values they learned during the cross-cultural design. The answers given by the students can be categorized as follows: The value of beauty comes from philosophical thoughts such as naturalism, wabi-sabi, and the duality of yin-yang balance. The value of dialogue between differences: Combining different characters creates an interesting and exciting design. The value of the middle way is that harmony is within reach because the occupants of the living space from different cultural backgrounds do not have or do not maintain extreme cultural characteristics. The husband who has Japanese culture does not demand a solid or thick representation of traditional Japanese cultural identity in the house but is more modern. Likewise, the wife who comes from Chinese culture does not demand a strong representation of traditional Chinese identity in the house's culture, but rather, it is more modern. Because both do not have extreme but moderate characteristics, a middle way can be taken to combine Japanese and Chinese cultural characters. (4) the value of prioritizing similarities over differences: Japanese-Chinese cross-cultural design can be done by prioritizing the value of similarities between Japanese and Chinese culture, namely implementing the naturalistic outlook on life.

Abstract Conceptualization

After reflecting on the cross-cultural design values, students learn to apply the cross-cultural design learning values. The step taken in this case is to conduct a dialogue between differences by combining Japanese and Chinese cultural values. An example is the value of

simplicity in Japanese interior design, influenced by the characteristics of Chinese design. For example, they use natural colors in the room's general color scheme, where red stands out as an accent. Another example is presenting decorative elements in abstracting plant shapes as decorative wall decorations or paintings or Chinese ornaments and paintings in the tatami room. The tatami room, which is usually simple and uses natural colors, is made more decorative, following the more decorative character of Chinese culture.

Figure 5: Study of Implementation of Dialogue among Differences Between Chinese and Japanese Cultures. (Source: Sharilyn Kambey, Residential Interior Design Studio, Interior Design Department, Faculty of Design, UPH, 2024)

Active Experimentation

Client feedback assesses the student's ability to convey the design concept clearly and whether the design is by the client's initial Terms of Reference (TOR). The terms of reference provided by the client relate to security, safety, physical and psychological comfort, and client needs and preferences.

In addition, because the client is a designer too, the client also assesses the quality of the presentation images provided and whether the design images created follow the design concept expressed, whether the design concept can be put into the design accordingly, and whether the design represents Japanese and Chinese culture.

From this section, students learn to accept confirmation, evaluation, and criticism of users when dialoguing with Japanese and Chinese cultures and combining Japanese and Chinese designs. This section is part of the validity of the research results because it is a phase to evaluate whether the positive values learned when conducting cross-cultural design get positive responses, approval, or support from clients in line with client needs.

Discussion

How to Dialogue Differences Between Japanese and Chinese Cultures

In our attempt to dialogue the Japanese and Chinese cultures, we first discussed Japanese and Chinese cultures by studying the Japanese and Chinese cultural systems. To understand a culture, we must first understand the perspective of that culture. As a culture, Japanese and Chinese cultures have universal elements of culture, such as belief systems, outlook on life, economic systems, technology, society, language, and art.

From these universal elements of culture, we learn the cultural values behind them. For example, from the Japanese cultural outlook on life, we learn the concepts of *wabi-sabi*, *bikan*, *mottainai, taru wo shiru*, flexibility or contextuality of meaning, the concept of ma about the value of empty space and transitional space, and naturalism. Meanwhile, examples of values from Chinese culture are the duality of yin-yang balance, familism, the concept of the middle way *chung-yung* and back to naturalism. After understanding each other's cultural perspectives and aspects of similarities such as naturalism, it is clear that it can be the same starting point for combining Japanese and Chinese cultures. Meanwhile, there are differences because in Japanese culture, there is an appreciation for the value of flexibility, and in Chinese culture, there is the concept of the middle way, *chung-yung*; both cultures have an open attitude towards differences.

The existence of this open attitude towards differences is the entry point for holding a dialogue. Thus, we learn that to dialogue differences, first, there must be an understanding of each other's perspectives, and second, there must be an open attitude towards differences and a willingness to take a middle path or compromise.

Figure 6: The Study of Dialoguing Japanese and Chinese Culture Through Dwelling Design (Source: Jennifer Welly Mulyanto, Residential Interior Design Studio, Interior Design Department, Faculty of Design, UPH, 2024)

The students reinforce this through their opinion that cross-cultural design is a strategy to make the design more interesting rather than simply displaying Japanese culture or Chinese culture. For example, when displaying a design representing Japanese cultural identity, the room appears minimalist through simple shapes, natural materials, and neutral and soft natural colors. However, when this Japanese space is influenced by Chinese cultural elements such as Chinese painting and red color accentuation, the Japanese space that was initially minimalist can appear not monotonous but more exciting and dynamic. The complementary combination of opposing characters, such as soft and natural colors as general or main colors and strong color accents or functional shapes as general or primary shapes and decorative shapes as accentuations, creates balance, or what in Chinese culture is known as the concept of *yin-yang* balance.

How to Represent the Dialogue Between the Two Cultures in a Hybrid Design

Design hybridity is done through adoption, adaptation, and adaptation strategies. Adoption strategy is taking cultural or design elements that already exist, without criticizing, in the sense of simply copying. An example of an adoption strategy in implementing naturalism is

the provision of an inner courtyard surrounded by a building mass to channel natural lighting and ventilation around the space. An adaptation strategy is taking cultural or design elements from the past. However, when applied to a modern interior, the existing elements are adjusted to modern needs and contexts regarding shape, size, material, color, and processing technology. An example of an adaptation strategy in implementing naturalism in interior design is providing a green wall in a room when the occupant has a limited land area to provide an inner courtyard. Adaptation strategy presents design elements or culture from the past in a new way. One example of an accreditation study applied by students to implement naturalism is presenting plants not in physical form but through the abstraction of the organic form of plants.

Figure 7: The Strategy of Implementing Naturalism in Japanese-Chinese Hybrid Design. (Source: Deo Alrego, Meisya Kwee, Sharilyn Kambey, Residential Interior Design Studio, Interior Design Department, Faculty of Design, UPH, 2024)

The Values Learned From the Hybrid Designs

The values learned from the Japanese-Chinese hybrid design are the views and attitudes towards differences, starting from being open to differences, accepting differences, understanding differences, appreciating differences, and dialoguing differences to produce something new. In the context of design lessons, this new thing is creativity and innovation to solve design problems that come from client needs and represent the user's (client's) cross-cultural identity. This also teaches students that design is not just about results, design is not just about the work process, and more than that, design is a value system. Design as a material culture is a medium for communicating or representing the value system in the cultural system that produces it. When creating a design work, designers must understand the cultural system of the user; likewise, when appreciating a design work, designers must use the perspective of the culture where the design was produced.

The Way of Learning the Value is Influenced by the Student's Character and Background

When we interviewed students about the lessons they learned when experiencing the cross-cultural design process, different students had different perspectives or saw different sides. There was a category of students who emphasized the aspect of similarities and saw it as the beginning of opening a dialogue between different cultures. It also turned out that this category of students came from a Chinese cultural background. He felt that the same cultural background between the designer and the client helped the designer to understand the client's needs, for example, in terms of applying feng shui in Chinese culture (one of the clients came from a Chinese cultural background). In this case, the student had the character of someone comfortable when in an environment with the same culture. When faced with differences, he saw the potential for dialogue if the differences were not too extreme or thick. When people from different cultural backgrounds do not defend their differences and are more willing to see similarities, the path to dialogue between differences is more open (more potential for dialogue).

On the other hand, a category of students prioritizes the aspect of difference. This category of students is enthusiastic and likes differences because they consider it a challenge or opportunity to produce something new, unusual, something not often seen or encountered in their surroundings. This category of students sees cross-cultural design as an opportunity to produce interesting and exciting (not monotonous) designs. This is produced by a category of students with a character who likes challenges or unusual or everyday things, the type of person who likes unique and challenging things. We can find another group of students who fit into the category of people who can see the intersection between aspects of similarities and differences. One of the things highlighted by this category is technological developments in the design of living spaces in Japanese and Chinese cultures. Although Japanese and Chinese cultures both develop living space technology, the character behind the technological system being developed has differences.

Japanese culture, in this case, develops living space design technology that still requires residents to work, make an effort, or move. However, the residential technology developed in Chinese culture, such as smart homes, seeks to provide optimal comfort to residents so that residents do not need to do as much as possible. The opinions of this category of students are interesting and still need to be tested in other studies. The areas the students observe are influenced by the areas of interest in their daily lives, such as technological progress. Thus, each student's life values are influenced by their character, personality, way of thinking, cultural background, or things in accordance with personal interests.

Conclusions

The value of cross-cultural design lessons is learning to accept, face, understand, appreciate, and dialogue differences to find new things. A positive attitude to face differences is needed because, amid global social conditions, students who are prospective designers will face clients and colleagues from different cultural backgrounds. The attitude of prioritizing understanding different cultural perspectives to find similarities at an essential level is needed to open dialogue between different cultures. The attitude of seeing differences as challenges and opportunities to present newness is needed in design education because design science aims to find new things that are more creative and innovative to solve complex human needs. Analyzing aspects of similarities and differences in culture helps build awareness that these two aspects are always in cross-cultural interactions. Cultural identity is constructed by the intersection or meeting point between similarities and differences.

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Developing an Online Learning Community Model Using Design Thinking to Create Innovation Among Community Enterprise Entrepreneurs: In-Depth Data Analysis

Thanathnuth Chatpakkarattana, Sukhothai Thammathirat Open University, Thailand
Patthanan Bootchuy, Sukhothai Thammathirat Open University, Thailand

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Abstract
This research article aims to study opinions and conduct an in-depth analysis of community enterprise entrepreneurs and experts regarding developing an online learning community model using design thinking for innovation creation. Data were collected through in-depth interviews using semi-structured interview guides, divided into two sets as follows: 1) Interviews with key informants, totaling 10 individuals, who are community enterprise entrepreneurs in Nonthaburi Province, selected using purposive sampling; and 2) Interviews with 5 experts in various fields, including learning management, educational technology, design thinking, and innovation. The collected data were then analyzed using content analysis, categorized, and presented descriptively. The research findings indicate that an online learning community using design thinking should serve as a space that inspires the creation or innovation of new ideas, facilitated by gathering individuals with shared interests or goals. A critical element is the connection of networks with experts or specialists who can provide advice and share experiences with entrepreneurs, enabling them to develop products that meet customer or market needs. Additionally, creating an online learning community should involve the provision of accessible spaces, employing technologies that entrepreneurs are familiar with or regularly use, to facilitate easy access to information, foster engagement, and provide mutual support within the online community. The components of an online learning community using design thinking for innovation creation for community enterprise entrepreneurs should include individuals, knowledge, technology and communication tools, and activities or assignments to develop innovative outputs.

Keywords: Online Learning Community, Design Thinking, Local Enterprise

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Introduction

According to 2021 statistics on community enterprise registrations in Thailand, a total of 137,764 community enterprises were registered, categorized into two main groups: 121,760 product-manufacturing enterprises and 16,004 service-oriented enterprises (Department of Agricultural Extension, 2021). Among the product-manufacturing enterprises, the three most common types are crop production, livestock production, and food processing and product manufacturing. For the service-oriented enterprises, the three leading types are other services, community savings, and community retail stores, respectively. When compared to the 2020 figures, community enterprises increased by 44,703. This data indicates a continuous growth trend in community enterprises. However, research and literature review reveal that many community enterprise groups face challenges. These challenges often stem from the high degree of similarity among enterprises, leading to intense internal competition and a lack of clear development direction. Moreover, there is an absence of sustained and genuine collaboration and integration among enterprises. The primary issue faced by community enterprises lies in marketing; entrepreneurs tend to adopt a production-led approach rather than a market-led one, often neglecting to study the real market demand—who the consumers are, what type of products they prefer, and where to sell them, among other factors. Additionally, several other critical issues need to be addressed, including accounting and financial systems, product design, production processes, foreign language skills, production costs, and the application of information technology.

Thus, driving innovation within community enterprises necessitates a learning process rooted in "community-based learning management," a vital tool that strengthens community group cohesion through shared learning, experience exchange, and skill and knowledge transfer. Especially in this era of rapid information technology advancement, online learning effectively bridges gaps in location, distance, and time, allowing learners to access knowledge resources anytime, anywhere. This broadens the learning scope beyond traditional classroom settings or face-to-face meetings. Managing learning for communities thus leverages the advantages of online learning, combining them into a process that develops individuals while simultaneously advancing community enterprise operations. This dual approach prepares enterprises to compete domestically and internationally, aligning with the structural shift towards an innovation-driven, value-based economy in line with Thailand's 4.0 model.

Literature Review

An online learning community refers to activities designed to create or simulate a community environment in an online format, fostering communication and knowledge exchange among individuals with shared interests or goals. It emphasizes creating a virtual space where community members can engage in discussions, conversations, and debates on topics of interest, allowing them to analyze and synthesize knowledge derived from research and shared experiences into new insights that align with community needs. This collaborative learning model is built on shared knowledge creation. The components of an online learning community include: 1) the structure of the online learning community, 2) interaction, 3) knowledge exchange, 4) individuals such as facilitators, community members, and experts, 5) technology as the foundation for learning, and 6) a learning management system that organizes the activity framework, learning activities, and assessment of learning outcomes.

Design Thinking is a problem-solving approach aimed at addressing issues or developing new concepts by identifying the most effective and suitable solutions. This process focuses on understanding and empathizing with the target group to create prototypes, test, and refine ideas, ultimately leading to solutions or innovations that meet the defined goals. Design Thinking promotes fresh perspectives on problem-solving and fosters innovation tailored to target groups, encouraging a diversified approach to addressing challenges and tasks. The Design Thinking process comprises five steps: 1) understanding the problem, 2) clearly defining the problem, 3) ideating, 4) prototyping, and 5) testing.

A local enterprise, or community enterprise, is a business formed by a group of community members with shared values, close ties, and a common lifestyle. It aims to produce goods, provide services, or engage in other activities using local materials, resources, and knowledge to generate income for families and the broader community. Local enterprises prioritize self-reliance, aligning with the principles of a sufficiency economy. They can be classified in two ways: by the type of activity, either goods production or services, and by operational or developmental characteristics. Based on operation, local enterprises can be divided into basic community enterprises and advanced community enterprises. By developmental stage, they can be categorized as family-level enterprises or community and network-level enterprises.

Data and Methodology

In-depth interviews were conducted using pre-determined questions to obtain primary data, ensuring accuracy and allowing both interviewer and interviewee to engage in detailed, focused discussions on specific topics. This approach facilitated a controlled setting and mutual understanding, enabling the collection of authentic data to guide the design and development of an online learning community model that applies Design Thinking for innovation among community enterprise entrepreneurs. The methodology is detailed as follows:

> *The research population* includes community enterprise entrepreneurs in a district of Nonthaburi Province, covering six areas: Mueang Nonthaburi, Bang Kruai, Bang Yai, Bang Bua Thong, Sai Noi, and Pak Kret districts. These districts encompass 307 community enterprises with a membership of over 2,149 individuals, including group leaders, vice leaders, committee members, and general members of the community enterprises. (Department of Agricultural Extension, as of May 25, 2021)

Research Sample

1) Key Informants: A total of 10 individuals, comprising group leaders, vice leaders, committee members, and general members of community enterprises, were selected as key informants. These informants were purposively sampled from Nonthaburi-based community enterprises with continuous product or service operations for at least five years. Information on community enterprises was retrieved from the Community Enterprise Information System of the Department of Agricultural Extension (https://smce.doae.go.th/), which provided access to the names, registration codes, addresses, phone numbers, and entrepreneurs' names.
2) Experts: Five experts were purposively selected, including one expert in community-based learning management, two experts in educational technology and communication, one expert in Design Thinking, and one expert in innovation. Each

expert was required to have at least three years of teaching experience and/or experience in publishing books, textbooks, or research relevant to their expertise.

Research Instruments

1) Semi-Structured Interview for Community Enterprise Entrepreneurs: This interview guide, with pre-determined questions, was developed for group leaders, vice leaders, committee members, and general members of community enterprises. The interviews aimed to gather information on: (1) general data and challenges related to innovation creation in community enterprises, (2) learning processes and knowledge-sharing methods, (3) foundational information technology skills, (4) product/service development processes, (5) techniques for differentiating and enhancing products/services, (6) opinions on the online learning community model, and (7) additional comments or suggestions. Interviews were conducted via telephone, with consent obtained to record audio for data analysis and synthesis, which supported the design and development of an online learning community model applying Design Thinking for innovation among community enterprise entrepreneurs.
2) Semi-Structured Interview for Experts: This interview guide included pre-determined questions for gathering information from experts on: (1) general information about the experts, (2) characteristics of an online learning community using Design Thinking, (3) learning techniques and processes to promote innovation creation among community enterprise entrepreneurs, (4) digital technology and tools, (5) components of the online learning community model utilizing Design Thinking for innovation, (6) steps for developing an online learning community model using Design Thinking for innovation among community enterprise entrepreneurs, (7) strategies for the sustainable development of an online learning community applying Design Thinking for innovation, and additional comments or suggestions.

Data Collection and Analysis

Data were collected by accessing the Community Enterprise Information System of the Department of Agricultural Extension (https://smce.doae.go.th/), which provided information on community enterprises' names, registration codes, addresses, phone numbers, and entrepreneurs' names. Telephone calls were then made to arrange interviews with community enterprise entrepreneurs and selected experts. Interview data were subsequently analyzed through content analysis, categorized for relational themes, and presented descriptively.

Results and Conclusion

From the interviews with 10 community enterprise entrepreneurs and five experts, the following conclusions were drawn:

1) Results from Community Enterprise Entrepreneurs: The majority of the interviewed entrepreneurs operate businesses centered on crop production, food processing, and herbal products. Challenges related to innovation include a lack of knowledge about the concepts and processes for creating innovation, as well as insufficient understanding of how to access information sources that could promote new product development. Consequently, the knowledge they seek pertains to agricultural product development, such as shelf-life extension, product processing, and innovative product creation. They expressed a need for learning approaches that involve small-group knowledge-sharing, focusing on discussions of common interests, with expert support

or collaboration from relevant organizations to help develop innovative, value-added products that meet recognized standards. Entrepreneurs prefer using LINE as a communication tool, suggesting that digital technology for building an online learning community should be simple, accessible, and efficient. In terms of product and service development, entrepreneurs need applicable knowledge that allows them to address customer and market demands. They also highlighted the importance of differentiation in product or service design through emphasizing natural ingredients, quality, and safety. The desired model for an online learning community should include groups of community enterprises, experts, technology, knowledge, and support networks. Particularly, they need a platform where they can exchange experiences, share knowledge, and learn from experienced individuals.

2) Results from Experts: Experts indicated that an online learning community using Design Thinking should serve as a space that inspires creativity and innovation for community enterprise entrepreneurs, enabling each individual to play the role of both leader and follower, fostering mutual acceptance of ideas. The community should connect networks of experts and specialists who can advise and share experiences with entrepreneurs. The platform should be accessible and built on familiar systems, allowing seamless engagement. The learning techniques should follow a structured process that is easy to understand and apply, promoting experience-based learning that leads to innovation aligned with customer needs. Digital technology and tools applied within the online community should be user-friendly, easily self-taught, and compatible with both iOS and Android smartphones, potentially using apps, digital platforms, or LINE Official Accounts that support both synchronous and asynchronous communication. The core components of an online learning community model using Design Thinking for innovation include (1) individuals, (2) knowledge, (3) technology and communication tools, and (4) activities. The model's developmental steps consist of six stages: (1) setting shared goals and defining member roles, (2) conducting a SWOT analysis to identify basic community resources, (3) gathering information and brainstorming, (4) studying Design Thinking concepts, (5) creating innovations or prototypes under expert guidance, and (6) testing, presenting, and evaluating results. To ensure sustainability, a support system is essential, allowing members to continually use the developed model. This involves establishing a core group skilled in using technology as an innovation tool or collaborating with local agencies to provide resources and publicize the model for use by other entrepreneurs. For the online learning community model using Design Thinking to effectively benefit entrepreneurs, it is critical to identify the specific challenges of each group, tailor the learning model to match users' needs, and offer periodic support to ensure that the online community meets their requirements optimally.

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Demand Analysis for Developing Decision-Making Skills Among Chinese International Students Using the ChatGPT-Enhanced Decision Tree Learning Model

Yanli Miao, King Mongkut's Institute of Technology Ladkrabang, Thailand
Kanyarat Sriwisathiyakun, King Mongkut's Institute of Technology Ladkrabang, Thailand
Thanin Ratanaolarn, King Mongkut's Institute of Technology Ladkrabang, Thailand

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Abstract
This study evaluates the demand among Chinese international students for using the ChatGPT-enhanced Decision Tree Learning Model to improve decision-making skills. A survey of 101 students revealed key needs in decision analysis, cultural sensitivity, adaptability, and self-confidence. The results show a strong demand for cultural sensitivity training and integrating cultural perspectives, but weaker interest in understanding diverse values. Students showed a lower demand for problem breakdown and tool usage in systematic analysis skills. In adaptability, students focused more on adjusting communication and flexibility in dynamic environments. The greatest need for autonomy and self-confidence was for confidence-building and training for independent decision-making under pressure. Additionally, students expressed strong interest in using AI tools and decision tree frameworks, particularly for solving complex problems and improving decision efficiency. Based on these findings, the study recommends targeted educational approaches: customized cultural sensitivity training, systematic decision analysis tools, integration of AI and decision tree methods, adaptability training, and confidence-building programs. These elements provide valuable insights for developing effective educational methods to help students make better decisions in diverse and dynamic environments.

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Introduction

Chinese international students play an important role in the global education system. When adapting to the complex academic, social, and cultural environments abroad, decision-making skills are crucial. Strong decision-making abilities not only enhance academic performance and career development, improving critical thinking and strategic problem-solving skills (Chang et al., 2020; Plummer et al., 2022), but also strengthen cross-cultural communication and social interactions, supporting the establishment of meaningful relationships and thriving in diverse environments (Shanshan et al., 2023; Xi, 2020). Chinese international students face multiple challenges in decision-making, mainly including cultural conflicts, information overload, and the lack of effective decision-support systems. First, Chinese students come from a collectivist culture, which significantly differs from the individualistic culture of the West. When making decisions, they are often influenced by family expectations and struggle to balance personal needs with family desires (J. Chang et al., 2020). Additionally, these students are faced with an overwhelming amount of information related to academic choices, career planning, and living expenses, leading to decision fatigue (J. Chang et al., 2020; Hari et al., 2023). Furthermore, the existing counseling and advisory systems often fail to provide practical and effective decision-support tools, resulting in a lack of sufficient structural guidance when making important decisions (Ran et al., 2022).

