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Abstract

Teaching ordinary differential equations (ODEs), while essential, is often challenging due to the abstract nature of the topic and students' difficulty in relating it to real-world applications. To address this, the Contextualized Learning via Enquiring, Answering, and Reflecting (CLEAR) approach was implemented to help students connect ODEs with authentic, real-life contexts. CLEAR was introduced during the Spring Semester of AY2025 in the graduate-level course "Applied Mathematics for Engineering" at the Singapore University of Technology and Design. As part of the assignment, students successfully developed nine unique real-world contexts, each leading to the formulation of questions and corresponding solutions involving the application of ODEs. The impact of CLEAR was explored through two guiding questions: (1) Does the CLEAR approach help students relate ODEs to observed phenomena beyond the classroom?; (2) How do students perceive the CLEAR approach? Overall, students demonstrated an enhanced ability to contextualize ODEs and reported a positive learning experience with the CLEAR assignment. Many expressed appreciations for how the approach extended their understanding beyond classroom theory and found the process engaging and enjoyable. These findings offer valuable anecdotal evidence that may inform and enhance future approaches to teaching ODEs. Furthermore, given that the CLEAR approach requires no additional hardware or software, it presents a scalable and cost-effective strategy that can potentially be adopted across a wide range of courses and disciplines.

Keywords: student-centered learning, assessment, active learning, higher-order thinking, engagement

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Introduction

In the teaching and learning of mathematics, ordinary differential equations (ODEs) constitute a foundational topic that provides the mathematical basis for modelling and explaining a wide range of real-world phenomena in engineering, the natural sciences, and applied research. Despite their importance, students often perceive ODEs as abstract, procedurally demanding, and disconnected from their lived experiences, which can impede both conceptual understanding and motivation (Santos et al., 2020). Although inquiry-based approaches have been proposed to address these challenges, prior work indicates that such methods still fall short in helping students build meaningful links between differential equations and their personal or observed contexts outside the classroom (Hyland et al., 2023).

To address this gap, scenario-based student-generated questions (sb-SGQA) have been developed as a pedagogical strategy that positions students as co-creators of learning materials, thereby increasing authenticity and engagement (Tay, 2024). By constructing their own scenarios and assessment questions, students take on a more active role in the learning process, which promotes autonomy and fosters the development of higher-order thinking skills such as synthesis, evaluation, and creative problem-solving (Yu & Wu, 2020). This shift from passive recipients to active agents enables learners to deepen their metacognitive awareness, strengthen conceptual understanding, and assume greater ownership of their learning trajectories. Building on this foundation, the integration of reflective practices within the sb-SGQA framework led to the development of the Contextualized Learning via Enquiring, Answering, and Reflecting (CLEAR) approach. CLEAR seeks not only to engage students in authentic mathematical inquiry but also to support iterative reflection as a means of consolidating understanding and enhancing personal relevance. Hence, this study seeks to explore the impact of the CLEAR in the context of teaching ODEs through the following research questions (RQ):

- RQ1: Does the CLEAR approach help students relate ODEs to observed phenomena beyond the classroom?
- RQ2: How do students perceive the CLEAR approach?

Methodology

The CLEAR approach was implemented during the Spring Semester of AY2025 in the graduate-level course “Applied Mathematics for Engineering” at the Singapore University of Technology and Design. Students, in groups of 2, were tasked to develop CLEAR assignments which are considered as their student-initialed assessment (SIA) that utilize ODEs concepts and principles to a context they could draw upon from life experience. To help with scaffolding, a sample contextualized CLEAR assignment was provided (Figure 1). A total of 10 graduate students were enrolled in the class. As the course was taught for the first time, a control was not available for comparison. Consequently, data for discussion would rely on analysis of students’ work (RQ1) and feedback from students (RQ2).

The implementation schedule of SIA outlines a structured sequence of activities across the entire semester. In Week 1, students are introduced to the SIA and informed that they will design their own examination questions as part of their mid-term assessment. By Week 4, they receive individualized formative feedback to support the development of their work. In Week 6, students submit the first draft of their SIA questions, which they subsequently present for class-wide peer review in Week 7. Following this feedback cycle, students refine

and submit the final version of their SIA in Week 9. In Week 11, a perception survey is administered to gather students' reflections on their experiences with the SIA process.

Figure 1

Sample CLEAR Assignment

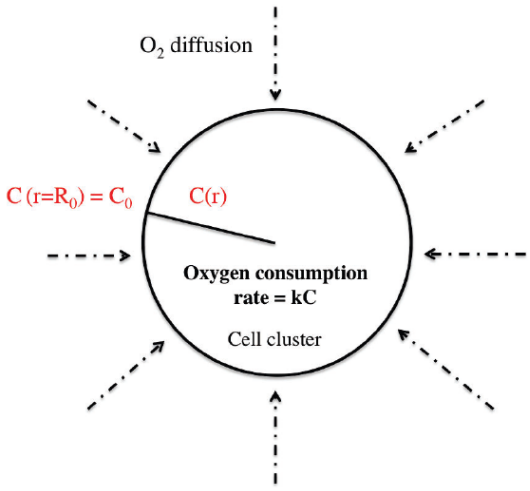
Question 1: Cellular respiration in cells

The cells in human body require a source of energy to function and they are able to obtain it by breaking down food molecules to release the stored energy inside. This process is called "cellular respiration". Oxygen is consumed to break down food (e.g. glucose) in this process.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

Assume a constant concentration of glucose inside the cells and its concentration is much more than the oxygen concentration. Therefore, the reaction rate can be approximated to be a 1st order reaction with respect to oxygen concentration. In this question, we will be looking at the transport and consumption of oxygen inside a cluster of cells.

We consider a steady-state O_2 diffusion in a sphere of radius R_0, with a irreversible reaction of O_2 consumption. Assume that the oxygen concentration at the outer surface of the cell cluster is maintained at C_0 where the value of rate constant k is $10^{-2}/s$, the spherical radius is $0.02\,m$, the diffusivity D is $10^{-5}\,m^2/s$ and C_0 is taken to be $5\,mol/m^3$.



(a) By using shell balance technique, derive the governing equation and the boundary conditions for oxygen concentration profile, C(r). State any assumptions you have made.

Note. The assignment showed 1) the context and 2) questions. Answers to the questions were also provided but not shown in the image above.

The assessment rubric for SIA comprises three major components designed to evaluate both the technical and higher-order learning outcomes of the project. The first component,

Technical Strength (55%), assesses the depth and breadth of students' understanding of relevant concepts, the accuracy with which they apply appropriate methods, theories, and calculations, and the proportionality of the workload required to produce their solution, with a small penalty applied when the scope is excessively heavy or insufficiently rigorous. The second component, Presentation (30%), evaluates the clarity and coherence of both the oral and written presentations, with particular emphasis on the articulation of the problem statement and the rationale behind the proposed solution. The final component, Advanced Learning (15%), measures students' higher-order cognitive engagement, including creative thinking, critical thinking, and the novelty and significance of their contributions. Collectively, the rubric provides a structured and balanced framework for assessing analytical rigour, communication quality, and innovative thinking.

Results and Discussion

An analysis of the contexts developed by the students revealed that students were able to meaningfully relate ODEs to real-world phenomena beyond the classroom (Table 1). Deep diving into one such assignment, heat transfer for nuclear fuel was used as a relevant and authentic context for the application of ODEs (Figure 2), along with reasonable answers to the questions developed (not shown in abstract). This finding addresses RQ1 and responds to the concerns raised in a previous study (Santos et al., 2020).

Table 1
List of Contexts Students Developed Questions and Answers for Through CLEAR

Context No.	Topic
1	Yeast modelling for beer fermentation.
2	Linearly-doped Schottky barrier diode.
3	Heat transfer in 3D printing.
4	Vibrations of circular membrane.
5	Movement of electrical signals transmitted in neurons.
6	Heat transfer in nuclear fuel.
7	Transverse diffusion of population inversion in a fiber laser.
8	Spring-mass system.
9	Geodesic distance.

Note. 9 contexts were shown as the 4th context was duplicated by another group.

Subsequently, student feedback was analyzed to gain insight into their perception of the CLEAR approach. Table 2 presents the semester's feedback, reproduced as provided. In general, graduate students appreciated the concepts taught to beyond the classroom (Feedback No. 1, 4, 5 and 6). One appreciated how approximations are commonly used (Feedback No. 3), and another enjoyed the learning process (Feedback No. 2). These results help to answer the second research question, indicating that students were generally positive.

Figure 2

Example of CLEAR Assignment by One Group for Context Number 6

Question 1: Heat Transfer in a Cylindrical Nuclear Fuel

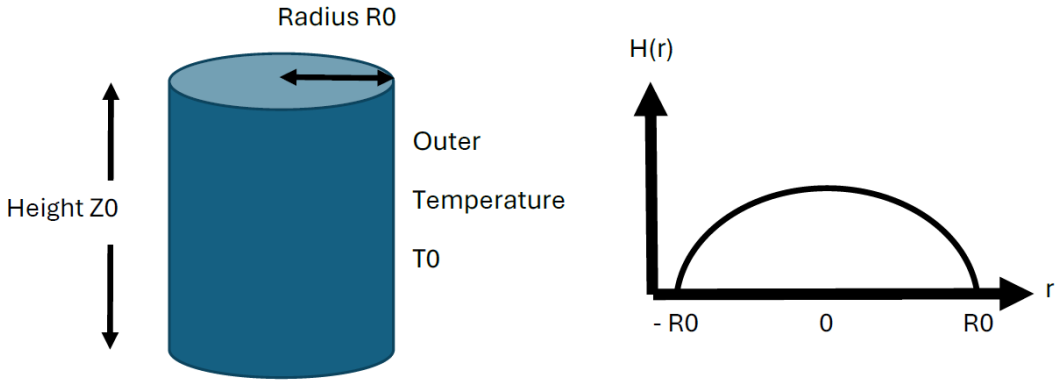
Nuclear materials generate heat due to some neutron interactions. To collect thermal energy, nuclear fuel is immersed in a coolant (e.g., water), which absorbs the heat and drives a turbine to produce electricity.

However, too much heat in the fuel creates thermal stress, risk of melting or structural failure. To prevent these problems, the temperature distribution must be analyzed within the nuclear fuel.

In this case, please consider a cylindrical nuclear fuel rod of constant thermal conductivity k, height Z_0 and radius R_0, where heat conduction occurs only in the radial direction. The outer cylindrical surface maintains a fixed temperature T_0. The heat generation rate, in W/cm^3, inside the fuel is given by

$$H(r) = H_0(R_0^2 - r^2)$$

where H_0 is a constant.



Assume that you are a nuclear engineer. Please:

a) Derive this ODE equation using shell-balance techniques.

$$\frac{1}{r}\frac{d}{dr}\left(r\frac{dT}{dr}\right) + \frac{H(r)}{k} = 0$$

b) Write boundary conditions for solving the ODE

c) Find the temperature profile T(r) over the cylindrical fuel by solving the given ODE.

Note. The first page of the assignment is shown for illustrative purposes.

Table 2
Student Feedback on the Use of CLEAR

Feedback No.	Feedback
1	Cool to be able to model real life scenarios
2	Applied math is fun to solve and useful in various problems
3	A lot of approximation is used in real life
4	He (the lecturer) can help with our research math relevant problems and bring Math to real–word applications
5	Very relatable to different scenarios
6	How to use maths knowledge in real engineering conditions

Conclusion

This study implemented the SIA as an instructional framework for teaching ordinary differential equations (ODEs) to graduate students. Although ODEs are traditionally regarded as challenging and often perceived as abstract or disconnected from students' lived experiences, the findings of this study indicate that the CLEAR approach in SIA can meaningfully bridge this gap. Students were able to construct a diverse range of authentic and personally relevant contexts for applying ODE concepts, demonstrating a notable shift from procedural engagement toward conceptual and contextual understanding. Furthermore, students' perceptions of CLEAR were generally positive, with feedback indicating that the learning process was not only accessible but also enjoyable. These outcomes provide preliminary yet valuable evidence that CLEAR has the potential to enhance students' engagement, agency, and relevance-making when learning ODEs. Importantly, because CLEAR relies solely on pedagogical design rather than specialized hardware, software, or costly infrastructure, the approach is inherently scalable. This positions CLEAR as a feasible and adaptable instructional model that can be implemented across different classes, course levels, and even disciplines beyond mathematics and engineering.

Limitations and Future Work

Despite the encouraging results, several limitations warrant consideration. First, the study involved a relatively small cohort of ten students, which restricts the extent to which quantitative findings can be meaningfully interpreted or generalized. Second, the participants were drawn from five different academic departments, each with varying degrees of prior mathematical preparation and disciplinary orientations. While this diversity offers rich qualitative insight, it also introduces heterogeneity that can obscure systematic patterns in students' responses or performance. To strengthen the validity and reliability of future analyses, subsequent studies would benefit from aggregating data across multiple cohorts to achieve a larger and more comparable sample size. Longer-term investigations could also examine the sustainability of the benefits observed, such as whether CLEAR supports deeper retention of ODE concepts or improved transfer to advanced coursework. Furthermore, future work may explore how CLEAR can be adapted or expanded—for example, through integration with digital tools, collaborative learning structures, or discipline-specific scenarios—to further enhance its impact on students' conceptual understanding and engagement.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Parental Engagement in Children's Literacy Development Across Income Groups: A Comparative Analysis

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Abstract

Parental engagement is a crucial element in children's literacy development. However, there are few studies focused on the influence of income levels and the consistency of support at home. This research examines the various aspects of parental engagement among the low-, middle-, and high-income families in Selangor. The data were collected via a survey administered to 419 parents of primary school children. The survey comprises 19 instruments designed to measure academic supervision, resource accessibility, emotional support, and digital engagement. This data is analysed using descriptive analysis. The results reveal that all the income groups demonstrate moderate to strong literacy support. However, there is a significant difference in the parents' engagement patterns. Parents with low incomes were highly emotionally involved and adaptable despite having limited financial resources. Parents with middle incomes were the most consistent in all areas, combining structure, access, and emotional support. High-income parents provided significant material and digital resources but exhibited comparatively lower direct academic and emotional engagement, presumably because they relied on external support systems. These results show that effective literacy engagement is not only determined by a family's income but also by parents' beliefs, the time they have, and how they adapt. The study enhances the existing literature by applying established parenting theories in a Malaysian context, offering comparative insights across income levels, and guiding targeted educational interventions that promote equitable literacy development.

Keywords: parental engagement, literacy development, income disparity, Malaysia, educational equity

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Introduction

Parental engagement is recognised as an important component in children's literacy development. This impacts children's reading readiness, academic success, and lifelong learning practices. A study by Boerma et al. (2017) emphasises *"Parents' interest in their children's reading is significantly linked to improved reading comprehension outcomes."* In varied educational settings, active engagement through emotional support, academic oversight, or the provision of learning materials has demonstrated efficacy in enhancing language proficiency and cultivating favourable attitudes towards reading.

In Malaysia, the disparities in household income correlate with the variations in home literacy environments, resource accessibility, and parents' views on education. Parents' socioeconomic status (SES) plays a vital role in how parents engage in their children's literacy development. As Rahman et al. (2024) note, *"socioeconomic status moderates the relationship between parental involvement and young children's literacy development."* Higher-income families have better access to books, digital tools, and enrichment opportunities. On the other hand, low-income families may struggle with these things. Nonetheless, previous studies suggest that parents with lower incomes can compensate for limited resources by being highly emotionally involved and employing flexible strategies.

Within the Malaysian context, studies on parental engagement and socioeconomic status remain scarce. Particularly, there is a lack of research on how families from different income groups promote literacy at home. Existing research has predominantly focused on general parental involvement or school-related activities, neglecting comprehensive comparative analyses that address the full spectrum of literacy support, including emotional, academic, and digital dimensions. Regardless of economic standing, Mad and Mohamed (2023) stated that parents who value literacy are more likely to create an environment that supports reading and learning. This suggests that it is necessary to examine how beliefs, resources, and engagement behaviours interact.

This study is guided by Epstein's Model of Parental Involvement framework and Hoover-Dempsey and Sandler's Theory of Parental Involvement. This study examines parental engagement in children's literacy development among three household income groups in Selangor. Epstein's framework emphasises the importance of parental engagement at home for learning, while Hoover-Dempsey and Sandler's model describes how parental involvement behaviours are shaped by attitude, self-efficacy, and perceived roles. When combined, these frameworks provide a comprehensive lens for observing the various forms and reasons of parental involvement across socioeconomic backgrounds.

Hence, this study contributes to the existing literature by providing a systematic comparison of low-, middle-, and high-income families, focusing on the interactions among emotional support, academic involvement, and digital practices across income groups. The study will foreground findings that will support interventions to promote literacy development by addressing key challenges and family dynamics (Calzada et al., 2014). This study will investigate parental engagement in children's literacy development in three different household income levels in Selangor, Malaysia.

Methodology

This quantitative study encompassed 419 parents of primary school children living in Selangor, Malaysia. Participants were classified into three income brackets according to monthly household earnings: Group A (low-income, below RM4,850), Group B (middle-income, RM4,851 to RM10,970), and Group C (high-income, above RM10,971). The sampling was intentional, focusing on households with school-aged children enrolled in government and private primary schools in urban and suburban regions.

A structured 19-item questionnaire was used to collect data on parental involvement in six important areas of home literacy support. These areas include academic supervision, access to learning materials, daily integration of literacy practices, digital literacy guidance, development of reading habits, and emotional support related to learning goals. Each item was evaluated on a 5-point Likert scale, with 1 indicating "Strongly Agree" and 5 indicating "Strongly Disagree." Lower scores signify greater agreement or more frequent engagement in the specified behaviour.

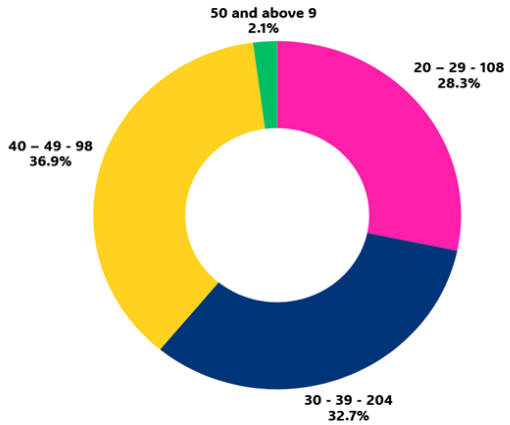
SPSS Version 27 was used to do descriptive statistical analysis. Mean scores and standard deviations were computed for each item across the three income groups to discern trends, behavioural patterns, and notable disparities in parental engagement. Specific focus was on domains that exhibit variance across income levels, yielding comparative insights into the impact of socioeconomic status on the nature and consistency of home support. The comparative interpretation in the results and discussion sections is based on these findings.

Results and Findings

This section presents the descriptive findings of parental engagement in children's literacy development across three household income groups: Group A (low-income), Group B (middle-income), and Group C (high-income). The analysis is based on 19 items encompassing academic supervision, access to learning resources, digital literacy support, reading routines, and emotional encouragement. Mean scores and standard deviations were computed for each item to assess patterns and variations in engagement. The results highlight both commonalities and unique trends across income groups, offering insight into how socioeconomic background influences the nature and intensity of parental involvement.

Demographic Information

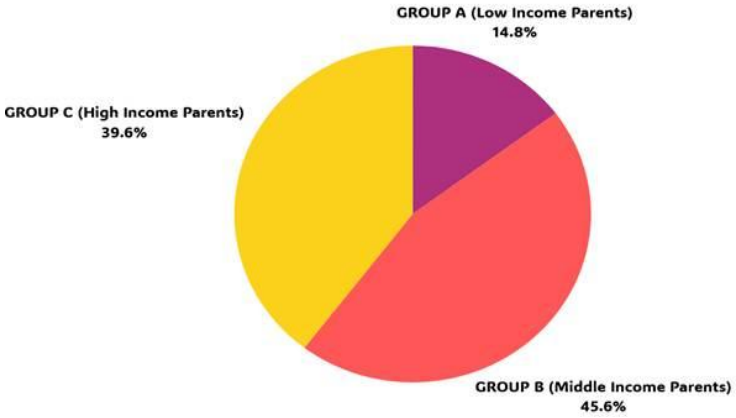
Figure 1
Distribution of Parents' Age



The parents' age distribution revealed the respondents' generational profile. As shown in Figure 1, most respondents were aged 30 to 39, accounting for 204 parents (48.2% of the total sample). This aligns with the common age range of parents with primary school children. The second largest group comprised parents aged 20–29 years, representing 25.5% (n = 108) of the respondents, followed closely by parents aged 40–49 years at 23.1% (n = 98). The smallest group comprised parents aged 50 and above, representing only 2.1% (n = 9) of the respondents. These findings indicate that many participants were within an active parenting age, which may contribute to their higher involvement in their children's education.

Figure 2

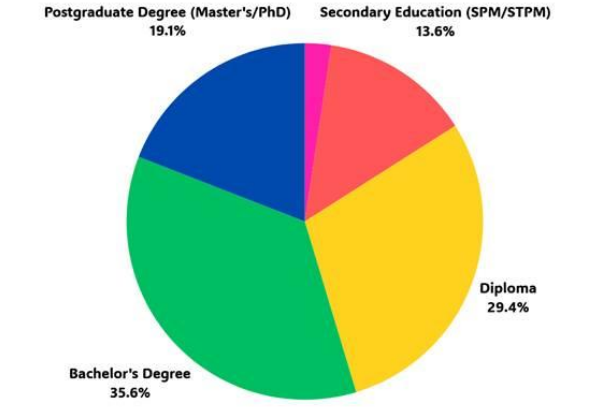
Distribution of Parents by Income Groups



The respondents' income distribution is illustrated in Figure 2. The largest proportion of parents fell into Group B, representing middle-income households, with 45.6% of the total sample. This was followed by Group C, comprising high-income parents, who accounted for 39.6% of respondents. The smallest proportion, 14.8%, belonged to Group A, representing low-income parents. These findings suggest that most participating parents came from middle- and high-income backgrounds, potentially influencing their capacity to provide educational resources and support for their children.

Figure 3

Highest Educational Qualifications of Parents



As illustrated in Figure 3, the majority of respondents hold a bachelor’s degree, accounting for 35.6% (n = 149) of the total sample. The statistic was followed by diploma holders, who represented 29.4% (n = 123) of the respondents. A significant proportion of the respondents, specifically 19.1%, had completed postgraduate qualifications at the master’s or PhD level. At

the same time, 13.6% had completed secondary school (SPM/STPM), while only 2.4% had completed primary school. These results reflect a predominantly well-educated parent population, suggesting that the respondents are more likely to engage actively and effectively in their children's academic development.