A decision tree is a tool that visualizes decision-making through a tree structure, where nodes represent choices, branches show paths and leaf nodes indicate outcomes (Maimon & Rokach, 2014a; Priyanka & Kumar, 2020). By supporting multi-factor analysis, including academic, economic, and cultural aspects, decision trees help students identify key factors and avoid emotional or externally influenced decisions, thereby enhancing decision transparency and interpretability. They also reduce information overload by breaking down complex decisions and focusing on critical factors. For Chinese international students, facing unique challenges like family expectations and cultural conflicts, decision trees offer a structured solution. While research on decision tree-based support for Chinese students is still emerging, some studies highlight their benefits in education and career planning. However, more research is needed to address the specific cultural, academic, and social adaptation challenges faced by these students (Costa & Pedreira, 2023).

Decision trees have theoretical advantages but present significant limitations in practical applications (Maimon & Rokach, 2014b; Priyanka & Kumar, 2020). They are prone to overfitting, especially with small or noisy datasets, which affects their performance on new data. The simple structure of decision trees also struggles to capture complex nonlinear relationships, making them less effective in dynamic decision contexts like study abroad decisions. Furthermore, decision trees can be biased in imbalanced datasets, favoring larger categories, and their rigid structure lacks flexibility, limiting their adaptability to evolving decision problems.

AI-based tools like ChatGPT can address the limitations of decision trees by reducing overfitting through dynamic adjustments based on user feedback, handling complex nonlinear relationships with deep learning, and offering more flexibility and adaptability in decision support. Unlike decision trees, ChatGPT provides real-time, personalized recommendations and explanations, enhancing interactivity, transparency, and trust, especially for students facing complex decisions.

Decision trees are valuable tools for helping Chinese international students make complex decisions, but they have limitations in handling nonlinear relationships, overfitting, and providing flexible support. As an AI-driven interactive tool, ChatGPT can effectively overcome these shortcomings by offering personalized, precise, and flexible decision support. Future research should explore combining decision trees with intelligent tools like ChatGPT to optimize decision support systems for international students, helping them make more informed choices in the complex context of studying abroad.

Problem Statement

To address the unique challenges faced by Chinese international students in their decision-making processes, it is crucial to understand their specific needs and how technology can support them. By focusing on personalized, flexible decision-making tools, we can better assist them in navigating complex academic, cultural, and personal decisions. In this context, the following questions need to be explored:

1) What are the specific needs of Chinese international students in enhancing their decision-making skills?
2) What key elements should the ChatGPT-enhanced Decision Tree Interactive Learning Model include to effectively meet the needs of Chinese international students?

Literature Review

Demand analysis is a systematic process for evaluating the needs and preferences of a target group, helping to identify the group's characteristics, prioritize needs, and design solutions (Sleezer et al., 2014). Chinese international students face a series of unique challenges while studying abroad, which impact their decision-making abilities. These challenges primarily include language barriers, cultural differences, differences in educational systems, and a lack of emotional regulation skills. Students with weaker language skills often feel insecure in both academic and daily life, which leads to greater caution or hesitation in decision-making, and cultural adaptation issues further limit their ability to make independent decisions (Klein, 2011). The traditional Chinese education model emphasizes memorization and authority, lacking training in independent thinking and decision-making (Liu et al., 2023). When Chinese students encounter Western educational systems, they often rely on external guidance rather than self-analysis, limiting their decision-making independence, while improving emotional regulation and resilience is crucial for enhancing their decision-making skills, as students with strong emotional resilience can remain calm and make rational decisions under academic and life pressures (Bechara, 2000).

The integration of ChatGPT and decision trees demonstrates significant potential in fields such as education, law, and medicine. ChatGPT enhances the decision tree algorithm in complex decision-making processes by providing personalized feedback and decision support through its natural language processing capabilities (Chiesa-Estomba et al., 2024; Hariri, 2024). While decision trees simplify the decision-making process by identifying key factors and optimizing decision paths, ChatGPT boosts decision-makers' sensitivity to outcomes through real-time feedback2025/02/18 13:29. Moreover, ChatGPT's generative capabilities make decision trees more interactive and transparent, helping users avoid emotional biases and external influences, particularly in multi-faceted decision-making scenarios (Guo & Wang, 2024). This combination improves the accuracy and adaptability of decisions, offering new perspectives and applications for decision support systems across various fields.

Methods

This study investigated the learning needs of Southeast Asian Chinese international students. Through questionnaires collected from 101 participants, the study identified key priorities for enhancing decision-making skills and developing a ChatGPT-augmented decision tree learning model.

Participants

This study employed a stratified random sampling method to recruit 101 participants, ensuring diversity in gender, age, academic level, and geographic location. The sample included a balanced gender distribution, with the majority aged 26–35 years, most of whom were master's students in management and STEM fields. Participants were primarily based in Thailand, with additional representation from Malaysia and the Philippines. Regarding familiarity with AI tools, most participants reported being familiar. This diverse sample provides comprehensive support for the research focus.

Participants Information.

Table 1: Participants Information

Category	Subcategory	Frequency	Percentage
Gender	Male	58	57.4
	Female	43	42.6
Age Group	18–25	13	12.9
	26–30	56	55.4
	31	32	31.6
Geographic Location	Thailand	66	65.3
	Malaysia	25	24.8
	Philippines	10	9.9
Academic Level	Undergraduate	13	12.9
	Master's	50	49.5%
	PhD	38	37.6%
Familiarity with AI Tools	Familiar	85	84.2
	Unfamiliar	16	15.8

Instruments

The instrument assesses participants' decision-making skills and learning tools needs, focusing on the integration of AI tools like ChatGPT and decision tree frameworks. It comprises 18 items divided into two dimensions: Decision-Making Skills and Learning Tools Needs. The Decision-Making Skills dimension evaluates cultural sensitivity, systematic analysis, adaptability, and confidence, essential for navigating complex and dynamic scenarios. Sub-dimensions include awareness of cultural diversity, systematic evaluation of options, adaptability to change, and confidence in independent decision-making, each measured with three targeted items. The Learning Tools Needs dimension examines participants' preferences for using AI tools like ChatGPT and decision tree frameworks in decision-making and learning. It evaluates the perceived utility of AI tools for problem-solving and efficiency and the need for decision tree tools to organize information

and access integrated learning resources. The instrument, developed through a comprehensive review of literature and theoretical frameworks, ensures content validity and reliability. Using a 5-point Likert scale, it evaluates decision-making skills and learning tool needs, focusing on cross-cultural and complex problem-solving contexts. Expert reviews, pilot testing, and Cronbach's alpha confirmed its reliability and construct validity. This tool provides actionable insights to guide the development of adaptive, culturally sensitive, AI-integrated learning models for education and professional training.

Data Collection and Analysis

This study distributed questionnaires to Southeast Asian international students through the WeChat-based Wenjuanxing platform, collecting 101 valid responses. The data were automatically processed by Wenjuanxing and manually screened to eliminate invalid responses, ensuring data quality and diversity. Strict adherence to privacy protection principles provided high-quality and reliable data support for the research.

This study employed descriptive statistical analysis to calculate the mean and standard deviation of questionnaire items, assessing participants' need levels and response consistency. Items were categorized based on their mean values into high demand (≥4.0), moderate demand (3.5–4.0), and low demand (<3.5). Trends within and across dimensions (decision-making skills and learning tool needs) were compared, and individual differences were evaluated through standard deviations. This approach identified key needs and weaknesses in areas such as cultural sensitivity, systematic analysis skills, and AI tool utilization, providing quantitative support for optimizing learning models.

Result

Table 2 presents the descriptive statistics of decision-making skills.

Table 2: Descriptive Statistics of Decision-Making Skills

Items	Mean	SD	Level
Decision-making skills			
Cultural Sensitivity			
1. understand the values and behaviors of people from different cultural backgrounds.	3.99	0.6	Moderate
2. I consider the cultural perspectives of others when making decisions.	4.74	0.5	High
3. I want more training or resources on cultural customs and communication styles.	4.45	0.73	High
Systematic Analysis Skills			
4. I evaluate all possible options and outcomes in decision-making.	4.28	0.4	High
5. I break down complex problems into manageable steps.	3.7	0.5	Moderate
6. I need tools like models or frameworks for rational decisions.	3.7	0.56	Moderate

Adaptability and Flexibility			
7. I adjust decision-making methods when conditions change.	3.58	0.62	Moderate
8. I adapt communication and behavior in unfamiliar environments.	4.63	0.85	High
9. Adaptability is important to me in dynamic environments.	4.28	0.44	High
Autonomy and Confidence			
10. I make independent decisions under external pressure.	4.42	0.66	High
11. I am confident in my decisions despite differing opinions.	3.53	0.71	Moderate
12. I want training to boost confidence in decision-making.	4.76	0.33	High
Learning Tools Needs			
AI Tools Utilization			
13. I need AI tools like ChatGPT to solve complex problems.	4.58	0.73	High
14. I am willing to use online platforms to improve AI tool skills.	3.78	0.42	Moderate
15. AI tools can greatly enhance decision-making efficiency.	3.74	0.35	Moderate
Decision Tree Tools and Learning Resources			
16. Decision trees help organize information and select the best options.	3.74	0.96	Moderate
17. I want more resources combining AI and decision-making frameworks.	3.9	0.98	Moderate
18. I need practical cases to learn AI and decision tree tools.	4.18	0.87	High

Participants demonstrated a high overall demand for both decision-making skills and learning tools integration, particularly in incorporating AI tools like ChatGPT and decision tree frameworks. The overall mean for decision-making skills was 4.13 (SD=0.57), reflecting a strong focus on capacity building across various dimensions. Similarly, the mean demand for AI tools and decision tree learning resources was also notable, indicating a clear interest in leveraging advanced tools for problem-solving and decision-making.

Decision-Making Skills

Participants demonstrated varied needs across four dimensions of decision-making skills. Cultural Sensitivity showed a high demand for integrating cultural perspectives (mean 4.74) and training resources (mean 4.45), with a moderate demand for understanding diverse values (mean 3.99). Systematic Analysis Skills prioritized evaluating options (mean 4.28), while breaking down problems and using tools had moderate demand (mean 3.7). Adaptability and Flexibility highlighted adjusting communication in unfamiliar settings (mean 4.63) and adaptability in dynamic contexts (mean 4.28), with less emphasis on decision-making

flexibility (mean 3.58). Autonomy and Confidence ranked highest for confidence-boosting training (mean 4.76) and independent decisions under pressure (mean 4.42), with moderate demand for managing differing opinions (mean 3.53).

AI and Decision Tree Tools

Participants expressed strong interest in integrating AI tools and decision tree frameworks into learning processes. AI Tools Utilization showed high demand for using AI tools like ChatGPT to solve complex problems (mean 4.58), while willingness to use online platforms (mean 3.78) and recognition of AI's efficiency potential (mean 3.74) were moderately rated. For Decision Tree Tools and Learning Resources, practical cases combining AI and decision trees (mean 4.18) and AI-integrated decision-making frameworks (mean 3.9) were prioritized, with moderate demand for decision trees' organizational benefits (mean 3.74).

Key Elements Identified

The analysis identified key elements to address participants' needs effectively: tailored cultural training to enhance sensitivity, structured tools for rational decision-making, integration of AI and decision tree methods for improved accuracy and efficiency, adaptability training for dynamic and cross-cultural environments, and targeted programs to build decision-making confidence across diverse scenarios.

In summary, the findings highlight the participants' significant demand for decision-making skills and AI-integrated tools. While cultural sensitivity and confidence emerged as the most critical areas, systematic analysis and adaptability were also emphasized. Addressing these needs through innovative, culturally sensitive, and AI-enhanced learning frameworks will be crucial for fostering effective decision-making in diverse and complex contexts.

Discussion

In a multicultural educational environment, Chinese international students often face challenges related to differences in academic standards, cultural norms, and societal expectations. These challenges not only impact academic performance but can also affect mental health and social interactions (Zhou, 2023). Therefore, improving the decision-making ability, cultural adaptability, and critical thinking of international students has become an urgent issue that needs to be addressed. AI-driven personalized learning tools, such as ChatGPT, can help students enhance their sensitivity to the consequences of decisions through real-time feedback and contextual simulations, enabling them to make more informed decisions in a cross-cultural environment (Kaur et al., 2024). By incorporating decision tree models, students can systematically analyze the risks and benefits of different decisions, thereby cultivating critical thinking and effective decision-making skill (Bogdanov et al., 2024). Moreover, integrating cultural contexts into AI tools' learning frameworks helps improve students' cultural sensitivity, assisting them in better addressing academic and social challenges across cultures (Salas-Pilco et al., 2022). Therefore, combining ChatGPT with decision tree models provides Chinese international students with a comprehensive decision-support system that helps improve their academic decision-making abilities and cross-cultural adaptability, leading to better academic performance and mental well-being. As technology continues to advance, AI tools will offer more personalized support to help international students better adapt to the challenges of studying abroad.

Conclusions

This study examined the needs of Chinese international students to improve decision-making skills and proposed a ChatGPT-based decision tree interactive learning model to address these challenges. The findings emphasized the importance of cultural sensitivity, systematic decision-making, and confidence-building. By integrating AI tools, structured frameworks, and cultural adaptability training, the proposed model enhances decision-making accuracy and cross-cultural competence. Future research should focus on optimizing the model's design and evaluating its effectiveness in practical teaching contexts. A well-implemented model will equip educators to better support Chinese international students, enabling them to navigate complex learning and career challenges and enhancing their global competitiveness.

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Contact email: miaoyanli172@gmail.com

The Impact of Class Scheduling on Academic Performance: A Study of First-Year Computer Engineering Students at Cebu Institute of Technology University

Jundith D. Alterado, Cebu Institute of Technology - University, Philippines
Johnalyn L. Figueras, Cebu Institute of Technology - University, Philippines

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Abstract
This study examines the significant influence of class scheduling on the academic performance of first-year engineering students at Cebu Institute of Technology University (CIT-U). Using data from grades and attendance records of 60 students enrolled in the computer programming course, this paper examines the effect of class schedule on academic performance among students in morning classes that start at 7:30 AM until 10:30 AM and afternoon classes that start from 12:00 PM to 3:00 PM. A between-subject research design using a two-sample, one-tailed t-test was applied on the dataset to achieve the research objectives. The result reveals that students in afternoon classes achieve significantly higher grades than the morning classes. Additionally, a moderate correlation was found between attendance and grades, indicating that regular attendance positively influences academic performance. These findings highlight the critical role of class scheduling in enhancing students' academic success and suggest that optimizing class schedules could improve both well-being and performance at Cebu Institute of Technology - University.

Keywords: Class Scheduling, Academic Performance, Two-Sample One-Tailed t-Test, Correlation

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Introduction

Time, an ever-precious resource, often proves elusive in our daily lives. Whether allocated for sleep, travel, socializing, meals, or studying, time consistently feels insufficient. This sentiment resonates particularly strongly among educators and students, navigating jam-packed school days teeming with diverse activities and obligations. In countries such as Taiwan and China, where school days stretch between 8 to 10 hours, and in the Philippines, where the average school day spans from 7:30 AM to 5:00 PM, the significance of time management in academic settings becomes glaringly evident. However, amidst these demanding schedules lies a critical question: Does starting early in the morning truly enhance academic performance, and how does the timing of the day impact students' learning and class attendance?

For so long, the potential impact of the timing of class commencement on the students' academic performance has been one of the ongoing concerns in academic circles. It is a subject of debate and scrutiny that involves educational establishments from elementary schools to universities, educators, policymakers, and researchers. Every educational institution aims to raise their students' learning, and the researcher believes that understanding the influence of class start time on students' performance is crucial for designing effective educational policies and practices. This research hopes to delve into this crucial aspect of educational dynamics, aiming to uncover the relationship between class start time and students' academic achievements, specifically their grades and class attendance.

The scheduling of classes is not merely a logistical consideration but holds significant implications for students' cognitive functions, attentiveness, and overall academic engagement. In recent years, there has been a growing body of research shedding light on the multifaceted influences of class timing on various aspects of student learning and well-being. However, the specific influence of class start time on the students' grades and attendance remains a complex and underexplored domain warranting rigorous investigation.

At the core of this study lies the recognition that the students' biological rhythms, also known as circadian rhythms, play an important role in determining their readiness to engage in learning activities at different times of the day. Adolescents experience a phase delay in their circadian rhythms during puberty, leading to a natural preference for later bedtimes and waking times (Carskadon, 2011). Consequently, early morning classes may coincide with a period of reduced alertness and cognitive functioning, potentially hindering students' ability to engage effectively in learning activities during these hours (Eide & Showalter, 2012).

Furthermore, the timing of classes can intersect with various socio-economic and cultural factors, further shaping its impact on students' academic performance. For instance, students from low-income households may face additional challenges related to transportation and work commitments, which can compound the effects of early morning classes on their academic success (Wolfson & Carskadon, 1998). Understanding these contextual subtleties is essential for designing interventions that address the diverse needs of students across different socio-economic backgrounds.

While some studies have indicated a positive association between later school start times and improved academic outcomes (Hinrichs, 2011), the conclusion remains mixed and context dependent. Individual sleep patterns, academic workload, and school culture may influence

the observed effects, emphasizing the need for a comprehensive, multi-dimensional research approach (Thacher, 2008).

Given this context, this research aims to contribute fresh insights into the influence of class start time on students' academic performance. This study aims to clarify the core reasons and influences shaping this relationship by combining findings from previous research with new data from first-year computer engineering students at CIT-University.

Ultimately, the findings of this research hold implications for educational policy and practice, informing interventions aimed at optimizing students' learning experiences and enhancing their academic achievements. By fostering a deeper understanding of the interplay between class timing and student outcomes, educators and policymakers can work towards creating learning environments that are conducive to academic success and supportive of students' holistic well-being.

Methodology

This research will use a quantitative approach to examine the relationship between class start times and students' academic performance, focusing on grades and attendance. For students' grades and attendance records analysis, the study will use correlation and regression techniques to determine whether class start times significantly influence academic outcomes. This research design approach aims to provide insights into how the timing of classes impacts students' attendance and academic performance, contributing to a deeper understanding of time-related factors in educational success.

Research Questions

This research will address the following questions derived from the problem statements. These questions aim to guide the study and provide the structure for data collection and analysis.

RQ1. Does the time in which the class starts affects the grades of CIT-University 1st Year Engineering students?
Ho: The time in which the class starts has no effect to the grades of CIT-University 1st Year Engineering students.
Ha: The time in which the class starts affects the grades of CIT-University 1st Year Engineering students.

RQ2. Does the time in which the class starts affects the absences of CIT-University 1st Year Engineering students?
Ho: The time in which the class starts has no effect to the absences of CIT-University 1st Year Engineering students.
Ha: The time in which the class starts has affects the absences of CIT-University 1st Year Engineering students.

RQ3. Do the students' absences have an effect to the grades of CIT-U 1st Year Engineering students?
Ho: The students' absences have no effect to the grades of CIT-University 1st Year Engineering students.

Ha: The students' absences affect the grades of CIT-University 1st Year Engineering students.

RQ4. Do classes hold in the morning yields lower grades than classes in the afternoon?
Ho: Classes which starts in the does not yield lower grades than classes held in the afternoon.
Ha: Classes which starts in the does not yield lower grades than classes held in the afternoon.

Data Gathering

The study uses a dataset from the Cebu Institute of Technology—University in Cebu City, Philippines. Specifically, it will utilize class records of first-year students enrolled in "Computer Programming I." The classes will be categorized into two major time periods: Morning (7:30 AM to 10:30 AM) and Afternoon (12:00 PM to 3:00 PM). The assessment of the student's academic performance includes students' grades (0-100) and attendance, measured by the total number of absences.

Elimination of Outliers.

Before sampling, each group of data (class) will undergo a preprocessing step to eliminate outliers using the quartile method. The method involves calculating the first (Q1) and third (Q3) quartiles of the dataset, then determining the interquartile range (IQR) as the difference between Q3 and Q1. Outliers are identified as data points falling below $Q1-1.5\times IQR$ or above $Q3+1.5\times IQR$, and these will be removed to ensure the data used for analysis is accurate and representative, leading to more reliable results.

Probability Sampling.

The researcher selected a random sample of 60 students from each class start time period using simple probability sampling. This method ensures that every student in each class has an equal chance of selection, minimizing bias and enhancing the generalizability of the results. The sample size of 60 students per class time was chosen to provide adequate representation across different start times and to obtain unbiased insights into students' academic performance.

Statistical Analysis

This research will utilize various inferential statistical methods to analyze the relationship between the variables: time of day (morning and afternoon), grades, and absences. The methods include correlation analysis to study the relationships between variables, t-tests or ANOVA to compare means across time periods, and regression analysis to examine how time of day affects grades and absences. By applying these methods, the study aims to uncover significant patterns and trends, providing a deeper understanding of how the timing of classes influences academic performance and attendance.

Strategy for Testing Hypothesis 1.

To examine whether class start time affects the grades of first-year engineering students, the study will use a between-subjects design. The independent variable is the class start time

(morning or afternoon), and the dependent variable is students' grades. The study will use a two-sample, one-tailed t-test to reject or accept the null hypothesis for the comparison.

Strategy for Testing Hypothesis 2.

The study employs a between-subjects design to determine whether the time of day when the class begins has an impact on the attendance of first-year engineering students. The independent variable is class start time (morning or afternoon), while the dependent variable is student attendance. A two-sample, one-tailed t-test will analyze whether to reject or accept the hypothesis.

Strategy for Testing Hypothesis 3.

A correlation analysis will examine the relationship between student absences and academic performance and use the linear regression method to assess whether a student's absences significantly influence a student's grades.

Strategy for Testing Hypothesis 4.

To determine if the classes held in the morning yield lower grades than classes held in the afternoon, this research would compare the mean average grades of the two time periods.

Results and Discussion

Statistical Analysis

Testing Hypothesis 1.

Ho: The time in which the class starts has no effect to the absences of CIT-University 1st Year Engineering students.

Ha: The time in which the class starts affects the absences of CIT-University 1st Year Engineering students

Table 1: Two-Sample t-Test of Morning vs. Afternoon Class Grades

	Morning	Afternoon
Mean	78.0820635	83.22853535
Variance	111.09514	74.59734893
Observations	60	60
Hypothesize Mean Difference	0	
df	114	
t Stat	-2.9254189	
P(T<=t) one-tail	0.00207593	

t Critical one-tail	1.65832997
P(T<=t) two-tail	0.00415187
t Critical two-tail	1.9809923
Analysis	Reject Null

Table 1 shows t-stat > $-t$-critical (two-tail), indicating a significant difference in average grades between morning and afternoon classes.

Testing Hypothesis 2.

Ho: The time in which the class starts has no effect to the absences of CIT-University 1st Year Engineering students.

Ha: The time in which the class starts affects the absences of CIT-University 1st Year Engineering students.

Table 2: Two-Sample t-Test of Morning vs. Afternoon Class Attendance

	Morning	Afternoon
Mean	0.3666667	0.15
Variance	0.6768362	0.23135593
Observations	60	60
Hypothesize Mean Difference	0	
df	95	
t Stat	1.7610791	
P(T<=t) one-tail	0.0407213	
t Critical one-tail	1.6610518	
P(T<=t) two-tail	0.0814427	
t Critical two-tail	1.985251	
Analysis	Do not Reject Null	

Table 2 shows t-stat < $-t$-critical (two-tail), indicating no significant difference in average grades between morning and afternoon classes.

Testing Hypothesis 3.

Ho: The students' absences have no effect to the grades of CIT-University 1st Year Engineering students.

Ha: The students' absences have an effect to the grades of CIT-University 1st Year Engineering students.

Table 3: Correlation Analysis Between Absences and Grades

	Absences	Grades
Absences	1	
Grades	-0.5	1
Analysis	Negative Moderate Correlation	

Table 3 shows a moderate correlation between student absences and grades, with the negative sign reflecting an inverse relationship.

Table 4: Regression Statistics of Data

	Values
Multiple R	0.471
R Square	0.222
Adjusted R Square	0.209
Standard Error	9.377
Observations	60

Table 4 result shows an R-squared value of 0.222, which is moderately acceptable. This means 22.2% of the variation in grades is explained by the independent variable, absences.

Using ANOVA analysis to further validate the significance of the above results.

Table 5 (a), (b): ANOVA Analysis Result

(a)

	df	SS	MS	F	Significance F
Regression	1	1454.823	1454.823	16.546	0.000
Residual	58	5099.790	87.927		
Total	59	6554.613			

(b)

	Coefficients	Standard Error	tStat	P-value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	80.2952	1.3272	60.4993	4.18E-54	77.6350	82.9519	77.6385	82.9519
Grades	-6.0358	1.4839	-4.0676	0.00015	-9.0061	-3.0655	-9.0061	-3.0656

Table 5 tells that the Significance F value, which reflects the reliability of the result, must be below 0.05 to confirm statistical significance. With a Significance F value close to 0, the results are statistically significant. Furthermore, the coefficients show that each additional unit of absences is associated with a 6.04 (rounded) decrease in grades.

Testing Hypothesis 4.

Ho: Classes which starts in the does not yield lower grades than classes held in the afternoon.

Ha: Classes which starts in the morning yields lower grades that classes held in the afternoon.

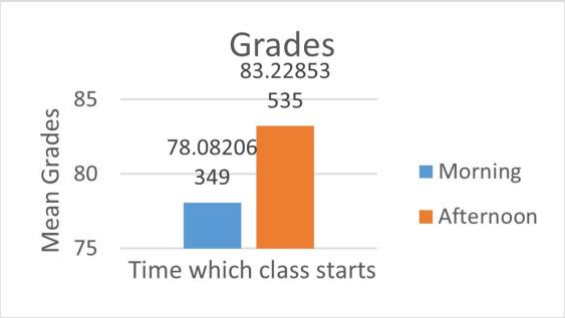

Figure 1: Mean Grades of Morning vs. Afternoon Classes

Figure 1, a bar graph, illustrates that, on average, students in morning classes tend to have lower grades compared to those in afternoon classes. This suggests that factors like class timing influence the performance difference between the two groups.

Conclusion

In conclusion, the timing of classes significantly impacts the grades of first-year engineering students at Cebu Institute of Technology—University. Students attending afternoon classes achieved higher grades with a notable difference in the results compared to the morning classes. While class timing has little effect on student absences, attendance moderately correlates with grades, indicating that regular attendance positively influences academic performance. Hence, these findings show the critical role of class scheduling in enhancing students' academic performance and success. Future research could expand the scope by exploring the long-term impact of class scheduling on student performance across different academic years and programs.

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The Role of Process Observation Analysis in Understanding Group Dynamics: Input to Effective Participation, Communication, and Interaction

Vielle P. Digor, Technological Institute of the Philippines, Philippines
Geewel P. Dariagan, Technological Institute of the Philippines, Philippines
Kristine Bernadette T. Empaynado, Technological Institute of the Philippines, Philippines
Jemerson L. Baldonado, Technological Institute of the Philippines, Philippines
Jeremie N. Nervar, Technological Institute of the Philippines, Philippines
Isaac Philip Eraga, Technological Institute of the Philippines, Philippines
Jaypy T. Tenerife, Technological Institute of the Philippines, Philippines

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Abstract
The process observation analysis, supported by Industrial Engineering skills, highlighted the practical applications of essential elements in group dynamics, such as interaction, participation, and task fulfillment. Analytical thinking and keen attention to detail enabled a nuanced breakdown of group interactions, drawing connections between observed behaviors and desired outcomes. The study emphasized that incorporating process observation techniques in educational counseling enhances student support, effective decision-making, and smooth conflict resolution. Findings demonstrated that organizational and planning skills—essential in time management and agenda setting—play a vital role in maximizing productivity during engagements. The Industrial Engineer's systems thinking skills provided a holistic view, capturing how structured agendas and managed timelines contribute to successful organizational meetings. The use of a participation matrix showcased an effective data collection and analysis approach, enabling a structured evaluation of each participant's contribution to group discussions and overall productivity. Additionally, integrating both qualitative and quantitative techniques illustrated the value of statistical and quantitative analysis in action research. Results indicated that purposeful seating arrangements and attention to environmental details foster equal engagement and open conversation. Creating a collaborative and supportive atmosphere promoted active engagement, showing the impact of effective interpersonal and communication skills. Finally, Industrial Engineers apply problem-solving and decision-making skills in process observation analysis to assess interactions, communication, and other elements essential for cooperative decision-making. Documenting these observations effectively through technical writing ensures that findings and recommendations are communicated clearly to stakeholders, making process observation analysis a robust tool for organizational growth and productivity.

Keywords: Communication, Group Dynamics, Interaction, Participation Matrix, Process Observation Analysis

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Introduction

This study employs Process Observation Analysis (POA) to examine group dynamics, specifically analyzing behaviors that impact how groups perform tasks and achieve their objectives. The primary goal is to conduct a thorough process observation to capture and evaluate the behaviors, interactions, and dynamics within a formal meeting. This investigation focuses on three key areas: individual participation, communication patterns, and the facilitator's role in managing discussions. The study of Winnie et al. (2020) indicates that by observing each member's behavior during discussions and identifying communication patterns that can either support or impede group success, this study aims to provide an in-depth analysis of complex social interactions and individual behaviors within their natural context. A significant aspect of this research is the integration of qualitative insights with observational data, which enables the study to uncover nuances that quantitative data alone might overlook. The elements such as tone, body language, and subtle patterns of engagement are critical to understanding the dynamics at play within the group.

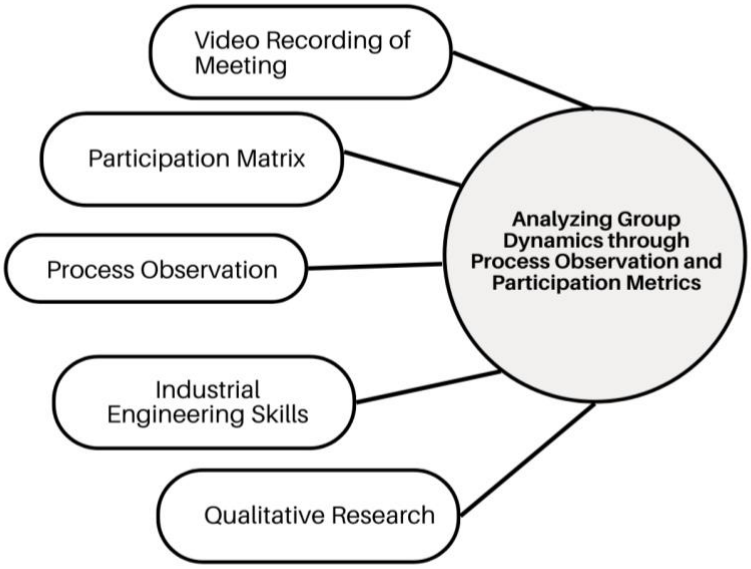

Figure 1: Conceptual Framework

Figure 1 illustrates the research's conceptual framework. A video recording of the meeting proceedings was used to enable precise post-meeting review and detailed analysis of interpersonal interactions. A key tool in the POA was the participation matrix, which documented the number of statements made by each member, categorizing participants as active (frequent and significant contributors) or passive (minimal contributors with shorter engagement). This classification provided critical insights into participation distribution within the group. The application of POA extends to virtual group interactions, identifying challenges unique to online settings. By addressing both interpersonal relationships and task-related behaviors, POA enables timely adjustments to improve task completion and group cohesion. Industrial Engineers utilize data collection, organizational planning, and systems thinking to enhance group dynamics, ensuring that relational and task-oriented behaviors align with group effectiveness.

By combining qualitative observation with structured participation metrics, the study highlights the strength of qualitative research in providing a rich, contextual understanding of group dynamics. Real-time observations, supported by video analysis, allow for a comprehensive evaluation of communication flow, role distribution, and facilitation effects. As work environments evolve, POA proves instrumental in fostering collaboration, cohesion, and productivity. This research contributes valuable insights into individual and collective behaviors, advancing the understanding of group interactions and the influence of facilitation on engagement and productivity in formal meetings.

Literature Review

Effective learning environments rely on understanding group dynamics, communication, participation, and interaction, as these factors shape decision-making, conflict resolution, and learning outcomes. The Process Observation Analysis (POA), combined with participation matrices, offers a structured method to analyze group interactions and their impact on learning and productivity. By identifying participation patterns, educators can enhance collaboration, engagement, and overall learning experiences. Gençer (2019) describes group dynamics as the evolving interactions and behavioral influences within a group. The (POA) framework complements this perspective by analyzing real-time communication patterns that either facilitate or obstruct success. Participation matrices, widely used in government, business, and education, quantitatively assess each member's contribution, highlighting engagement levels and communication barriers. In educational contexts, they ensure balanced participation, fostering decision-making and conflict resolution (Joy et al., 2019). Dada et al. (2022) introduced the Involvement Matrix as a conceptual framework designed to facilitate the participation of youth with severe communication disabilities in health research. Their study identified four distinct roles—listeners, advisors, decision-makers, and partners—distributed across three research phases. This structured approach not only fostered meaningful engagement but also empowered participants by recognizing their unique contributions, thereby addressing conventional communication barriers. This study draws on foundational theories, including Tuckman's Stages of Group Development, Systems Theory, Social Exchange Theory (SET), and Hackman's Group Effectiveness Theory, illustrated in Figure 2. Choudhuri and McCarthy (2023) emphasized POA's value in task-oriented and psychoeducational groups, noting its role in identifying individual and external influences on group dynamics. Systems Theory reveals feedback loop disturbances hindering balanced interactions, allowing corrective actions (Mellenthin et al., 2021). The SET provides insights into participation and communication, analyzing interactions through efforts to maximize rewards and minimize costs. Sunyoto et al. (2021) explored group engagement using SET, highlighting how employee relationships evolve through exchanges shaped by organizational norms and trust. By integrating these theories with POA, this research underscores its effectiveness in uncovering participation patterns and improving group dynamics in diverse settings. Integrating POA with Hackman's Group Effectiveness Theory offers a framework for improving group dynamics. By focusing on outcomes, individual needs, and future collaboration, this approach enables organizations to evaluate interactions and enhance participation and communication. Recent studies emphasize the role of management strategies in boosting employee engagement. A people-centered approach that values active participation fosters greater team cohesion and effectiveness (Amit, 2024).

Methodology

Methodology Process observation was conducted to evaluate behaviors, group dynamics, and interactions during a formal meeting, focusing on individual participation, communication patterns, and the facilitator's role. This method used qualitative research to provide an in-depth analysis of social interactions and individual behaviors in their natural context. Qualitative research prioritizes rigor and relevance when studying complex social phenomena, offering insights into the context and meaning behind behaviors that quantitative data may overlook, such as tone, body language, and subtle engagement patterns (Liu, 2024). Braun and Clarke (2019) argue that qualitative methods can capture complex interaction patterns often missed in quantitative research. Nowell et al. (2017) highlight the importance of trustworthiness in qualitative research, noting that real-time observation and systematic analysis provide a deeper understanding of group dynamics. To ensure accurate post-meeting analysis, the process observation was supplemented with a video recording of the proceedings.

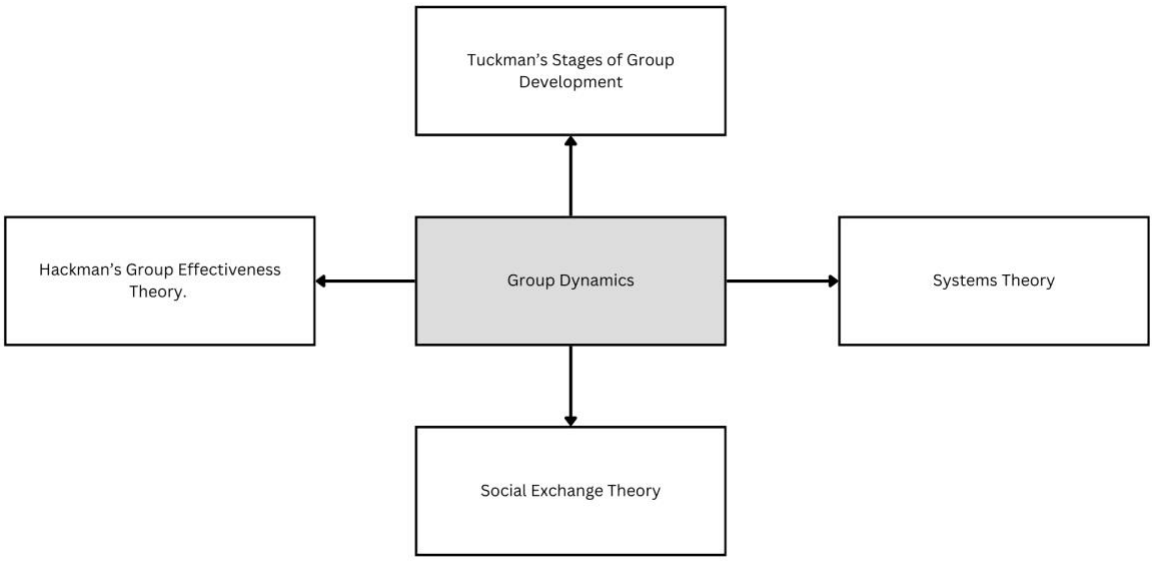

Figure 2: Theoretical Framework

A key tool in this observation was the participation matrix, which evaluates engagement by measuring the number of statements made and the time spent by each participant. Active participants are those with higher contributions, while passive participants make minimal contributions. Combining qualitative observation with structured participation metrics offers a nuanced understanding of group dynamics. Real-time observations, alongside video analysis, enabled a comprehensive evaluation of communication flow, role distribution, and facilitation impact. These insights provide a deeper understanding of individual and collective behaviors in group settings. A system was developed to monitor group dynamics in video-conferencing environments, assessing communication patterns and facilitation's influence within groups (Gordon et al., 2022). Building on this approach, a study introduced dynamic scene analysis to assess student participation in collaborative learning. By tracking group dynamics and participant interactions over extended periods, this methodology provided significant insights into engagement patterns, enhancing the understanding of collaborative learning processes (Shi et al., 2024).

Participants

About 20 participants, consisting of 65 percent male (*n = 13*) and 35 percent women (*n = 7*), attended the observed meeting. With an average age of 62.5 from the range of 46 to 75 years old, the group was made up of Lupong Tagapamayapa members, with two secretaries attending as well. *Lupong Tagapamayapa* (Pacification Committee), created pursuant to Republic Act 7160, commonly known as the "Local Government Code" of the Philippines, serves as an alternative dispute resolution in a barangay, settling conflicts without the costs normally occurring when filing cases in higher courts (Villamor & Dagohoy, 2021). The participants were informed of a meeting beforehand through a written letter issued by the Circle Head. The letter includes the agenda, the time, and the venue of the meeting.

The participants were positioned around the room, occupying the seats at the front of the walls (see Figure 3). Another row of seats facing the presider was occupied as well. The researchers were also present at the meeting, collecting data and writing down observations. However, to ensure accurate information and that data will not be skewed, the participants were not informed of the presence of the researchers. Furthermore, the researchers did not sympathize with the group, as Gaille (2020) mentioned that the reliability of data is at risk when the normal group dynamics are interfered with. Consent from all the members of the participants was secured to publish the photo of the group discussion.

Figure 3: The Members of the Group Discussion Subjected to Process Observation Analysis

Measures

The assessment of group dynamics utilized measurements of effective participation, communication, and interaction to understand if a group is well-functioning or is experiencing challenges. Wu and Paluck (2022) stated that a boost in performance and an increase in effective cooperation might be caused by effective participation by sharing information and taking perspectives of one another. In a separate study, it was found that an enhanced level of commitment by the group members is caused by a successful establishment of identity through social communications. (Edward & Amalua, 2022). The total amount of time spent by each of the members engaging in the discussion and the number of times

conveying statements were used to fill the participation matrix. The data was then used to present time and frequency percentages, respectively, relative to the overall data collected from the group.

Data Gathering Procedure

Figure 4 shows the steps of how the researchers conducted the Process Observation Analysis. The researchers initially sought and received approval from the head and members of the Barangay Sta. Cruz's Lupong Tagapamayapa to observe and record their meeting. Following the acquisition of consent, the researchers attended the meeting in person, during which they utilized mobile phones to capture both video and audio recordings. Due to confidentiality concerns, certain segments of the video were excluded from the final dataset. Subsequent to data collection, the researchers transcribed the recorded conversations. The transcription process was informed primarily by the video recordings, with the researchers carefully listening to the audio and reviewing the video to accurately identify each speaker and record the frequency of their contributions.

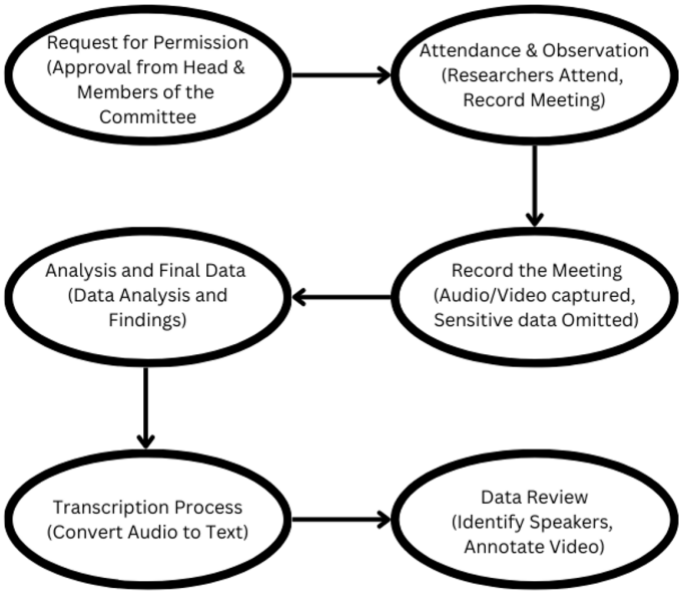

Figure 4: Steps of Conducting the Process Observation Analysis

In the digital era, transcription has significantly improved due to advancements in recording technologies. Researchers now rely on high-quality devices, such as video cameras and mobile phones, to capture meetings and interviews. These recordings are subsequently transcribed to facilitate in-depth analysis. For example, a study published in the European Journal of Cardiovascular Nursing examines how transcription transforms audio or video recordings into written formats, thereby enhancing the accessibility and utility of qualitative data analysis (Eftekhari, 2024). Similarly, McMullin (2021) highlights transcription as a common practice in qualitative research. However, they noted that transcription is not the sole method for data analysis, suggesting alternative approaches may also be employed.

Data Analysis

Table 1 shows that the group discussion lasted for 101.91 minutes, or 1 hour and 41.91 minutes, accounting for 80.75 percent of the recorded meeting time. For anonymity purposes and as part of confidentiality agreements agreed upon by the researchers and the group,

letters of the alphabet were used to replace the names of the members of the group. As the facilitator of the meeting, Participant A contributed to more than 75% of the communication exchange between the members. Meanwhile, both Participant C and Participant K were identified as the least active participants in the group. With this uneven distribution in mind, fostering collaborative decision-making and positive group dynamics was hindered. This was also what Strauß and Rummel (2021) found out — that reduced opportunities for productive interaction are present when there is unequal participation from the group members.

While Participant A was expected to speak more as the convener of the meeting, the collective communication contribution of the rest of the members was less than 25%, indicating that there was minimal to no involvement from most of the participants. With a big group, participants tend to be distracted, and silent ones are discouraged from contributing to decision-making and group discussions (Crisianita & Mandasari, 2022; Engineer et al., 2021).

Table 1: Participation Matrix

No.	Group Member	Particulars			Time Spent		No. of Statements
		Gender	Age	Designation	Recorded Time (min)	%	f
1	Participant A	M	68	Circle Head	77.05	75.61	284
2	Participant B	M	66	Circle Member	6.33	6.21	37
3	Participant C	M	63	Circle Member	0.00	0.00	0
4	Participant D	F	74	Circle Member	0.10	0.10	3
5	Participant E	M	75	Circle Member	0.53	0.52	17
6	Participant F	F	57	Circle Member	0.01	0.01	0
7	Participant G	M	54	Circle Member	1.86	1.83	39
8	Participant H	F	57	Circle Member	0.14	0.14	3
9	Participant I	F	46	Circle Member	2.60	2.55	30
10	Participant J	M	63	Circle Member	3.33	3.27	35
11	Participant K	M	74	Circle Member	0.00	0.00	0
12	Participant L	M	74	Circle Member	0.20	0.20	14
13	Participant M	M	64	Circle Member	0.27	0.27	9
14	Participant N	M	64	Circle Member	0.26	0.26	5
15	Participant O	F	64	Circle Member	3.81	3.74	44
16	Participant P	M	64	Circle Member	0.33	0.23	12
17	Participant Q	M	54	Circle Member	2.75	2.70	30
18	Participant R	F	56	Secretary	0.65	0.64	27
19	Participant S	M	61	Circle Member	1.63	1.60	29
20	Participant T	F	52	Secretary	0.06	0.06	3
	Total				101.91	100	208

The group's interaction was found to be low, with 40 percent, or eight participants, speaking less than ten times. While some individuals showed their enthusiasm by asking questions and

seeking clarifications, how Participant A encouraged the group affected the group's motivation and interaction. Cole (2024) noted that a good leader has authority, has confidence in what they do, and encourages everyone to speak up and interact with each other.

Results and Discussion

The result showed that only Participant A had the highest participation percentage in the discussion. In contrast, Participants C, K, and J had the lowest participation percentage in which they did not give any participation at all. Participant A initiated most of the topics as the facilitator, while the rest of the participants responded by either laughing, agreeing, or disagreeing to show their interest in the meeting.

The process observation revealed that the group discussion was largely dominated by a few participants, with a noticeable gender imbalance among active contributors. Although the group's average age was relatively high, this factor did not appear to affect participation levels significantly. The participation matrix highlighted a clear divide between active and passive members, suggesting that future meetings could benefit from strategies to encourage more balanced engagement and address potential gender biases. Examining factors such as personality traits, communication styles, or cultural differences might further illuminate the reasons behind these participation patterns and provide insights for enhancing group dynamics (Forsyth, 2015).