Figure 4

Group A (Low-Income Parents)

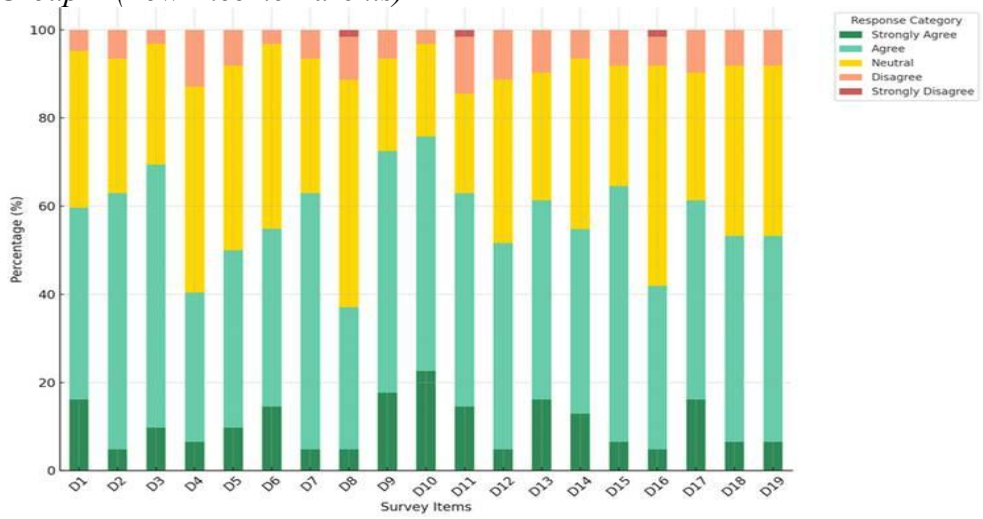


Figure 4 presents the distributions for Group A (low-income parents, n = 62) on 19 items measuring parental involvement in children's literacy development. The overall results indicate a moderate to strong parental engagement.

The lowest average score was observed for Item D10 (M = 2.05, SD = 0.756), which examines how parents seek limited other learning resources. This indicates that, despite financial limitations, these parents exhibit resilience and problem-solving skills in surmounting educational obstacles. Likewise, items D9 (M = 2.16) and D3 (M = 2.24) demonstrate significant integration of literacy into daily routines and motivational support, respectively, underscoring a practical and emotionally engaged approach to the child's education.

Items measuring support for digital literacy (D11–D13) had average scores ranging from 2.32 to 2.55. Notably, item D11, which assesses parental oversight and guidance in the utilisation of digital tools, exhibited a higher standard deviation (SD = 0.947), suggesting variability in digital engagement, potentially affected by disparities in technology access or parental digital proficiency.

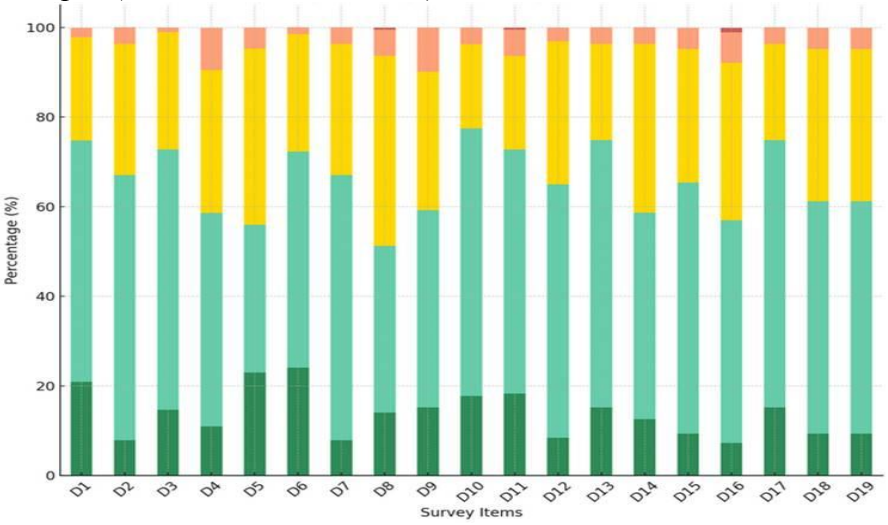
The provision of diverse learning materials (D8) recorded the highest mean score (M = 2.71), indicating challenges in accessing literary support among low-income parents. This is likely due to financial constraints that limit access to learning materials. Despite that, the mean score remained below the neutral point, which indicates that parents value and support literacy development despite the limited availability of learning materials.

The mean values for the emotional support indicators (D17–D19) ranged from 2.32 to 2.48, indicating that parents consistently want their children to do well in school and set goals for them. Even though they have structural disadvantages, these parents are very emotionally invested and intrinsically motivated to help their children learn to read and write.

In short, parents in Group A are highly involved in their children's literacy journey, especially in motivation, emotional support, and finding new ways to address limited resources. Nonetheless, access to educational resources and ongoing digital support remains a significant limitation. These results show how important it is to recognise and support the strengths of low-income families by making sure they have equal access to literacy tools and digital infrastructure through policies and programs.

Figure 5

Group B (Middle-Income Parents)



The income of middle-income parents (n = 191) was generally consistent, and they had moderately high engagement in their children's literacy development. Mean scores ranged from 2.05 to 2.45, indicating a general level of engagement across all areas.

The highest level of engagement was seen in Item D6 (“I give my child various reading materials,” M = 2.05, SD = 0.752), followed closely by D1 (“I regularly check my child's assignments,” M = 2.06, SD = 0.723) and D10 (“I address challenges in accessing resources by finding alternatives,” M = 2.08, SD = 0.713). These scores indicate robust engagement in both oversight of academic tasks and problem resolution to enhance literacy.

Digital engagement indicators (D11–D13) showed that people were participating effectively. For example, D11 (“I monitor and guide digital tool use”) had a mean of 2.16, indicating that parents with middle incomes are not only giving their children access to digital tools but also actively supervising their digital literacy activities. The standard deviation (SD = 0.806) indicates some variability, which may be due to differences in digital fluency or access to resources.

Emotional support and goal setting (D17–D19) also received favourable scores (M = 2.14–2.34), indicating that parents want their kids to do well in school. D17, which asked parents if they set educational goals for their child, had a mean of 2.14, which was low. This finding shows that parents were very involved in planning their child's academic path.

Nonetheless, items like D16 (“I help my child understand difficult words/concepts,” M = 2.45) and D8 (“My child has access to various learning materials,” M = 2.41) had the highest mean scores, indicating that people didn't agree with them as much. These findings may indicate that middle-income parents are more likely to promote independent reading or encounter

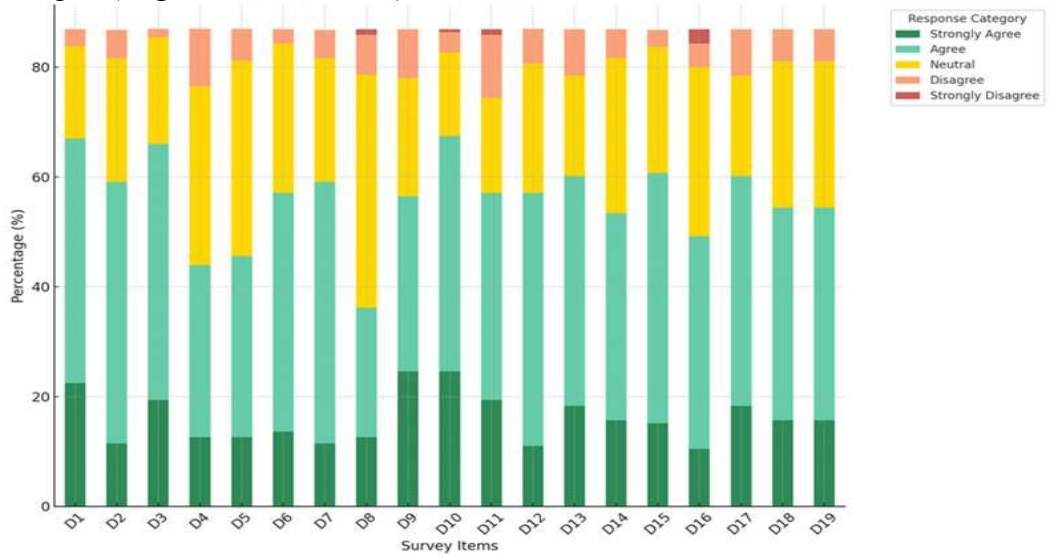
constraints in delivering comprehensive academic assistance. Even these numbers are below the midpoint, indicating that people are generally interested.

Parents in Group B were more balanced than parents in Group A in all areas. They provided more consistent, less variable emotional, academic, and digital support. The high level of agreement on key issues, such as D2 (homework help) and D3 (motivation), also shows that this group is taking action.

To sum up, parents with middle incomes are very involved in their children's literacy development in a strong, organised, and balanced way. This group is the most consistent in terms of both breadth and depth of involvement across the three income categories because they have the resources and time to support schoolwork, provide emotional support, and supervise digital literacy.

Figure 6

Group C (High-Income Parents)



The responses from Group C (n = 166), which are from parents with high incomes, show that parents are generally moderately to strongly involved in their children's literacy development. The average scores for the 19 items ranged from 1.99 to 2.55, indicating a positive trend. Lower means indicate more agreement.

The item with the most agreement was D10 (“I find alternatives to problems with getting learning resources”), which had the lowest mean score of 1.99 (SD = 0.828). The items D1 (“I regularly check my child's assignments,” M = 2.01) and D3 (“I motivate my child to get good grades,” M = 2.04) were also very close. This means that parents with a lot of money are actively involved in their children's education and are also resourceful, even though they already have enough access to learning tools.

On the other hand, D8 (“My child has access to various learning materials such as books, apps, and educational videos,” M = 2.55) had the highest mean score, even though they were relatively privileged. This might mean people think they should have access to something rather than trying to obtain it. Furthermore, D4's higher average score (M = 2.47) than the other groups suggests that this group may place less importance on direct verbal reinforcement.

Digital engagement (D11–D13) had moderate means (2.19–2.29), indicating that technology was consistently used to support literacy. However, D11, which involves monitoring the use of digital tools, exhibited a higher standard deviation (SD = 0.995), suggesting that high-income parents may not be equally involved in their children's digital learning. The difference could mean that kids have more freedom online, that they are given more responsibility by their parents, or that they have different ideas about how much time they should spend on screens.

Emotional and routine-based support (D14–D19) also showed a moderately positive range (M = 2.16–2.27). These responses indicate that affluent parents maintain aspirational, goal-directed involvement, albeit potentially less structured than that of middle-income families. For example, D16 ("I help my child understand hard words and ideas") had a mean of 2.42, which is a little higher. These results could mean that outside teachers give this kind of help more often or that kids in this group are more academically independent.

Even though access to resources is high, the higher mean response does not necessarily mean that parents are more directly involved. This difference is clear in the neutral or higher mean responses to items like D5 (M = 2.40) and D8 (M = 2.55), which suggests that people are less actively involved in providing materials.

In conclusion, parents in Group C provide strong material support and are moderately involved in their children's schoolwork, especially in motivating and monitoring their progress. However, their participation in emotional scaffolding and direct instructional support may be implemented more selectively, potentially due to reliance on external educational services. These findings indicate that although financial capital enhances resource accessibility, it does not necessarily lead to extensive parental engagement.

Discussion

This study investigated the differences in parental involvement in children's literacy development among three income groups in Selangor, Malaysia. While income is frequently seen as the principal factor influencing educational engagement, the findings revealed a more complex dynamic, with each income group demonstrating its own strengths and weaknesses.

The finding revealed that low-income parents exhibit strong motivation, emotional engagement, and ways to support literacy despite limited material resources. Middle-income parents demonstrated the most consistent engagement with their children. Their involvement remained balanced across academic supervision, active monitoring, and emotional support, as well as digital literacy monitoring. Lastly, high-income parents offer greater access to material resources but are less directly involved in their children's literacy engagement. These parents rely heavily on external support systems, such as tuition or enrichment programs, or on their children's emphasis on independent learning. This study shows that access to resources mainly does not mean active parental engagement.

Overall, the results suggest that parental engagement is influenced by socioeconomic status rather than its presence, illustrating the importance of tailored approaches to identify the engagement patterns of each income group.

Conclusion

This study offers an extensive comparison of parental involvement in children's literacy development across low-, middle-, and high-income families in Selangor. The findings suggest that socioeconomic status shapes that pattern of parental involvement, but it is not the only determining factor in parental engagement in literacy development. Low-income parents invest more emotional support in their children's literacy development than the two higher-income groups. Whereas the middle-income group appeared as the most consistent and balanced in their involvement, while the high-income group relied more on external academic support. In sum, the findings challenge one-size-fits-all assumptions about parental engagement in children's literacy development. There should be policies and programmes to support parental engagement to overcome the constraints and align with the strengths across income groups.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, QuillBot, and ChatGPT, AI-assisted writing software, were used for proofreading and refining the language of the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. All ideas, designs, procedures, findings, analyses, and discussions are originally written and derived from the careful and systematic conduct of the research.

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Enhancing Internship Support: Evaluating Student Teacher Performance for Program Development

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Abstract

This study utilized a descriptive quantitative research design, employing an institutional research tool to assess the effectiveness of the Internship/OJT program in the PETE program at CHK. The respondents comprised 189 student-teachers assigned to various training stations across Metro Manila. Findings revealed that student-teachers were placed in academic institutions near their residences, with all completing the required 350 hours of training. Their performance was evaluated by cooperating teachers, receiving outstanding ratings in teacher personality (4.82), lesson planning (4.91), subject mastery (4.72), teaching methods (4.66), and classroom management before (4.80), during (4.77), and after instruction (4.75). Analysis of performance variations across training stations indicated significant differences in teacher personality ($p = 0.0012$, $F = 3.6042$), subject mastery ($p = 0.0329$), teaching methods, and classroom management before instruction. However, no significant differences were observed in lesson planning or classroom management during and after instruction. These findings suggest that student-teacher performance varies based on institutional assignments, particularly personality expression and subject mastery. The study underscores the importance of continuously assessing and enhancing internship programs to better prepare student-teachers for real-world teaching environments. Thus, an integrated internship development plan was proposed to further improve the performance of the Pre-Service Physical Education interns.

Keywords: internship support, ST performance, development program

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Introduction

Internship programs are essential in teacher education, as they bridge the gap between theory and practice. They equip aspiring educators with hands-on classroom experience under the mentorship of seasoned professionals, preparing them for the real-world challenges of teaching. The success of these programs, however, is largely dependent on the quality of support and feedback provided during the internship.

Evaluating student-teacher performance is vital for both personal and institutional growth. It offers invaluable insights that help student-teachers recognize their strengths and pinpoint areas for improvement, fostering professional development. Additionally, these evaluations provide institutions with data to refine program structures, curricula, and support systems, ultimately creating a more effective and supportive learning environment for future educators.

Material & Methods

This study employed a descriptive quantitative research design using an institutional questionnaire to evaluate student-teachers' performance during their On-the-Job Training (OJT). The primary research instrument used was the "Evaluation Instrument for Practice Teacher – Regular and Face-to-Face," an assessment tool adopted by the university. Additionally, open-ended questions were incorporated to gain deeper insights into the strengths and weaknesses of student-teachers.

The questionnaire consists of four sections. Part 1 collects demographic information, including age, sex, total number of training hours completed, and assigned training station. Part 2 assesses student-teacher performance across key areas, including teacher personality, lesson planning, mastery of the subject matter, teaching methods, and classroom management. Parts 3 and 4 identify the strengths and areas for improvement in student-teacher performance.

For data analysis, frequency, mean, weighted mean, and ANOVA were used to interpret the results. Data collection was conducted during the actual teaching demonstration of the student-teachers, ensuring an accurate evaluation of their practical teaching skills. By employing quantitative measures of feedback, this study provides a comprehensive assessment of the internship program's effectiveness and highlights potential areas for improvement in student-teacher training.

Results & Discussion

Table 1
Assessment of the Effectiveness Performance of Student-Teachers in Terms of Teacher's Personality

Areas	Weighted Mean	Verbal Interpretation
Displays a neat and well-groomed appearance	4.91	Outstanding
Exudes confidence that commands respect and attention	4.86	Outstanding
Cautious of his/her gestures not to disturb the student's attention	4.83	Outstanding
Shows dynamism and enthusiasm that foster a harmonious relationship with the students	4.80	Outstanding

Possesses a pleasing/modulated voice	4.76	Outstanding
Employs a wide range of different skills and attitudes to assist students in achieving high outcomes.	4.76	Outstanding
General Weighted Mean	**4.82**	**Outstanding**

Table 1 highlights the professional qualities demonstrated by the Physical Education Teacher Education interns, all of which were rated as *Outstanding*. The highest-rated attribute is *"Displays a neat and well-groomed appearance"* with a mean score of 4.91, indicating that the interns consistently maintain a professional and presentable demeanor. This is followed by *"Exudes confidence that commands respect and attention"* with a score of 4.86, emphasizing the interns' ability to project self-assurance, which positively influences student engagement.

Additionally, *"Cautious of his/her gestures not to disturb the student's attention"* received a score of 4.83, showing their awareness of non-verbal communication to maintain student focus. The interns also demonstrated *"Dynamism and enthusiasm that foster harmonious relationships with students"* (4.80), which reflects their ability to create a positive and engaging learning environment.

With a *General Weighted Mean* of 4.82, the results confirm that the interns exhibited outstanding professional traits, contributing to an effective and engaging learning experience for their students. These findings highlight their preparedness for the teaching profession and their ability to create a conducive and productive classroom environment.

Table 2
Assessment of the Effectiveness Performance of Student-Teachers in Terms of Lesson Planning

Areas	Weighted Mean	Verbal Interpretation
Follows the prescribed format of the school	4.93	Outstanding
Articulates congruence between Objective and Subject matter	4.94	Outstanding
Articulates congruence between Objective and Teaching Procedure	4.89	Outstanding
Articulates congruence between Objective and Assessment	4.89	Outstanding
Articulates congruence between Objective and Assignment	4.92	Outstanding
General Weighted Mean	**4.91**	**Outstanding**

Table 2 assesses the interns' competency in lesson planning, with all indicators receiving an *Outstanding* rating. The highest-rated aspect is *"Articulates congruence between Objective and Subject Matter"*, with a weighted mean of 4.94, indicating that the interns effectively align learning objectives with the subject content. Similarly, the criterion *"Follows the prescribed format of the school"* scored 4.93, demonstrating the interns' adherence to institutional guidelines and standards in lesson planning.

Moreover, both *"Articulates congruence between Objective and Assignment"* (4.92) and *"Articulates congruence between Objective and Teaching Procedure"* (4.89) highlight the interns' ability to ensure that instructional strategies and assigned tasks align with the intended

learning outcomes. The same high rating (4.89) was observed for *"Articulates congruence between Objective and Assessment"*, emphasizing their capability to design assessments that accurately measure student learning based on set objectives.

With a *General Weighted Mean* of 4.91, the results affirm that the interns excel in structuring well-planned lessons that are coherent, aligned, and effective in delivering quality instruction. These findings underscore their preparedness in lesson planning, which is essential for ensuring meaningful and goal-oriented classroom instruction.

Table 3
Assessment of the Effectiveness Performance of Student-Teachers in Terms of Mastery of the Subject Matter

Areas	Weighted Mean	Verbal Interpretation
Explores the use of relevant materials and preliminary activities (e.g. recall and motivation to stimulate student's prior knowledge	4.82	Outstanding
Shows creativity and versatility in lesson presentation	4.77	Outstanding
Integrates relevant, innovative ideas, and in-depth knowledge on the subject matter	4.69	Outstanding
Provides sufficient and concrete meaningful learning experiences that relate to actual life situations	4.66	Outstanding
Knows how to address learners' concerns and queries with clarity and/or assurance	4.67	Outstanding
General Weighted Mean	**4.72**	**Outstanding**

Table 3 presents the assessment of the interns' performance based on their mastery of the subject matter, with all indicators receiving an *Outstanding* rating. The highest-rated competency is *"Explores the use of relevant materials and preliminary activities (e.g., recall and motivation) to stimulate students' prior knowledge"*, with a weighted mean of 4.82. This suggests that the interns effectively utilize engaging strategies to activate students' prior knowledge, enhancing lesson comprehension.

Additionally, *"Shows creativity and versatility in lesson presentation"* received a score of 4.77, highlighting the interns' ability to deliver lessons in dynamic and adaptable ways. *"Integrates relevant, innovative ideas, and in-depth knowledge on the subject matter"* scored 4.69, reflecting their capability to enrich discussions with meaningful insights and modern approaches.

Furthermore, *"Provides sufficient and concrete meaningful learning experiences that relate to actual life situations"* (4.66) and *"Knows how to address learners' concerns and queries with clarity and/or assurance"* (4.67) indicate that the interns effectively facilitate learning by making lessons relatable and addressing student inquiries with confidence.

With a *General Weighted Mean* of 4.72, the results confirm that the interns demonstrate strong subject matter expertise, creativity, and responsiveness to students' needs. Their ability to integrate innovative teaching strategies and connect lessons to real-life situations further underscores their preparedness for the teaching profession.

Table 4
Assessment of the Effectiveness Performance of Student-Teachers in Terms of Mastery of the Teaching Methods

Areas	Weighted Mean	Verbal Interpretation
Prepares creative visual aids and other examples to illustrate the lesson adaptive to the learner's ability and congruent with the lesson objectives,	4.81	Outstanding
Consistently handles class discussions in any medium of instruction (Mother Tongue/Filipino/English) with linguistic eases, confidence, and competence in complex communication task	4.55	Outstanding
Elicits learner's active participation through various learning activities	4.74	Outstanding
Promotes open communication and polite interactions between the teacher and learners and their peers while exhibiting sensitivity to learner's differences	4.79	Outstanding
Motivates learners to investigate the subject matter to expand their knowledge and satisfy their curiosity	4.67	Outstanding
Asks questions that promote Higher-Order Thinking Skills (HOTS)	4.42	Outstanding
Helps learners articulate their ideas and thinking processes while observing safe and secure learning atmosphere	4.68	Outstanding
Facilitates collaborative activities that promote learner's multiple intelligences	4.64	Outstanding
Uses formative assessment effectively to monitor student learning progress	4.65	Outstanding
Maximizes the use of feedback mechanism	4.54	Outstanding
General Weighted Mean	**4.66**	**Outstanding**

Table 4 shows the assessment of the interns' teaching methods reveals an *Outstanding* performance across all indicators, with a *General Weighted Mean* of 4.66. The highest-rated competencies, *"Prepares creative visual aids and other examples to illustrate the lesson adaptive to learners' ability and congruent with the lesson objectives"* (4.81) and *"Provides homework/agreement for the continuity of the lesson"* (4.81), emphasize the interns' ability to design engaging instructional materials and extend learning beyond the classroom. These findings align with Mayer's (2009) **Cognitive Theory of Multimedia Learning**, which highlights that well-designed visual aids enhance student comprehension and retention.

Additionally, the interns excel in *"Promoting open communication and polite interactions while exhibiting sensitivity to learners' differences"* (4.79) and *"Eliciting learners' active participation through various learning activities"* (4.74). This supports **Vygotsky's (1978) Social Constructivist Theory**, which emphasizes the role of social interaction in cognitive development. Encouraging student participation fosters collaboration and enhances learning experiences (Palincsar, 1998).

Furthermore, the ability to *"Motivate learners to investigate the subject matter to expand their knowledge and satisfy their curiosity"* (4.67) is crucial in fostering **student-centered learning** (Bransford et al., 2000). Likewise, facilitating *"Collaborative activities that promote learners'*

multiple intelligences" (4.64) aligns with Gardner's (1983) **Theory of Multiple Intelligences**, which suggests that students have different learning preferences that should be accommodated in instruction.