Participant A dominated the discussion, accounting for over 75% of communication exchanges, which may have limited equal participation and hindered a thorough exploration of topics. This observation suggests that the counselor should consider interventions to promote a more balanced discussion flow. Additionally, the meeting ran for 1 hour and 41 minutes, raising concerns about the efficiency and productivity of the session. According to Forsyth (2015), future sessions would benefit from strategies aimed at both promoting balanced participation and optimizing meeting length. To improve upcoming meetings, strategies such as round-robin discussions, equal speaking time, and encouraging quieter members to contribute could be implemented (Cook, 2024). Creating an inclusive environment that challenges gender stereotypes may also help reduce biases and foster a more equitable space for all participants. By addressing these areas, future meetings can be more productive, inclusive, and efficient (Bond, 2020). Figure 5 illustrates how Effective Participation, Communication, and Interaction can be achieved through POA. Ensuring active participation, open communication, and positive interactions within group dynamics brings numerous benefits. When every member contributes, it creates a rich environment for sharing diverse viewpoints, encouraging more innovative and balanced decision-making (Tasca, 2021).

The works of Mohanty and Mohanty (2018) discussed how effective communication fosters trust and transparency among group members, strengthening collaboration and minimizing misunderstandings. This also allows for the constructive and timely resolution of conflicts, which is essential for maintaining a positive, productive group environment. Tasca (2021) further highlights that positive interactions cultivate supportive relationships within the group, enhancing morale and cohesion. Consequently, this increases engagement and motivation, as members feel valued and respected. By focusing on effective participation, communication, and interaction, groups can leverage their collective intelligence, leading to improved problem-solving and more efficient goal attainment.

Research Reflexivity

This analysis examines the role of Industrial Engineering skills in process observation analysis, focusing on group dynamics, student counseling, and decision-making facilitation. The authors leveraged their structured, analytical training to observe and interpret group interactions, linking specific behaviors to desired outcomes such as task fulfillment and effective participation. Their attention to detail and technical documentation skills ensured that findings were communicated clearly, emphasizing the value of technical writing in sharing results with stakeholders.

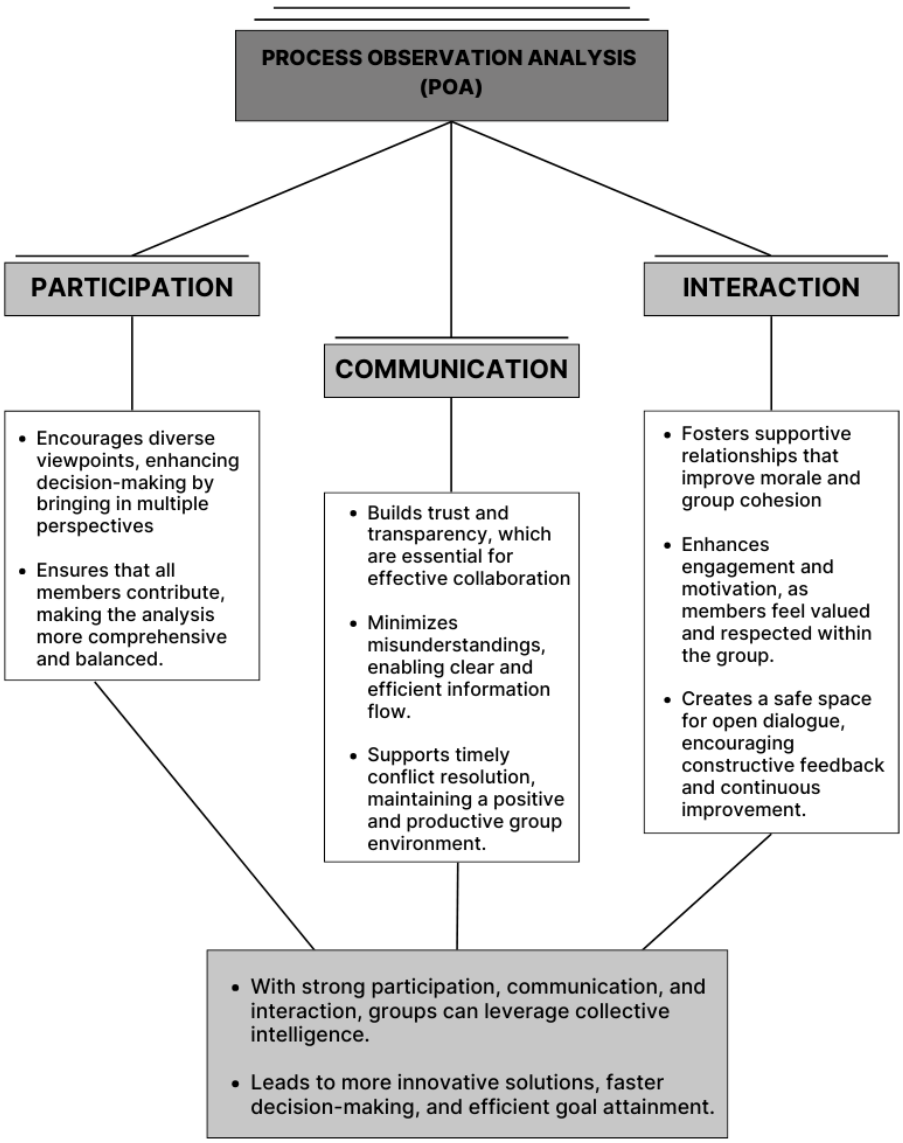

Figure 5: Effective Participation, Communication, and Interaction Through POA

The reflexivity exercise highlighted how the authors' engineering background shaped their observations, showcasing the potential of structured thinking, data analysis, and documentation to enhance teamwork, collaboration, and productivity in organizational settings. By combining quantitative methods with qualitative approaches like interviews and observations, the researchers gained a holistic understanding of group behavior and dynamics. Quantitative data revealed statistical patterns, while qualitative insights offered

nuanced perspectives on participants' experiences and challenges. Reflective practices, as applied by Rania et al. (2021), helped participants deepen their awareness of group dynamics and individual roles, emphasizing the value of qualitative insights in understanding subjective experiences. The researchers acknowledged potential biases by focusing on measurable outcomes, balancing objectivity with subjective interpretations. By maintaining transparency and recognizing their positionality, they ensured that findings reflected both their technical expertise and the diverse perspectives of participants. This reflexive approach enriched their understanding of group processes and enhanced the effectiveness of interventions in organizational settings.

Conclusion

Familiarity with POA is crucial for facilitators, as it provides them with the tools to analyze group dynamics and interactions effectively. A solid understanding of POA enables facilitators to observe, interpret, and adapt to team behaviors in real-time, enhancing their ability to guide discussions and achieve desired outcomes. Recent research highlights POA's importance in fostering positive team dynamics, increasing motivation, and boosting morale among team members. Studies have explored the impact of team roles and emergent states, such as group potency and cohesion, which are vital for facilitators aiming to understand and improve group interactions as they unfold.

Enhancing Team Dynamics Through Proficient Facilitation and POA Expertise

Facilitators with POA expertise can effectively guide group behaviors, creating supportive environments that enhance motivation and collaboration (Woodley et al., 2019). This skill enables facilitators to identify areas for improvement while fostering growth and teamwork. Effective collaboration relies on cooperation, communication, and coordination, which together drive team synergy and performance gains that surpass individual contributions. These gains create a feedback loop that reinforces collaborative processes and supports ongoing team development (Bisbey & Salas, 2019). By providing constructive feedback based on careful observation, facilitators help team members feel valued and acknowledged. Recognizing individual strengths and areas for growth allows facilitators to offer tailored support, fostering a sense of belonging and encouraging deeper engagement. This personalized approach boosts morale and strengthens team cohesion. Strong facilitators who utilize POA also demonstrate critical leadership skills. Recent historiometric analyses of team leadership in mission-critical and isolated environments have provided valuable insights into team dynamics. Studies by DeChurch et al. (2011) and Burke et al. (2018) highlight how understanding leadership in challenging contexts can enhance team performance and inform strategies for effective facilitation

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Driving Organizational Productivity and Innovation Through Effective POA Facilitation

Effective POA facilitation has a significant impact on organizational productivity and efficiency. Motivated teams with high morale are more likely to collaborate effectively, enhancing problem-solving and innovation. Research by McKinsey highlights that successful facilitation improves team performance by establishing clear roles, using effective communication tools, and fostering a culture of continuous improvement, enabling seamless collaboration (Comella-Dorda et al., 2023). Engaged teams show higher productivity as empowered individuals take the initiative and contribute ideas. This collective effort improves work quality and streamlines processes by minimizing misunderstandings and

ensuring goal alignment. Skilled facilitators using POA regularly assess team dynamics and encourage feedback, building a culture of ongoing learning and adaptation. This approach not only enhances team performance but also supports organizational strategic goals, driving efficiency and effectiveness.

Transformational leadership plays a key role in boosting team dynamics. Leaders with a participative style promote employee involvement, cultivating a sense of ownership that increases motivation and morale. This leadership approach aligns team efforts with organizational objectives, improving both productivity and efficiency (Akinniyi et al., 2021). By prioritizing active listening and meaningful connections, participative leaders foster open communication, enabling constructive conflict resolution and strengthening team cohesion.

Fostering Continuous Learning and Resilience Through Proficient POA Facilitation

In addition to boosting team morale and motivation, POA fosters an environment of continuous learning and development. Skilled facilitators create a feedback-rich atmosphere, enabling team members to gain insights into their contributions and those of others. The A-B-C framework—attitudes, behaviors, and cognitions—emphasizes the role of trust and cohesion in effective teamwork. POA helps facilitators understand and guide these emergent states by capturing real-time interactions and tracking team dynamics over time, leading to targeted improvements (Delice et al., 2019). Continuous feedback reinforces mutual respect and recognition, strengthening interpersonal bonds and encouraging team members to leverage their strengths for collective success.

Teams practicing POA develop resilience and agility, promoting adaptive, real-time responses to challenges. These qualities are crucial in modern organizations, where collaborative innovation and problem-solving drive long-term success (Harvey et al., 2023). Additionally, POA enables facilitators to identify and address potential issues proactively, reducing conflicts and misunderstandings. This approach cultivates a culture of open communication and adaptability, where constructive feedback and learning from past experiences become standard practices, ensuring teams remain aligned and effective.

Directions for Future Research

The POA can become a valuable tool across a range of fields outside the traditional industry, enhancing areas such as team building, strategic planning, and coaching practices. In team-building and coaching contexts, POA enables facilitators to objectively observe interactions, revealing communication patterns, decision-making styles, and areas for potential growth. When applied thoughtfully, POA strengthens team cohesion by emphasizing constructive feedback over personal critique. For instance, it supports coaches in guiding teams to refine behaviors that impact productivity and morale, creating a more collaborative and supportive atmosphere (Collier, 2021).

Exploring the Impact of Process Observation Analysis on Leadership Development and Strategic Team Performance

In leadership development, the POA can be beneficial for managers who want to enhance and guide team behaviors without resorting to micromanagement. By utilizing observation, leaders can concentrate on identifying key actions or areas that need improvement, which can significantly influence organizational objectives. This approach enables them to provide

targeted support to teams by addressing specific, observable behaviors, thereby making feedback sessions more impactful and productive (Alula, n.d.). Additionally, POA has been integrated into coaching practices as a method for providing real-time feedback, allowing coaches to adjust their strategies based on direct observations of athletes' or employees' reactions (UK Coaching, 2024). These insights can also be applied to strategic planning efforts, aiding organizations in evaluating the alignment of their processes with overarching objectives.

The application of POA across these diverse areas underscores its versatility and effectiveness in improving both individual and team performance. By utilizing observation-driven feedback, various industries and professional practices can foster environments that encourage ongoing improvement and purposeful change.

The Value of Multidisciplinary Approaches in Enhancing Industrial Engineering Approach in Conducting Process Observation

Relying only on an Industrial Engineering perspective to analyze data has its inherent limitations, as it might not encompass the entire complexity of the research subject (Hassan, 2024). Studies by Rosell et al. (2018) and Hassan (2024) state that a singular focus on Industrial Engineering may miss important psychological, educational, and socio-economic factors that can affect the outcomes. The research highlighted by the British Medical Journal (BMJ) demonstrates that multidisciplinary approaches, incorporating insights from fields such as psychology, education, and development studies, can offer a more holistic understanding of the research problem. Different disciplines bring unique perspectives and methodologies, uncovering dimensions of the data that a single lens might overlook. For instance, psychologists can provide insights into human behavior and motivation, education experts can shed light on learning processes, and development studies professionals can emphasize socio-economic impacts. By integrating these varied viewpoints, the research conclusions are likely to be stronger and more comprehensive (Saunders et al., 2023).

Leveraging Process Observation Analysis for Enhanced Team Dynamics, Coaching, and Strategic Planning

The POA is a versatile tool for analyzing group dynamics, decision-making, and organizational effectiveness across industries. Cherkowski and Walker's Model for Flourishing through Mentorship emphasizes appreciative inquiry in school leadership, promoting inclusive and supportive environments. Reflective coaching strengthens relationships, teamwork, and goal setting (Cherkowski & Walker, 2018). In team building, POA evaluates interactions, identifies strengths and weaknesses, and enhances collaboration. Systematic observation helps facilitators tailor interventions to improve communication and trust. In coaching, POA offers a method to analyze coach-client dynamics. Peters and Carr’s research shows how aligning coaching with team structures boosts performance and cohesion (Peters & Carr, 2013). By identifying communication patterns and decision-making approaches, POA informs coaching strategies. Lowery’s study on a "coach mindset" demonstrates its impact on teachers' well-being and how mentoring fosters collaborative environments critical for organizational growth (Lowery, 2019). In strategic planning, POA ensures inclusivity and effectiveness, amplifying all voices in the process.

Expanding the Applications of Process Observation Analysis in Healthcare, Education, and Community Development

Beyond specific applications, POA benefits healthcare, education, and community development, particularly within participatory action research (PAR) frameworks. By involving researchers as active participants, communities collaboratively identify issues and propose sustainable solutions, especially in rural areas (Jorgensen, 2015). In healthcare, POA aids in observing interdisciplinary team meetings, helping professionals better understand diverse roles' contributions to patient care. A Human Resources for Health review highlights strategies like systematic team training, simulation-based activities, and tools like checklists to enhance collaboration. These methods demonstrate how POA can refine team efforts for improved patient outcomes (Buljac-Samardzic et al., 2020). A study in BMJ Open explored communication barriers during interdisciplinary consultations for critically injured patients, using participant observation and thematic analysis. The research emphasized that physical and psychological accessibility is critical for effective communication. However, using POA solely from an Industrial Engineering perspective presents limitations. This narrow lens may overlook key factors influencing group dynamics and decision-making. Multidisciplinary inputs could provide richer insights: psychologists can explore emotional and cognitive aspects, education experts can assess learning and engagement strategies, and development studies specialists can contextualize socio-economic factors. These perspectives enhance the depth and applicability of POA findings.

Enhancing Organizational Insights through Multidisciplinary Process Observation Analysis

Incorporating a multidisciplinary approach to POA is essential for contextualizing research findings and giving greater meaning to the data. Researchers can gain deeper insights from POA data by using a multidisciplinary approach, resulting in more effective team development, coaching techniques, and organizational transformation tactics. This collaborative approach enhances the validity of findings and ensures solutions are anchored in a comprehensive understanding of human behavior, team dynamics, and organizational environments (Widdowson et al., 2020). By collaborating with experts from various fields, researchers can draw upon diverse methodologies and theoretical frameworks, resulting in a more comprehensive understanding of group dynamics. In multidisciplinary teams, collaboration across disciplines like group dynamics, leadership, and behavioral science can improve decision-making, communication, and performance. Research on team dynamics shows that a broad range of expertise fosters richer outcomes, such as increased innovation, better problem-solving, and enhanced productivity in organizational settings. This approach is particularly beneficial in environments like strategic planning and team coaching, where varied expertise can optimize both process and impact (Slade et al., 2023). This collaborative approach can enhance the validity of the findings and improve the applicability of POA across different contexts and industries. The applications of POA are vast and impactful across various professional practices, including team building, coaching, and strategic planning.

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Authorship Contribution Statement

Vielle Digor contributed to the overall idea and helped in scrutinizing the accuracy of the paper. Geewel Dariagan provided substantial support in formulating key arguments held by the group. Kristine Bernadette Empaynado focused on highlighting the possible recommendations and recognizing the shortcomings of the research paper. Jemerson Baldonado monitored the group's internal perspectives and how they helped in shaping the research process. Jeremie Nervar and Isaac Philip Eraga have facilitated data collection, data analysis, and gave conclusions based on the available data. Jaypy Tenerife reviewed and edited the paper and provided expertise in mixed-method research and the overall process of conducting Process Observation Analysis.

Declaration of Competing Interests and the Use of Artificial Intelligence in Academic Writing Research

The authors confirm that there are no conflicts of interest associated with this manuscript. The authors also declare that no generative artificial intelligence (AI) or AI-related technologies were used to develop ideas and concepts introduced in the paper. The AI was only applied to improve readability and language. Following these improvements, the authors conducted a thorough editing and review process to ensure accuracy and clarity. While recognizing that AI can generate content that may seem credible, the authors are aware of its potential for bias, inaccuracies, and other limitations. To address these concerns, the authors meticulously reviewed the manuscript. The authors followed research ethical guidelines throughout the writing process.

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Contact email: jaypy.tenerife@tip.edu.ph

Case Study on Use of "Back to the Future" in English Instructions for Engineering Students

Mikako Nobuhara, Nagaoka University of Technology, Japan
Takashi Okoda, Tokyo Metropolitan College of Industrial Technology, Japan

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Abstract
This study presents an educational practice that integrates the American movie *Back to the Future*, directed by Robert Zemeckis, into English language instruction for engineering students in Japan. Participants included four classes from a Japanese college dedicated to training future engineers and one university class specializing in technical sciences. Using Google Forms, students from two classes that incorporated the movie into their English lessons provided their impressions. The students found movies valuable for improving everyday conversational skills, expanding vocabulary, understanding cultural and social contexts, and gaining insights into nonverbal communication. Post-viewing analysis revealed that while the students conducted detailed scene analyses using their engineering knowledge, their comprehension of English vocabulary and expressions remained equivalent to that of lower secondary to early high school students in Japan. The study concluded that the main insights gained from the movie were engineering-related, with limited progress in language acquisition. To enhance the effectiveness of using movies in engineering education, teachers should include previewing activities focusing on conversational expressions, vocabulary, and engineering concepts in their classes.

Keywords: American Movie, Engineering Expertise, English as a Foreign Language, Google Forms

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Introduction

The Ministry of Education, Culture, Sports, Science and Technology (MEXT, 2024) outlines its vision for national universities in its publication, Policies for the Reform of National Universities. It highlights the need for a future society that embraces sustainability, inclusion, and diversity, emphasizing that education should be structured around these core principles. The report also stresses the significance of undertaking comprehensive reforms to achieve these educational objectives.

In addition it aims to cultivate individuals with interdisciplinary and integrated knowledge across both the arts and sciences, while ensuring sufficient learning time and rigorous graduation standards.

In Japan, it is said that English education traditionally focuses on linguistic skills such as grammar and vocabulary, often neglecting the broader goal of fostering well-rounded English proficiency. To develop globally competent individuals, educators must not only enhance students' language abilities but also integrate subject-specific knowledge, such as engineering, into their English instruction.

Sakaue (2015) explored in the study that student engagement by applying text-mining techniques to analyze feedback on classroom activities. The research highlighted the importance of motivating students to learn and to enhance their learning outcomes. With the context of a 15-session English course, educators can focus on the four core language skills—listening, speaking, reading, and writing—while simultaneously fostering cultural understanding.

In this study, the authors aim to improve their management in usual classes by taking a look at students' free-text feedback collected during a course. The questions were given to identify insights for improving lesson design and classroom practices. By examining recurring themes and patterns in student feedback, the research seeks to develop strategies that address both linguistic and interdisciplinary educational objectives more effectively.

Methodology and Participants

This study incorporated the American movie *Back to the Future*, directed by Robert Zemeckis, into English language instruction for engineering students.

Participants included four classes of students at a Japanese college that focused on training future engineers and one university class specializing in technical sciences:

- At Kosen College A: 160 participants (total of 4 classes).
- At University B in the field of Technology: 22 participants.

At Kosen College A, the academic year is divided into two semesters, and English classes mainly focus on reading and listening skills. Among the 30 90-minute lessons conducted annually, two sessions were allocated to lessons that incorporated *Back to the Future*. Typically, classes are conducted using an authorized textbook without incorporating movies. The participants were all second-year students aged 16–17.

The class activities mainly included reading and listening exercises based on the textbook, followed by comprehension and practice problems. In addition, in the Computer-Assisted

Language Learning (CALL) classroom, students engaged in listening exercises, repeating activities, and shadowing activities, culminating in recording their voices and submitting them as assignments. While English presentation and writing activities were not included, basic exercises such as sentence rearrangement and fill-in-the-blank activities were partially incorporated into textbook-based lessons. Overall, the subject is characterized by strong reading and listening skills.

All four classes comprised students with varying degrees of proficiency, some of whom had difficulty learning English but demonstrated motivation to engage with the lessons. The class progressed without any significant challenges. Instructions for the movie-based lessons were provided orally by a designated teacher, and a teacher answered any questions raised by students before watching a movie.

In English classes at University B, teachers improve all four language skills,t reading, listening, speaking, and writing. For instance, reading and listening activities are conducted using a textbook similar to the text used at Kosen College A. However, the textbook is a nonauthorized version that includes engineering-related topics. Writing activities involve composing short sentences as part of the class. In some classes, English presentations are mandatory, and students should engage in writing while preparing their scripts. In addition, in those classes, all students were required to deliver English-only presentations during the 15 lessons in a semester, and a teacher evaluated these presentations. The participants were all second-year students aged 19–20.

Among the 15 90-minute lessons per semester, two sessions were allocated to lessons incorporating the abovementioned movie. Students in this class generally have clear future goals, such as pursuing graduate studies, and demonstrate motivation for learning. However, several students struggle with English, and while classes proceed without significant challenges, maintaining motivation remains a challenge. Some students in the class had never experienced lessons involving movies, as revealed through an oral survey conducted by the teacher. Instructions for the movie-based lessons were provided orally by a designated teacher, and a teacher answered any questions raised by students in advance.

For both colleges, a teacher told their students to write their impressions of the lessons that used a movie by using Google Forms after each class. The questions were given to them in their native language (Japanese), and the students wrote their responses in Japanese:

1.工学的な観点で面白いと思った点について説明してください。(in Japanese)
Please explain what you find interesting from an engineering perspective.
2.印象に残った英語表現を記載してください。(in Japanese)
Write an English phrase or sentence that leaves a strong impression on you.
3.今日の授業について自由にコメントをしてください。(in Japanese)
Can you provide your comments on today's class?