Although all aspects were rated outstanding, the lowest-rated competency, *"Asks questions that promote Higher-Order Thinking Skills (HOTS)"* (4.42), suggests an area for improvement. Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001) emphasizes the importance of HOTS in developing students' analytical, evaluative, and creative abilities. Research by King et al. (1998) also highlights that effective questioning techniques significantly impact students' critical thinking and problem-solving skills.

The use of *"Formative assessment to monitor student learning progress"* (4.65) and *"Maximizing feedback mechanisms"* (4.54) aligns with **Black and Wiliam's (1998) formative assessment theory**, which states that timely feedback enhances learning outcomes by allowing students to reflect on their progress.

Table 5
Assessment of the Effectiveness Performance of Student-Teachers in Terms of Classroom Management – Before

Areas	Weighted Mean	Verbal Interpretation
Establishes a safe and secure learning environment by providing classroom rules that allow learners to learn without distractions	4.88	Outstanding
Regularly conducts preliminary activities (i.e prayer, checking attendance, cleanliness of the environment, etc.) to ensure effective teaching-learning process	4.87	Outstanding
Ensures that lesson objectives are presented and well-discussed	4.79	Outstanding
General Weighted Mean	**4.80**	**Outstanding**

Table 8 presents the assessment of the respondents regarding the effectiveness of student-teachers in terms of classroom management *before* the lesson begins. The findings reveal an *Outstanding* performance across all indicators, with a *General Weighted Mean* of 4.80. This highlights the interns' competence in establishing an organized and conducive learning environment that sets the stage for effective teaching and learning.

The highest-rated competency, *"Establishes a safe and secure learning environment by providing classroom rules that allow learners to learn without distractions"*, received a weighted mean of 4.88. This underscores the importance of structure and discipline in the classroom, aligning with Wong and Wong's (2018) Classroom Management Theory, which emphasizes that well-defined rules and expectations contribute to a productive and disruption-free learning environment. Ensuring a safe and structured space enhances student engagement, minimizes behavioral issues, and promotes effective learning (Marzano et al., 2003).

Similarly, *"Regularly conducts preliminary activities (i.e., prayer, checking attendance, cleanliness of the environment, etc.) to ensure an effective teaching-learning process"*, with a weighted mean of 4.87, highlights the interns' ability to establish classroom routines. Research

suggests that structured preliminary activities help set a positive tone for learning and foster a sense of responsibility and discipline among students (Emmer & Evertson, 2016).

Meanwhile, *"Ensures that lesson objectives are presented and well-discussed"*, which scored 4.79, signifies that the interns effectively communicate learning goals at the beginning of the lesson. Clearly defined objectives guide student learning, enhance motivation, and improve overall comprehension (Hattie, 2009). This practice aligns with Robert Gagné's Nine Events of Instruction, which states that informing learners of the objectives helps them understand expectations and mentally prepare for the lesson (Gagné et al., 1992).

Overall, the assessment indicates that the interns demonstrate excellent classroom management skills before the lesson begins. Their ability to establish a well-structured, organized, and motivating learning environment ensures a smooth transition into instruction. These results affirm their preparedness to foster a positive classroom atmosphere that supports student engagement and academic success.

Table 6
Assessment of the Effectiveness Performance of Student-Teachers in Terms of Classroom Management – During

Areas	Weighted Mean	Verbal Interpretation
Uses an appropriate and well-prepared instructional material such as presentation slides PPT/Traditional visual aids, board works, and other's	4.83	Outstanding
Check systematically the classroom activities indicated in the prepared lesson plan	4.80	Outstanding
Implements orderliness and discipline in the classroom	4.85	Outstanding
Acts proactively, bringing attention to possible areas of learner's misconceptions	4.75	Outstanding
Conveys openness and warmth that encourage learners to interact with one another	4.78	Outstanding
Observes time management	4.59	Outstanding
General Weighted Mean	**4.77**	**Outstanding**

The assessment of student-teacher classroom management during instruction reveals an *Outstanding* performance across all evaluated indicators, with a *General Weighted Mean* of 4.77. This underscores the interns' proficiency in maintaining an effective and conducive learning environment throughout the instructional process.

The highest-rated competency, *"Implements orderliness and discipline in the classroom"*, with a weighted mean of 4.85, highlights the importance of maintaining structure during lessons. Effective classroom management is crucial in physical education settings, where the dynamic environment requires clear expectations and consistent enforcement to ensure student safety and engagement. Research indicates that establishing and maintaining order is foundational to successful teaching in physical education (SHAPE America, 2018).

The competency *"Uses appropriate and well-prepared instructional materials such as presentation slides (PPT), traditional visual aids, the board works, and others"*, rated at 4.83,

emphasizes the significance of utilizing diverse teaching aids to enhance lesson delivery. Well-prepared instructional materials cater to various learning styles and can increase student engagement and understanding. In physical education, where visual demonstration is key, the use of such materials is particularly beneficial (SHAPE America, 2018).

The ability to *"Check systematically the classroom activities indicated in the prepared lesson plan"*, with a rating of 4.80, reflects meticulous adherence to planned instructional activities. Systematic monitoring ensures that lessons proceed as intended and learning objectives are met. This practice is essential in physical education, where activities must be organized and aligned with educational goals (SHAPE America, 2018).

The competency *"Conveys openness and warmth that encourage learners to interact with one another"*, rated at 4.78, underscores the importance of fostering a positive classroom climate. A supportive environment encourages student interaction, collaboration, and a sense of community, which are vital for effective learning in physical education settings (SHAPE America, 2018).

The rating of 4.75 for *"Acts proactively, bringing attention to possible areas of learners' misconceptions"* highlights the interns' attentiveness to student understanding. Proactive identification and correction of misconceptions are crucial for effective learning, ensuring that students build accurate knowledge and skills (SHAPE America, 2018).

The competency *"Observes time management"*, with a rating of 4.59, while still outstanding, indicates a relative area for improvement. Effective time management is essential in physical education to maximize active learning time and ensure that all planned activities are conducted efficiently (SHAPE America, 2018).

Overall, these findings demonstrate that the student-teachers exhibit exceptional classroom management skills during instruction, effectively utilizing instructional materials, maintaining discipline, fostering positive interactions, addressing misconceptions, and managing time. These competencies are crucial for creating an environment conducive to learning and are particularly significant in the context of physical education.

Table 7
Assessment of the Effectiveness Performance of Student-Teachers in Terms of Classroom Management – After

Areas	Weighted Mean	Verbal Interpretation
Utilizes various forms of formative, self-assessment tools, and other data to determine student's instructional outcome success and academic growth		Outstanding
Recognizes learner's differences through the provision of activities for: · remediation · reinforcement · enhancement		Outstanding
General Weighted Mean	**4.75**	**Outstanding**

Table 7 shows the assessment of student-teacher classroom management after instruction reflects an outstanding performance, with both evaluated competencies receiving a weighted mean of 4.75. This indicates the interns' effectiveness in utilizing formative assessments and recognizing learner differences to enhance instructional outcomes.

Utilization of Formative and Self-Assessment Tools – The competency *"Utilizes various forms of formative, self-assessment tools, and other data to determine student's instructional outcome success and academic growth"* underscores the importance of continuous assessment in the learning process. Formative assessments, conducted during instruction, allow educators to monitor student progress, provide timely feedback, and adjust teaching strategies to meet learners' needs. In physical education, these assessments can include peer reviews, self-assessments, and observational checklists, which help students develop self-awareness and accountability in their learning journey. According to SupportREALteachers.org (n.d.), formative assessments are essential for evaluating program effectiveness and determining whether students are meeting learning objectives.

Recognition of Learner Differences through Differentiated Activities – The competency *"Recognizes learners' differences through the provision of activities for remediation, reinforcement, and enhancement"* highlights the significance of differentiated instruction in accommodating diverse student needs. Differentiation involves tailoring teaching methods and activities to address varying abilities, learning styles, and interests, ensuring that all students have equitable access to learning opportunities. In physical education, this approach may involve modifying tasks, offering varied equipment, or providing alternative activities to cater to individual skill levels. The PE Project (n.d.) emphasizes that differentiation is crucial for meeting the needs of all learners in physical education, promoting inclusivity, and maximizing each student's potential.

Implications for Physical Education – Implementing formative assessments and differentiated instruction in physical education fosters a supportive and effective learning environment. These strategies enable educators to identify and address individual student needs, promote active engagement, and facilitate skill development. By employing various assessment tools and recognizing learner differences, student-teachers can enhance instructional outcomes and contribute to students' overall academic growth and physical literacy.

In conclusion, the outstanding performance of student-teachers in utilizing formative assessments and recognizing learner differences reflects their commitment to effective teaching practices. These competencies are vital in creating inclusive and responsive physical education programs that cater to the diverse needs of all learners.

Table 8
Overall Result of Assessment of the Effectiveness of Student-Teachers

Areas	Weighted Mean	Verbal Interpretation
Teacher's Personality	4.82	Outstanding
Lesson Planning	4.91	Outstanding
Mastery of the Subject Matter	4.72	Outstanding
Teaching Methods	4.66	Outstanding
Classroom Management – Before	4.80	Outstanding

Classroom Management – During	4.77	Outstanding
Classroom Management – After	4.75	Outstanding
General Weighted Mean	**4.77**	**Outstanding**

Table 8 reveals the overall assessment of the ST Performance, which has demonstrated an outstanding level of effectiveness across various domains of teaching performance. With a **General Weighted Mean of 4.77**, the evaluation reflects strong competencies in critical teaching areas such as teachers' personality, lesson planning, subject mastery, teaching methods, and classroom management. These findings align with existing research that highlights the essential qualities of effective teachers.

The **teacher's personality**, with a weighted mean of **4.82**, plays an important role in fostering a positive learning environment. Research by Darling-Hammond (2000) suggests that effective teachers exhibit enthusiasm, confidence, and empathy, which contribute to stronger student engagement and motivation. The high rating in this category indicates that student-teachers demonstrate professional and approachable behavior, which positively impacts classroom dynamics. Similarly, **lesson planning**, which received the highest rating of **4.91**, is a fundamental aspect of effective teaching. Marzano (2007) emphasizes that well-structured lesson plans ensure clear learning objectives, appropriate instructional materials, and engaging activities. This outstanding performance suggests that student-teachers are well-prepared in designing lessons that cater to diverse learning needs.

Another key aspect of teacher effectiveness is **mastery of the subject matter**, which scored **4.72**. According to Shulman (1987), teachers must possess deep content knowledge to provide accurate explanations and meaningful learning experiences. The high rating in this area implies that student-teachers have a strong command of their subjects, allowing them to facilitate discussions effectively and address student inquiries with confidence. Additionally, their ability to employ diverse **teaching methods**, rated at **4.66**, suggests that they are successfully implementing instructional strategies that accommodate different learning styles. Hattie (2009) found that active learning, differentiated instruction, and technology integration significantly enhance student engagement, reinforcing the effectiveness of the student-teachers approach.

Classroom management, a critical component of teaching effectiveness, received consistently high ratings across all phases—**before (4.80), during (4.77), and after (4.75) instruction**. Studies by Wang et al. (1993) highlight that well-managed classrooms contribute directly to student achievement by ensuring a structured, supportive, and disciplined learning environment. These ratings suggest that student-teachers are adept at maintaining order, managing student behavior, and implementing smooth transitions between activities.

Overall, the outstanding ratings in all domains indicate a high level of preparedness and competence among student-teachers. Their strong lesson planning, subject knowledge, engaging teaching methods, and effective classroom management strategies reflect their potential to become highly effective educators. These findings emphasize the importance of teacher preparation programs in shaping skilled professionals. Moving forward, continuous professional development, mentoring, and reflective teaching practices will further enhance their teaching effectiveness and ensure sustained success in the classroom.

Conclusions

The assessment results indicate that student-teachers have demonstrated an **outstanding** level of effectiveness across all key areas of teaching performance. Their strong competencies in **lesson planning, mastery of the subject matter, teaching methods, classroom management, and professional demeanor** reflect their readiness to enter the teaching profession with confidence. The consistently high ratings highlight their ability to plan and deliver well-structured lessons, engage students effectively, and maintain a conducive learning environment.

These findings align with existing research, which emphasizes the importance of **teacher preparation programs** in developing skilled and competent educators. The student-teacher's exceptional performance suggests that they are well-equipped with the necessary knowledge, strategies, and professional attributes to positively impact student learning. Moving forward, continuous professional development, mentorship, and reflective practice will be essential in sustaining and enhancing their effectiveness as future educators.

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Tasbih Huruf: Improving Islamic Education Achievement Among *Jawi* Remedial Pupils in Rural Areas

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Official Conference Proceedings

Abstract

This action research was conducted to improve the academic achievement of pupils in the *Jawi* remedial programme, which is a component of the Islamic Education subject. The intervention involved the application of the "Tasbih Huruf" method. A total of 20 Level 1 pupils from one of the rural primary schools, Subis, Sarawak, Malaysia was selected as the target group for this study. A preliminary survey using the *Jawi* Diagnostic Test served as the basis for the initial findings. The pupils who failed appeared confused when given the test. In order to better analyze the particular learning challenges these pupils were experiencing, the teacher regrouped them into smaller learning groups. The primary problem found was the pupils' incapacity to commit the *Jawi* single letters to memory, which in turn impacted their capacity to write and construct *Jawi* script. The *Tasbih Huruf* method was introduced by the teacher to assist pupils in learning and mastering these letters, and this was the main focus of the intervention. The goal of this tactic was to significantly improve their *Jawi* writing abilities. Additionally, the project involved working with teachers who served as facilitators, which enhanced the validity and credibility of the research process. Within the allotted time, the pupils' post-test performance significantly improved following the implementation of the intervention. Pupils' motivation and engagement were successfully raised by the *Tasbih Huruf* method, which also improved their recognition and memorization of the *Jawi* single letters.

Keywords: Islamic education, *Jawi* remedial, Tasbih Huruf

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Introduction

According to Fatah Yasin, Raudlotul Firdaus and Jani, Mohd. Shah (2013), Pendidikan Islam in primary level includes the following subject matters in its syllabus: Asas "Ulum Syar"iyah (The foundation of Shari'ah Knowledge) which includes aqidah (Islamic belief), ibadah (prostration), sirah (Prophetic history). Adab and akhlak which include adab in daily life, towards parent and family, dealing with society, seeking knowledge, dealing with the Qur'an and Jawi Script. This study focuses on the *Jawi* domain, particularly among pupils in one of the rural primary schools in Subis District, Miri, Sarawak. It has an enrolment of 250 pupils and 45 staff members and is recognized for its strong academic and co-curricular achievements.

Kolej Yayasan UEM Research Institute stated that, Socioeconomic status (SES) is defined as a way to describe an individual according to their education, income and type of job, while tertiary education is an education after secondary education that includes college and university. In Malaysia, the SES of individuals of a family is classified into three different income groups, which are B40, M40 and T20. B40 refers to the bottom 40% of income earners; M40 is the middle 40%, and T20 is the top 20%. In contrast, pupils from higher-income families typically receive additional learning support. Consequently forming a huge gap in *Jawi* literacy skills, particularly in *Jawi* writing among the pupils.

Early childhood Jawi literacy studies hold important value because they influence a range of aspects including identity growth and religious knowledge retention and cultural tradition preservation. The ongoing impact of globalization and digitalization threatens to disconnect younger generations from their historical script which separates them from their cultural roots (Ghazali et al., 2025).

Early diagnostic assessments revealed that 20 pupils, particularly in lower primary, were unable to recognize and sequence *Jawi* letters accurately. Islamic Education teachers (GPI) identified this issue as the main barrier in learning thus committed to address it through the targeted intervention.

In response, this study introduced the *Tasbih Huruf* method, a simplified teaching approach tailored to pupils' learning levels regardless of the background. Following the approval from school leadership, the method was adopted as the best practice among the GPI teachers to enhance *Jawi* literacy mastery.

Focus of the Study

The purpose of this action research is to address pupils' learning gaps in *Jawi* writing, with specific focus on recognizing and memorizing single *Jawi* letters from *alif* to *ya*, as taught during Level 1 Islamic Education lessons.

The objective of this action research is:

- To enhance pupils' ability to recognize and memorize single *Jawi* letters.

The research question of this study is:

- How does the *Tasbih Huruf* method support pupils in improving their ability to recognize and memorize single *Jawi* letters?

Literature Review

The mastery of the Jawi script remains a persistent challenge among Malaysian school pupils despite its long-standing inclusion in the national curriculum. Previous studies have consistently highlighted weaknesses in students' reading and writing skills, suggesting that existing instructional practices may be insufficient to address learners' needs. This section critically reviews relevant literature to identify gaps that justify the present study.

Ab Rahman (2020) examined secondary school students' mastery of Jawi reading and writing using a survey-based design. The study revealed that students demonstrated low confidence and limited proficiency in recognising Jawi letters and constructing words accurately. While the study effectively highlighted students' perceptions and general proficiency levels, its reliance on self-reported data limited deeper insight into specific learning difficulties. Nevertheless, Ab Rahman's findings strongly suggest the need for more innovative and learner-centred pedagogical approaches, as traditional memorisation-based methods were found to be ineffective in improving sustained mastery of Jawi.

Focusing more specifically on foundational skills, Azman (2021) investigated the effectiveness of an intervention aimed at improving students' recognition of single Jawi letters. The study demonstrated that targeted and systematic instruction significantly enhanced students' letter recognition skills. Unlike broader survey studies, this research provided empirical evidence that mastery of basic Jawi letters is a prerequisite for successful reading and writing. However, the study was limited to letter recognition and did not extensively explore how these gains translated into improved word construction or writing fluency. Despite this limitation, the study is highly relevant as it underscores the importance of strengthening foundational skills through focused interventions.

The Primary school students face significant hurdles in mastering the critical skill of connecting Jawi letters to form words. This difficulty is a substantial obstacle that impedes their ability to learn Jawi effectively. Moreover, the observed lack of enthusiasm and motivation towards Jawi writing can negatively impact their broader educational experience. It is essential to address these challenges promptly. Innovative methods and engaging teaching strategies are needed to inspire and encourage students to improve their Jawi writing skills. Such efforts will not only enhance their cultural literacy but also contribute positively to their overall academic development (Abdul Malik et al., 2024).

In contrast to studies focusing on students, Tajuddin and Zulkifli (2024) explored the level of Jawi content knowledge among Islamic Education Teachers (IETs). Their findings revealed that teachers possessed a high level of content knowledge, suggesting that students' low mastery of Jawi is unlikely to stem from teachers' lack of subject knowledge. This shifts the focus towards instructional strategies, teaching methods, and the effectiveness of teaching materials. However, the study did not examine actual classroom practices, leaving unanswered questions about how teacher knowledge is translated into instructional delivery.

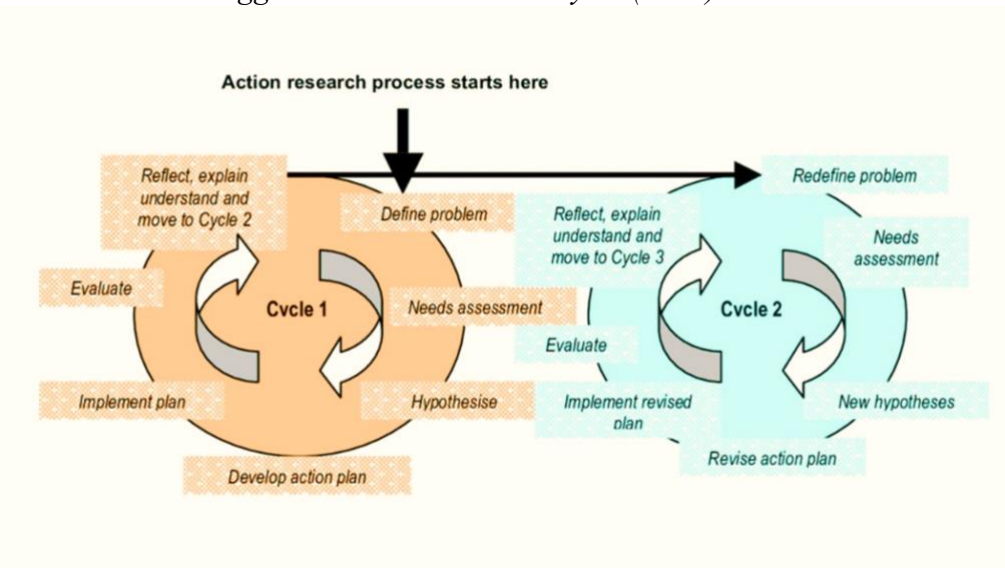
In summary, the literature indicates that students' difficulties in mastering Jawi are not due to a single factor but are influenced by weaknesses in foundational skills, limited instructional innovation, and insufficient reinforcement strategies. While previous studies have identified key issues related to student proficiency and teacher knowledge, there remains a lack of empirical research on targeted classroom interventions that address basic Jawi skills in a structured manner. Therefore, the present study seeks to fill this gap by implementing and

evaluating an instructional intervention aimed at improving students' foundational mastery of the Jawi script.

Research Methodology

This study adapted an action research design using the Action Research Model developed by Kemmis and McTaggart's Cyclical Action Research Model (Kemmis & McTaggart, 1988). The model operates in a cyclical process consisting of four phases: reflecting, planning, acting, and observing.

Figure 1
Kemmis and McTaggart's Action Research Cycle (1988)



In the reflection phase, the researcher identified pupils' weaknesses in recognizing single *Jawi* letters, which highlighted the need for a structured intervention. During the planning phase, the *Tasbih Huruf* approach was designed as an instructional strategy to address this issue. The action phase involved implementing the intervention in Level 1 Islamic Education lessons in one of the Subis rural primary schools. Finally, in the observation phase, the researcher monitored pupils' progress and documented the outcomes to evaluate the effectiveness of the intervention and to inform subsequent cycles of improvement.

Before entering the first cycle, the researcher must identify the focus of the study, namely the issue or problem to be investigated. In the educational context, the researcher is required to identify what is the most obvious problem that occur during the lesson after reflecting on their own instructional practices in the classroom.

To identify the issue or problem, attention must be given to the following three aspects:

1. What is currently happening?
2. How does the issue, problem, or situation arise?
3. What actions can I take?

The planning stage requires the formulation of improvement measures to guide subsequent actions after the research focus has been identified. Kemmis and McTaggart (1988) suggested several key steps to be undertaken, namely:

- Writing a clear statement of the research focus.

- Defining the related variables.
- Formulating the research questions.
- Explaining the proposed intervention or innovation.
- Identifying the research collaborators involved.
- Outlining the procedures to be implemented.
- Developing a research timeline.
- Stating the resources that can and will be utilized.
- Presenting ideas for data collection.

Accordingly, the researcher adapted the Kemmis and McTaggart (1988) model as the primary reference framework for conducting this action research.

Problem Statement

The mastery of Jawi script among primary school pupils in rural areas remains low and continues to be a major concern. Observations conducted by Islamic Education teachers at Sekolah Kebangsaan Bekenu revealed that many lower primary pupils, particularly those in the remedial group, still struggle to recognize and write individual Jawi letters accurately. This weakness hinders their ability to read and comprehend Jawi words, thereby affecting their overall achievement in the Islamic Education subject.

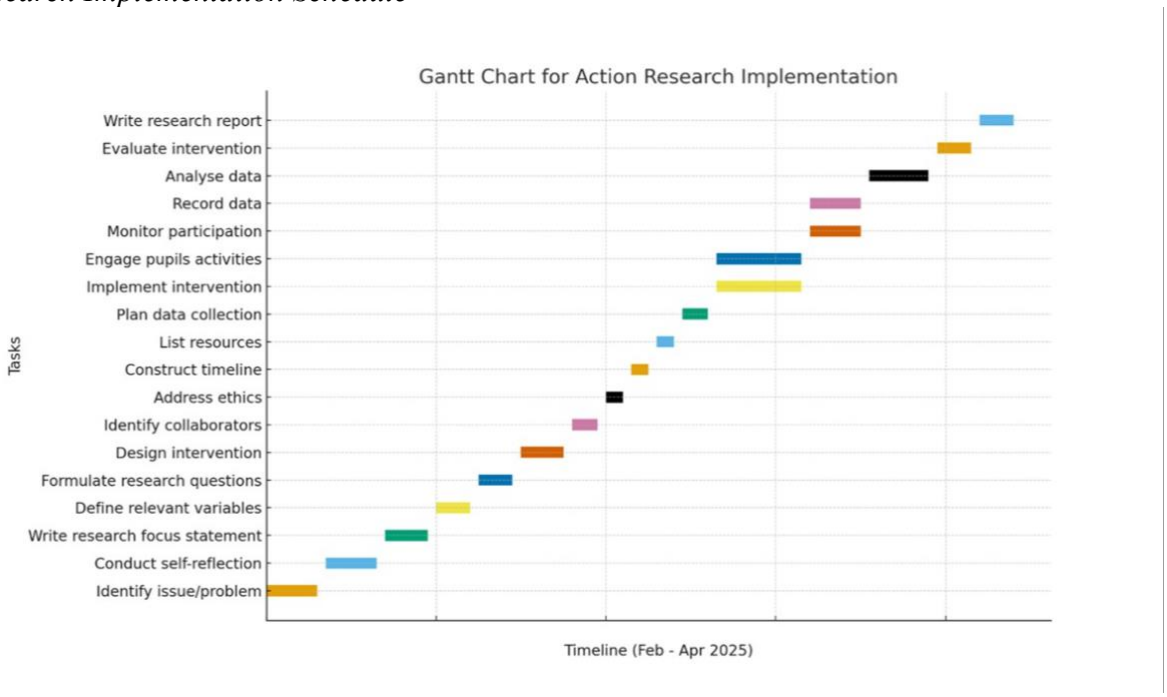
Several factors contribute to this issue. The predominant use of traditional teaching methods, such as rote memorization and flashcards, has proven insufficient in engaging pupils or supporting their long-term retention of Jawi letters. Moreover, the lack of attractive and suitable teaching aids that cater to pupils' diverse learning abilities further limits the effectiveness of classroom instruction.

As a result, pupils often lose interest, experience low motivation, and find it difficult to stay focused during Jawi lessons. This situation negatively impacts their foundational literacy skills, confidence, and overall participation in Islamic Education learning activities. The persistent gap in Jawi literacy among rural pupils highlights the urgent need for an innovative and child-friendly approach that promotes active learning and meaningful engagement.

Therefore, this study introduces the "Tasbih Huruf" method as an innovative intervention designed to assist pupils in recognizing and memorizing Jawi letters through a structured and interactive approach. The method integrates the use of prayer beads (tasbih) and a systematic learning module to enhance tactile and visual learning experiences. It is anticipated that this intervention will increase pupils' interest, attention, and mastery of Jawi letters, ultimately improving their academic performance and strengthening the quality of Islamic Education teaching in rural schools.

Planning

Figure 2
Research Implementation Schedule



Observation Findings From Islamic Education Panel Teachers (GPI)

Prior to the implementation of this study, several recurring issues were identified based on feedback from the Islamic Education Panel Teachers (GPI). A key concern highlighted was the persistent weakness among lower primary pupils in recognizing and memorizing single *Jawi* letters. This issue has been observed annually and significantly affects pupils' overall performance in *Jawi* writing.

To obtain a more comprehensive understanding, the researcher collaborated with the GPI to conduct detailed observations of pupils experiencing such difficulties. The findings revealed that a number of pupils consistently underperformed in *Jawi* assessments, particularly in recognizing and memorizing the individual letters.

For the purpose of this study, a small group of pupils was identified as the target group. The primary issue observed was their inability to recognize and memorize the basic *Jawi* letters, which consequently hindered their mastery of *Jawi* writing skills. This fundamental limitation underscores the necessity for a systematic intervention to strengthen pupils' *Jawi* basic literacy skills.

Jawi Diagnostic Test Data

A diagnostic test on single *Jawi* letters was administered to 20 pupils as the first screening. The test consisted of 10 questions at both basic and intermediate levels. The assessment was conducted over one hour, during which pupils' behaviours were also observed.

Based on the teacher's observations, pupils were unable to accurately arrange single *Jawi* letters and demonstrated difficulties in writing them correctly. Furthermore, many pupils frequently looked at one another's work and displayed signs of boredom, waiting passively for the test to end.

Figure 3
Diagnostic Test on Single Jawi Letters

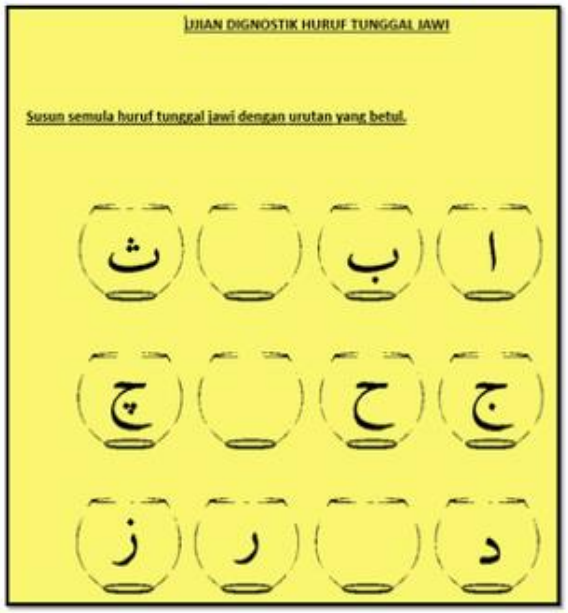


Figure 4
Implementation of the Jawi



Diagnostic Test

Intervention

The study implemented the *Tasbih Huruf* method, an intervention agreed upon by all Islamic Education teachers (GPI) to address pupils' difficulties in recognizing and memorizing individual *Jawi* letters. This method employed a systematic arrangement of 37 letters using a structured module and prayer beads (*tasbih*), enabling pupils to recall letter sequences more effectively. Teachers also jumbled letter arrangements to reinforce recognition skills.

Repeated practice strengthened pupils' memory and recognition of *Jawi* letters, consistent with Skinner's Operant Conditioning Theory (1965), which highlights the role of reinforcement in shaping behaviour. In addition, the intervention incorporated principles of Constructivist

Learning Theory, allowing pupils to actively engage, explore, and construct knowledge through interaction with learning materials.

Figure 5
Jawi Single Letter Module



Implementation Steps of the *Tasbih Huruf* Method:

1. Pupils are provided with 37 beads (tasbih).
2. Pupils refer to the *Jawi* Single Letter Module.
3. Pupils write the *Jawi* single letters in the correct sequence.
4. The teacher demonstrates the correct method of arranging the *Jawi* single letters.
5. Pupils are given a string to rearrange the *Jawi* single letters.
6. Pupils pronounce each *Jawi* single letter one by one and repeat them continuously using a rhythmic *zikir*.

Figure 6
Steps of the Tasbih Huruf Method



Figure 7
Activity Log

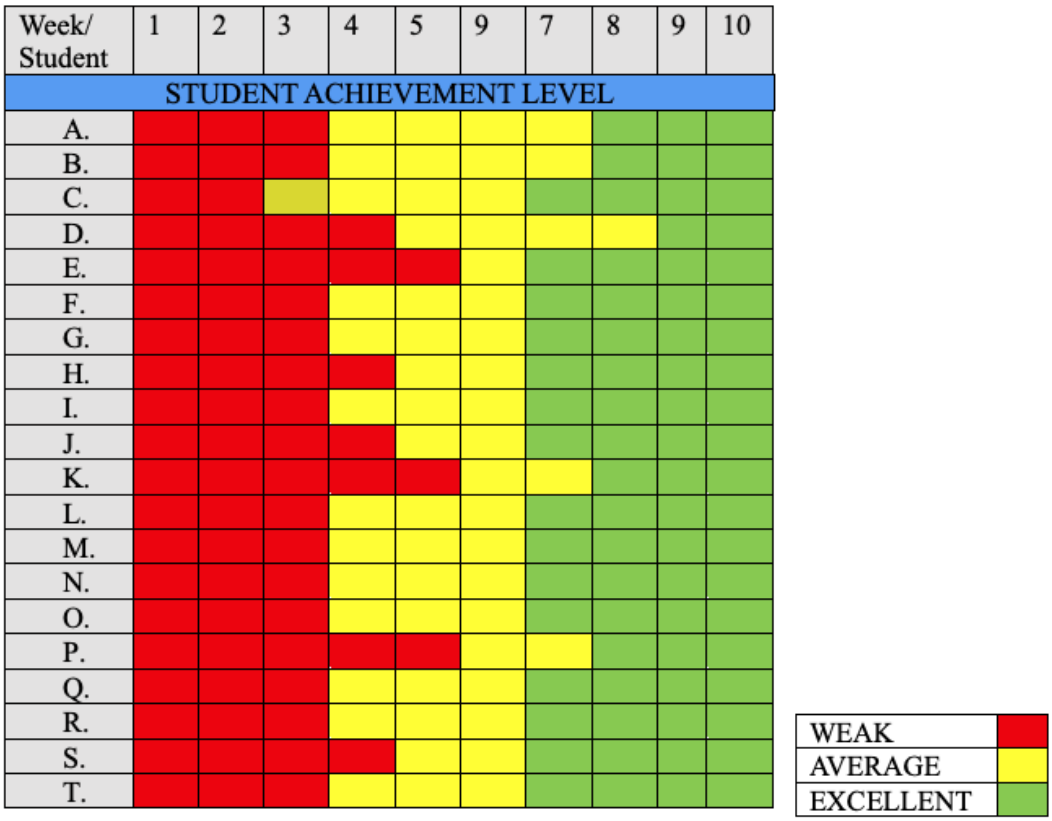


Figure 8
Result of Student

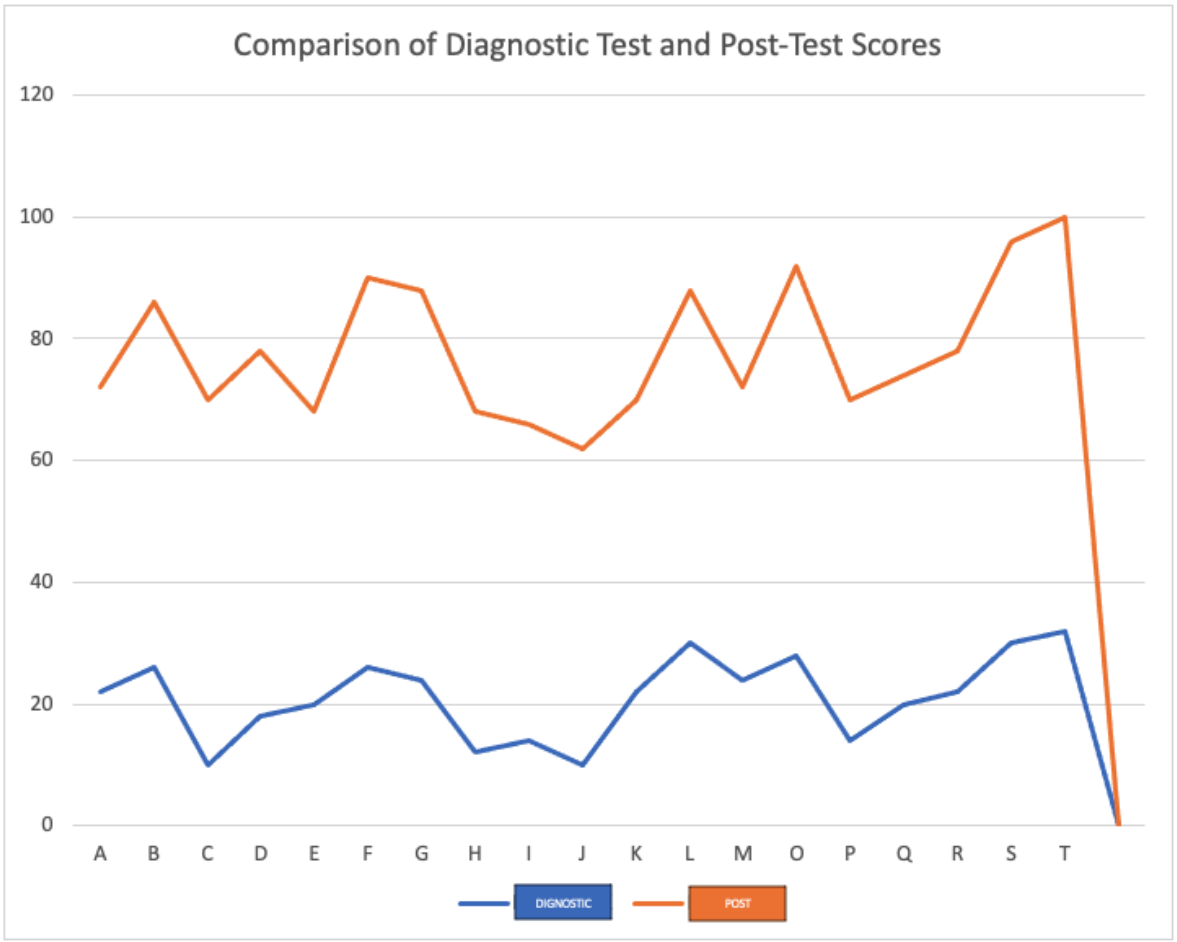
Number	Student	Diagnostic score	Post-test score
1	A	20	50
2	B	22	60
3	C	26	60
4	D	10	60
5	E	18	48
6	F	20	64
7	G	26	64
8	H	24	56
9	I	12	52
10	J	14	52
11	K	10	48
12	L	22	58
13	M	30	66
14	N	24	48
15	O	28	64
16	P	14	56
17	Q	20	54
18	R	22	56
19	S	30	66
20	T	32	68

Research Findings

The findings of this study revealed that the *Tasbih Huruf* method founds the most effective strategy that teachers can employ to systematically enhance pupils' proficiency in recognizing and memorizing individual *Jawi* letters. Moreover, teachers are able to implement this method within a well-structured classroom management framework in collaboration with subject panel members. The pupils' achievement is evidenced by the results of the post-test and survey administered.

This approach is highly accessible and affordable for all pupils to practice despite their backgrounds, particularly in mastering single *Jawi* letters. Furthermore, it holds significant relevance as an introductory tool for pupils' subsequent mastering of additional *Jawi* letters.

Figure 9
Comparison of Test Results



Conclusion and Implications

The present action research provides empirical evidence that the *Tasbih Huruf* approach constitutes an effective pedagogical intervention for enhancing teachers' instructional competencies and facilitating pupils' systematic mastery of individual *Jawi* letters. The method promoted active learning, engagement, and motivation among pupils, rendering the acquisition of *Jawi* letters both accessible and enjoyable.

Traditional instructional strategies, primarily flashcard-based methods, proved inadequate for pupils with lower proficiency levels. Through targeted interventions, structured lesson planning, and collaborative discussions among educators, the *Tasbih Huruf* method effectively addressed these learning gaps, resulting in measurable improvements in pupils' outcomes.

The findings underscore the critical importance of aligning instructional strategies with pupils' diverse learning needs and employing both pupil-centred and resource-centred approaches. Optimal lesson planning, time management, and classroom organization emerged as key factors in ensuring the effectiveness of the intervention. Additionally, collaborative teamwork among teachers was instrumental in overcoming pedagogical challenges and sustaining pupils' engagement.

To sum up, this study shows how well-structured and engaging interventions can enhance teaching methods and pupils' learning outcomes. Continuous reflective practice and methodical improvement of teaching techniques to suit changing classroom requirements are necessary for sustained progress. The *Tasbih Huruf* technique offers a flexible and adaptable way to promote *Jawi* literacy, and it may find use in more general educational settings where comparable issues arise.

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How Should Immersive Learning Spaces Be Designed? Formalising the Intersection Between School Design and XR Technologies

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Abstract

In recent years, the design of learning spaces has increasingly gained traction in school contexts, capturing the attention of scholars, architects, and educational communities. Following a long period of standstill in the condition of school buildings, European countries have undertaken significant efforts to renovate and modernise their school facilities through new policies and design guidelines. At the same time, a major trend in education has emerged: the adoption of eXtended Reality (XR) technologies to support and enhance learning experiences. However, despite the proliferation of research and practical implementations in both fields, physical space design and immersive learning experiences, there remains a lack of an integrated theoretical framework linking the two. Therefore, this study aims at creating a unified theoretical framework to represent and describe how virtual environments supporting learning experiences should be designed, outlining first practical indications on how the various key principles to design physical spaces can be translated into virtual environments. Using thematic analysis, the research examines key international documents and guidelines to identify the core design features and pedagogical principles on both fronts. These are then intertwined through the construction of a correlation matrix that highlights alignments and points of translation between physical and virtual design strategies. While the qualitative findings of this study require further analyses such as ethnographic techniques or quantitative assessments, this work represents a first step towards bridging the fields of educational architecture and immersive learning in that it provides preliminary design guidelines for XR learning environments.

Keywords: school design, immersive learning environments, XR

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Introduction

For much of the twentieth century, the spatial configuration of classrooms remained largely unchanged, continuing to reproduce standardised layouts that reflected a transmissive model of education. Only recently has this long-standing condition begun to shift. The design of educational spaces has garnered renewed attention in discussions on 21st-century education, emerging as a central concern for scholars, designers, educators, and school communities. Across Europe, this renewed focus has translated into extensive renovation initiatives, supported by new policies and design frameworks aimed at improving the quality and performance of school buildings. Concurrently, educational practices are being reshaped by the increasing adoption of eXtended Reality (XR) technologies. These technologies introduce immersive digital environments that allow learners to engage with content in ways that extend beyond the limits of the physical classroom, whether by navigating historical settings, interacting with abstract scientific phenomena, or collaborating within shared virtual spaces. In doing so, XR expands the spatial and experiential dimensions of learning and challenges traditional assumptions about where educational activities can take place.

Although both developments seek to redefine learning environments, they have largely evolved independently rather than in dialogue. On the one hand, the redesign of physical school spaces has mainly concentrated on the material qualities of space, such as spatial organisation, comfort, safety, and functional programming. On the other hand, the development of immersive learning environments has been driven by a focus on experience, prioritising immersion, interaction, and the feeling of presence within digital worlds. As a result, the physical and virtual dimensions of learning environments are often treated as separate domains, despite their overlapping educational goals. This separation, therefore, reveals a deeper issue: the absence of a shared conceptual framework capable of linking the principles that shape physical learning spaces with those that inform the design of immersive digital ones. Without a common language to connect these domains, both research and practice remain fragmented, making it difficult to develop integrated learning environments that fully respond to contemporary pedagogical needs across physical and virtual contexts.

This paper contributes to this integration by examining influential European policies and guidelines for school design alongside international recommendations for immersive learning environments. Through a thematic analysis, it identifies key pedagogical and spatial principles present in both domains and brings them into relation through a correlation matrix. By revealing alignments and tensions between design criteria for physical and virtual spaces, the matrix provides a tool for bridging these parallel discourses and for informing future approaches to learning environment design that span material and digital realms.

Methodology

To investigate how learning spaces, both physical and virtual, are currently being reimagined and to identify emerging design features across these domains, this study adopted a qualitative document-based methodology. The analysis drew on a targeted selection of policy documents, guidelines, and reports widely recognised as influential within the design of educational spaces and immersive learning environments.

Two complementary bodies of literature were examined: documents addressing the design of physical educational spaces and those focusing on the design of XR-based learning environments. For the design of physical learning spaces, seven key documents were

selected. Four reflect recent Italian design directions and policy frameworks: the latest *Legambiente Report* (2024), the *1+4 Learning Areas Manifesto* developed by INDIRE (2016), *Piano Scuola 4.0* (Futura PNRR, 2022a), and the *Futura* design guidelines (Futura PNRR, 2022b). To situate these national perspectives within a broader European context, three additional documents were included: the *OECD Handbook for Innovative Learning Environments* (OECD, 2017), *Spazi educativi e architetture scolastiche* (Borri, 2016), and *The Classroom Has Broken* (Borri, 2018). Although the latter two were produced by the Italian research institute INDIRE, they explicitly integrate international case studies and perspectives from several European countries, including Finland, Germany, and Sweden. With respect to XR learning environments, the selection revealed a more limited body of design-oriented literature. Three documents were identified that explicitly address the design of virtual learning spaces, rather than focusing solely on learning experiences or instructional strategies: *Designing Effective VR Learning Environments: Immersive Strategies and Methods* (Pradhan & Mantry, 2025), *The Immersive Classroom: Create Customized Learning Experiences with AR/VR* (Donally, 2022), and *Virtual Reality in Education: Designing Immersive and Innovative Learning Experiences* (Sulisworo et al., 2023).

All selected documents were reviewed and analysed using Thematic Analysis, a qualitative method that supports the identification, interpretation, and reporting of recurring patterns within textual data (Braun & Clarke, 2006). The analysis was applied consistently across both sets of documents to extrapolate the main pedagogical and spatial principles, and it involved a systematic coding process in which relevant excerpts were assigned to conceptual categories capturing key design principles and criteria (Vaismoradi & Snelgrove, 2019). These thematic categories were then synthesised into a unified framework intended to support the design and development of immersive learning environments informed by spatial design knowledge.

Subsequently, to examine relationships among the identified codes and themes, correlation matrices were generated using MAXQDA, a software for qualitative and mixed-methods data analysis. These matrices visualised code co-occurrences, enabling a deeper exploration of how different design concepts and features related to one another within and across the two domains. As a final step, an overarching correlation matrix was constructed to integrate all themes emerging from the analysis. This comprehensive matrix mapped points of contact between physical and virtual learning environments, highlighting areas where architectural and pedagogical design concerns intersected with the affordances and constraints of immersive technologies. In doing so, it made visible shared design features and provided a structured basis for bridging the design of physical and virtual learning spaces.

Results and Discussion

Thematic Analysis Results

The thematic analysis revealed distinct yet complementary sets of design principles for physical learning spaces and immersive XR learning environments. While the two domains were articulated through different vocabularies and priorities, the results highlighted meaningful points of convergence as well as structural gaps that help explain their parallel development.

Concerning physical learning environments, the analysis identified five core themes: "Building quality", "Sustainability", "Pedagogical Design of Spaces", "Inclusion", and "Community", each capturing a critical dimension of contemporary school design.