These are standard questions typically used in regular English classes to hear students comment for teachers to improve their class management.

Data Collection

The authors reflected responses on Google Forms onto an Excel sheet. It focuses on the responses to three questions. Frequently mentioned keywords that students mentioned were identified through text search and manual review. The authors recorded the number of

respondents referencing each keyword. The Open-ended responses regarding impressions of the class were categorized into the following three themes:

- Comments related to English expressions.
- Comments related to posture or gestures (e.g., "posture").
- Other topics.

Responses in each category were counted. Then, frequently mentioned answers were identified. The author utilized the search function of an Excel sheet. Though this way, the authors were able to see the area that students focused mainly on. By examining the categorized feedback, the impact of the movie became evident. It would lead to better class management in English classes.

Activity

The book of ATEM (2012), it clearly showed that using the movie *Back to the Future* in classroom practice can facilitate conversation practice based on previously learned grammatical structures through worksheets. However, this approach puts an emphasis on the potential of using movies to support the acquisition of natural conversational skills.

The primary purpose of introducing movies in this study was not to engage in the meticulous research of English expressions but to encourage students to practice critical thinking during lessons. Moreover, the activities aimed to encourage students to reflect on the engineering technologies that were shown in the film. They also share their ideas and experiences of cross-cultural elements presented in the movie.

At Kosen College A, the lessons were conducted in a CALL classroom, while at University B, they took place in a traditional classroom setting. They watched the first part, which comprised approximately 70 minutes of the film. After viewing the part, a teacher told the students to submit their reflections on the lesson through Google Forms. A teacher showed the movie's second half in the following lesson, after which students once again submitted their reflections using the same method.

Results

In several classes, response rates varied between the first and second sessions. Additionally, as shown in Class 3 (Figure 1), while the response rates before and after the sessions were nearly identical, the overall response rate remained relatively low.

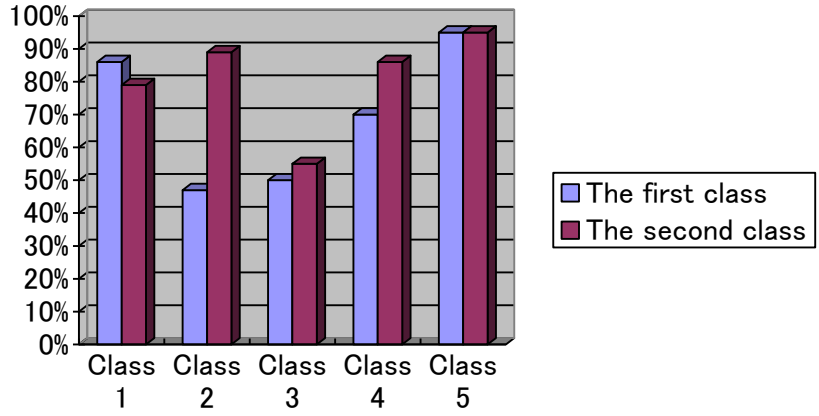

Figure 1: Response Rate for Feedback Across Classes

Table 1: After the First Class

	Class 1	Class 2	Class 3	Class 4	Class 5
the highest number	Plutonium, Fuel 10	Plutonium, Fuel 8	Time Machine, DeLorean 5	Time Machine, DeLorean 10	Time Machine, DeLorean 8
the second-highest number	electric current, electricity 3	Time Machine, DeLorean 4	Plutonium, Fuel 3	Plutonium, Fuel 6	Plutonium, Fuel 6

Table 2: After the Second Class

	Class 1	Class 2	Class 3	Class 4	Class 5
the highest number	Time Machine, DeLorean 9	Time Machine, DeLorean 17	Time Machine, DeLorean 10	Time Machine, DeLorean 4	electric power, lightning 14
the second-highest number	Plutonium, Fuel 5	Plutonium, Fuel 4	Plutonium, Fuel 8	Plutonium, Fuel 6	Time Machine, DeLorean 3

In this study, words related to “plutonium” and “fuel” were counted when they appeared as exact matches, and similar terms with closely related meanings were used in the context. Since students in Japanese wrote the comments, it was easy to determine contextual understanding.

For Question 1, across Classes 1–5, students consistently focused on and frequently mentioned terms such as “plutonium,” “fuel,” “time machine,” and “DeLorean.” This pattern remained essentially unchanged in the first and second sessions. However, in Class 5, after the later sessions, several students shifted their focus to terms such as electric power and lightning.

In addition, as for Question 2, responses varied considerably, making it challenging to identify clear trends. The English sentences mentioned by the students were generally of a

level equivalent to what Japanese students in Grades 8 through 10 would learn. Some students reported that they "could not catch" or understand the English dialogue in the movie. For Question 3, there was a significant trend in which references to the linguistic aspects of English and second language acquisition increased across three of the five classes, with six additional students commenting on these aspects. Conversely, the number of students who mentioned linguistic elements decreased in the remaining two classes. These two classes revealed that while some students recognized the importance of English language learning, others were more interested in the storyline, mechanical design of time machines, and other specialized fields.

The results of this study indicate that incorporating movies into English lessons at Kosen College A and University B effectively stimulated students' motivation for future English learning. Teachers achieved this by engaging students in activities that encourage them to express their opinions using their existing engineering knowledge. Though students' academic year and age are different, it could be curious that they draw similar perspectives from the same film. This would indicate that incorporating movies into English education can offer us meaningful insights in order to create future English education policies.

While this study focused on using movies, previous research by Fujita (2019) suggests that TV dramas, regardless of the student's proficiency levels, can also be highly effective teaching materials. It allows dramas to be incorporated into English lessons as an alternative or supplementary resource. In addition, Kadoyama (2017) indicated that both English for General Purpose and English of Specific Purpose materials significantly motivated learners and led to statistically significant improvement in listening skills.

In light of these findings, it is evident that TV dramas, like firms, can be valuable teaching resources that cater to various proficiency levels. These studies could suggest that English teaching materials including films, are suitable as listening materials. In other words, they would also potentially improve students' listening skills. Additionally, creating complementary speaking and writing exercises and designing methods for analyzing these activities presents significant challenges for future research.

Post-viewing Analysis

The post-viewing analysis of students' reflections revealed that students were able to interpret scenes from the movie from an engineering perspective based on their technical knowledge. However, their understanding of English vocabulary and expressions was limited to the level typically observed in Japanese lower-secondary to early high school students. This indicates that the need to enhance the practical aspects in English conversation activities as an important challenge for future curriculum development.

Conclusion

This study concluded that though the primary insights gained from the movie were engineering-related, there was limited progress in terms of language acquisition. To enhance the educational impact of film in English education at Colleges of technology, the study suggests that previewing activities should be introduced, focusing not only on engineering concepts but also on conversational expressions,vocabulary, and listening.

As a limitation, this study primarily focused on classroom practices rather than conducting a research-oriented investigation. Consequently, there were discrepancies in class size, the number of classes, and the timing and duration for feedback on written assignments in classes. Moreover, in some courses at Kosen College, the submission rate for feedback was relatively low. For future research, it would be beneficial to standardize these elements across both institutions. In addition, adopting unified participation practices, such as having at least one instructor observe all classes, could enhance the consistency of the research.

The classes in this study were conducted separately at two different schools. When teachers implement lessons for research purposes, it is essential to standardize survey questions and the timing of collection and conduct preliminary observations of the students' characteristics.

This study gave some insights into effective classroom management through examining students' reflections on English lessons using a film. From the results, future improvements in lesson design and future data analysis would be possible to boost students' motivation in future English learning in classes.

Acknowledgment

The authors received support from Professor Daisuke Fujiyoshi for his cooperation in facilitating the lessons.

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Comparative Study of Environmental Education Systems in Elementary Schools in China and Japan

Mao Yuying, Ritsumeikan Asia Pacific University, Japan
Li Yan, Ritsumeikan Asia Pacific University, Japan

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Abstract
This study undertakes a comparative analysis of the environmental education system in elementary schools in China and Japan. We first compared the elementary school system, including school years, subjects and teaching hours of both countries. We found that Japan and China's elementary education systems share essential subjects such as Language, Mathematics, Science, and Moral Education, and both lack a subject of environment. The second section examines the national environmental education policies. Japan's environmental education policies are systematic and consistent, integrated into the curriculum since 1998, with continuous improvements for sustainability. China has rapidly advanced its environmental education since 2003. Finally, we compared both countries' national environmental education guidelines and found that they have similar objectives but different teaching approaches. China treats environmental education as part of school education, focusing on shaping students' mindsets. Japan, however, emphasizes practical learning in each subject to prepare students for contributing to future environmental sustainability. The detailed information about both countries' environmental education systems in this paper may also help other countries improve their systems.

Keywords: Environmental Education, Comparative Analysis, Elementary School, Japan, China

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Introduction

Amid escalating global environmental crises, countries prioritize sustainable development. China and Japan, as influential nations in East Asia, face pressing challenges. China struggles with severe air pollution and is the largest greenhouse gas emitter (Cheng et al., 2021). Japan deals with waste management and marine pollution, notably from the Fukushima Daiichi nuclear power plant (Guo et al., 2022). These pressures emphasize fostering early environmental awareness through education.

Empirical research demonstrates that Japanese elementary school students exhibit significantly higher levels of pro-environmental behavior than Chinese students. This discrepancy is largely attributed to Japan's emphasis on experiential learning, outdoor activities, and cultural values that promote harmony with nature (Liu & Kaida, 2024). Such approaches are deeply integrated into Japan's educational and societal frameworks, fostering greater environmental responsibility among students. While both nations recognize the importance of environmental education, variations in implementation and pedagogy lead to differing outcomes. Japan's experiential and culturally immersive model effectively cultivates pro-environmental behaviors, offering valuable insights for global environmental education (Kodama, 2016; Liu & Kaida, 2024).

This paper aims to examine the differences and similarities in environmental education at the elementary school level in China and Japan. By conducting a comparative analysis of their environmental education guidelines, the study seeks to identify key differences that may contribute to Japan's environmental education's effectiveness and provide references that can be used for the development of environmental education curricula in Chinese elementary schools. The detailed information about both countries' environmental education systems in this paper may also help other countries improve their systems.

This paper includes three main parts: a comparison of the elementary school systems of China and Japan, an analysis of their national environmental education policies, and an exploration of differences in their education guidelines.

Elementary School System in China and Japan

China and Japan's elementary education systems prioritize comprehensive student development, reflecting cultural values and national policy goals through structured curricula and region-specific adaptations (Kodama, 2016; Wang, 2020).

Elementary School System in China

China's elementary education system operates under a centralized framework led by the Ministry of Education (MoE), which is responsible for formulating national policies, establishing curriculum standards, and overseeing educational reforms. Figure 1 explains the structure of China's elementary education system. The MoE ensures uniformity in educational quality and content across the country, setting guidelines for subjects such as Chinese, mathematics, science, and moral education. At the provincial, municipal, and county levels, local education departments are crucial in adapting national instructions to implement education properly and meet regional and local needs. These departments manage school administration, teacher recruitment, and resource allocation, ensuring that national policies are effectively implemented at the grassroots level.

Schools, as the elementary execution units, must follow the national curriculum while incorporating region-specific elements to address local cultural and social contexts. The MoE retains authority over textbook design, teacher certification, and educational assessments, while local governments oversee infrastructure, teacher placement, and student welfare. This tiered structure seeks to balance national standardization with localized flexibility, promoting equitable and inclusive access to quality education across diverse regions (Wang, 2020; Zhang & Liu, 2022).

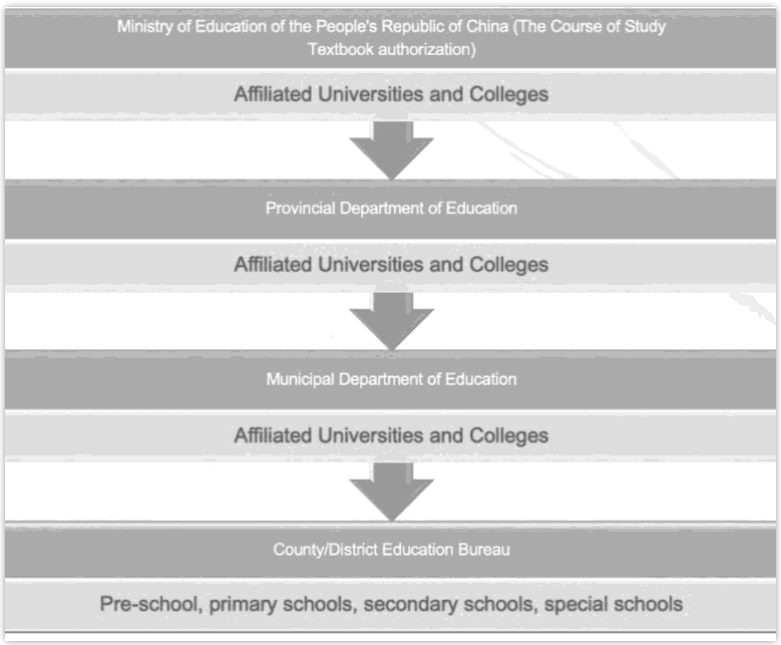


Figure 1: Elementary Education System in China

In China, elementary school textbooks are produced by various publishers, including the People's Education Press (PEP), local education bureaus, and regional publishers such as Shanghai Education Publishing House, Beijing Normal University Press, Jiangsu Education Press, and Guangdong Education Press. These localized editions reflect regional educational priorities and cultural characteristics. However, since 2019, subjects such as Chinese, Moral and Legal Education, and Physical Education have adopted nationally unified textbooks to ensure consistency and standardization across the country (Ministry of Education of the People’s Republic of China, 2019). This reform aims to reduce regional disparities, enhance the quality of basic education, and promote educational equity.

Table 1: Arrangement the Total Class Hours for Each Subject Over Nine Years in China

<table>
<tr><td></td><td colspan="9">Grade</td><td>Total class hours in nine years (%)</td></tr>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td></td></tr>
<tr><td rowspan="12">National Curriculum</td><td colspan="9">Morality and Law</td><td>6%–8%</td></tr>
<tr><td colspan="9">Chinese</td><td>20%–22%</td></tr>
<tr><td colspan="9">Mathematics</td><td>13%–15%</td></tr>
<tr><td></td><td></td><td colspan="7">English</td><td>6%–8%</td></tr>
<tr><td colspan="7"></td><td>History and Geography</td><td>3%–4%</td></tr>
<tr><td colspan="7">Science</td><td>Physics, Chemistry, Biology(or Science)</td><td>8%–10%</td></tr>
<tr><td></td><td></td><td colspan="6">Information Technology</td><td></td><td>1%–3%</td></tr>
<tr><td colspan="9">PE & & Health</td><td>10%–11%</td></tr>
<tr><td colspan="9">Art</td><td>9%-11%</td></tr>
<tr><td colspan="9">Labor</td><td>14%-18%</td></tr>
<tr><td colspan="9">Comprehensive Practical Activities</td><td></td></tr>
<tr><td>Local Curriculum</td><td colspan="9">Designed and planned by provincial education departments</td><td></td></tr>
<tr><td>School-Based Curriculum</td><td colspan="9">Determined by individual schools</td><td></td></tr>
<tr><td>Weekly Hours</td><td>26</td><td>26</td><td>30</td><td>30</td><td>30</td><td>30</td><td>34</td><td>34</td><td>34</td><td></td></tr>
<tr><td>Total Course Hours</td><td>910</td><td>910</td><td>1050</td><td>1050</td><td>1050</td><td>1050</td><td>1190</td><td>1190</td><td>1122</td><td>9522</td></tr>
</table>

(*Source: Adapted from Ministry of Education and translated by the authors*)

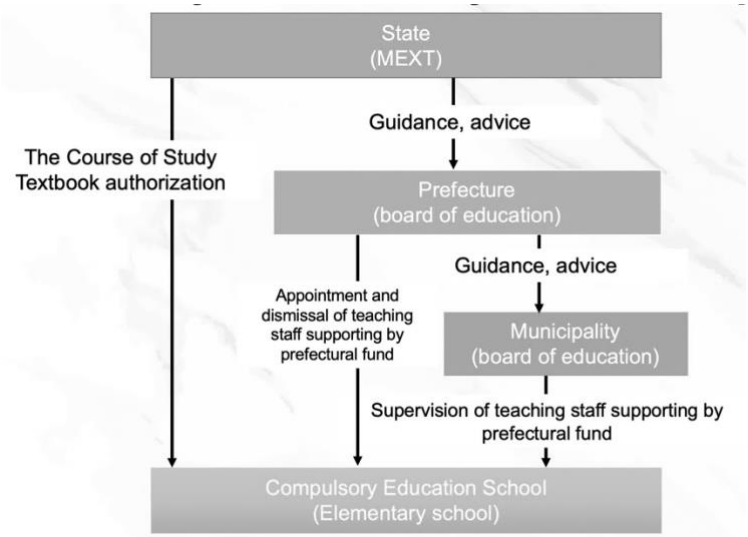
The MoE's 2022 curriculum plan specifies elementary school class hours. details the curriculum structure and class hours for elementary and secondary education in China. Elementary school (grades 1-6) includes core subjects: Chinese, Mathematics, and Moral and Legal Education, making up a major portion of total hours. Chinese comprise the largest share (20%-22%), followed by Mathematics (13%-15%) and Moral and Legal Education (6%-8%). Physical Education and Health (10%-11%) and Arts (9%-11%) are also included and emphasized.

Science is introduced in grade 3 and gradually increases in complexity. Foreign Language (6%- 8%) begins in grade 3, while Information Technology (1%- 3%) is included in grade 4. Comprehensive Practical Activities and Labor courses are integrated across grades. Provincial education authorities and schools allocate local and school-based courses in addition to the national curriculum, accounting for 14% to 18% of total hours.

Elementary School System in Japan

Japan’s elementary education system is renowned for its structured and highly coordinated administration, ensuring consistency and quality across regions. This well-organized system reflects the nation’s commitment to fostering equal educational opportunities for all students.

Figure 2 illustrates the structure of Japan's elementary education system, highlighting the roles of different administrative levels. At the top, the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) establishes national policies, authorizes textbooks, and defines the Course of Study (OECD, 2018). MEXT also provides guidance and advice to prefectural boards of education, which oversee regional educational administration. Prefectures manage the appointment and dismissal of teaching staff, which is funded by the prefectural budget.



(*Source: Adapted from National Institute of Educational Policy Research*)

Figure 2: Elementary Education System in Japan

Municipal boards of education operate under the guidance of prefectures, supervising teaching staff and managing the day-to-day operations of compulsory education schools. This hierarchical structure ensures that national educational policies are effectively implemented locally, maintaining consistency while allowing for regional adaptation. The collaboration between state, prefectural, and municipal authorities reflect Japan's commitment to high-quality, standardized education across the country (Nakata, 2019).

The 2021 Education Curriculum Department meeting set standard class hours for Japanese elementary school subjects. Table 2 shows the instructional hour distribution across six years. Japanese has the highest allocation, starting at 306 hours in first grade and decreasing to 175 hours by fifth and sixth grades. Mathematics remains at 175 hours from third grade onward, emphasizing numeracy.

Social Studies and Science begin in the third year, with their hours gradually increasing as students progress. Physical Education and Music are consistently included throughout all six years, although their hours decrease slightly in the upper grades. "Life Studies" is emphasized in the first two years but is gradually phased out afterward.

Moral Education and Special Activities have set hours across all grades, promoting character development and extracurricular participation. Home Economics starts in the fifth year, and Integrated Studies begins in the third year for interdisciplinary support.

Foreign Language Activities occur in the third and fourth grades, leading to formal Foreign Language classes in the fifth and sixth grades. Annual instructional hours steadily rise, reaching 1,015 by the fourth year and remaining consistent through the sixth grade.

Table 2: Standard Teaching Hours for Elementary Schools in Japan

Subject	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Japanese	306	315	245	245	175	175
Social Studies	——	——	70	90	105	105
Mathematics	136	175	175	175	175	175
Science	——	——	90	105	105	105
Life Studies	102	105	——	——	——	——
Music	68	70	60	60	50	50
Art	68	70	60	60	50	50
Home	——	——	——	——	60	55
PE	102	105	105	105	90	90
Special Subject: Morality	34	35	35	35	35	35
Special Activities	34	35	35	35	35	35
Integrated Learning Time	——	——	70	70	70	70
Foreign Language Activities	——	——	35	35	——	——
English	——	——	——	——	70	70
Total	850	910	980	1015	1015	1015

(*Source: Adapted from Ministry of Education, Culture, Sports, Science and Technology and translated by the authors*)

Comparison of the Elementary Education Systems of China and Japan

Japan and China's elementary education systems share essential subjects such as Language, Mathematics, Science, and Moral Education. Both countries emphasize comprehensive development through Physical Education and the Arts. More could be compared in detail as for their subjects and time allocation, but one important finding from this paper's perspective is that both countries don't have a subject called "environment" or a subject that could be directly interpreted as environment-related subject.

However, this does not mean they don't implement environmental education. They both have National Environmental Education Guidelines. The following sections will compare the national environmental education policies and selected guidelines from both countries in elementary schools.

The Environmental Education Policy in Elementary Schools in China and Japan

In this chapter, we will review the national environmental education policy in elementary schools in both countries.

Environmental Education Japan

Since 1947, Ministry of Education of Japan, now Ministry of Education, Science, and Culture (MEXT), has meticulously and systematically developed school educational guidelines. These foundational documents, known as the Gakushū Shidō Yōryō (Curriculum Guidelines), have provided detailed frameworks for all subjects, supported by explanatory notes to ensure consistent application nationwide. Revised approximately every ten years, these guidelines evolve to reflect changing societal and educational priorities, maintaining their relevance in a

rapidly transforming world. All versions can be found on the website of the National Institute for Educational Policy Research.

The Japanese government took actions on environmental education in a quite early time. The first environmental education materials for elementary schools were published in 1992 and in the revision Curriculum Guidelines for elementary schools in 1998 (Heisei 10) revision, environmental education was formally incorporated to curriculum. Specifically, it encouraged learning about environmental issues during periods such as Integrated Studies to raise awareness about environmental problems. Before this, topics related to the environment were covered in natural sciences and life studies, but it was not until the 1998 revision that environmental education became a systematic theme within the curriculum guidelines. Following this revision, the 2008 curriculum revision further strengthened environmental education, and today, it is a crucial theme aimed at realizing a sustainable society. The latest revision of primary school Curriculum Guidelines was issued in H29 (2017), and the environmental education in each subject is summarized on the website of MEXT. A new version of environmental education materials is provided by the same National Institute for Educational Policy Research in 2016.