The first theme, "*Building Quality",* refers to the importance of ensuring high-quality built environments, which depend on several interrelated aspects. A first dimension is represented by *Spatial organization* (n = 17), highlighting the need to carefully consider the size, proportions, and distribution of spaces (*Size and distribution*) to support flexible management of learning activities, while also maintaining strong connections with other school areas, both indoor and outdoor (*Flexible and interconnected spaces*). Alongside spatial organisation, the analysis shows that attention should also be paid to *Aesthetic quality* (n = 3), which contributes to creating a relaxed and stimulating environment for students and simultaneously functions as a behavioural reference. In addition, *Comfort and safety* (n = 17) emerged as a key concern, encompassing aspects such as appropriate lighting, thermal comfort, air quality, acoustics, and the provision of adequate safety measures. The documents further underline the importance of integrating the school building into its urban or natural context (*Integrating the school into the context*, n = 3) and of providing outdoor spaces, which are considered essential for informal learning and students' well-being (*Give importance to outdoor spaces*, n = 6). Finally, in response to the ongoing digital transition, school spaces are expected to accommodate technological infrastructure capable of supporting new teaching modalities (*Integrating spaces with technology*, n = 16). The second theme, "Sustainability"*,* relates to the construction of more environmentally responsible school buildings. This involves not only the use of sustainable materials and building techniques (*Sustainable materials and building techniques*, n = 3) and low-tech solutions (*Low-tech solutions*, n = 5), but also the enhancement of natural light (*Natural light*, n = 2) and a more conscious use of energy through energy-efficient systems (*Energy efficiency*, n = 5) and renewable energy sources (*Renewable energy sources*, n = 3). Another prominent theme identified in the documents is "Inclusion". In this respect, school buildings are expected to support diverse abilities and learning styles in order to guarantee an inclusive and equitable learning environment for all students (*Supporting learning for all*, n = 13). In addition, all classrooms and school areas should be fully accessible, ensuring that no student is excluded from participation (*Accessibility for all*, n = 7).

These themes are closely connected to the broader concept of "Pedagogical Design of Spaces"*,* which emerges through a strong focus on the needs of both students and teachers. From the students' perspective, the theme *Supporting students* (n = 40) highlights the importance of providing a variety of educational spaces capable of accommodating different needs, such as movement, rest, collaboration, or privacy, while also enabling personalised learning experiences and supporting the development of multiple skills. Achieving this requires a shift in perspective, placing students at the centre of educational design and, consequently, redefining the spaces in which innovative teaching methodologies take place. From the teachers' perspective, the analysis emphasises the importance of *Valuing pedagogical leadership* (n = 18). This includes the provision of appropriate and welcoming spaces for teachers, recognition of the role of teaching design and classroom allocation, and the promotion of interdisciplinary collaboration between educators and designers. More broadly, educational architecture should support active and collaborative learning approaches while contributing to the learning and well-being of the entire school community (*Supporting learning and well-being of the school community*, n = 47). Finally, the theme "Community" emphasises the role of the school as more than a place for formal instruction. The school building is conceived as a social environment capable of transmitting shared values through

an “implicit pedagogy” (*The school as a social place to promote an implicit pedagogy*, n = 5). As such, school design should foster meaningful social interactions both within the building (*The school as a place to foster social interaction*, n = 13) and beyond it, encouraging the involvement of students, teachers, families, and the wider non-school community (*Involvement of school and non-school community*, n = 6).

With regard to immersive learning environments, the thematic analysis identified two main themes: *XR Pedagogical Aspects* and *XR Technical Aspects*.

The first theme concerns the educational potential of VR and AR technologies, both in terms of learning activity design and alignment with virtual environments. According to the documents, XR technologies can increase the level of challenge for students, for example, through the use of gamification strategies (*Challenging students*, n = 3), while also enabling flexible lesson designs that can be adapted to different learners (*Lesson flexibility*, n = 4). The possibility of customising virtual environments, whether realistic, abstract, or imaginary, also emerged as a relevant factor in addressing students’ needs and learning goals (*Environment customisation*, n = 2). Moreover, immersive environments can enrich learning experiences by allowing students to explore complex or abstract concepts and to access environments that would otherwise be difficult or impossible to visit (*Immersive environments can enrich learning experiences*, n = 5). XR technologies are also associated with increased accessibility, particularly in relation to mobility and interaction, through the use of alternative input methods and personalisation options (*Immersive environments offer inclusivity and accessibility*, n = 4).

The second theme, *XR Technical Aspects*, encompasses the features that contribute to user experience design. *Immersion* (n = 7) refers to the extent to which users feel cognitively and emotionally involved in the virtual environment, while *Presence* (n = 2) relates to the sensation of being physically located within it. These experiences are supported by *Usability* (n = 2), which involves intuitive interfaces and smooth navigation, and by *Realism* (n = 4), referring to visual fidelity and environmental authenticity. The most frequently cited components within this theme are *Interaction* (n = 15) and *Engagement* (n = 14). Interaction enables users to meaningfully manipulate virtual objects and environments, whereas engagement supports sustained interest and active participation through strategies such as gamification, storytelling, and interactive challenges.

From Themes to Matrices to Guide the Design

Following the thematic analysis, five themes emerged that describe the key aspects to be considered in the design of physical learning spaces, alongside two themes addressing the main dimensions relevant to the design of immersive virtual learning environments. Each theme was articulated through a set of related codes. Building on these results, three main groups of correlations were identified and represented through three distinct matrices: (1) the relationship between building quality and sustainability; (2) the pedagogical design of spaces in relation to building quality, inclusion, and community; and (3) the pedagogical aspects of XR in relation to the technical aspects of XR.

Each matrix illustrates the co-occurrence of codes, enabling a more in-depth exploration of the connections and patterns linking different design concepts and features. In this sense, the matrices function as conceptual maps that make visible the intersections between pedagogy, architecture, and XR technologies, highlighting how these domains interact and overlap. The

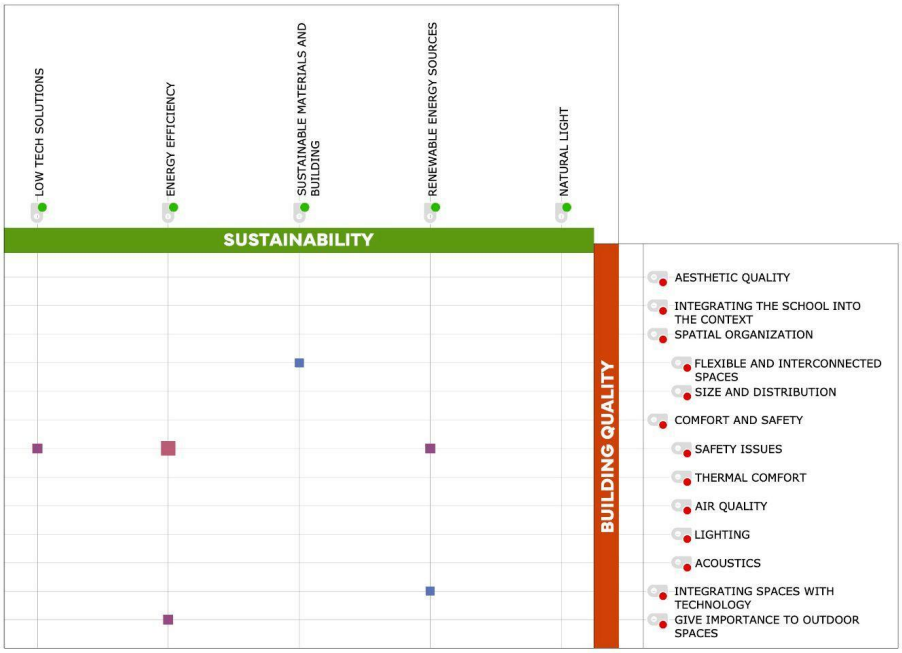
intersections are represented by squares of varying sizes, indicating the frequency with which two codes appear together within the same text segment, with larger squares corresponding to stronger associations.

Matrix 1. Building Quality – Sustainability

The first matrix focuses on the interaction between the themes of "Building quality" and "Sustainability", highlighting the extent to which architectural design considerations are aligned with environmental concerns (**Figure 1**).

Figure 1

Matrix 1 (Relationship Between "Building Quality" and "Sustainability")



Note. Authors' elaboration

The most prominent relationship emerges between *Safety issues* and *Energy efficiency*. This strong association indicates that ensuring a safe school environment also entails minimising resource consumption and promoting responsible energy use, suggesting that safety and efficiency are understood as mutually reinforcing aspects of building quality. Indeed, *Safety issues* are also linked to both *Low-tech solutions* and *Renewable energy sources*, pointing to a conception of safety that, incorporating long-term robustness and resilience, is not limited to present conditions but is also oriented toward safeguarding future well-being. Another relevant association is observed between *Energy efficiency* and *Giving importance to outdoor spaces*. This relationship reflects a vision of sustainability in which energy performance is not restricted to building systems but is also influenced by spatial design choices. Outdoor spaces can support passive environmental strategies, reduce dependence on artificial lighting and ventilation, and encourage healthier daily practices.

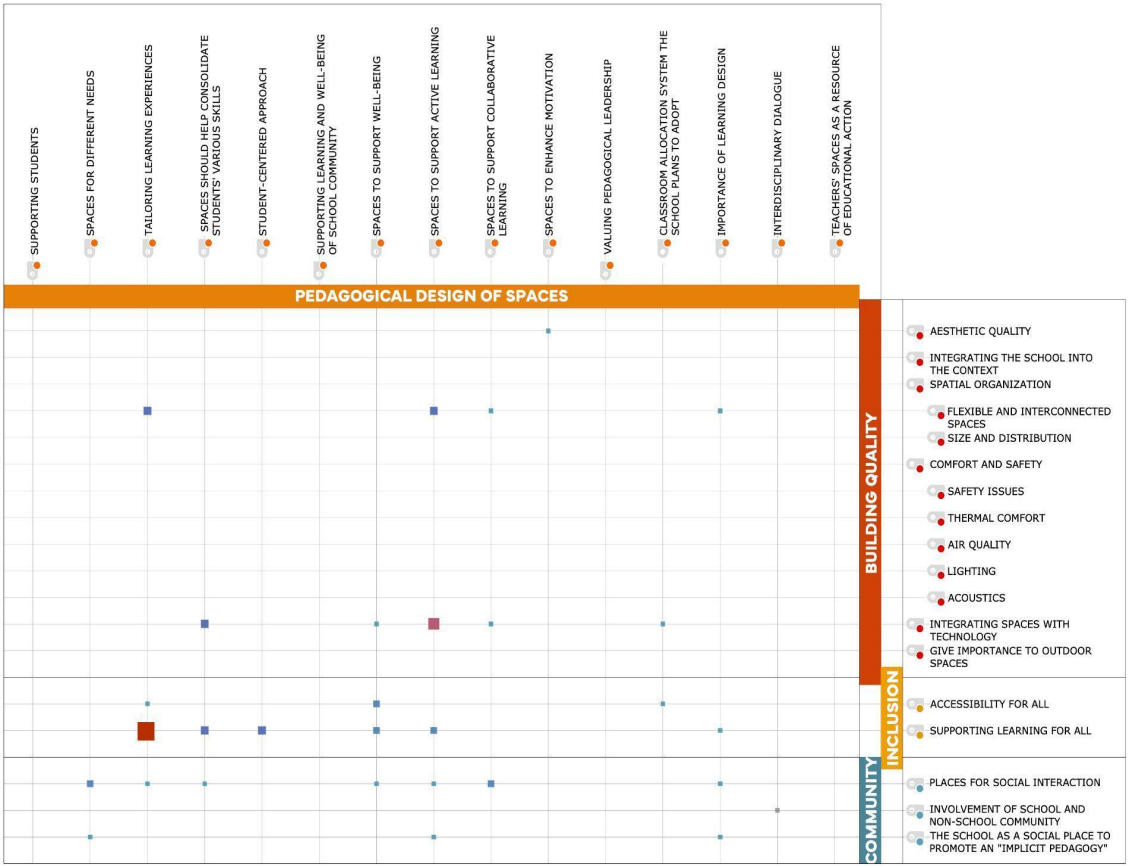
Matrix 2. Pedagogical Design of Spaces - Building Quality, Inclusion, and Community

The second matrix examines how "Pedagogical design of spaces" intersects with the themes of "Building quality", "Inclusion", and "Community", conveying more than the other

matrices an understanding of the school environment as an active component of the educational process, capable of shaping learning practices and social relations (**Figure 2**).

Figure 2

Matrix 2 (Connection of "Pedagogical Design of Spaces" With "Building Quality", "Inclusion", and "Community")



Note. Authors' elaboration

Within the area of "*Building quality"*, the strongest relationships involve *Spaces to support active learning* and *Integrating spaces with technologies.* This pattern suggests that architectural quality is closely linked to the ability of spaces to accommodate contemporary pedagogical approaches. Technology integration, in this sense, is not treated as an add-on but as an integral feature that enables active and participatory learning. A similar interpretation is supported by the association between *Integrating spaces with technologies* and *Spaces should help consolidate students' various skills*, indicating that school buildings are conceived as infrastructures that facilitate the development of transversal competencies. Furthermore, the connections between *Flexible and interconnected spaces* and both *Tailoring learning experiences* and *Spaces to support active learning* emphasise the importance of spatial adaptability in supporting student-centred pedagogies. Strong relationships also emerge in relation to "Inclusion". The most pronounced association links *Tailoring learning experiences* with *Supporting learning for all*, underscoring the idea that personalisation is a key mechanism for achieving inclusive education. *Supporting learning for all* is also connected to *Spaces should help consolidate students' various skills* and to a *Student-centred approach*, suggesting that inclusion is understood not only in physical terms but also as the capacity of spaces to support diverse learning pathways. Additionally, though less prominent, links with *Spaces to support well-being* and *Spaces to support active learning* reinforce the view of inclusion as a multidimensional principle embedded in both spatial and pedagogical

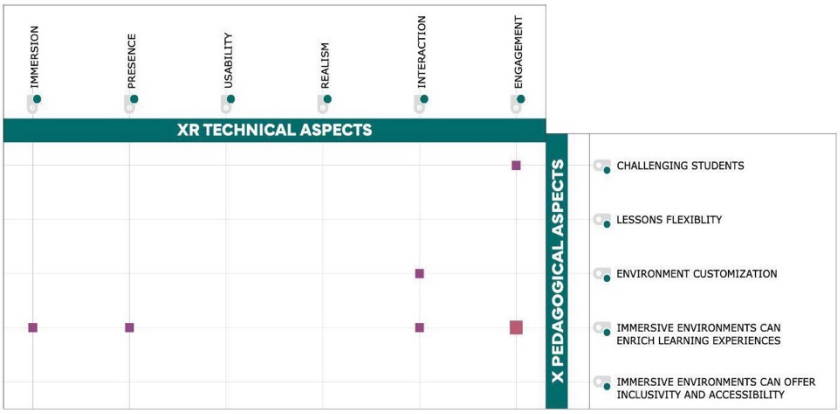
design. The intersection with the theme of "Community" reveals another set of meaningful relationships. In particular, the code *Places for social interaction* is strongly associated with *Spaces for different needs* and *Spaces to support collaborative learning*. These links reflect an understanding of the school as a socially rich environment, where spaces must simultaneously address individual requirements and foster collective engagement. The emphasis on collaboration and interaction points to a conception of the school as a civic space, in which architectural design and pedagogical intentions converge to support participation and a sense of belonging.

Matrix 3. XR Pedagogical Aspects - XR Technical Aspects

The third matrix explores the relationship between *XR pedagogical aspects* and *XR technical aspects*, showing how pedagogical objectives (e.g., enhancing learning experiences, increasing challenge, or adapting environments to learners) are directly connected to technological characteristics (e.g., immersion, presence, interaction, usability, realism, and engagement) (**Figure 3**).

Figure 3

Matrix 3 (Relationship Between "XR pedagogical Aspects" and "XR Technical Aspects").



Note. Authors' elaboration

The most prominent association is observed between *Engagement* and *Immersive environments can enrich learning experiencess*. Rather than being a secondary outcome, engagement appears as the mechanism through which immersive environments support meaningful and memorable learning experiences. The code *Immersive environments can enrich learning experiences* is also strongly linked to *Interaction*, *Presence*, and *Immersion*, suggesting that learning enrichment is conceived as the result of multiple, interrelated processes. Interaction enables learners to actively influence virtual environments; presence contributes to a heightened sense of involvement and authenticity; and immersion provides the sensory depth necessary to sustain attention and emotional engagement. Further associations add nuance to this interpretation. The link between *Challenging students* and *Engagement* indicates that the capacity of XR to stimulate deeper cognitive processes and push learners beyond routine activities depends on sustained motivation and involvement. Likewise, the connection between *Environment customization* and *Interaction* suggests that the pedagogical aim of adapting learning contexts to specific needs relies on the degree of agency and control afforded to users within the virtual environment.

Intersecting Learning Space Design and XR Technologies

The final correlation matrix (**Figure 4**) offers an integrated view of how the design principles associated with physical learning spaces relate to those emerging from immersive virtual learning environments. By bringing together all the themes identified in the analysis, the matrix allows us to observe where the two domains intersect and where they remain distinct, thereby highlighting shared design features as well as structural gaps between physical and virtual learning spaces.

Figure 4

Final Correlation Matrix



Note. Authors' elaboration

What emerges from this overall view is that the themes related to immersive environments, "XR pedagogical aspects" and "XR technical aspects", do not show substantial connections with "Sustainability" or "Community", and display only marginal associations with "Building quality". These dimensions, which play a central role in the design of physical learning spaces, appear to remain largely confined to the material, environmental, and social characteristics of school buildings. In contrast, the points of contact between physical and virtual environments are concentrated primarily around the themes of "Inclusion" and "Pedagogical design of spaces".

With respect to "Inclusion", the strongest relationships in the final matrix link *Supporting learning for all* with *Environment customization* and with *Immersive environments can offer inclusivity and accessibility*. These correlations indicate that immersive technologies are perceived as extending inclusive educational practices by enabling adaptable environments and new forms of access that are not limited by physical constraints. Additionally, though less prominent, connections with *Lesson flexibility* reinforce this interpretation. Similarly, *Accessibility for all* is associated with both *Environment customization* and *Immersive environments can offer inclusivity and accessibility*, suggesting that XR environments support inclusion through the alignment of technical affordances with pedagogical goals.

An even denser set of relationships emerges around the theme of "Pedagogical design of spaces". Within the final matrix, the most prominent association links *Spaces to support active learning* with *Engagement*, indicating a strong convergence between pedagogical intentions rooted in physical space design and XR features that sustain learner involvement. This pedagogical code is also closely connected with *Interaction* and *Immersive environments can enrich learning experiences*, while slightly weaker but still relevant associations appear with *Challenging students*. In addition, *Engagement* shows strong links with a *Student-centred approach* and with *Spaces to enhance motivation*, highlighting how XR's technical characteristics align with pedagogical strategies that prioritise learner agency and motivation. Another important group of connections links *Tailoring learning experiences* with both *Lesson flexibility* and *Environment customization*, reinforcing the role of XR in supporting differentiated and adaptable learning pathways.

Beyond these central clusters, the matrix also reveals a range of weaker but meaningful associations between the pedagogical design of spaces and both XR pedagogical and XR technical aspects. While less pronounced, these connections contribute to the overall pattern emerging from the matrix, suggesting a shared conceptual ground between physical and immersive learning environments.

Overall, the final correlation matrix shows that the most substantial bridges between physical and virtual learning spaces are built around inclusion and pedagogical design. In contrast, sustainability, community, and building quality remain largely disconnected from XR-related themes. These findings suggest that immersive technologies currently extend and amplify educational principles that are already central to the design of physical learning environments, particularly those related to learner-centred pedagogy and inclusion, rather than redefining the broader spectrum of design considerations.

Conclusion

This contribution examines the relationship between two domains that are increasingly central to educational innovation but have often developed in isolation from one another: the

design of physical learning spaces and the creation of immersive digital environments for learning. By considering policy documents, guidelines, and recommendations at both European and international levels, the analysis has made it possible to identify the main principles guiding each domain and to explore how these principles intersect.

The comparison reveals a differentiated pattern of alignment. Elements such as building quality, sustainability, and the role of the school as a community space continue to be primarily associated with the physical learning environment and find little correspondence in current approaches to immersive environments. By contrast, the pedagogical and technical dimensions of XR show strong affinities with inclusive educational aims and with pedagogical strategies that inform the design of learning spaces. Most notably, the recurring links between support for active learning and XR features such as engagement and interaction point to the capacity of immersive technologies to enhance educational practices through adaptable, personalised, and learner-centred experiences.

On the basis of these findings, a preliminary conceptual framework can be outlined, positioning inclusion and pedagogical design as the primary bridges between physical and virtual learning spaces. This framework offers an initial interpretive lens for an emerging and multidisciplinary field, while also serving as a guiding reference for architects, educators, technologists, and school communities engaged in the design of immersive learning environments.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The authors further declare that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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The Effect of Passive Voice Writing Checklist on the Writing Task of Mathayom Suksa 4 Students

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Abstract

This classroom-based research aimed to enhance the writing skills of Grade 10 (Mathayom Suksa 4) students in an intermediate English class at Surawiwat School, Suranaree University of Technology. Initial writing assessments revealed recurring grammar errors, especially in the use of passive voice, despite students' familiarity with basic English grammar. The study hypothesized that integrating peer feedback with a passive voice grammar checklist could improve accuracy in writing. Students engaged in peer review using the checklist over three writing assignments. Results showed an increase in the number of students correctly using passive voice: from 58 students (70.73%) in the first task, to 64 (78.05%) and 71 (86.59%) in subsequent tasks. The mean writing score significantly improved from Task 1 to Task 2 ($p = .001$), though no significant differences were found between later tasks. The findings support the effectiveness of checklist-based peer feedback in improving grammatical accuracy.

Keywords: grammar checklist, passive voice, writing skills

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Introduction

English serves as a global language for communication across economics, education, science, and technology (Crystal, 2012). Moreover, the global role of English makes writing skills especially important for students who expect to express ideas clearly and participate in academic communities. In Thailand, the Basic Education Core Curriculum in 2008 emphasizes the importance of strengthening learners' English proficiency prepare them for the challenges and skills required in the 21st century (OBEC, 2008).

Among the four language skills, writing is widely regarded as the most cognitively demanding for English as a foreign language learners, as it requires the simultaneous control of grammatical accuracy, syntactic complexity, lexical selection, and logical organization (Nation, 2009). In the Thai EFL context, students' writing difficulties are further compounded by negative language transfer, particularly due to structural and rhetorical differences between Thai and English which often result in persistent errors and reduced clarity in written task. In other words, writing challenges in Thailand often result from language transfer due to differences between Thai and English structures (Prapaisit de Segovia & Hardison, 2008).

Moreover, long-standing reliance on traditional, grammar-oriented, teacher-centered instructional practices have limited opportunities for meaningful writing practice and learner autonomy. Such approaches tend to emphasize rule memorization over communicative purpose, thereby constraining students' ability to develop fluency and critical thinking in written discourse. In contrast, learner-centered pedagogical approaches that integrate process-based writing, feedback, and authentic communication have been shown to foster greater engagement and improved writing performance (Brown, 2007). Collectively, these factors highlight the need for instructional reforms that address both linguistic and sematic issues.

Based on the principles of Second Language Acquisition (SLA), one of the key theories related to the development of writing skills is Ellis's (2009) concept of corrective feedback, which emphasizes that receiving feedback on errors plays a crucial role in helping learners revise and improve their language use effectively. In particular, the process of peer feedback has been supported by empirical evidence demonstrating its significant contribution to the development of writing skills. Through peer feedback, learners are required to analyze and evaluate their peers' written work, which simultaneously enhances their awareness of their own errors (Lundstrom & Baker, 2009).

From a practical perspective, integrating a grammar checklist with the peer feedback process is considered an effective instructional strategy. This approach provides learners with a concrete tool to systematically monitor grammatical accuracy, such as the appropriate use of the passive voice, and helps reduce recurring errors in their writing (Bitchener & Ferris, 2012).

Given the observed problems among Mathayom Suksa 4 or Grade 10 students at Surawiwat School, Suranaree University of Technology, who frequently demonstrate repeated errors in the use of passive voice structures in their writing and lack the ability to self-correct these errors, this study aims to investigate the effects of using a passive voice grammar checklist in conjunction with peer feedback on students' English writing development. The findings are expected to contribute to the development of instructional strategies that are better aligned with the Thai EFL context and that promote sustainable language learning, and pedagogical challenges in order to enhance EFL learners' writing competence.

Research Objectives

The purpose of this study is to examine the effects of using a passive voice grammar checklist on the development of English Writing skills among Mathayom Suksa 4 or Grade 10 students at Surawiwat School, Suranaree University of Technology. The study aims to address the following research questions:

1. Does peer feedback increase the number of students correctly using passive voice structures?
2. Does peer feedback improve students' overall accuracy in using passive voice?
3. Do peer-assessed scores correlate with teacher-assessed scores of passive voice accuracy?

Literature Review

Second Language Acquisition (SLA) Theory

Learning English as a second or foreign language, particularly in relation to writing skills, is a complex process that requires the development of both grammatical accuracy and effective meaning-making. Among various grammatical structures, the passive voice is frequently perceived by EFL learners as especially challenging due to its structural complexity and its divergence from learners' first languages. For instance, Thai typically favors active voice constructions, which contributes to persistent difficulties when learners attempt to produce passive structures in English. Consequently, insights from Second Language Acquisition (SLA) theory are essential for understanding how learners develop writing competence and acquire complex grammatical forms such as the passive voice. This is particularly relevant when examining the comparative effects of peer feedback and teacher feedback within the writing process.

The Importance of Passive Voice in English Writing

The passive voice plays a significant role in English writing, especially in academic and formal contexts, including research reports, scholarly articles, and professional correspondence. Appropriate use of passive constructions allows writers to adopt a more formal tone and to emphasize actions or results rather than agents. Despite its importance, Thai learners often struggle to use the passive voice accurately due to both its grammatical complexity and its contrast with Thai sentence structures. As a result, systematic instruction, repeated practice, and focused feedback on passive voice usage are essential components in the development of students' English writing proficiency.

The Use of Grammar Checklists to Enhance Writing Skills

A grammar checklist serves as a practical instructional tool that enables learners to review and evaluate the grammatical accuracy of their own writing. By providing clear criteria and structured guidance, checklists help learners identify recurring errors and revise their work more effectively. Previous research has demonstrated that the use of grammar checklists in conjunction with feedback can significantly improve students' writing performance, particularly with respect to grammatical accuracy (Bitchener & Ferris, 2012). When learners are equipped with such tools, they are better able to monitor their language use systematically and develop greater autonomy in the writing process.

Peer Feedback in Writing Development

From a theoretical perspective, Krashen's (1982) Monitor Model offers important insights into the role of feedback in language learning, particularly through the Input Hypothesis and the Affective Filter Hypothesis. According to The Input Hypothesis, it finds that the most effective way to learn new language is when learners are exposed to input that is slightly beyond their current level of competence (i+1), while the Affective Filter Hypothesis highlights how anxiety and stress can hinder language learning. In this regard, peer feedback may provide a less threatening environment than teacher feedback, thereby lowering learners' affective filters and facilitating writing development.

Peer feedback involves learners exchanging comments and suggestions on one another's written work, enabling them to gain alternative perspectives and to develop analytical and evaluative skills. According to Processability Theory (Pienemann, 1998), learners acquire grammatical structures in a developmental sequence determined by their language-processing capacity. The passive voice, which requires coordinated control of tense, auxiliary verbs, and past participle forms, represents a relatively advanced structure. Consequently, systematic and well-scaffolded feedback plays a crucial role in supporting learners' ability to produce accurate passive constructions once they reach the appropriate developmental stage.

Empirical studies provide strong support for the effectiveness of peer feedback. Lundstrom and Baker (2009) found that peer feedback contributes significantly to improvements in writing quality, particularly in grammatical accuracy and organizational structure. Similarly, Topping (1998) reported that peer feedback fosters greater learner responsibility and engagement in the revision process. Furthermore, Rollinson (2005) demonstrated that combining peer feedback with structured tools such as checklists enables learners to identify and correct errors more effectively, resulting in notable improvements in writing quality.

In addition to linguistic benefits, peer feedback promotes critical thinking skills and language awareness, as learners must analyze both form and content in their peers' writing (Lundstrom & Baker, 2009). This reflective process often leads learners to recognize similar issues in their own work. Peer feedback also helps reduce fear of criticism and supports a learner-centered classroom environment, which encourages active participation and collaborative learning.

Peer Feedback and Teacher Feedback: A Complementary Approach

While teacher feedback is generally more accurate and particularly valuable for addressing complex grammatical issues such as passive voice usage, it may also increase learner anxiety or foster excessive dependence on the teacher (Ferris, 2006). Research suggests that integrating both peer and teacher feedback yields the most effective outcomes. Peer feedback encourages self-reflection and independent problem-solving, whereas teacher feedback provides authoritative guidance and clarification of complex grammatical structures. Together, these feedback modes offer complementary benefits that enhance learners' writing development.

This study focuses on the development of English writing skills among Grade 10 students enrolled in an intermediate English course during the second semester of the 2022 academic year at Surawiwat School, Suranaree University of Technology. The grammatical focus of the study is the passive voice, specifically constructions in which the grammatical subject functions as the receiver of an action. Across three assessed writing tasks, students were

required to incorporate passive voice structures into their compositions. These tasks were designed to evaluate both the accuracy of passive voice usage and students' ability.

Methodology

Participants

The participants in this study were 82 Grade 10 students drawn from five intact classes enrolled in an intermediate English course during the 2022 academic year at Surawiwat School, Suranaree University of Technology. All participants shared a similar instructional background and followed the same curriculum and course objectives.

Research Instruments

Three primary instruments were employed in this study: writing tasks, analytic scoring rubrics, and a passive voice grammar checklist. The writing tasks were designed to elicit the use of passive voice structures within meaningful and contextually appropriate written texts. The scoring rubrics were used by the teacher to assess students' writing performance, with particular emphasis on grammatical accuracy and appropriate use of passive voice. The passive voice checklist served as a structured tool to guide students during the peer feedback process, enabling systematic identification and correction of grammatical errors related to passive constructions.

Data Collection Procedures

Data were collected through three consecutive writing assignments administered over the instructional period. In the first task (Task 1), students completed an initial writing assignment, which served as the baseline measure of their passive voice usage. Following Task 1, students engaged in a peer feedback process using the passive voice checklist to review and comment on their peers' writing. Based on the feedback received, students revised their work and submitted subsequent drafts in Task 2 and Task 3. Teacher assessments were conducted after each task using the established scoring rubrics to ensure consistent evaluation of writing performance across all stages.

Data Analysis

The collected data were analyzed using both descriptive and inferential statistical methods. Descriptive statistics were used to summarize students' writing performance across the three tasks. To examine changes in writing performance over time, a Repeated Measures Analysis of Variance (ANOVA) was conducted. In addition, Pearson product–moment correlation coefficients were calculated to investigate the relationship between students' scores derived from the peer feedback process and the teacher-assigned writing scores. Statistical analyses were performed to determine the effectiveness of the instructional intervention and the relationships among key variables.

Results

Background Characteristics of the Participants

The participants in this study consisted of 82 Grade 10 students from Surawiwat School. The majority of the participants were female (58.84%). With regard to class distribution, students from Class M.4/4 represented the largest proportion of the sample (34.15%), followed by students from Class M.4/5 (24.39%), Class M.4/3 (14.63%), and Classes M.4/1 and M.4/2 (13.41% each). Detailed demographic information is presented in table 1.

Table 1

Demographic Characteristics of the Participants (n = 82)

gender / class	male		female		total	
	number	percent	number	percent	number	percent
Class 4/1	6	54.55	5	45.45	11	13.41
Class 4/2	5	45.45	6	54.55	11	13.41
Class 4/3	7	58.33	5	41.67	12	14.63
Class 4/4	10	35.71	18	64.29	28	34.15
Class 4/5	6	30.00	14	70.00	20	24.39
Total	34	41.46	48	58.54	82	100.00

Number of Students Able to Accurately Use Passive Voice Structures

Research Question 1 (RQ1): Does the number of students who can accurately use English passive voice structures increase after the implementation of peer feedback? The analysis revealed that 39 students (47.56%) were able to use English passive voice structures correctly across all three writing tasks. When examining each measurement point separately, the number of students demonstrating accurate use of passive voice increased progressively over time. Specifically, 58 students (70.73%) used passive voice correctly in the first writing task, 64 students (78.05%) in the second task, and 71 students (86.59%) in the third task. These results indicate a consistent improvement in students' ability to use passive voice structures following the peer feedback process. Detailed results are shown in table 2.

Table 2

Number and Percentage of Students Demonstrating Accurate Use of Passive Voice Across Three Writing Tasks

Accuracy	Number of Students (n = 82)	
	Number	Percent
none	1	1.22
once	8	9.76
twice	34	41.46
No mistake	39	47.56

Task number	Accuracy	
	Number	Percent
First task	58	70.73
Second task	64	78.05
Third task	71	86.59

Differences in Passive Voice Writing Ability Across Measurement Times

Research Question 2 (RQ2): Does peer feedback lead to improvement in students' ability to write English passive voice structures? Descriptive statistical analysis of students' writing scores across the three measurement occasions revealed differences in mean performance and score dispersion. The highest mean writing score was observed in Task 2 (M = 8.976, SD =

0.853), followed by Task 3 (M = 8.726, SD = 0.900) and Task 1 (M = 8.463, SD = 1.009). In terms of score variability, Task 2 exhibited the lowest coefficient of variation (CV = 9.503%), indicating more consistent performance among students compared to Task 3 (CV = 10.314%) and Task 1 (CV = 11.922%).

Prior to conducting the repeated measures analysis, Mauchly's Test of Sphericity indicated that the assumption of sphericity was violated (W = .920, p = .035). Therefore, the Greenhouse-Geisser correction was applied. The results of the repeated measures ANOVA revealed a statistically significant difference in mean writing scores across at least one pair of measurement occasions, F (2, 1.851) = 7.752, p = .001, η^2 = .087.

Post-hoc comparisons using the Bonferroni adjustment indicated that the mean writing score for Task 2 was significantly higher than that of Task 1 (Mean Difference = 0.512, p = .001). However, no statistically significant differences were presented between Task 1 and Task 3 or between Task 2 and Task 3 at the .05 significance level. The detailed results are presented in table 3.

Table 3

Results of Repeated Measures ANOVA and Pairwise Comparisons of Passive Voice Writing Scores

Task	n	M	SD	CV	SE	95% Confidence Interval	
						Lower Bound	Upper Bound
1st task	82	8.463	1.009	11.922	0.111	8.242	8.685
2nd task	82	8.976	0.853	9.503	0.094	8.788	9.163
3rd task	82	8.726	0.900	10.314	0.099	8.528	8.923
Mauchly's Test of Sphericity = **.920**, p = **.035** Greenhouse-Geisser = **10.758,** F(***2, 1.851***) = **7.752**, p = **.**001, n_p^2 = **.**087							
Pairwise comparisons (Post-Hoc Test): Bonferroni							
Tasks		**Mean Diff.**	**SE**	**p**		**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
1st and 2nd task		0.512	0.140	.001*		-0.855	-0.170
1st and 3rd task		0.262	0.138	.182		-0.599	-0.075
2nd and 3rd task		0.250	0.140	.078		-0.019	0.519

Relationship Between Peer-Assessed and Teacher-Assessed Writing Scores

Research Question 3 (RQ3): Is there a relationship between students' peer-assessed passive voice writing scores and teacher-assessed English writing scores? Pearson correlation analysis revealed that students' peer-assessed passive voice writing scores in Task 2 and Task 3 were positively correlated with their teacher-assessed English writing scores. This finding indicates that students who received higher passive voice writing scores through peer feedback also tended to receive higher writing scores from the teacher. Correlation coefficients for all measurement occasions are presented in Table 4.

Table 4
Pearson Correlation Coefficients Between Peer-Assessed and Teacher-Assessed Writing Scores

Task	1st peer	2nd peer	3rd peer	1st teacher	2nd teacher	3rd teacher
peer 1st task	1.000					
peer 2nd task	-0.147	1.000				
peer 3rd task	-0.096	.310**	1.000			
teacher 1st task	0.188	-0.043	0.148	1.000		
teacher 2nd task	0.052	.418**	0.109	0.068	1.000	
teacher 3rd task	0.022	0.150	.284**	0.188	.414**	1.000

Discussion

The present study aimed to examine the effects of integrating a passive voice grammar checklist with a peer feedback process on the development of English writing skills among Grade 10 students at Surawiwat School, Suranaree University of Technology. The findings provide several important insights into the role of structured feedback and learner involvement in EFL writing development.

First, the results revealed a consistent increase in the number of students who were able to accurately use English passive voice structures throughout the intervention period. The proportion of students demonstrating correct usage increased from 70.73% in the first measurement to 78.05% and 86.59% in the second and third measurements, respectively. This progressive improvement supports Vygotsky's (1978) sociocultural theory, which emphasizes that learning is mediated through social interaction and collaborative support. In this context, peer feedback functioned as a form of scaffolding that enabled learners to internalize grammatical knowledge through interaction, reflection, and shared problem-solving.

Second, analysis of mean writing scores indicated a statistically significant improvement between the first and second writing tasks, suggesting that the combined use of a grammar checklist and peer feedback had a substantial impact on students' writing performance during the initial stage of the intervention. However, no significant difference was observed between the second and third measurements. This pattern suggests a plateau effect in later stages of development, which may reflect limitations in the instructional challenge provided or the need for more advanced or varied writing tasks to stimulate higher-level language development. These findings imply that while structured peer feedback is effective in supporting early improvement, sustained progress may require more complex tasks and deeper cognitive engagement.

Third, the results demonstrated significant positive correlations between peer-assessed passive voice writing scores and teacher-assessed writing scores in the second and third measurements. This finding aligns with previous research indicating that learners benefit not only from receiving feedback but also from actively providing feedback to others (Lundstrom & Baker, 2009). Engaging in peer assessment appears to enhance learners' metalinguistic awareness and self-monitoring abilities, leading to improved writing performance. The ability to identify and

evaluate grammatical errors in peers' writing may, therefore, contribute to more accurate and reflective language use in students' own written work.

Conclusion

The findings of this study provide empirical support for the effectiveness of integrating a passive voice grammar checklist with peer feedback as a pedagogical approach to EFL writing instruction at the secondary level. The results highlight the importance of learner participation in the feedback process and demonstrate how structured, collaborative assessment can contribute to improved grammatical accuracy and writing development.

Recommendations

Expansion of the Sample Population

Future studies should be conducted with a more diverse sample, including students from different grade levels and educational institutions with varying contexts. This would enhance the generalizability and external validity of the research findings.

Longitudinal Investigation

It is recommended that future research examine the long-term effects of using writing checklists in combination with peer feedback. Such longitudinal studies would allow researchers to evaluate the sustainability of writing skill development and identify factors that influence the retention of these skills over time.

Comparison of Feedback Modalities

Further research should compare the effectiveness of peer feedback and teacher feedback in order to determine which feedback approach contributes most effectively to the development of students' writing skills.

Additional Qualitative Inquiry

Future studies are encouraged to incorporate qualitative data collection methods, such as interviews and classroom observations, to gain deeper insights into students' cognitive processes and the strategies they employ when revising their writing based on feedback.

In addition, the lack of statistically significant improvement in writing scores between the first and third writing tasks may be attributed to differences in task conditions. Specifically, both the first and third writing tasks were completed under time constraints in a classroom setting, whereas the second task, which showed a statistically significant increase in scores compared to the first task, allowed students to complete the writing assignment outside the classroom after initial in-class instruction. As a result, students may have utilized additional writing support tools, which could have influenced their performance. Therefore, future data collection should ensure that writing task conditions are as consistent as possible across all assessment occasions to obtain more reliable results.

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Exploring TikTok as a Learning Resource in Maritime Higher Education: Educator Perspectives and Practices

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Abstract

While social media platforms have increasingly been adopted across various educational disciplines, less is known, from an empirical perspective, about their application within maritime higher education. This pioneering study examines the emerging phenomenon of TikTok use among maritime educators, representing one of the first empirical investigation into social media integration within this traditionally conservative field. A qualitative research design was employed, conducting semi-structured interviews with 12 maritime educators across international institutions who have begun creating TikTok content for educational purposes. Participants represented diverse maritime specializations including navigation, marine engineering, port operations, and maritime law. Interview data were analyzed using reflexive thematic analysis, revealing four key themes: (1) democratizing maritime knowledge beyond traditional maritime academies, (2) developing micro-learning approaches for complex shipboard procedures and emergency protocols, (3) engaging digitally native students entering the seafaring profession, and (4) navigating institutional resistance within hierarchical maritime education structures. The study reveals innovative educational practices including the use of TikTok's short-form video format to demonstrate intricate maritime procedures typically requiring hands-on shipboard experience, creation of virtual vessel walkthroughs for land-based students, and development of maritime safety mnemonics through engaging visual content. However, significant challenges emerged including concerns about maintaining the seriousness of maritime safety education while creating accessible content, preserving professional standards, and overcoming institutional skepticism within a field where tradition and hierarchy remain paramount. This groundbreaking research establishes foundational knowledge about social media's potential role in maritime education, offering crucial insights for maritime institutions considering digital pedagogical innovations in an increasingly technology-driven maritime industry.

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Introduction

The maritime industry stands at a critical juncture where traditional hierarchical structures intersect with rapidly evolving digital technologies. Maritime education, which prepares future seafarers, port operators, and maritime professionals, has historically adhered to conservative pedagogical approaches rooted in centuries-old traditions of apprenticeship, hands-on training, and strict adherence to safety protocols (Sharma et al., 2011). These conventional methods, while effective in maintaining industry standards and professional rigor, face mounting pressure to adapt to the expectations and learning preferences of digitally native students entering the profession (Manuel, 2017). As the maritime workforce undergoes generational transformation, educators increasingly confront the challenge of bridging the gap between time-honored instructional practices and contemporary digital engagement strategies. Of particular interest is the emerging adoption of social media platforms, specifically TikTok, within this traditionally conservative educational context, raising questions about how such platforms are being integrated into maritime teaching practices.

Literature Review

Social Media in Higher Education

Social media platforms have proliferated across educational contexts over the past decade, transforming how knowledge is created, shared, and consumed (Greenhow & Lewin, 2016). Platforms such as YouTube, Instagram, and Facebook have been widely adopted by educators across disciplines to enhance student engagement, facilitate informal learning, and democratize access to educational content (Manca & Ranieri, 2016). Research demonstrates that social media can support collaborative learning, foster communities of practice, and provide authentic audiences for student work (Carpenter & Krutka, 2015). However, challenges persist regarding privacy concerns, digital divide issues, platform sustainability, and the tension between informal communication norms and academic rigor (Selwyn, 2019).

Despite widespread adoption in many educational sectors, maritime education has remained notably resistant to social media integration, with limited empirical research examining digital innovation within this specialized field (Sellberg & Øvergård, 2022). The field's conservatism reflects concerns about maintaining the seriousness of safety-critical training, preserving professional standards, and navigating institutional structures where hierarchy and tradition remain paramount (Kitada et al., 2018). This resistance may stem from the high-stakes nature of maritime operations, where errors can result in loss of life, environmental disasters, and significant financial losses (Sellberg, 2018). Within this broader landscape of social media in education, one platform has emerged as particularly disruptive in its format and reach.

TikTok as an Educational Platform

TikTok has emerged as a particularly disruptive social media phenomenon, characterized by short-form video content, algorithmic content distribution, and predominantly youth-oriented user demographics (Anderson, 2020). While initially dismissed as entertainment-focused, TikTok has increasingly attracted educators who recognize its potential for micro-learning, visual demonstration, and reaching students through platforms they already inhabit (Escamilla-Fajardo et al., 2021). The platform's format, typically 15 to 60-second videos, aligns with cognitive science principles supporting chunked information delivery and spaced repetition (Jamet et al., 2008).

Recent scholarship has documented TikTok's educational applications across various disciplines, including language learning (Yang, 2020), science education (Barton & Ilić, 2021), medical education (Comp et al., 2021), and health promotion (Basch et al., 2021). These investigations reveal both promising pedagogical possibilities and significant challenges. TikTok enables creative knowledge dissemination, democratizes expert knowledge, and facilitates informal peer learning networks (Southgate, 2021). However, concerns include content accuracy, oversimplification of complex topics, the potential for misinformation, and questions about whether entertainment-focused platforms can maintain educational credibility (Zhu et al., 2020). Platform governance issues, data privacy concerns, and the ephemeral nature of social media trends raise questions about the sustainability of educational investments in TikTok (Cervi, 2021).

Existing research has focused predominantly on mainstream educational settings, with specialized professional education contexts remaining largely unexplored. This represents a significant gap given that professional education fields often face unique constraints and affordances that differ substantially from general higher education contexts. Maritime education exemplifies such a specialized context.

Maritime Education and Digital Technology

Maritime education presents a unique context for examining social media integration due to its distinctive characteristics. Unlike general higher education, maritime training combines academic instruction with practical skill development in safety-critical domains where errors can result in catastrophic consequences (Sellberg, 2018). The field operates within complex regulatory frameworks established by international bodies such as the International Maritime Organization, requiring standardized competencies and certification processes (Muirhead, 2020). Additionally, maritime education grapples with geographic dispersal, as students often complete portions of training aboard vessels at sea, creating challenges for sustained educational engagement (Gekara & Sampson, 2021).

The integration of digital technologies in maritime education has historically been limited to specific applications such as ship simulators, electronic navigation systems training, and maritime safety management systems (Baldauf et al., 2011). These technologies have enhanced technical skill development but have largely replicated traditional instructional models rather than fundamentally transforming pedagogical approaches. The COVID-19 pandemic accelerated some digital adoption, particularly regarding remote learning delivery (Burdová & Vujović, 2021), yet questions remain about whether this shift represents genuine pedagogical transformation or merely emergency adaptation.

Social media platforms, despite their ubiquity in students' personal lives, have seen minimal formal integration into maritime curricula. This reflects institutional reluctance to embrace tools perceived as informal, unprofessional, or incompatible with maritime education's serious purpose. Generational divides may also contribute to this resistance, as maritime educators often possess extensive sea-going experience and hold professional certifications earned through traditional training pathways (Kitada & Ölçer, 2015).

Gaps in Current Knowledge

Less is known, from an empirical perspective, about the intersection of TikTok adoption and maritime education practice. This gap is particularly significant for several reasons. First,

maritime education's conservative culture and safety-critical context provide a test case for understanding social media adoption in resistant institutional environments. Second, TikTok's particular affordances, such as visual demonstration capabilities and short-form format, may align with maritime education's emphasis on procedural knowledge and practical skill demonstration. Third, understanding how individual educators navigate institutional resistance to pedagogical innovation offers insights relevant to change processes in other conservative professional fields.