Environmental Education in China

The Ministry of Education issued the 2003 Implementation Guide for Environmental Education in Schools and published the related announcement and document on its official website. This marked the beginning of the formal integration of environmental education into the national curriculum. This guide was pivotal in creating a structured framework for incorporating environmental topics into the curriculum across grade levels. It emphasized three core aspects: emotional engagement, practical processes and methods, and knowledge and skills, ensuring a holistic approach to fostering ecological awareness among students.

In 2022, the Ministry of Education introduced the Implementation Plan for a Green and Low-Carbon Education System. This plan built upon earlier initiatives by emphasizing environmentally sustainable practices, such as carbon reduction and green lifestyles, to prepare students for challenges in a sustainable future. Furthermore, in 2023, the Opinions on Strengthening Science Education in Schools reinforced environmental education by promoting scientific approaches to sustainability, aligning with national goals of innovation and ecological responsibility. These documents are very brief but also available on the official website of the Ministry of Education of the People's Republic of China.

In conclusion, Japan has methodically integrated environmental education into its curriculum since 1998, persistently refining it to foster sustainability. Conversely, China formally introduced environmental education into its national curriculum in 2003 and has achieved significant advancements since then.

Comparison of the National Environmental Education Guidelines of China and Japan

The 2007 Environmental Education Instructional Materials in Japan and the 2003 Guidelines in China were chosen for their foundational roles in shaping environmental education. These key documents highlight each country's historical progress and strategic approaches to integrating environmental education into their curricula.

Overview of Document Contents

Japan's document includes four chapters, along with references, and stretches across 106 pages. The four chapters are structured as below:

- Chapter 1: Environmental Education and Environmental Issues
- Chapter 2: Environmental Education in Elementary Schools
- Chapter 3: Practical Examples of Environmental Education in Schools
- Chapter 4: References

Chapter 1 outlines the importance of environmental education and discusses various perspectives on the topic. In Chapter 2, it emphasizes practicality by offering clear guidance on incorporating environmental education into every discipline. Chapter 3 presents case studies and implementation strategies, providing actionable insights for educators to apply theoretical knowledge in the classroom setting effectively. Chapter 4 details the document references, serving as a gateway for thorough exploration.

China's document comprises five chapters and totals 26 pages, focusing on building a structured framework for environmental education. The five chapters are structured as below:

- Chapter 1: Background and Environmental Issues
- Chapter 2: Definition and Objectives of Environmental Education
- Chapter 3: Learning Content
- Chapter 4: Teaching Strategies
- Chapter 5: Evaluation Suggestions

The document starts with Chapter 1, which covers global and domestic trends, their significance, and the basic principles of environmental education. Chapter 2 outlines its goals, focusing on emotional engagement, processes and methods, and knowledge for sustainability. Chapter 3 details the learning content across emotional, methodological, and knowledge-based areas with activity suggestions. Chapter 4 provides practical guidance on implementation, emphasizing hands-on and locally relevant activities. Finally, Chapter 5 focuses on evaluation methods to assess and improve the effectiveness of environmental education in schools.

This illustrates Japan's emphasis on detailed and actionable content within more extensive documents, whereas China provides concise guidance that can be adapted to local contexts' needs. Japan integrates environmental education into practical applications, while China emphasizes a broad framework. These differences highlight each country's educational priorities and provide complementary strategies for environmental education.

Objectives of Environmental Education

Japan's document defines the objectives of environmental education as:

> Having an interest in and knowledge about the environment and environmental issues, based on a comprehensive understanding and recognition of the relationship between human activities and the environment. It aims to equip individuals with the skills and critical thinking needed to take desirable actions for environmental conservation, develop the ability to make judgments, and actively participate in creating a sustainable society. Ultimately, it fosters attitudes and behaviors that take responsibility for the environment. (P.9)

China's document defines the objectives of environmental education as:

> The objective is to guide students in recognizing environmental issues that pertain to their families, communities, nations, and the global context. This initiative emphasizes the importance of understanding the interdependent relationships between society and nature, thereby facilitating acquiring knowledge and skills necessary for meaningful interaction with the environment. Additionally, it cultivates feelings, attitudes, and values that are advantageous to environmental stewardship, encouraging students to engage actively in decisions and actions related to sustainable development, ultimately shaping them into socially responsible citizens with practical capabilities. (P.5)

Japan's environmental education fosters interest, knowledge, and critical thinking to encourage responsible actions for environmental conservation and active participation in building a sustainable society. China's environmental education emphasizes understanding global and local environmental issues, cultivating values for environmental stewardship, and encouraging socially responsible actions for sustainable development.

Approaches of Environmental Education

The 2003 Guidelines in China provide a framework for implementing environmental education in Chinese primary schools in Chapter 3. It details objectives and activities for different grade levels and highlights three core aspects: emotional engagement, processes and methods, and knowledge and skills. These three aspects are structured as below:

- Emotional Engagement, Attitudes, and Values
  - Focuses on fostering respect and empathy for nature.
  - Encourages activities like observing natural phenomena, listening to nature sounds, and role-playing as animals or plants.
- Processes and Methods
  - Emphasizes developing problem-solving skills.
  - Includes identifying local environmental issues, conducting sensory observations, and proposing solutions in group discussions.
- Knowledge and Skills
  - Natural Ecosystems: Understanding ecological processes, biodiversity, and environmental interactions.
  - Social Life: Exploring the relationship between human activities and environmental sustainability.
  - Economy and Technology: Analyzing the impact of resource use and technological advancements on the environment.
  - Participation and Decision-Making: Encouraging active involvement in environmental protection and sustainable development initiatives.

Additionally, the document offers content and guidance on teaching activities for grades 1 through 6, ensuring a structured and age-appropriate approach to environmental education. Here, we use the first aspect, "emotional engagement, attitudes, and values," as an example (Table 3). This underscores the importance of cultivating students' respect for nature and various life forms. Engaging in activities such as observing natural phenomena, listening to natural sounds, and reading poetry focused on the environment facilitates a deeper connection with nature. Additionally, role-playing as animals or plants within a balanced ecosystem promotes empathy and a sense of responsibility towards the natural world.

Table 3: Emotional Engagement and Activity Suggestions in Environmental Education (Grades 1–6)

Content and Requirements	Activity Suggestions
Appreciate nature's beauty and respect living organisms' right to exist.	Experience sunrises, sunsets, blue skies, fluffy clouds, winding rivers, and birdsong. Listen to flowing water... Write poems to celebrate nature's beauty and embrace harmony with it. Adopt a plant or animal and enjoy thriving alongside living beings.
Respect and care for others, treating them kindly while sharing joy and happiness together.	Use topics like "If I were..." to explore the needs of diverse ethnic, social, and economic groups. Organize activities, like creating a poster for "A Harmonious 2010."
Acknowledge and honor the varying needs while promoting a simple and eco-friendly lifestyle.	Recognize when needs differ, such as distinguishing necessities from luxuries in life. Determine what is essential versus non-essential.
Respect and recognize the cultural diversity of various peoples and explore methods to preserve and appreciate nature.	Engage with communities to appreciate their unique cultures. Recognize cultural traditions and explore the links between culture and nature.
Recognize your environmental rights and responsibilities; actively engage in school and community initiatives to protect the environment and assess behaviors that impact the environment.	Explore environmental protection systems and regulations. Grasp the importance of environmental rights and responsibilities. Organize school recycling campaigns or join community cleanups.

(*Source: Adapted from Ministry of Education and translated by the authors*)

Japan, similar to China, highlights the significance of skills and mindsets in environmental education, although its framework is less comprehensive than China's guidelines. Here are the abilities and attitudes emphasized in the document:

- Abilities
  - Identifying Issues: Engage with and identify environmental issues proactively.
  - Planning: Create plans from observations and experiments to address issues.
  - Inference: Inferring cause-and-effect relationships through problem-solving and data analysis
  - Utilizing Information: The ability to gather and analyze information on environmental issues and communicate effective findings.
- Attitudes
  - Forming and Expressing Opinions: The approach of forming and sharing personal opinions while respecting and understanding others' perspectives.
  - Making Fair Judgments: A comprehensive and objective mindset towards environmental issues, emphasizing fairness and responsibility.
  - Active Participation: Engaging in environmental protection, exchanging ideas, and participating in practical activities and solutions.

These abilities and attitudes form the foundational skills required for environmental education, which are further complemented by the six key perspectives that provide a structured framework for understanding and addressing environmental issues. These perspectives are structured in detail as below:

- Cycles
  - Emphasizes the interconnected flow of materials and energy in the natural world, aiming to develop awareness of sustainable resource use and waste reduction.

- Diversity
  - Highlights the variety of organisms, energy sources, and ecosystems on Earth, encouraging respect for biodiversity and an understanding of its critical role in maintaining ecological balance.
- Ecosystems
  - Focuses on the relationships and interdependence among living organisms, their physical environment, and human activities, promoting an understanding of ecosystem dynamics.
- Symbiosis
  - Encourages coexistence and mutual support between humans and the environment, fostering actions that contribute to sustainable living.
- Finiteness
  - Draws attention to the limited nature of Earth's resources, urging careful use and conservation to prevent resource depletion.
- Preservation
  - Stresses the importance of protecting natural environments and ecosystems, encouraging active efforts to maintain biodiversity and ecological health.

The document delineates comprehensive requirements for environmental education across all subjects, guided by six distinct perspectives, thereby ensuring thorough integration throughout the curriculum. In this context, we utilize the Science as a pertinent example to illustrate how Japan integrates the six environmental perspectives into its curriculum. (Table 4)

For instance, the "cycles" perspective is addressed through topics such as the movement of water in nature and the human body's structure. "symbiosis" is explored through lessons on the interaction between plants, animals, and their environment, while "diversity" emphasizes seasonal changes and the variety of life forms. The "finiteness" perspective examines the limitations of resources like air and fuel, and "preservation" focuses on conserving ecosystems and water. Finally, the "continuity of life" is highlighted through teachings on plant growth, reproduction, and the lifecycle of living organisms. This structured integration demonstrates how Science in Japan holistically incorporates sustainability principles.

Table 4: Environmental Perspectives in Japanese Science Education

Examples of Science Learning Content	Examples of Perspectives on Understanding the Environment
Seasons and Living Things , Structure of the Human Body, Heat Retention, Combustion and Air, The Behavior of Water in Nature, Functions of Flowing Water	Circulation
The Growth of plants and insects, Seasons and the habitats of living organisms, Life and Environment of Organisms	Coexistence
Seasons and Organisms, The Living Environments of Organisms, The Functions of Flowing Water	Diversity
Living organisms and the Environment Functions of Electricity and Light, Combustion and Air, Effect of Current,	Finiteness
Living organisms and the environment, The Functions of Flowing Water	Conservation
The Growth of plants and insects, Seasons and the habitats of living organisms, Life and Environment of Organisms, Plant Germination, Growth, and Fruiting,	Respect for life
The Growth of plants and insects, Plant Germination, Growth, and Fruiting, The birth of man and fish	The continuity of life

(*Source: Adapted from Ministry of Education, Culture, Sports, Science and Technology and translated by the authors*)

For instance, the "cycles" perspective is addressed through topics such as the movement of water in nature and the human body's structure. "symbiosis" is explored through lessons on the interaction between plants, animals, and their environment, while "diversity" emphasizes seasonal changes and the variety of life forms. The "finiteness" perspective examines the limitations of resources like air and fuel, and "preservation" focuses on conserving ecosystems and water. Finally, the "continuity of life" is highlighted through teachings on plant growth, reproduction, and the lifecycle of living organisms. This structured integration demonstrates how Science in Japan holistically incorporates sustainability principles.

Comparison of Distinctive Features in Environmental Education

In Japan, environmental education is woven into specific subjects with clear and practical teaching suggestions. This approach is highly structured, with key themes like "cycles," "diversity," and "symbiosis" integrated into lessons across various disciplines. The goal is to help students connect theoretical concepts with real-life examples, encouraging them to think critically and actively address environmental issues. However, the way these guidelines are implemented often varies depending on the resources available and how individual schools interpret them.

China takes a different approach, focusing on a broader framework emphasizing emotional connection, practical skills, and basic environmental knowledge. The guidelines encourage

schools to design activities suited to local conditions, with a gradual progression tailored to different grade levels. This flexibility allows schools to address specific environmental challenges while promoting respect for nature and sustainable values. However, differences in regional resources and school capacities mean that actual practices often diverge from the overall framework.

Conclusion

This paper presents a comparative analysis of the environmental education systems in elementary schools in China and Japan. It examines the differences in both countries' school structures, national policies, and educational guidelines. The study highlights similarities in foundational subjects and objectives but identifies distinct approaches to implementing and integrating environmental education into the curriculum.

The main contribution of this study is its detailed comparison of China and Japan's environmental education systems, offering insights into their respective strengths. China's approach emphasizes cultivating emotional engagement, skills, and knowledge within a structured and clearly defined framework. In contrast, Japan provides specific, detailed guidance for cross-disciplinary teaching, integrating environmental education into each subject area with clear instructions. These findings provide valuable perspectives for other countries aiming to improve or establish their environmental education frameworks.

Future research could focus on exploring how these differing guidelines are practically integrated into specific subjects. Such studies could provide valuable insights into their effectiveness and reveal how subject-level implementation influences students' environmental understanding and engagement.

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Teaching Film Appreciation as a Theoretical and Practical Course: A Pedagogical Reassessment

Indumathi Somashekar, Christ University, India

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Abstract
Film appreciation is an academic course that teaches students the art of reading and analysing films. The study of films as an art involves analysing films through various lenses, including film history, narratives, technical aspects, school of cinema, genres, and film theories. Although the course is founded in theory, it has wider practical pedagogy as the course instructor, screens films in class and facilitates discussion based on the theoretical aspects of films. The larger aim is to critically analyse film either in the written or spoken form to appreciate film as an art. The fundamental objective of the course is to inculcate critical thinking, analytical, and writing skills among students. It can be argued that film appreciation is a combination of theory and practical course even though it is predominantly viewed as a theoretical course. This conceptual paper challenges the dominant notion of film appreciation course as a theoretical course pedagogy using the basic principles of distinction between a practical and theory course. It applies the theory of interconnectedness between theory and practical to support the argument. By emphasising active learning through experience and reflection, this paper re-envisions film appreciation course as a combination of theory and practical pedagogy. This can help in reconceptualising and reenergising courses that are often viewed with traditional prism.

Keywords: Film Appreciation, Theoretical, Practical Course, Pedagogy

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Introduction

Film appreciation as a course is the art of understanding and analysing films. It is a course that is often opted by cinephile students, which can be perceived as their desire to study the art form that they revere. As a film enthusiast, I found myself drawn towards the course back in my college days, while pursuing post-graduation studies. Fortunately, the course instructor had structured the course to ensure that course included dedicated film screening hours every week along with film discussion, in addition to theory classes. It was an enriching experience to study the elements, aesthetics of films, philosophy, semiotics, among others. As I delved into teaching, I was keen on teaching the film appreciation course, but the experience was not as expected. It was a long haul of theory classes with no screening of films. The course was structured in a way that that the total number of hours were divided into teaching theory hours for different units. It was an unthinkable scenario to teach films without film screening and discussion. I tried to improvise by screening films during the free hours of the respective class, which was met with fair share of protests from a sizable portion of students, who did not like the idea of forgoing their free hours. However, students would attend the classes due to attendance. Since it was a general course for the whole class, some film enthusiasts looked forward to the film screenings, while others grumbled and even sometimes fell asleep during the sessions.

When I moved to a different university, I tried a different formula. The course was fours hours per week, and so I would screen film for two hours, and teach theory and lead discussions in the other. Since the overall evaluation was in the form of theory exams, I found it challenging to finish teaching all the concepts. When this did not work as it should, I devised a plan of converting the theory course into a practical or submission-based course, and changed a larger part of the syllabus. Until then I did not have the autonomy to decide if a course could be theory or practical. I planned the syllabus in such a way that I incorporated compulsory film screenings in each of the units related to the film concepts. Since it was a practical paper, the evaluations were based on assignments, and not written examinations. I had greater freedom to change my methods of teaching, the nature of assignments and naturally my satisfaction level with the teaching experience improved considerably. Students enjoyed some of the assignments, which were reflective in nature. Although I was able to bring in experiential learning, reflective discussions and critical thinking in my film appreciation course, traditionalists started asking questions. At different levels of presentations such as the Board of the Studies meeting, objections were raised regarding the practical nature of the course, as they strongly opined that it was a theory course. The conflict served as the starting point for this conceptual paper.

Is film appreciation a theory or a practical course? This question forms the fundamental basis for this conceptual paper that attempts to delineate the apt pedagogy to teach film appreciation in higher education. Film appreciation is a popular course often taught as part of programmes like film studies and communication studies at both undergraduate and postgraduate level. In India, it is often regarded as a theoretical course and the teaching method may primarily involve lectures and the method of evaluation is often written exams and assignments. However, the andragogy of teaching and assessments are also determined by the educational systems of countries where the course is taught, and may vary in teaching approach and philosophy. In countries, where examinations are the main means of determining the grades of students, courses like film appreciation or film studies are often treated as purely theoretical subjects with little or no room for film screenings, discussions, and creative assignments. This practice can take away the real essence of film appreciation course, which is largely experiential and introspective in nature. This paper argues the need and basis to treat and teach film appreciation

as a combination of theory and practical course to enhance the teaching and learning process of film appreciation.

Research Questions

Is film appreciation solely a theoretical course?

Can changing the teaching approach of film appreciation enhance experiential learning among students?

Dichotomy of Theory and Practice

The academic courses are often classified as theoretical or practical courses. A clear-cut distinction is established between the two types. A theoretical course is described as a course that deals with theories, concepts, and principles, and in doing so it provides foundational knowledge. Aside from this a theory course is said to enhance critical thinking and develops analytical skills. On the contrary, a practical course is often considered as learning by doing. It involves application of theoretical knowledge and includes hands on experience. It helps in development of applied skills.

The study of film appreciation includes the study of the history of cinema, elements of film, context of film, film movements, style of directors, themes, symbolism, film theories, film critique, and writing, among others (Monaco, 2009). However, it includes film screenings and discussions. In addition to this, it also involves writing film reviews and other form of film critiques. This brings us to our first research question if film appreciation can solely be considered as a theoretical course. Aside from learning theoretical concepts, the course should primarily involve films screening, discussion, and written analysis. This process is an active analysis of film in the form of viewing, critical thinking, spoken and written analysis. The analysis in the form of discussion and written analysis is practical application of learned knowledge.

While it is evident that courses such as film appreciation is a combination of theory and practical components, this will not be readily accepted due to the largely accepted dichotomous understanding. There is a common misconception that practical courses are taught in the laboratory using mechanical or electronic instruments.

The dichotomy of theory is thinking, and practice is doing is directly linked to theory as the realm of the mind, and practice is connected to the realm of body. There is a need to create a greater awareness that dividing line between theory and practice can be blurred effectively. The distinctness or closeness between theory and practice depends on school of thought. “The distinctness of theory and practice tends to fade under the influence of a naturalistic psychology which stresses a controlling cognitive function (explicit and implicit) in virtually all behavior beyond sheer physical movement.” (Edel, 1988, p. 159) Historically, it can be seen that the distinction between such dualities have blurred. Further, the rigidity has transformed into contextual distinctions. In the due process, theory and practice are interconnected.

Conclusion

From the analysis above it is evident that there is a need for pedagogical reassessment of film appreciation course to understand the true nature of this course, which will determine its

authenticity. To enhance experiential learning among students this combination of theory and practical can be useful. This will encourage course instructors to change both teaching methods and give creative assignments to cater to the approach of course. This will reduce dependence on only lectures, exams, and essays. It will also create an atmosphere for dedicated film screening hours, discussions, and creative assignments. This conceptual study concludes that film appreciation is not purely a theoretical course; it is a combination of both theory and practice, as it employs theory to actively critique films in written and spoken form.

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Contact email: indyindiana.24@gmail.com

ORCID: 0000-0002-0340-1526

Using Short Films to Develop Cultural Intelligence in the Classroom

Marco Aponte-Moreno, University of Southern California, United States

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Abstract
This paper explores the use of short films as an innovative teaching tool to develop cultural intelligence (CQ) in classroom settings. CQ is defined as the capacity to effectively interact with and adapt to diverse cultural contexts. It is often described through three elements: knowledge of other cultures, mindfulness of cultural differences and personal biases, and cross-cultural skills. Weekly discussions centered around short films from various cultures enable students to deepen their understanding of other cultures and enhance their awareness of cultural differences. This paper outlines the theoretical foundation, activity structure, criteria for film selection, and examples of films used. Additionally, it discusses the pedagogical implications and recommendations for educators aiming to integrate this method into their teaching practices.

Keywords: Cultural Intelligence, Short Films, Experiential Learning

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Introduction

Globalization has made cultural intelligence (CQ) an essential skill in education and professional settings. Understanding other cultures has become a critical ability not only in domestic contexts, where people from diverse cultural backgrounds often work together, but especially in global settings. In today's global business environment, it is common to be based in one country while interacting daily with people in other countries (Adler, 2008). Cultural intelligence has become a vital skill for professionals worldwide.

Thomas and Inkson (2017) define CQ as the ability to understand, respect, and adapt to cultural differences. They distinguish three components:

1. Knowledge: Understanding cultural norms, values, and behaviors.
2. Mindfulness: Awareness of cultural differences and self-reflection on biases.
3. Skills: Adaptation to intercultural situations and effective communication across cultures.

This paper proposes the use of short films from different cultures as a pedagogical tool to develop CQ. Films serve as windows into cultural contexts, offering students the opportunity to engage critically with cultural similarities and differences. The integration of weekly discussions of international films into the curriculum provides a structured and experiential approach to fostering CQ in diverse classroom environments.

The Activity

This activity was developed in an undergraduate course on Cross-Cultural Negotiation at the Marshall School of Business, University of Southern California. The course had two main objectives: to improve students' negotiation skills in cross-cultural settings and to foster cultural intelligence. The class met twice per week for two hours. The short films were shown at the beginning of the first weekly class session. The activity was conducted in the Fall semester of 2023 in a class of 32 students. It consisted of showing students a short film from another culture in the classroom as a springboard for discussing that culture and its differences from the students' own culture. The ultimate goal of the activity was to develop students' cultural intelligence. The activity is structured as follows:

1. Watching the Film: Students view a short fictional film from another culture (maximum 15 minutes) that reflects cultural nuances.
2. Cultural Analysis: Using theoretical frameworks like Hofstede's model or the GLOBE project, students identify and discuss cultural differences and similarities between their culture and the culture of the film.
3. Reflective Exercise: Students reflect on the cultural differences and similarities noted in the films through journaling, group discussions, or presentations.

This activity enhances both the knowledge and mindfulness components of CQ while encouraging critical thinking and meaningful dialogue. With strong knowledge and mindfulness of cultural differences, students are equipped with the necessary tools to perform effectively in cross-cultural settings (also developing the skills component of CQ).