Maritime educators who adopt TikTok represent early adopters operating at the margins of institutional acceptability. Their experiences likely involve negotiating multiple tensions: between professional credibility and platform accessibility, between comprehensive instruction and brevity requirements, between institutional expectations and student engagement strategies, and between maintaining maritime education's serious purpose and leveraging creative, engaging content formats. Understanding how these educators experience and navigate these tensions remains unexplored territory.

The Purpose of This Study

The present study addresses these knowledge gaps by examining how maritime educators experience and navigate the integration of TikTok into their teaching practices within traditionally conservative maritime higher education contexts. By exploring the lived experiences of educators who have begun creating TikTok content for educational purposes, this research seeks to illuminate both the innovative practices emerging at the intersection of maritime education and social media, and the challenges these pioneers encounter within traditional institutional structures. This investigation extends the emerging literature on TikTok in education by examining its application within a specialized professional context characterized by unique constraints and affordances, while contributing to understanding digital innovation processes in conservative educational institutions.

Research Question

How do maritime educators experience and navigate the integration of TikTok into their teaching practices within traditionally conservative maritime higher education contexts?

Method

Design

This study employed a qualitative research design using semi-structured interviews to explore TikTok integration in maritime higher education. This approach was selected for its capacity to capture rich, contextual data regarding educators' experiences, motivations, and challenges in adopting social media platforms within a traditionally conservative academic field (Creswell & Poth, 2018).

Participants

Participants were recruited using purposive criterion sampling to identify maritime educators actively creating TikTok content for educational purposes (Campbell et al., 2020). Inclusion criteria required participants to be: (a) employed as educators at recognized maritime higher education institutions, (b) actively creating educational TikTok content for minimum six

months, and (c) able to participate in English-language interviews. Recruitment occurred through professional maritime education networks, social media platforms, and snowball sampling.

The final sample comprised 12 maritime educators from six countries (France, Myanmar, Thailand, Norway, Singapore, and Philippines) representing diverse specializations: navigation (n = 4), marine engineering (n = 3), port operations (n = 2), maritime law (n = 2), and maritime safety (n = 1). Teaching experience ranged from 3 to 22 years (M = 11.5, SD = 6.2), while TikTok content creation experience ranged from 6 months to 3 years (M = 16 months, SD = 8.4). The sample included nine male and three female participants. All participants held relevant professional maritime qualifications, with 10 holding master's degrees and two holding doctoral degrees. Sample size was determined by information power principles (Kyriakou et al., 2025; Malterud et al., 2016).

Data Collection

Semi-structured interviews were conducted via Zoom between January and April 2024. An interview guide addressed: (a) motivations for adopting TikTok, (b) pedagogical approaches and content creation strategies, (c) perceived benefits and learning outcomes, and (d) challenges and institutional responses. A pilot interview refined question clarity and flow. Interview duration ranged from 45 to 90 minutes (M = 62 minutes, SD = 12.8). The interviewer employed active listening, reflective probes, and follow-up questions to elicit detailed responses (McGrath et al., 2019). Field notes captured contextual observations and initial analytic impressions.

The first author transcribed all interviews verbatim, producing approximately 185,000 words of data. The second and third authors validated transcripts against recordings to verify accuracy. Discrepancies were resolved through consensus. All identifying information was removed and replaced with pseudonyms. Transcripts were uploaded to NVivo 12 for analysis.

Analytical Strategy

Data were analyzed using reflexive thematic analysis (Braun & Clarke, 2019; Clarke & Braun, 2017; Kyriakou et al., 2025), emphasizing researchers' active interpretive role in generating meaningful patterns. This approach suited the exploratory investigation of a novel phenomenon where theoretical frameworks remain underdeveloped.

Analysis proceeded iteratively through data immersion, systematic coding, theme development, and refinement. The first author engaged deeply with transcripts while documenting observations in analytic memos (Birks et al., 2008; Daher et al., 2025). Line-by-line coding captured both semantic content and latent meanings, generating 437 initial codes. All three authors then collaboratively reviewed, sorted, and clustered codes to identify broader patterns. Through intensive discussion sessions, the team interrogated candidate themes for coherence, distinctiveness, and meaningfulness. Themes underwent two-level review: first against coded extracts, then against the entire dataset, resulting in refinement, splitting, or collapsing of themes. Sub-themes captured nuanced variations within broader patterns. Each theme was clearly defined with attention to its unique contribution to understanding the phenomenon.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board at the International Executive School in Strasbourg, France. The research adhered to Declaration of Helsinki principles. All participants provided written informed consent after receiving detailed study information. Participants were informed of their right to withdraw at any time and to decline answering questions.

Confidentiality was maintained through: (a) pseudonym assignment, (b) secure storage of identifiable data on encrypted devices, (c) removal of identifying details from transcripts, and (d) restricted data access limited to the three authors. Additional care avoided including details that might identify participants through their public TikTok profiles or specialized expertise. Participants received no compensation but were offered study findings summaries. Data will be retained for five years post-publication before secure destruction.

Quality and Rigor

Multiple strategies enhanced credibility, dependability, and authenticity (Korstjens & Moser, 2018; Kyriakou et al., 2025; Tracy, 2010). All three authors independently developed preliminary coding frameworks before collaborative refinement. This investigator triangulation ensured multiple perspectives informed theme development, reducing individual bias. The first author maintained analytic memos documenting decision-making rationales and theme evolution, creating an audit trail. Four participants reviewed preliminary findings, confirming themes captured their experiences while contributing additional nuances (Candela, 2019). This member checking enhanced authenticity by ensuring interpretations aligned with participants' understandings. These strategies collectively strengthened confidence that findings authentically represented participants' perspectives while acknowledging the interpretive role of the research team.

Reflexivity

Building on these quality considerations, reflexivity involved critical reflection on how researcher backgrounds, assumptions, and positioning influenced all research stages (Haynes, 2021). The research team brought complementary backgrounds. Three of four authors had substantial maritime education experience, with two holding executive ship captain credentials. This insider positioning facilitated rapport-building and enabled nuanced interpretation of shipboard procedures, safety protocols, and industry-specific constraints. However, it also required conscious attention to potential assumptions and biases that could privilege perspectives aligned with the team's professional values or downplay criticisms of maritime education structures.

To mitigate this risk, the one author without maritime education background provided valuable outsider perspective, regularly questioning interpretations and challenging taken-for-granted assumptions. This created productive analytical tension, forcing the team to articulate and justify interpretations rather than relying on insider knowledge. The researchers' positive orientation toward educational technology required conscious attention to remain open to participants' expressions of concern or skepticism. The first author's reflexive journal documented instances where enthusiasm needed bracketing to appreciate institutional resistance and pedagogical tensions. Regular team meetings examined emerging interpretations, ensuring conclusions remained grounded in participant perspectives.

The team's shared maritime background also created potential for collective blind spots regarding taken-for-granted assumptions within maritime culture. The team actively questioned normative practices regarding hierarchical structures, gender dynamics, and resistance to innovation. The reflexive process involved ongoing interrogation of whether interpretations reflected participants' intended meanings or the research team's own professional socialization. While participants' experiences represented genuine realities of maritime education contexts, the researchers' analytical interpretations constituted one possible reading informed by particular theoretical perspectives and maritime professional knowledge. This acknowledgment of interpretive partiality situates findings appropriately within broader knowledge production about educational technology integration in specialized professional fields.

Results

Reflexive thematic analysis of interview data revealed four major themes that illuminate how maritime educators experience and navigate TikTok integration within traditionally conservative maritime higher education contexts. These themes capture both the innovative pedagogical practices emerging at this intersection and the significant challenges educators encounter. Table 1 provides an overview of the themes with illustrative excerpts.

Table 1
Summary of Findings

Theme	Description	Example Excerpt
Democratizing Maritime Knowledge Beyond Traditional Academies*	Expanding access to maritime education outside formal institutional boundaries	"I'm getting messages from kids in places like Mongolia, Paraguay, places nowhere near water, and they're asking me about becoming ship captains."
Developing Micro-Learning Approaches for Complex Shipboard Procedures and Emergency Protocols**	Adapting maritime instruction to short-form video format through innovative chunking strategies	"I'll do one video on just the breathing gear, that's it. Next one is how you approach the fire. Students aren't trying to remember 50 things at once anymore."
Engaging Digitally Native Students Entering the Seafaring Profession**	Connecting with students through their preferred digital platforms and communication styles	"My students are on their phones constantly. Like, why would I fight that? Just meet them where they already hang out."
Navigating Institutional Resistance Within Hierarchical Maritime Education Structures*	Confronting skepticism and policy ambiguity within conservative institutional contexts	"One of my senior colleagues actually said to me, you're turning maritime education into a joke by being on the same platform as teenagers doing dances."

Note. * Endorsed by all participants (n = 12). ** Endorsed by 10–11 participants.

Theme 1: Democratizing Maritime Knowledge Beyond Traditional Academies

TikTok emerged as a powerful mechanism for breaking down geographic and economic barriers that have historically limited access to maritime education. A navigation instructor captured this democratizing effect:

> I'm getting messages from kids in places like Mongolia, Paraguay, places nowhere near water, and they're asking me about becoming ship captains. That just wouldn't happen without TikTok. The algorithm puts my stuff in front of people who never would've stumbled onto maritime careers otherwise.

This experience resonated across the sample, with educators reporting unexpected audiences including teenagers exploring career options, adults considering career changes, and even active seafarers looking for quick refreshers.

A marine engineering educator explained:

> Our normal recruitment stuff reaches people already thinking about maritime careers. TikTok reaches people who didn't even know this world existed. I've had comments from folks saying they had no idea container ships were so massive or that maritime jobs paid so well.

This democratization also extended to family members of seafarers and coastal community members wanting to learn about the shipping industry's local economic impact.

However, tensions emerged around making specialized professional knowledge publicly accessible. One educator put it bluntly:

> There's a line, you know? A 60-second clip about emergency procedures can give someone a general idea, but it's not training. It can't be training. I always worry someone's gonna watch my video and think they actually know how to handle a real situation when they don't.

This concern about incomplete or misapplied knowledge was particularly acute for safety-critical content where partial understanding could lead to dangerous overconfidence.

Theme 2: Developing Micro-Learning Approaches for Complex Shipboard Procedures and Emergency Protocols

Creative strategies emerged for adapting complex maritime instruction to TikTok's short-form format. Rather than viewing time constraints as limiting, educators reframed them as opportunities to break down procedures into digestible pieces. A marine safety instructor detailed this approach:

> I'll do one video on just the breathing gear, that's it. Next one is how you approach the fire. Next one is extinguisher types. Students aren't trying to remember 50 things at once anymore. They can watch each piece multiple times, really nail it down, then move to the next part. It actually works better than the old way where we'd dump everything on them in one lecture.

The visual demonstration capabilities of TikTok proved particularly valuable for conveying procedural knowledge. One port operations educator explained:

> Before, I'd describe how to secure cargo or tie specific knots, maybe show some photos. Now I can literally film myself doing it on an actual ship. Students can see exactly how the rope moves, how much tension you need, the whole thing. It's so much better for learning hands-on skills.

TikTok's audio features enabled innovative safety mnemonics that leveraged the platform's trending sounds. A maritime law educator shared:

> I put SOLAS requirements to a popular audio track that was all over TikTok. Students told me they'd be walking around campus and the song would pop in their head and they'd suddenly remember the regulations. Is it conventional? Hell no. Does it work? Absolutely.

The format also addressed practical constraints faced by students at sea with limited internet access. One educator noted:

> Cadets on ships have terrible WiFi most of the time. They can't stream hour-long lectures or download huge files. But a 45-second video that reminds them how to do something specific? That actually works with their reality.

Theme 3: Engaging Digitally Native Students Entering the Seafaring Profession

TikTok facilitated meaningful connections with students who expect educational content to meet them in their digital spaces. A navigation instructor articulated this reality:

> My students are on their phones constantly. Like, why would I fight that? Just meet them where they already hang out. If they're scrolling TikTok for two hours a day anyway, I might as well put some navigation content in that feed.

Strategic use of TikTok supplemented rather than replaced classroom instruction. A marine engineering educator explained:

> I'll post a preview video before we cover a topic in class. Then after class, I'll post something that reinforces the key points. Students show up already having some idea what we're talking about, and then they've got the TikTok to go back to when they're studying. It's like bookends for the formal learning.

Several educators reported that students who engaged with their TikTok content participated more actively in class and asked more sophisticated questions.

The informal nature of TikTok helped break down traditional barriers between faculty and students. One educator shared:

> Students message me on TikTok asking questions they'd never ask in my office or in class. The whole vibe is different. It's less intimidating somehow. They feel comfortable just reaching out, and that leads to way better conversations about the material.

TikTok also enabled educators to showcase aspects of maritime careers that traditional materials missed. A port operations educator explained:

> I can show these massive container ships, the scale of the operations, how cutting-edge the technology is. Maritime jobs have this old-fashioned image problem, like it's all ancient sailors with no tech. TikTok lets me show students this is actually a modern, high-tech, globally connected industry.

Theme 4: Navigating Institutional Resistance Within Hierarchical Maritime Education Structures

Despite clear pedagogical benefits, significant pushback from institutions characterized all educators' experiences. This resistance manifested through absent or unclear policies and criticism from colleagues. A policy vacuum left many educators unsure of their institutional standing. One explained:

> My dean doesn't say I can't use TikTok, but there's definitely no support for it either. It's this weird gray area. So I do everything on my personal time with my own phone because I don't want them coming back later saying I shouldn't have been doing it on work time or using institutional resources.

Criticism from colleagues proved particularly difficult to navigate. A maritime law educator recounted:

> One of my senior colleagues actually said to me, you're turning maritime education into a joke by being on the same platform as teenagers doing dances. Like, he couldn't see past the dancing videos to understand there's actual educational value there.

Maintaining appropriate seriousness for safety content while making it engaging particularly troubled educators. One marine safety instructor wrestled with this:

> People die when safety procedures get screwed up. That's not exaggerating. So how do I make content about that engaging enough for TikTok without it feeling disrespectful or trivial? Sometimes I'll film something five or six times trying to get the tone right.

Generational divides compounded these challenges. One educator observed:

> There's definitely this attitude that real maritime educators earned their stripes through years at sea, not by having followers on social media. Some senior faculty treat my TikTok like it's proof I'm not serious about teaching.

Despite these obstacles, educators found ways to build legitimacy through evidence-based approaches. One navigation instructor explained:

> I started tracking how students who watched my TikToks did on practical exams compared to students who didn't. When I could show my department chair actual numbers proving the ones engaging with my content performed better, suddenly the conversation changed.

Connections with educators in other fields facing similar resistance provided valuable validation. One noted:

> Talking to a medical educator using TikTok or a science teacher doing the same thing helped me realize this isn't about maritime education being uniquely conservative. It's about institutions everywhere struggling with what legitimate teaching looks like when the platforms and tools are changing so fast.

Discussion

This study examined how maritime educators experience and navigate TikTok integration within traditionally conservative maritime higher education contexts. The four themes revealed through reflexive thematic analysis offer important insights into both the potential and challenges of social media adoption in professional education fields characterized by strong occupational cultures and safety imperatives.

The democratization of maritime knowledge beyond traditional academy boundaries carries significant implications for access and equity in professional education. TikTok's capacity to reach geographically dispersed and economically marginalized populations challenges the historic concentration of maritime education in specialized coastal institutions, potentially addressing longstanding barriers to entry in the seafaring profession. This democratization aligns with broader calls for educational equity and workforce development in maritime industries facing documented labor shortages (Gekara & Sampson, 2021). However, the tensions educators identified regarding oversimplification raise critical questions about knowledge stewardship and professional gatekeeping. The concern that brief videos might foster dangerous overconfidence in safety-critical procedures suggests that democratization without corresponding credentialing or competency verification mechanisms may introduce new risks (Hodgkinson-Williams & Trotter, 2020). Maritime education institutions may need to develop frameworks that acknowledge TikTok's value for awareness-raising while maintaining clear boundaries distinguishing informal exposure from formal professional qualification.

The innovative micro-learning approaches educators developed demonstrate how platform constraints can drive pedagogical creativity rather than merely limiting instructional possibilities. The alignment between TikTok's format and cognitive load theory principles suggests that effective educational practice may emerge from working with rather than against platform affordances (Leahy & Sweller, 2020). Virtual vessel tours and smartphone-filmed procedural demonstrations represent scalable, low-cost alternatives to expensive simulator training, potentially transforming how maritime skills are taught. The creative use of trending audio for safety mnemonics illustrates how educators can leverage viral culture and platform-specific features to enhance learning rather than viewing entertainment-oriented platforms as inherently incompatible with serious education (Southgate, 2021). However, institutions must carefully consider which competencies can be effectively addressed through micro-learning and which require more comprehensive instruction to avoid curricular fragmentation.

The enhanced engagement with digitally native students has important implications for maritime education's future viability. As generational turnover continues, maritime institutions must adapt pedagogical approaches to remain relevant to students whose media consumption habits differ substantially from previous generations (Parry, 2021). The finding that TikTok functions effectively as supplementary scaffolding challenges binary framings of traditional

versus digital pedagogy, suggesting successful integration involves strategic combination rather than wholesale replacement. The breakdown of hierarchical barriers between faculty and students through informal platform communication may facilitate more dynamic learning relationships. The capacity to showcase modern, technology-driven aspects of maritime careers addresses critical image problems that have hindered recruitment (Gekara & Sampson, 2021), suggesting digital platforms can serve important marketing functions beyond direct instruction.

The institutional resistance educators encountered reveals systemic challenges that extend beyond individual adoption decisions. The policy vacuum surrounding social media use reflects institutional governance structures struggling to keep pace with technological change, leaving early adopters professionally vulnerable while limiting institutional capacity to support effective innovations (Williamson, 2021). The colleague skepticism educators faced illuminates deeper conflicts about pedagogical authority and legitimacy in rapidly changing educational landscapes. The assumption that TikTok's association with entertainment precludes serious educational application reflects technological determinism that oversimplifies how platforms are actually used and fails to recognize educator agency in shaping platform practices (Escamilla-Fajardo et al., 2021). Generational divides between faculty raise important questions about professional development, faculty hiring, and knowledge transfer in maritime education.

The ethical tension around maintaining appropriate seriousness for safety-critical content while creating engaging material highlights how context matters profoundly in educational technology adoption. Maritime education's stakes differ meaningfully from many other educational contexts, and solutions cannot simply be imported from fields where errors carry less catastrophic potential (Sellberg & Øvergård, 2022). The strategies educators developed for navigating institutional resistance, particularly evidence-based documentation of learning outcomes, offer practical models for change agents in other conservative contexts (Trust et al., 2020).

Limitations and Future Research

Several limitations warrant consideration when interpreting these findings. The sample of 12 educators represents early adopters willing to experiment with TikTok despite institutional ambiguity or resistance. These educators may possess characteristics including higher technological fluency or greater tolerance for professional risk that distinguish them from the broader maritime education population. The sample's geographic distribution across six countries provided international perspectives but also introduced contextual variability in institutional cultures and regulatory frameworks. Data collection relied exclusively on educator self-reports without direct observation of TikTok content, student engagement patterns, or learning outcomes, limiting conclusions about actual educational effectiveness.

Future research should examine student perspectives on TikTok use in maritime education to understand learning experiences and perceived benefits from the learner viewpoint. Quantitative studies assessing relationships between TikTok engagement and measurable learning outcomes would provide crucial evidence regarding pedagogical effectiveness claims (Barana et al., 2021). Comparative research examining TikTok adoption across different professional education fields could identify whether patterns observed in maritime education reflect broader dynamics or represent field-specific phenomena. Longitudinal research tracking how institutional policies and pedagogical practices evolve as TikTok becomes more established could illuminate processes of digital innovation normalization. Investigation of

optimal content design principles for maritime education TikTok videos could provide practical guidance for educators (Ng & Ye, 2023). Research examining potential negative consequences including student overreliance on brief videos or development of superficial understanding would provide important counterbalance to predominantly positive findings reported here.

Conclusion

This study is one of the first to explore the integration of TikTok within maritime higher education, revealing how educators navigate the complex terrain between pedagogical innovation and institutional conservatism. The findings demonstrate that maritime educators are developing creative instructional strategies that leverage TikTok's unique affordances for democratizing access, facilitating micro-learning, and engaging digitally native students, while simultaneously confronting significant professional challenges including policy ambiguity, colleague skepticism, and concerns about maintaining appropriate seriousness for safety-critical content. As maritime education continues evolving to meet the demands of increasingly digital maritime industries and changing student populations, understanding how educators successfully integrate disruptive digital tools despite institutional resistance becomes crucial for the field's future. The experiences documented here offer valuable insights not only for maritime education stakeholders considering digital pedagogical innovations but also for other conservative professional fields grappling with how to balance tradition with innovation, rigor with accessibility, and preservation of core professional values with necessary adaptation to technological and generational change.

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Middle School Libraries as Active Agents of Risk Awareness: Post-disaster Knowledge Curation and Public Engagement in Thailand

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Abstract

Following the March 28, 2025, magnitude 7.7 earthquake centered in Myanmar—which triggered long-period ground motion (LPGM) and serious disruption in Bangkok—this study explores how a Thai middle school library responded educationally to the event. It presents a case where the library served as a pilot site for youth-centered disaster learning during and after the 15th Pre-Book Fair (April–July 2025). The library launched a three-part program titled "Survive and Be Safe from Disasters," focusing on earthquake and tsunami awareness. With support from disaster experts, librarians co-designed hands-on activities such as evacuation drills and tsunami simulations using virtual reality (VR). Students also joined risk mapping using colored Post-it notes to mark safe and hazardous zones inside the library. A key element was storytelling, where students shared personal experiences of the March 28 earthquake. Accounts—from confusion in high-rises to chaotic evacuations—offered insight into how youth perceive and react to disaster risk. Their stories highlighted gaps in disaster education and increased awareness of local vulnerabilities. This paper argues that middle school libraries could serve as decentralized disaster risk reduction (DRR) nodes. By curating local knowledge, enabling experiential learning, and fostering civic dialogue, libraries can become active players in community-based DRR. Rather than passive information holders, school libraries should be integrated into national DRR education strategies. We advocate for recognizing school librarianship within disaster governance and propose a model for embedding libraries into DRR planning through outreach, learning design, and collaboration.

Keywords: school libraries, disaster education, youth engagement, disaster risk reduction (DRR), Thailand

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Introduction

Natural disasters such as earthquakes pose a significant risk to children and schools in urban areas, especially in developing countries where preparedness and awareness programs are unevenly implemented. While national disaster plans often emphasize structural safety and emergency drills, the role of educational institutions in cultivating risk awareness through information literacy remains underexamined. This paper presents a case study of one middle school in Thailand during the post-earthquake period following the 2025 Mandalay earthquake. It explores how librarians assumed proactive roles in curating information, engaging students, and contributing to community resilience.

Case Context: The 2025 Mandalay Earthquake and Its impacts in Thailand

On March 28, 2025, a magnitude 7.7 earthquake struck central Myanmar. Although the epicenter was far from Bangkok, long-period ground motion (LPGM) was observed in several high-rise buildings across the capital, causing public concern, particularly among students, parents, and the education sector.

Following the event, educational authorities implemented urgent measures, such as postponing entrance examinations at certain levels to allow time for school building safety inspections. This response underscored the importance of safety and preparedness in educational settings.