Well-known analytical models that compare two or more cultures include Hofstede's cultural dimensions (Hofstede, 1980) and the GLOBE project (House et al., 2004). These models propose different dimensions along which cultures are compared to characterize leadership

styles. In this activity, we used the Hofstede Framework, mainly for its simplicity, scope, and accessibility.

The Hofstede Framework

Hofstede's cultural dimensions model is one of the most widely used frameworks for analyzing cultural differences. Developed by Dutch social psychologist Geert Hofstede in the 1970s, it is a model for understanding cultural differences across nations and their impact on organizational behavior and management. Hofstede initially derived his framework from a study of IBM employees in over 50 countries, analyzing how national culture influences workplace values and attitudes. Today, the framework includes data from over 90 countries, making it one of the most comprehensive tools for comparing cultural dimensions globally. The framework includes the following six dimensions:

1. Power Distance: The extent to which less powerful members of a society accept and expect unequal power distribution.
2. Individualism vs. Collectivism: The preference for independence and self-reliance versus group interdependence.
3. Motivation toward Achievement and Success: The focus on achievement, competitiveness, and material rewards versus quality of life and care for others.
4. Uncertainty Avoidance: The degree to which people feel threatened by ambiguity and take measures to avoid it.
5. Long- vs. Short-Term Orientation: The emphasis on future planning and perseverance versus a focus on immediate outcomes.
6. Indulgence vs. Restraint: The degree to which a society allows free gratification of basic and natural human desires.

This model provides a structured way to analyze and discuss cultural differences, offering insights into how cultural values influence behavior and decision-making. For example, comparing China and the United States along the six dimensions reveals distinct cultural patterns that shape interactions and expectations.

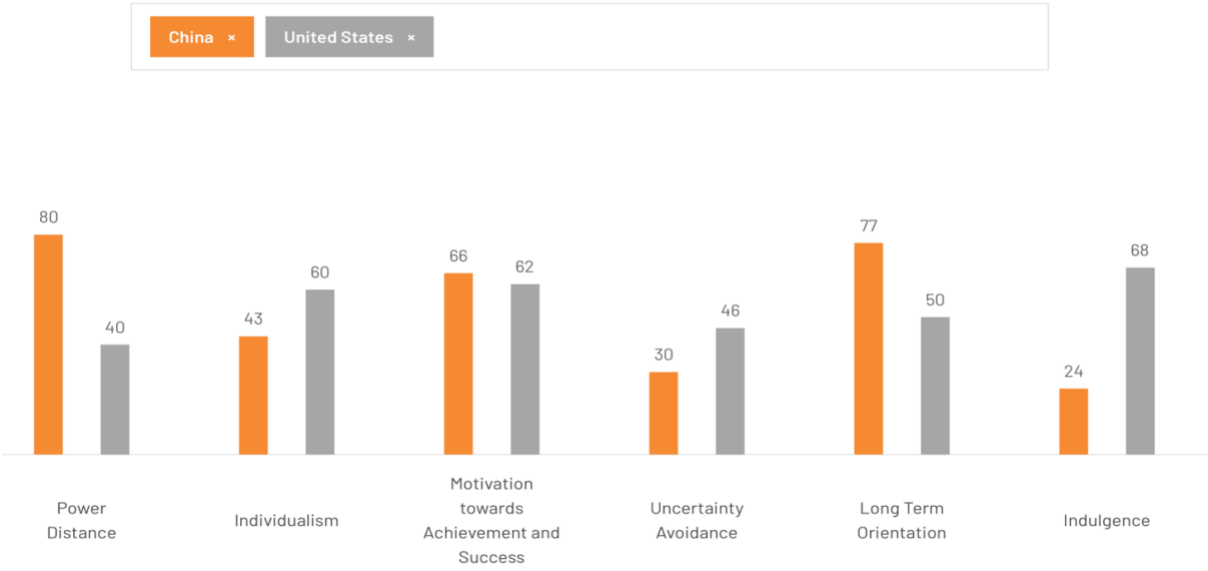

Figure 1: Hofstede's Cultural Comparison Between China and the United States

Film Selection Criteria

To achieve the desired learning outcomes, films must meet specific criteria:

- Length: Short films (up to 15 minutes) maintain focus and facilitate concise discussions.
- Artistic Quality: Preference for award-winning films with rich cultural narratives.
- Cultural Context: Films should feature clear cultural elements, especially in workplaces or schools.
- Accessibility: Films in English or with subtitles, readily available on platforms like YouTube or Vimeo.

Online searches on YouTube and Vimeo could include keywords like "Short film from [Country]," "Award-winning," "Oscar-winning," etc. Filters to obtain films of less than 15 minutes can be applied. The American publication *The New Yorker* has a YouTube channel with recent short films of high artistic quality, offering an excellent source of short films from various cultures.

Table 1: Some of the Films Shown in Class

Film	Culture	Director	Year
Time	Australia	Liam Connor	2013
Cow Theory	France	Solal Moisan & Daniel Sicard	2016
Level 13	India	Samir Tewari	2019
Two and Two	Iran	Babak Anvari	2011
The Widow	Japan	Kenjo McCurtain	2018
La Madre Buena	Mexico/US	Sarah Clift	2016
The Funeral	Nigeria	Odiachi Ashimedua & Godwin Nzekwe	2022
Final Exam	Singapore	Kai Xiang	2019
Stutterer	UK/Ireland	Benjamin Cleary	2015
La Inquilina	Uruguay	Raul Pierri	2019
Alternative Math	USA	David Maddox	2017
036	Spain	Juanfer Andrés & Esteban Roel	2011

Example and Discussion Points

An example of the type of short film that can be used in this activity is the American film *Alternative Math* (dir. David Maddox, 2017). This film could be used to discuss American cultural dimensions in a non-American educational context. This short film, with elements of satire, tells the story of a teacher who faces backlash from parents and the school administration after marking a student's answer incorrect, despite following basic mathematical principles. Potential observations drawn from an analysis of the film based on the Hofstede's framework could include:

- Low Power Distance: Egalitarian interactions between teacher and students.
- High Individualism: Accountability placed on the teacher rather than collective support.
- Short-Term Orientation: Immediate resolution of conflicts without long-term planning.

- Low Uncertainty Avoidance: Openness to unconventional methods, reflected in the idea of "alternative" math.
- High Motivation toward Achievement and Success: Competitive, assertive decision-making by school authorities.
- High Indulgence: A relaxed and informal classroom environment.

Other Pedagogical Implications, Student Experience, and Biggest Challenge

In addition to improving cultural intelligence, short films from other cultures create a more engaged classroom. They captivate students, offering a window into other ways of life. Furthermore, they provide opportunities to develop critical thinking as students compare and contrast their own culture with the culture of the film. Educators should prepare guiding questions, contextualize films, and ensure cultural sensitivity during discussions to maximize learning outcomes. For example, students may be asked to consider how their cultural biases shape their interpretation of the film.

Student evaluations of the course reflected positive feedback about the activity. Many students expressed enjoyment and noted how much they learned from the films. They appreciated being exposed to films from various countries and cultures.

The biggest challenge was selecting the films, a process that proved to be very time-consuming. We had to identify films of high artistic quality that were suitable for a classroom setting while also containing sufficient cultural elements. Additionally, the films needed to be subtitled in English, which further complicated the search for the right ones.

Conclusion

Short films are a powerful tool for developing cultural intelligence (CQ). They offer an engaging and reflective platform for students to explore cultural differences and enhance their intercultural competencies. By integrating theoretical frameworks like Hofstede's model, the activity ensures a systematic approach to the analysis.

Future activities could be designed to expand this approach into diverse educational settings beyond business education. For example, in language learning, short films could be used to immerse students in the cultural nuances of a target language. In sociology or anthropology classes, they could serve as case studies to analyze societal norms and values across cultures.

Outside traditional classrooms, this method could be adapted for corporate training programs, where employees learn to navigate multicultural workplaces, or for community workshops aimed at fostering intercultural understanding. These activities could be tailored to specific audiences and contexts, making the use of short films a versatile and impactful tool for teaching CQ across disciplines.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

ChatGPT was used to assist with editing this paper.

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Contact email: apontemo@usc.edu

Development and Implementation of an English Pronunciation Learning Website

Akemi Ishii, Shibaura Institute of Technology, Japan

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Abstract
In this study, a web-based pronunciation learning system was developed. The site targets words and expressions studied in class. Students can use it in the classroom, but they can also self-practice pronunciation anywhere. The English audio was created using a free, high-quality speech synthesis site. Words and short sentences from a textbook used in class were selected, and spelling, phonetic symbols, and Japanese translations were displayed on the webpage. Buttons for audio playback were also placed on the screen. Words and phrases are arranged in the order they appear in the textbook. A search function is added to enable pinpoint search. Students were surveyed at the end of the Fall 2023 and Spring 2024 semesters. The results were highly encouraging, with many positive comments and valuable feedback in the free-response section.

Keywords: Pronunciation Learning, Web-Based Learning Materials, Classroom Use, Self-Study

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Introduction

Traditionally, in Japan, emphasis has been placed on acquiring knowledge through reading and expressing thoughts through writing, which left the learning of speaking and listening behind[1]. Until recently, university entrance exams focused on grammar and vocabulary, with few questions testing oral communication skills, and consequently, high school education prioritizes writing ability over pronunciation. The phonetic differences between Japanese and English also create difficulties, as some sounds in English don't exist in Japanese. This factor makes learning English pronunciation even more difficult in Japan. Since Japan is a relatively homogeneous society with limited opportunities for real-life English interaction, students rarely can listen to and practice speaking English outside the classroom. Also, non-native English teachers without strong pronunciation skills make it difficult for students to learn accurate pronunciation. For these reasons, and from the cultural background that Japanese people are not very active in speaking up, Japanese students tend to avoid speaking English aloud when they don't have confidence in pronunciation. This hesitation hinders their pronunciation development.

So, how can students learn English pronunciation? In the days when speech reproduction was not yet technically easy, pronunciation learning was done by referring to phonetic symbols in dictionaries. However, in recent years, a significant number of students have not been taught and understand how to read phonetic symbols before entering university. Now, with the advancement of technology, students can easily reproduce sounds as many times as they wish. Therefore, the most effective way to improve pronunciation is to integrate more listening and speaking exercises using native speech in and outside classrooms so that students can cultivate confidence in English communication.

One practical approach to improving listening and speaking skills is mimicry, which involves imitating a speaker's pronunciation, including sounds, rhythm, intonation, and other aspects of the speech. Native speakers are the best source of authentic pronunciation, intonation, and rhythm, but it is not always accessible when you reside in non-native environments. In such cases, thanks to technology again, synthesized speech is a strong partner. Modern speech synthesis technology can produce high-performance synthesized speech equivalent to human speech, and some are free of charge. Students can then choose the voice they wish to imitate. There are several options for voice quality as well as gender. They can also select the country or region where English is spoken, as English is pronounced differently with regional pronunciation and accents.

In this study, a web-based pronunciation learning application was developed. It utilizes speech playback, where speech was generated using speech synthesis. Students can use it on a PC, smartphone, and tablet in and outside classrooms, allowing them to learn pronunciation efficiently, irrespective of location and time.

1. Development Environment

This application was developed on Xserver with the cooperation of a software developer. Xserver is a popular web hosting service based in Japan, known for its high-speed performance and reliability. With this application, students can learn pronunciation repeatedly by playing sample audio files on the site. Using WordPress, teachers can create and register content such as spelling, phonetic symbols, Japanese translations, and audio. WordPress is a content management system that allows teachers to create, manage, and

publish websites without advanced coding skills. The audio files are in mp3 format, generated by the high-quality speech synthesis site "Ondoku-san"[2]. We selected American male and female voices.

2. Material Contents

This application has two categories: one for classroom texts and the other for leisure content. For efficient learning, a longest-match search function has been added.

Content for Classes

A website for each class is password-protected. Vocabularies are displayed in order of appearance in the text, along with spelling, phonetic symbols, and Japanese translations. There is also a button to play the corresponding audio files. A search function allows users to search for words, translations, unit numbers, and keywords with the longest match. Each webpage usage is limited to students registered for that class.

Figure 1: Class Login Page, Which Requires Passwords

Figure 2: Top Page (Left), Example Class Page (Right)

Fun Websites for Students to Learn English Pronunciation

Websites for learning English for fun were created. Students can enjoy a site with minimal pairs of English vowels with illustrations and a site with tongue twisters to practice English consonants, which Japanese people are not good at.

Figure 3: Vowel Minimal Pairs (Left), Tongue Twisters (Right)

English Lyrics Site

Students can also enjoy a website for English lyrics, focusing on songs familiar to students and music used in movies. The song list is in alphabetical order, and when you click the song title, the screen transitions to the lyric page, where you can generate speech phrase by phrase. By mimicking the words, users can acquire the pronunciation. At the bottom of each page is a reference link to YouTube and some information about the song.

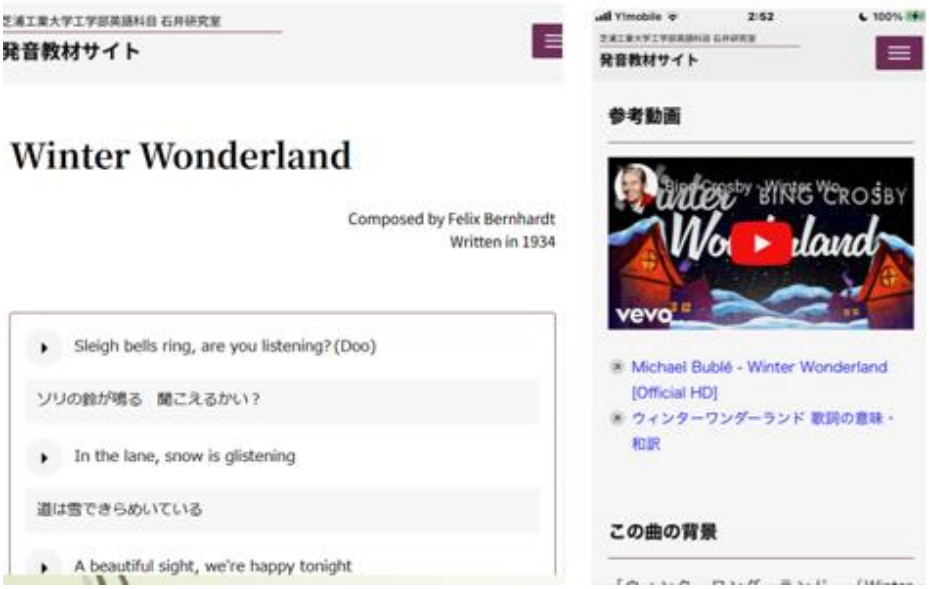

Figure 4: Lyric Site English Songs

Evaluation

Evaluation for Contents for Classes (Fall 2023)

80 students used this pronunciation site during the fall semester of 2023 and completed a questionnaire at the end of the semester. As a result, 45 of 80 students (56%) answered "easy to use," and 31 (39%) answered "fair". When asked if they could learn pronunciation, 73 out of 80 (91%) responded "definitely yes" or "yes". Students gave positive comments and valuable feedback in the free response column, suggesting the effectiveness of this site.

Evaluation for Contents for Classes (Spring 2024)

76 male and 21 female students answered the questionnaire. To the question, "Are you using this application?" 14 (14%) students responded "frequently," and 59 (61%) responded "sometimes." As for the device, 62 (64%) students were using this application with PC. 13 (13%) students answered the application is "great fun," and 35 (36%) students chose "Fun." 30 (31%) students answered "Very much so" to the question, "Do you think it will improve your pronunciation?" and 53 (55%) students replied, "Yes to that question.

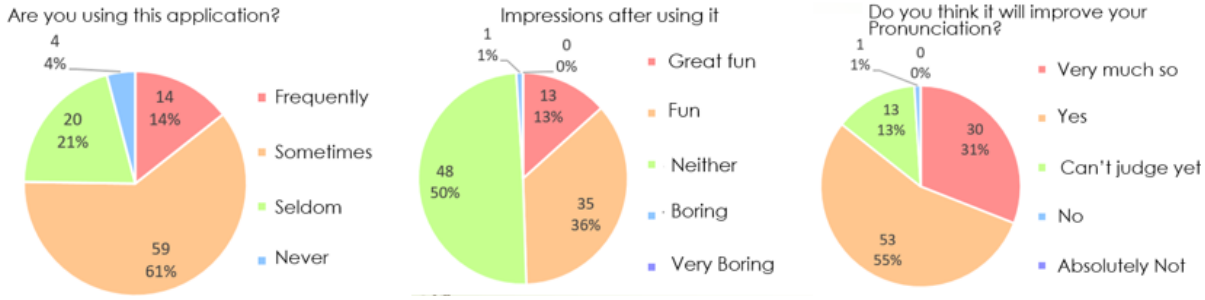

Figure 5: Class Evaluation (Spring 2024)

Evaluation for Spring 2024 Lyric Site Evaluation

I asked 10 people (three male and seven female) taking singing lessons to use the site and answer the questionnaire. Eight people used smartphones. Four people answered that using the site is "great fun," and five replied, "fun." Eight people answered"very much so" to the question, "Do you think it will improve your pronunciation?" In addition, I asked them to select features they liked, allowing multiple answers. The results are shown in Figure 7.

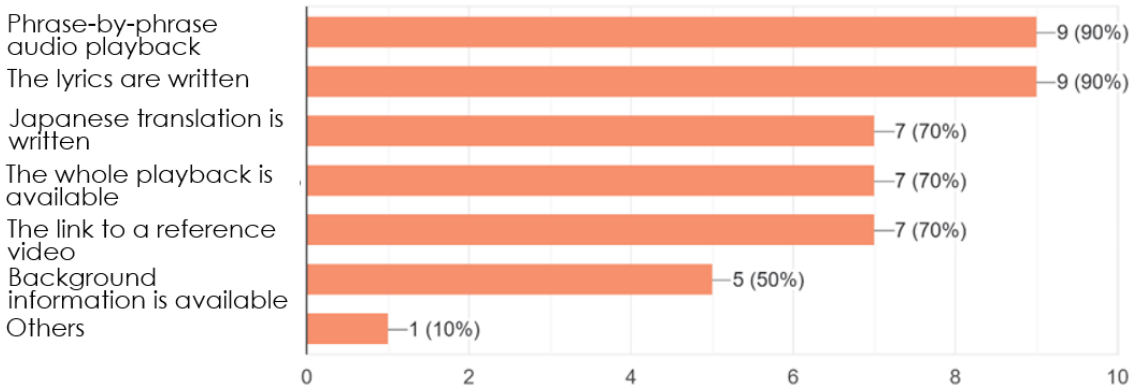

Figure 6: Preferred Characteristics

Conclusion

In this study, a web-based pronunciation learning application was developed. It utilizes speech playback, where speech is generated using speech synthesis. Students can use it on a PC, smartphone, and tablet in and outside classrooms, allowing them to learn pronunciation efficiently, irrespective of location and time. The site was used in class to introduce new vocabulary in each unit and was found helpful for students to understand the meaning and pronunciation of the words. The site also helps students with self-study for preparation and reviewing, especially in engineering English, where many words are tricky to pronounce. Lyric sites also received high results in the evaluation.

Acknowledgments

I would like to thank the students and all involved in cooperating in developing and evaluating the teaching materials.

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Contact email: ake@shibaura-it.ac.jp

Exploring the Challenges in Parenting Style That Contribute to Adolescent Sexual Behavior

Sakinah Salleh, Universiti Pendidikan Sultan Idris, Malaysia
Abu Zarrin Selamat, Universiti Pendidikan Sultan Idris, Malaysia
Norhafiza Mohd Hed, Universiti Pendidikan Sultan Idris, Malaysia
Alwi Mohd Yunus, Universiti Teknologi MARA, Malaysia
Fatin Farhanah Ammer, Universiti Pendidikan Sultan Idris, Malaysia

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Abstract
The growing concerns surrounding sexual education in Malaysia are underscored by a rise in ethical and moral challenges, including premarital sex, issues related to LGBT, and pornography addiction among teenagers, reflecting a worrisome trend. Sexuality remains a sensitive and often taboo topic in society, resulting in limited discourse on related issues. Consequently, this study seeks to explore the gaps and challenges in parenting practices that contribute to adolescent sexual behavior and related concerns. This study adopts a qualitative approach by conducting interviews with five teenagers and five parents, complemented by library research. The results reveal several aspects where parental strategies may fall short in managing adolescent sexual challenges: a) monitoring of gadget and teenage activities, b) parenting style, c) family communication, d) religious education, and e) family time. Effective parental coping strategies are essential for providing appropriate sexual guidance to teenagers. The findings of this study can assist parents in better addressing adolescent sexual issues while offering valuable insights to the Social Welfare Department (JKM) for enhancing training programs, community services, and guidance initiatives.

Keywords: Premarital Sex, Sexuality, Adolescent, Parenting, Coping, Pornography

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Introduction

The National Family Policy (Dasar Keluarga Negara) was established to enhance the well-being of families and communities, aligning with the vision of 'Keluarga Malaysia.' However, various contemporary challenges, such as moral decline, including issues like premarital sex, Lesbian, Gay, Bisexual, and Transgender (LGBT) concerns, and pornography addiction among Malaysian teenagers, have become increasingly alarming. For example, a 2015 report by the Malaysian Ministry of Health (KKM) documented 13,831 cases of premarital pregnancies involving individuals aged 10 to 19. One significant factor contributing to these adolescent sexual issues is ineffective parenting, which often results in adolescents losing trust in their parents, especially regarding discussions about sexuality. Furthermore, societal taboos surrounding sexuality exacerbate the lack of open conversations on the topic.

Effective parenting plays a vital role in providing adolescents with proper sexual guidance. A study conducted by the USM Institute of Public Health involving teenagers aged 13 to 17 revealed that nearly 50% of those who had engaged in sexual activities did so before the age of 14. The study highlighted that adolescents involved in such behaviours were often influenced by insufficient parental supervision in enforcing social boundaries. Additionally, these teenagers were found to lack regular prayer practices and tended to act impulsively without considering the negative consequences (Abd Hamid et al., 2018). Similarly, a study by Talib et al. (2012) examining respondents' perceptions of sex education in Malaysian schools reported that 90% of respondents believed sex education was inadequately addressed. Respondents also noted that the informal information provided by many teachers was vague and failed to meet the objective of educating students on this topic. Consequently, this study seeks to explore whether shortcomings in parental coping mechanisms contribute to teenage sexual issues.

Theoretical Framework

This study applies Baumrind's theory, developed by Diana Baumrind, which identifies three primary parenting styles and their associated outcomes: authoritative, authoritarian, and permissive (Baumrind, 1971). According to this theory, the parenting style adopted by parents significantly influences teenagers' development. Parenting styles and education are essential components in shaping the psychological, intellectual, and emotional growth of adolescents (Baumrind, 1991). Additionally, the Islamic perspective on parental coping mechanisms is rooted in character education models, encompassing upbringing, education, knowledge, personality, attitudes, values, and environment. Al-Ghazali (2007) emphasizes that childhood is the most critical period for shaping and developing an individual's character. A child raised with proper guidance will grow accustomed to a virtuous way of life, ultimately attaining happiness in both this world and the hereafter. Similarly, Al-Miskawayh (1968) asserts that character is formed through upbringing and the natural conditions in which an individual is nurtured. Upbringing involves training, education, learning, and social interaction, while natural conditions refer to inherent temperament or attitudes. These theories serve as the foundation for examining effective parental coping strategies in the context of guiding adolescents on matters of sexuality (refer to figure 1):

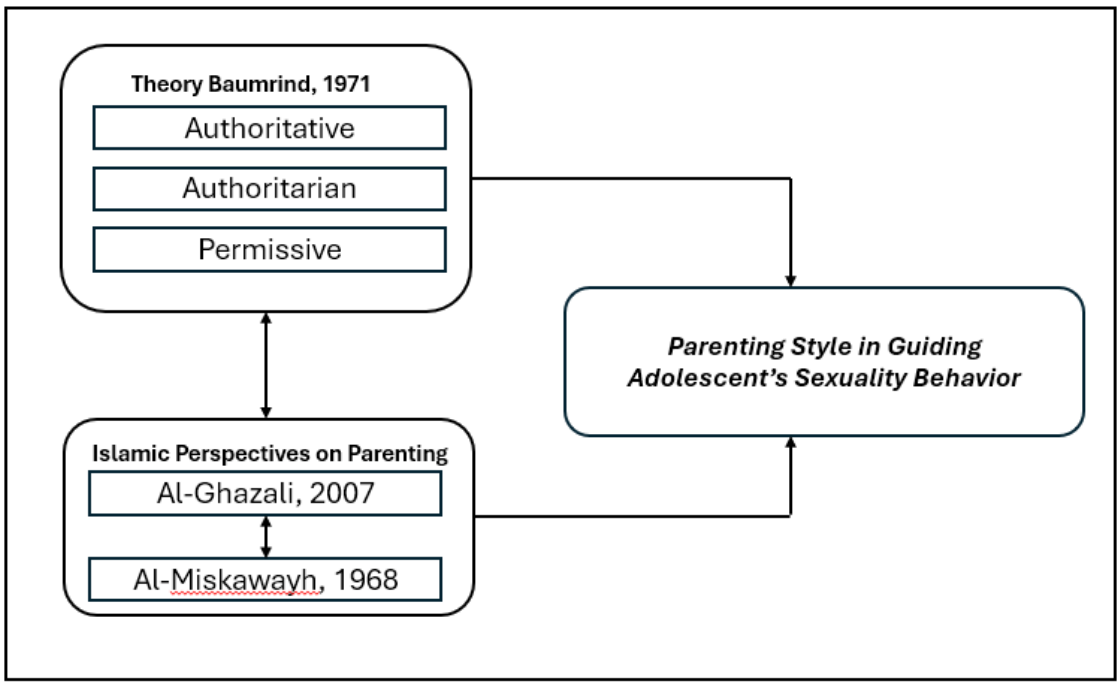

Figure 1: Framework of Parenting Style in Guiding Adolescent's Sexual Behavior: Islamic and Western Approaches

Challenges on Adolescent Sexuality

The prevalence of premarital sexual activity has been rising in recent years. Efforts rooted in religious activities aimed at curbing adolescent sexual behaviours have shown limited effectiveness, acting only as minor deterrents and failing to prevent adolescents from yielding to their desires when these become overwhelming. This indicates that religious influences may no longer hold the same significance in the lives of today's youth (Muhammad et al., 2017). Factors contributing to moral decline and social challenges among adolescents are frequently tied to family crises, often arising from parents neglecting their responsibilities and roles (Masdin et al., 2014; Wan Sulaiman et al., 2014). The disintegration of the family unit increases adolescents' susceptibility to peer pressure, particularly in contexts of acceptance and rejection by peers. Additionally, poor communication between parents and adolescents, along with family conflicts, has been linked to low self-esteem and compromised psychological well-being in young people (Xiao et al., 2011).

Premarital sex is influenced by several factors, including exposure to pornography, inadequate religious education, curiosity, peer pressure, willingness to engage in sexual activity, lack of awareness about reproductive and sexual health, insufficient parental attention, and incidents of sexual abuse by siblings (Wan Sulaiman et al., 2014). Furthermore, ineffective communication between parents and children exacerbates deviant behaviour among adolescents. Poor communication often leads to a breakdown of trust, causing children to hesitate to share their problems with their parents (Aziz et al., 2019). Instead, adolescents tend to confide in their friends and seek stress relief through social activities. Research suggests that parents who actively engage in open and consistent communication with their children create an environment of love and security, which adolescents value greatly (Kartikasari et al., 2020; Shahruddin et al., 2017).

The 2011 Malaysian Family Well-being Index, conducted as part of the National Transformation Program 2010-2020 and updated every 10 years, highlighted various initiatives aimed at addressing adolescent issues. Programs such as the Reproductive and Social Health Education Module (PEERS) by the Ministry of Education (MOE) and the Self-Awareness Module by LPPKN were introduced. However, these efforts have shown limited effectiveness, as reflected by the rising number of cases. A study by LPPKN on teenagers' awareness of pregnancy prevention revealed that only 30% understood how to avoid premarital sex (Hasbullah, 2016). While approximately 80% were familiar with condoms and 60% had knowledge of birth control pills, only 30% demonstrated an understanding of strategies to prevent premarital sex. Additionally, statistics from the Ministry of Women, Family, and Community Development indicated that between 2008 and 2010, there were 152,182 illegitimate births recorded across Malaysia. Sabah had the highest number of cases, with 41,490 illegitimate births, followed by Selangor (18,983), Sarawak (17,570), Johor (16,298), and the Federal Territory of Kuala Lumpur (12,095) (Hasbullah, 2016).

The effectiveness of communication between parents and adolescents is strongly linked to the enhancement of psychosocial attributes, such as improved sexual health knowledge, better interpersonal skills for resisting sexual advances, and increased self-esteem in young people (Sutan et al., 2017). A study by Shahruddin et al. (2018), which surveyed 130 unmarried pregnant teenage girls aged 14 to 19, found a notable level of closeness between parents and their teenage daughters. Conversely, another study indicated that nearly 50 percent of adolescents in Malaysia had engaged in sexual relationships before the age of 14, largely due to parental neglect in setting boundaries for social interactions. This highlights the urgent need for intervention programs to address the growing issue of unwed pregnancies (Ismail & Abd Hamid, 2016). As a result, counselling through psycho-educational strategies, particularly in family-based interventions, is essential to strengthen family support, teach effective coping skills, and improve communication through training, problem-solving, and crisis management techniques (Faudzi et al., 2020). These factors are crucial in shaping family intervention approaches to ensure effective parenting practices and improve the family's ability to manage adolescent challenges (Abdul Rahman, 2020). The failure of parents to fulfill their roles and responsibilities often triggers the breakdown of the family unit (Wan Sulaiman et al., 2014), which in turn contributes to the increasing rates of premarital sex among adolescents (Faudzi et al., 2020).

Moreover, factors such as parental neglect of their duties, particularly in providing religious education, parental divorce, and poor communication between parents and children, often push adolescents to seek guidance and support from peers or external sources (Shahruddin et al., 2017, 2018). Adolescents facing social issues are frequently those who are seeking attention and support from their families and parents (Masdin et al., 2014). However, obstacles like a lack of confidence among teachers and parents, along with the absence of suitable educational materials, prevent the effective implementation of sex education programs (Tin, 2014). Additionally, cultural and religious sensitivities compound these challenges, leading to a shortage of education, guidance, and services concerning sexuality (Bashir et al., 2017). Sexuality and reproductive health topics remain taboo in many families, even though adolescents have a strong need for trustworthy and open sources of information (Faswita et al., 2018; Ismail et al., 2016).

Effective parental coping has a significant influence on adolescent behaviour. The strategies parents use in coping and their involvement in parenting play a vital role in either preventing or rehabilitating adolescent behavior. Abd Hamid et al. (2018) emphasize that effective

parenting is crucial, as adults can guide adolescents through their challenging "storm and stress" phase. Therefore, the importance of parental involvement in addressing sexuality issues among adolescents must be highlighted, especially since knowledge about sexuality remains limited among Malaysian adolescents (Masdin et al., 2014). Research also indicates that peers often exert more influence over adolescents than family members (Abd Manaf et al., 2013). A study by Jatmikowati et al. (2015), which developed a model for addressing adolescent sexual abuse, highlighted the pivotal roles that family and the surrounding environment play in guiding sexuality. Moreover, Faudzi et al. (2020) argue that sexuality education is instrumental in preventing and reducing the risks of teenage pregnancies, HIV, and sexually transmitted infections. Consequently, it is essential for parents to develop effective parenting techniques and coping strategies to address the sexual health challenges their adolescents may face (Abdullah et al., 2020).

The Importance of Sexuality Guidance in Sexuality Education

Sexuality guidance is a lifelong process of gaining knowledge and shaping attitudes, beliefs, and values concerning identity, relationships, and intimacy (Faudzi et al., 2020). It includes a broad range of topics such as sexual development, human reproduction, health, interpersonal relationships, love, intimacy, body language, and gender roles (Tin, 2014). From an Islamic viewpoint, sexuality guidance involves introducing and educating children about matters related to sex and sexuality in an open and honest manner from the age of understanding (Ulwan, 1988). In Islam, sexuality guidance is viewed as crucial and should begin early, in alignment with Islamic teachings, to instil moral, social, and religious values throughout the child's developmental stages. This responsibility falls under the domain of education (Oktarina et al., 2020). Such guidance also includes understanding the objectives of Shariah, particularly the protection of progeny, as curiosity may prompt children and adolescents to seek sexual information from various sources, which may not always be reliable. Knowledge about sexuality is not exclusively gained from parents; adolescents may also obtain information from schools, peers, mass media, and the Internet (Faswita et al., 2018).

To prevent adolescents from receiving inaccurate information, it is crucial to address the issue proactively and take responsibility for providing accurate sexual education (Kartikasari et al., 2020; Said, 2017). Parents must take preventive measures to educate their children about sexual matters, as emphasized by Aziz (2014), helping them differentiate between what is permissible and what is not in the real world by offering clear explanations, guidance, and expectations. This approach aims to prevent teenagers from engaging in risky social behaviours. Therefore, in the context of this research, sexuality guidance is understood as a lifelong learning process that encompasses multiple dimensions of sexuality: offering accurate information, instilling values, developing interpersonal skills, and nurturing responsible self-concepts (Wazakili, 2010).

Research Methodology

The study utilizes a semi-structured interview method, involving five teenagers and five parents whose children are involved in premarital sex issues (refer to Table 1). Individual interview sessions are conducted to maintain sensitivity and encourage open, transparent communication from both parents and teenagers. This approach is designed to minimize any potential risks to the participants. The aim of the interviews is to identify shortcomings in parental interventions that contribute to adolescent sexuality issues. The semi-structured format allows for the collection of more in-depth, detailed data. The research is conducted in

teenage shelters under the supervision of the Department of Social Welfare (JKM), specifically the Bayt Al-Rahmah Pregnancy Guidance Center and the Muallim District Shelter Home. The qualitative data gathered from the interviews are analyzed using thematic analysis, which involves processes such as coding, creating nodes, and ultimately developing several key themes.

Table 1: Background of Study Respondent

Respondent	Age	Status
RA/1	17	Student
RA/2	16	Student
RA/3	17	Student
RA/4	17	Student
RA/5	16	Student
RIB/1	45	Parent
RIB/2	40	Parent
RIB/3	46	Parent
RIB/4	52	Parent
RIB/5	48	Parent
Total	**10 Respondents**	

Research Findings

The analysis and discussion of this study are based on qualitative data gathered through interviews. The findings indicate that factors such as parenting styles, religious education, family time, monitoring of gadgets and teenage activities and family communication contribute to adolescent sexual behavior (refer to Figure 2).

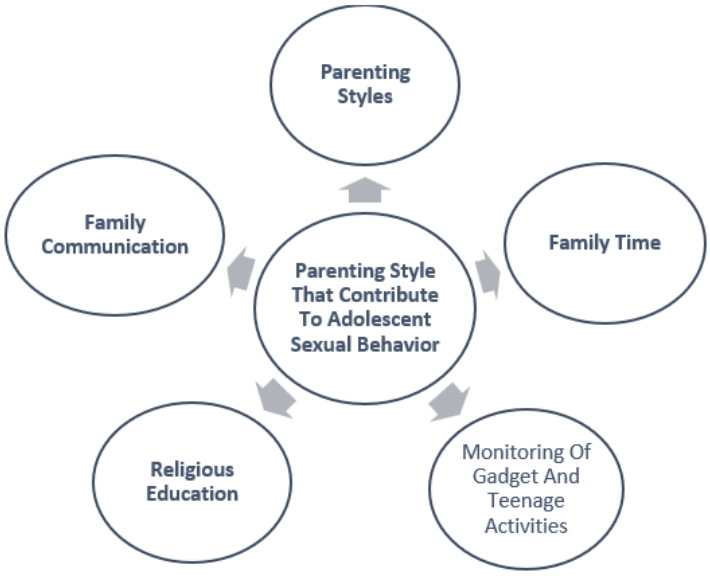

Figure 2: Parenting Styles That Contribute to Adolescent Sexual Behavior

Monitoring of Gadget and Teenage Activities

The study found that oversight of gadget used and teenage activities, therefore parental monitoring plays a crucial role in addressing teenage sexuality issues. When parents fail to take action, it can have a negative impact on teenagers. All respondents emphasized the importance of parental supervision in preventing involvement in sexual matters. One teenager specifically mentioned that the lack of oversight regarding gadgets and internet usage, especially on social media and exposure to pornography, contributed to their behaviour.

As stated by RA 5: *"But, when I grew older, there was even less monitoring because maybe I was already older, right? So, in terms of the phone, it started with the phone—there was no monitoring"* (RA/5/40). Respondent RA/5 also admitted: *"Adolescents will stay awake until midnight like that. Because parents usually go to bed early (RA/5/372). So they are okay with chatting."*

This statement suggests that adolescents may engage in watching pornography and participating in inappropriate activities on social media late at night, when their parents and other family members are asleep. As a result, it is essential for parents to monitor and ensure that gadgets and the internet are used appropriately. Parental monitoring should not be limited to just gadgets and internet usage but should also extend to overseeing the daily activities of their teenage children. According to one respondent, the mother's busy daily routine caused her to overlook her children's activities: *"I don't really monitor her daily activities because of work, you know"* (RIB/2/32).

Additionally, placing too much trust in their children is another contributing factor. One respondent admitted: *"That was my mistake. Too trusting. That friend of hers"* (RIB/4/217). Parents who recognize that they have placed too much trust in their child may find that their child becomes difficult to control in friendships and begins to cross boundaries. This statement underscores the importance of knowing who their children's friends are in order to prevent inappropriate associations and boundary-crossing behaviours. This view is supported by Atabik et al. (2015) who argue that effective child education must involve an element of

monitoring and control, including overseeing their activities outside the home as well as their use of gadgets and the internet.

Religious Education

Religion plays a central role in the family dynamic. Parents who neglect religious education can have a profound impact on their children's upbringing, potentially leading to gaps in moral guidance and values that are crucial for their development. This was acknowledged by a respondent, a father, who stated: *"I have never been an imam in my own home because I am the mosque's muezzin"* (RIB/2/258-260). The respondent further expressed: *"Firstly, parents must emphasize matters of religion from a young age"* (RA/4/352). This statement emphasizes the importance of instilling religious education in children from an early age, as this is the period when they are most impressionable. These findings are supported by studies (Atabik et al., 2015; Salleh et al., 2021; Sumari et al., 2019), which suggest that parents must lead by example and that religious upbringing and education should start at home.

Parenting Styles

Parenting style is a significant factor influencing children's involvement in premarital sex. The findings suggest that adolescents engaged in premarital sex often come from families where parents use violence as a disciplinary method. One respondent, who admitted to using violence against their child, stated that, *"Back then, during my time, even with my husband, yeah, you know, young blood, made a few mistakes, ended up hitting the child, so the child became a victim"* (RIB/3/335). The respondent added: *"My husband didn't really hit much. It was me. I was the one who liked to hit"* (RIB/3/337). As a result of this violence, children may rebel and seek attention from external sources. Additionally, the role of the family is vital; all family members must fulfill their responsibilities for the family to function effectively and provide the necessary support for everyone.

Family Communication

Communication is a fundamental aspect of family dynamics. Poor communication between parents and children can be a significant factor influencing children's involvement in premarital sex. One respondent, a teenage father, shared that his failure to inquire about his daughter's menstrual cycle resulted in him not knowing she was pregnant out of wedlock until the day she gave birth. He explained that the lack of communication on sexuality-related issues played a role in his daughter's involvement in premarital sex, *"I stopped asking about whether she had her period or not because she was grown up, and I thought my wife could handle it. It turns out I failed in 2019, around that time"* (RIB/2/28). He added, *"Even up until she was about to give birth, I still didn't know"* (RIB/2/56). The lack of communication within the family makes it easier for teenagers to seek external sources that may be misleading. RIB/3 emphasized: *"Most of their children learn about sexuality not from their parents but from influencers. And the way they obtain that information is also incorrect because they learn from pornographic videos"* (RIB3/1).

Family Time

A lack of communication between parents and children, coupled with insufficient family time, can significantly contribute to parental responsiveness failures. When families don't spend quality time together, it becomes harder for parents to understand their children's

emotional, social, and developmental needs. This lack of connection can lead to missed cues, misunderstandings, and a reduced ability for parents to respond effectively to their children's needs. In today's fast-paced world, with work, extracurricular activities, and other responsibilities, it's easy for family time to take a back seat. However, when parents are physically present but emotionally disengaged, children can feel neglected or misunderstood, which can impact their emotional well-being and development. Creating opportunities for open communication and making time for shared activities can help foster better understanding and responsiveness within the family. Whether through regular family meals, shared hobbies, or simply setting aside time to talk, these efforts can strengthen the bond and improve overall parental responsiveness. As one respondent stated: *"I'm not trying to criticize, but I ask my children: 'Dad? Hmm, Dad?' I wake up, and Dad's not there. Dad's gone. No family time activities, no communication with the children"* (RIB/4/716). Family time is crucial, and according to the respondent, the lack of it led to the family being neglected. The respondent further explained: *"My ex-husband, he was the type that just worked. Sometimes, even on his days off, he would take overtime or something. And with the kids, he wasn't really that involved. Rarely"* (RIB/3/553).

Discussion and Analyses

Diana Baumrind's theory of parenting styles (1971) provides a foundational understanding of how different parenting approaches influence children's development. Baumrind identifies three main styles: authoritative, authoritarian, and permissive. The findings closely align with this theory, as the identified parenting shortcomings—such as insufficient monitoring of gadgets and daily activities, the use of physical punishment, and limited family time—can be linked to ineffective parenting practices. A key finding is the lack of parental supervision, especially when it comes to teenagers' use of gadgets and internet access. This is related to permissive parenting, where parents have low levels of control and supervision. According to Baumrind, permissive parents grant their children excessive freedom, resulting in a lack of structure and boundaries. This mirrors the experiences of the adolescents in the study, who reported engaging in inappropriate behaviours, such as watching pornography or using social media irresponsibly, due to the absence of parental oversight. Permissive parenting fails to offer the necessary guidance and discipline, which can lead to teenagers making poor choices regarding their sexual behaviour.

Furthermore, the use of violence in parenting, as reported by some participants in the study, reflects authoritarian parenting. Baumrind characterizes authoritarian parents as highly controlling and demanding yet lacking warmth and open communication. The findings indicate that the use of violence fosters resentment and rebellion in adolescents, leading them to seek attention and validation from external sources, such as peers or unhealthy relationships. This supports Baumrind's observation that authoritarian parenting can result in low self-esteem and deviant behaviours in children, including risky sexual activities. In contrast, authoritative parenting—characterized by a balance of control, warmth, and communication—was notably absent in the families discussed in the study. Authoritative parents establish clear expectations while fostering open communication with their children, which is essential for healthy adolescent development. The absence of family time and meaningful communication observed in the study underscores the negative impact of not embracing this balanced parenting approach. According to Baumrind's theory, teenagers raised in authoritative households are more likely to develop self-discipline and make responsible decisions, including regarding their sexual behaviour.

In the context of Islamic perspectives, particularly the theories of Al-Ghazali and Al-Miskawayh, there is a strong emphasis on the importance of religious education and moral upbringing. In Islam, the family is regarded as the primary unit responsible for imparting moral and religious values to children. Al-Ghazali (2007) asserts that childhood is a crucial period for shaping character, and the absence of religious education can lead to moral decline in adulthood. The findings suggest that in families where religious education is neglected, adolescents are more likely to engage in premarital sex or other forms of sexual misconduct. One respondent in the study acknowledged that religious practices, such as leading prayers at home, were neglected due to external commitments. This neglect aligns with Islamic teachings, which emphasize the significance of early and ongoing religious education in guiding a child's moral development.

Al-Miskawayh (1968) also emphasizes that both upbringing and natural temperament contribute to character formation. When parents fail to provide a religious and morally grounded environment, adolescents are more likely to seek guidance from other, less reliable sources. From an Islamic perspective, sexuality is a sensitive but essential topic that should be addressed openly and honestly within the family. Parents who neglect to guide their children on matters of sexual morality risk allowing their children to learn about sexuality from inappropriate sources, such as peers or the internet. This failure to provide adequate religious and moral education aligns with the broader findings in the study, where teenagers who lacked proper religious guidance were more likely to engage in risky sexual behaviours.

Conclusion

The study's findings regarding parental responsiveness failures that contribute to teenage sexuality issues include inadequate monitoring of gadget usage and teenage activities, ineffective parenting styles, lack of religious education, poor family communication, and insufficient family time. Therefore, it can be concluded that parents play a crucial role in providing sexual guidance to teenagers. Sumari et al. (2021) stated that a functional family should employ effective parenting styles, which include parenting skills and methods. Additionally, parents need to be good role models, and religious upbringing and education should begin at home (Atabik et al., 2015; Salleh et al., 2021; Sumari et al., 2019). For a family to function well, all family members must play their respective roles. This is further supported by Atabik et al. (2018) study, which emphasized the importance of monitoring and supervision in parenting, including overseeing children's activities outside the home and their use of gadgets and the internet. This highlights the need for a holistic approach to guide parents in overcoming responsiveness failures and in raising productive teenagers who contribute positively to their religion, nation, and country. Therefore, cooperation from all parties—parents, educators, and the government is crucial in educating teenagers about sexuality issues and creating a healthy environment.

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Contact email: sakinah.salleh@fsk.upsi.edu.my

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The International Academic Forum (IAFOR)
Sakae 1-16-26-201
Naka Ward, Nagoya, Aichi
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