Methodology

This study adopts a qualitative case study design and employs participatory observation to examine disaster-related learning activities conducted in the library of a public middle school in Thailand. The school library served as a pilot site for youth-focused Disaster Risk Reduction (DRR) learning activities carried out during and after the 15th Pre-Book Fair, held between April and July 2025.

Qualitative data were collected from multiple sources, including field observations conducted during the activities, photographs documenting the implementation process, and activity-related documents produced throughout the study period.

Results

This section summarizes the outcomes of the library-based disaster learning activities conducted at a public middle school following the March 28, 2025 earthquake. The activities were implemented as part of a three-part program titled *"Survive and Be Safe from Disasters,"* carried out during and after the 15th Pre-Book Fair between April and July 2025.

The program combined expert-supported sessions and student-centered learning activities. Disaster specialists were invited to speak with students, explain basic concepts related to earthquakes and tsunamis, and respond to student questions. These sessions were complemented by hands-on activities designed and facilitated by librarians, including evacuation drills and tsunami simulations using virtual reality (VR).

Students also participated in risk mapping activities using colored Post-it notes. They marked areas they considered safe or hazardous within the library space and discussed their choices

with peers. Through this activity, students identified concerns related to building layout, evacuation routes, and crowded spaces.

Another core activity involved storytelling, where students shared personal experiences related to the March 28 earthquake. Many described feelings of confusion, fear, and uncertainty, particularly in high-rise buildings or during evacuation. These stories reflected how students understood and interpreted disaster risk based on their own experiences and the information available to them at the time.

Field observations indicated active student participation across all activities. Students engaged in discussions, asked questions during expert sessions, and exchanged views with peers during mapping and storytelling exercises. The library environment supported open communication and allowed students to move between individual reflection and group interaction.

Overall, the activities produced a range of learning materials and interactions that captured how students experienced, understood, and discussed disaster risk. The results show that the school library functioned as an active learning space where disaster-related knowledge, personal experience, and dialogue came together during the post-earthquake period.

Discussion

This case illustrates the potential role of school libraries in disaster-related contexts. The findings suggest that libraries can function as decentralized knowledge hubs within broader disaster risk reduction (DRR) systems by translating complex risk information into forms that are accessible to young people, providing spaces for reflection and learning, and connecting schools with disaster experts. However, such roles remain limited within current formal DRR policies and educational frameworks.

In the context of Southeast Asia, where earthquake risks are increasingly shaped by rapid urbanization and infrastructure vulnerability, educational institutions play an important role in community-level disaster risk reduction. The experience of this Thai middle school highlights the importance of building localized capacity for knowledge sharing and learning during crisis periods, particularly when formal instruction is constrained.

Conclusion

The response of the middle school library to the 2025 Mandalay earthquake draws attention to the role that librarians can play within disaster-related learning environments. This case suggests that, beyond providing information, school libraries may support localized disaster risk reduction (DRR) education and offer learning opportunities for young people in post-disaster settings.

The findings indicate that school libraries could be considered more carefully within discussions on disaster education and preparedness. Recognizing the contributions of librarians in areas such as disaster communication, learning activity design, and community engagement may help strengthen educational responses to disaster risk. In this context, professional development opportunities related to disaster education, as well as collaboration with disaster science experts, could support similar initiatives in other schools.

Overall, this study highlights the value of engaging students with risk-related knowledge in ways that are sustained and sensitive to local contexts. As familiar and trusted spaces within schools, libraries may provide a practical setting for such engagement, particularly where formal disaster education is limited.

Future Work

Future research should further examine how librarians and other information professionals can develop a deeper understanding of disaster risks, such as earthquakes, and translate this knowledge into practical guidance for library users. Strengthening the capacity of librarians to support safe evacuation, provide clear risk information, and promote preparedness before disasters occur remains an important area for continued study.

In addition, future work may explore the development of training programs, guidelines, and collaborative frameworks that enable libraries to function more effectively as supportive spaces during emergencies. By enhancing librarians' risk awareness and preparedness skills, libraries may better assist users in understanding evacuation procedures and necessary pre-disaster measures, thereby contributing to safer and more resilient communities.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The authors further declare that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Empowering Global Citizens Through Multidisciplinary Collaboration in Education for Sustainable Development: Insights From the Learning Express (LeX) Programme

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Abstract

This paper explores the transformative potential of multidisciplinary collaboration in Education for Sustainable Development (ESD) through the lens of the Learning Express (LeX) Programme at Singapore Polytechnic. The LeX Programme, operational since 2013, engages students in cross-cultural, multinational teams to address real-world challenges aligned with the United Nations Sustainable Development Goals (SDGs). By embedding Singapore Polytechnic's Design Thinking Framework within Education for Sustainable Development, the programme fosters holistic and pluralistic approaches to problem-solving, emphasising empathy, innovation, and sustainability. A mixed-methods survey of 336 participants from ASEAN LeX trips revealed high levels of socio-economic awareness, global mindset, and acquisition of career-relevant skills, though some uncertainty remains regarding long-term application and global career interest. The findings highlight the importance of facilitator support, authentic immersion, and iterative learning in nurturing global citizens equipped to tackle complex sustainability challenges. Limitations include self-reported data and regional focus. The study concludes that integrating design thinking with Education for Sustainable Development can reinforce student identity, motivation, and purposeful engagement for sustainable futures (Boeve-de-Pauw et al., 2015; Cheah et al., 2022; Singapore Polytechnic, 2025; UNESCO, 2017).

Keywords: education for sustainable development, design thinking, global mindset, multidisciplinary collaboration, Learning Express

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Introduction

The urgency of sustainable development has prompted educational institutions worldwide to rethink their pedagogical approaches. Education for Sustainable Development (ESD), championed by UNESCO, seeks to empower learners with the knowledge, skills, values, and attitudes necessary to address interconnected global challenges such as climate change, inequality, and resource depletion (UNESCO, 2017). ESD emphasises holism—recognising the interdependence of social, economic, and environmental systems—and pluralism, which values diverse perspectives in addressing sustainability challenges (Boeve-de-Pauw et al., 2015).

Singapore Polytechnic (SP) operationalises these principles through its Graduate Attributes Framework, which defines qualities essential for future-ready graduates. Among these, three attributes are particularly relevant to the LeX Programme:

- Global Mindset: Ability to understand behaviours in cultural and economic contexts and collaborate on cross-boundary projects.
- Communication & Collaboration: Ability to tailor and convey information to suit the audience, negotiate, and work with people from diverse backgrounds to achieve common objectives.
- Creativity, Innovation & Enterprise: Ability to view issues from different perspectives, generate ideas, and capitalise on opportunities and resources to create value and implement solutions (Singapore Polytechnic, 2025).

The LeX Programme exemplifies SP's commitment to cultivating these attributes through multidisciplinary, cross-cultural collaboration. By embedding Design Thinking within ESD, LeX provides students with authentic opportunities to engage in problem-solving that is empathetic, innovative, and sustainable. This paper examines how LeX fosters global mindset and related graduate attributes, drawing on survey data and situating the discussion within the broader discourse on ESD and experiential learning.

Literature Review

Education for Sustainable Development

ESD aims to develop learners who can critically comprehend and act upon global issues (Cheah et al., 2022). It is participatory and transformative, encouraging learners to question assumptions, embrace diversity, and engage in collaborative problem-solving. UNESCO (2017) identifies competencies such as systems thinking, anticipatory skills, and collaboration as essential for sustainability.

Graduate Attributes and Global Competence

Globalisation demands graduates who can navigate cultural diversity and complexity. A global mindset enables individuals to interpret behaviours in different socio-economic contexts and collaborate across borders (Javidan & Bowen, 2013). Communication and collaboration are equally critical, as multicultural teams require negotiation, adaptability, and shared understanding (Cheah et al., 2022). Creativity and innovation drive sustainable solutions, allowing learners to generate ideas and leverage resources effectively (Brown, 2009).

Design Thinking and Experiential Learning

Kolb's (1984) experiential learning theory posits that knowledge is constructed through experience, reflection, and application. Authentic, real-world contexts enhance learning by engaging students in complex, ambiguous situations that require adaptability and problem-solving (Lombardi, 2007). Design Thinking complements this approach by providing a structured framework—empathy, ideation, prototyping—that fosters creativity and collaboration (Brown, 2009).

Methodology

The LeX Programme adopts a four-phase Design Thinking Framework to guide students through authentic problem-solving experiences. Participants collaborate with peers from regional universities and polytechnics, addressing local needs while developing academic and interpersonal skills.

A survey was conducted with 336 students (70% of the cohort) who participated in LeX trips to Cambodia, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. Administered one month after a 12-day immersion, the survey measured indicators related to global mindset, communication and collaboration, creativity and innovation, and socio-economic awareness using both quantitative (5-point Likert scale) and qualitative (thematic analysis) methods (Singapore Polytechnic, 2025).

Results

Programme Reach

Since its inception in 2013, LeX has operated in 10 countries and 28 cities, involving over 11,500 participants and 38 partner institutions. Its objectives include fostering empathy, global awareness, and sustainable innovation aligned with SDGs (Singapore Polytechnic, 2025).

Survey Findings

The survey results indicate strong evidence of growth across the three graduate attributes relevant to the Learning Express (LeX) Programme. In terms of global mindset, an overwhelming 95% of respondents reported an enhanced understanding of cultural and economic contexts. This suggests that the immersive nature of the programme successfully exposed students to diverse socio-economic realities, fostering adaptability and cultural sensitivity.

For communication and collaboration, 93% of participants indicated improved ability to tailor communication for different audiences and negotiate effectively within multicultural teams. This reflects the programme's emphasis on teamwork and cross-cultural engagement, which required students to navigate language barriers and diverse perspectives to achieve common objectives.

The attribute of creativity, innovation and enterprise also showed significant development, with 90% of respondents expressing increased confidence in generating ideas and leveraging limited resources to create value. The design thinking framework, central to LeX, appears to

have played a critical role in stimulating innovative problem-solving under real-world constraints.

Beyond these core attributes, the survey revealed additional insights. A notable 98% of students recognised opportunities and challenges within host countries, and 97% acknowledged the complexity of global issues, indicating heightened socio-economic awareness. Furthermore, 93% reported gaining career-relevant skills, including project management, teamwork, and cross-cultural empathy. However, despite these positive outcomes, only 66% expressed heightened interest in pursuing international careers, highlighting a gap between short-term learning experiences and long-term global engagement.

Finally, the role of facilitators emerged as a key success factor. Students consistently identified facilitators as instrumental in guiding the learning process. Facilitators provided cultural context, supported teams through the design thinking stages, mediated conflicts, and led structured reflection sessions. These contributions were essential in helping students consolidate their learning and connect their experiences to broader sustainability concepts.

Discussion

The findings affirm that LeX effectively cultivates global mindset and related graduate attributes. Immersive experiences in diverse socio-economic contexts challenge students to move beyond ethnocentric perspectives, fostering cultural intelligence and adaptability. Collaborative projects, framed by Design Thinking, provide opportunities to practise communication and negotiation skills. Resource constraints and cultural diversity stimulate creativity and innovation, enabling students to develop solutions that are both contextually appropriate and sustainable.

However, sustaining global engagement beyond the programme remains a challenge. While students exhibit heightened awareness and skills, only 66% expressed interest in international careers. This suggests the need for post-programme interventions, such as alumni networks, industry partnerships, and global internships, to translate short-term learning into long-term aspirations.

Facilitators play a critical role in mediating cultural differences and guiding reflection. Their contributions align with Vygotsky's (1978) concept of scaffolding, reinforcing the social dimension of learning. Investing in facilitator training and cross-cultural competence is essential for programme scalability.

Limitations

The study relied on self-reported data, introducing potential bias. The timing of data collection (one-month post-trip) may have led to memory bias. The regional focus on ASEAN participants limits generalisability, and the absence of longitudinal tracking prevents assessment of long-term impact. Future research should adopt longitudinal designs and expand to non-ASEAN contexts.

Conclusion

Embedding Design Thinking within Education for Sustainable Development, as exemplified by the LeX Programme, offers a powerful model for nurturing global citizens equipped to address sustainability challenges. By fostering global mindset, communication and collaboration, and creativity and innovation, LeX prepares students to become future-ready graduates. Future iterations should address limitations related to regional focus and explore strategies to sustain global engagement through structured follow-up initiatives.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

This manuscript was drafted with the assistance of Microsoft Copilot, an AI-powered writing tool, improve clarity, and ensure adherence to academic formatting. The AI was used for summarisation, language refinement, and structure, while all content was reviewed and verified by the author for accuracy and integrity.

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Parallax of Heritage: Intersecting Deep Learning, VR, and Cultural Narratives for Preservation

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Abstract

The preservation of cultural heritage plays a crucial role in strengthening national identity and supporting educational development; however, conventional preservation approaches often fail to engage younger generations effectively. Recent studies highlight the potential of digital and immersive technologies to transform cultural heritage learning experiences (Giannini & Bowen, 2019; Hutson, 2024). Addressing this gap, this study investigates the integration of Deep Learning (DL) and Virtual Reality (VR) as innovative tools for cultural heritage education at the high school level. An experimental study was conducted at Senior High School 18 in Pekanbaru, Riau, Indonesia, involving 72 purposively selected students across Grades 9, 11, and 12, consisting of 40 female and 32 male participants. The study examined the effectiveness of a DL- and VR-based learning approach in enhancing students' cultural heritage knowledge as well as their interest and engagement. The findings indicate a statistically significant improvement in students' cultural heritage knowledge following the intervention ($p < 0.01$). In addition, 87.5% of the participants demonstrated increased interest and engagement in cultural heritage preservation. These results underline the strong potential of combining DL and VR to create immersive and engaging learning environments for cultural heritage education, suggesting that technology-enhanced approaches can substantially improve student engagement and knowledge retention. Further research is recommended to explore the scalability and applicability of this approach across diverse educational and cultural contexts.

Keywords: cultural heritage, deep learning, virtual reality, education, student engagement

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Introduction

The preservation of cultural heritage stands as one of the most critical challenges of the 21st century, a global imperative to safeguard the fragile repositories of collective memory, identity, and human history against the erosive forces of time, conflict, and environmental change (Malik, 2024; Otero, 2022). While international bodies like UNESCO report that countless tangible and intangible heritage sites remain at risk (Alex & Ichumbaki, 2024; Machat & Ziesemer, 2020), the digital turn has offered a powerful new arsenal for conservation, promising to immortalize cultural artifacts in virtual forms (Suroyo et al., 2021). However, the dominant paradigm of digitization, often limited to high-fidelity scans and photorealistic models, frequently results in sterile, decontextualized replicas. These digital archives, while valuable for documentation, often fail to capture the living essence of heritage: the stories, rituals, and socio-cultural narratives that imbue objects and places with meaning. This creates a fundamental problem: we are preserving the form of heritage but risk losing its soul, leaving a silent digital echo where a vibrant cultural voice once resonated (Hutson, 2024).

A critical review of the literature reveals a scholarly landscape fragmented into disciplinary silos. On one side, computer scientists have made remarkable advances in applying deep learning (DL) to heritage (Gil et al., 2024), successfully using neural networks for artifact reconstruction, script decipherment, and data analysis. On another, researchers in human-computer interaction have explored the power of virtual reality (VR) to create immersive, embodied experiences of historical sites, fostering a sense of presence and place (Suroyo et al., 2023). Concurrently, scholars in the humanities and social sciences continue to underscore the primacy of narrative in understanding cultural significance (Suroyo et al., 2022). Yet, a significant methodological and theoretical gap exists at the intersection of these domains. To date, few studies have attempted to systematically synthesize the analytical power of deep learning, the immersive potential of virtual reality, and the profound context of cultural narratives into a single, cohesive framework. The result is a missed opportunity to transition from static digital preservation to dynamic, intelligent, and pedagogically rich heritage engagement. The purpose of this study is to design, implement, and evaluate a novel framework that intersects deep learning, VR, and cultural storytelling to create living, interactive heritage experiences. To achieve this aim, the research is guided by the following central questions: (1) How can deep learning models be architected to analyse fragmented historical data and reconstruct plausible, context-aware cultural narratives? (2) What are the core principles for designing an immersive VR environment that dynamically integrates these AI-generated narratives to foster empathetic engagement and historical understanding? (3) To what extent does this integrated DL-VR approach enhance learning outcomes and affective connection to cultural heritage when compared with conventional digital museum exhibits?

The primary contribution of this work is threefold: theoretical, methodological, and empirical. Theoretically, it introduces the “Parallax of Heritage” model as a new conceptual lens for digital humanities and heritage studies. Methodologically, it pioneers an integrative pipeline for merging AI-driven content generation with immersive VR design for educational purposes. Empirically, it provides evidence-based insights into the efficacy of this approach, offering a validated blueprint for museums, educators, and cultural institutions seeking to create more meaningful and impactful digital heritage initiatives. This study is delimited to a case study focused on the reconstruction of a specific historical site and its associated oral histories, providing a focused context for developing and testing the framework. This paper will now proceed by reviewing the pertinent literature across the fields of deep learning,

virtual reality, and narrative theory. Following this, the methodology for the framework's development and evaluation is detailed, after which the results are presented and analyzed. The paper concludes with a discussion of the findings' broader implications for the future of cultural preservation and international education.

Literature Review

Deep Learning for the Digitization and Interpretation of Cultural Assets

The application of deep learning in cultural heritage has predominantly focused on the technical challenges of object classification, restoration, and 3D reconstruction (Grilli & Remondino, 2019). A significant body of work demonstrates the efficacy of Convolutional Neural Networks (CNNs) in automating the classification of artifacts like pottery shards, historical coins, and architectural styles (Gualandi et al., 2021), achieving accuracy levels that rival human experts (Zhang et al., 2025). Building on this, other researchers have employed Generative Adversarial Networks (GANs) for digital restoration, successfully in-painting damaged frescoes or predicting missing fragments of eroded sculptures (Harris et al., 2024; Karl et al., 2022). This trend highlights a clear progression from descriptive tasks (classification) to generative ones (reconstruction), showcasing the increasing sophistication of AI methodologies. However, a critical analysis of this literature reveals two significant limitations. First, these applications are overwhelmingly object-centric, treating heritage as a dataset of physical attributes to be processed. The focus is on the "what" the material form, while often neglecting the "why," the intangible stories, social functions, and cultural values embedded within the object. Second, the reliance on vast, curated datasets introduces a risk of algorithmic bias, potentially reinforcing existing canonical narratives and marginalizing heritage from underrepresented cultures for which extensive digital data is unavailable (Djabarouti, 2021). Consequently, while deep learning has proven its power in preserving the physical form of heritage, its current trajectory often results in sterile, decontextualized digital replicas, thereby missing an opportunity to engage with the richer, narrative layers of culture.

From Digital Museums to Immersive Experiences

In parallel, Virtual Reality has emerged as a powerful platform for heritage dissemination, moving beyond static online galleries to offer immersive, embodied experiences. The prevailing research in this area champions VR's ability to enhance user engagement and provide access to otherwise unreachable sites, such as fragile archaeological digs or reconstructed historical environments (Hijazi & Baharin, 2022; Wu et al., 2022). These studies consistently find that the sense of "presence" afforded by VR can foster a stronger emotional and cognitive connection to the past compared to traditional museum displays. The methodological trend has been a push towards greater photorealism and environmental fidelity, leveraging technologies like photogrammetry and laser scanning to create visually stunning "digital twins" of heritage sites (Giannini & Bowen, 20019). Despite these advancements, the dominant paradigm for VR in heritage often results in what can be termed "digital dioramas." In a critique similar to that leveled against deep learning applications, many VR heritage projects are visually spectacular but narratively shallow. User interaction is frequently limited to simple navigation, positioning the user as a passive observer rather than an active participant in the historical context. The narrative, if present at all, is typically delivered through linear, non-interactive overlays like audio guides or text panels, failing to exploit the unique affordances of the VR medium for dynamic, user-driven storytelling. A central debate within the field revolves around authenticity versus experience, with many projects prioritizing visual accuracy over interpretive depth. This leaves a critical gap

between the medium's potential for complex narrative exploration and its current implementation as a high-fidelity sightseeing tool.

The Primacy of Narrative in Contextualizing Heritage

Distinct from the technology-focused literature, scholarship in museum studies, anthropology, and digital humanities posits that cultural heritage is fundamentally constituted by narratives. An object's significance is not inherent in its material form but is constructed through the stories of its creation, use, provenance, and cultural meaning (Maulana & Ibrahim, 2021). This body of work argues compellingly for a shift away from a single, authoritative curatorial voice towards polyvocality, the inclusion of multiple, diverse, and sometimes conflicting perspectives that reflect the complex social life of an object. These scholars emphasize that heritage is not a static relic of the past but an active process of meaning-making in the present (Suroyo et al., 2021). The primary limitation of this theoretical discourse is its frequent disconnect from practical technological implementation. While the importance of dynamic, multi-vocal narratives is well-argued, the methods for embedding such complexity into interactive digital systems like VR remain undertheorized and underdeveloped. Current digital storytelling in heritage often fails to escape the linearity of traditional media, presenting pre-scripted stories rather than creating systems where narratives can emerge from user interaction with a context-rich environment (Suroyo et al., 2023). Therefore, a chasm exists between the sophisticated narrative theories developed in the humanities and the relatively simplistic narrative models employed in most digital heritage projects.

The preceding analysis reveals a clear and compelling research gap existing at the confluence of these three domains. The deep learning literature is technically robust but narratively impoverished. The VR literature is experientially immersive but often interactionally and narratively passive. The narrative theory literature is interpretively rich but technologically disconnected. No significant body of research has yet attempted to systematically integrate these streams: to use deep learning not merely to reconstruct an object's form, but to analyze and structure its associated cultural narratives; to then embed these dynamic, multi-layered narratives within a truly interactive VR environment; and to design an experience where the user's "parallax" view—their shifting perspective and interaction—co-creates their understanding of heritage. This study is positioned directly within this gap, proposing a novel framework that intersects these three fields to move beyond digital replication and toward a more holistic, meaningful, and narrative-driven form of cultural preservation.

Methodology

This study employed a quantitative, experimental research design to rigorously investigate the impact of a Virtual Reality (VR) intervention, enhanced by deep learning algorithms, on students' engagement with and understanding of cultural heritage narratives. The experimental approach was chosen for its strength in establishing cause-and-effect relationships, allowing for a controlled examination of how the immersive VR experience influenced specific, measurable outcomes related to cultural preservation. This design facilitated a systematic comparison of student learning and perception before and after exposure to the technological intervention.

Participants and Sampling

The research was conducted at Public High School 18 in Pekanbaru, Riau, Indonesia. The study's population comprised all senior high school students within this institution. From this population,

a sample of 72 students was selected using a purposive sampling technique. This non-probability sampling method was deemed most appropriate as it allowed for the deliberate selection of participants who fit the specific criteria of the study namely, students across a representative range of senior high school grade levels who could provide rich data on the learning experience. The sample was intentionally stratified to ensure proportional representation across three key age groups: Grade 9 (ages 14–15), Grade 11 (ages 16–17), and Grade 12 (ages 17–18). This stratification aimed to capture potential developmental differences in engagement and learning. The final sample consisted of 40 female (55.6%) and 32 male (44.4%) participants, reflecting the natural gender distribution within the school.

Research Instruments

To ensure a comprehensive data collection process, multiple research instruments were developed and validated. The primary instruments included:

A Cultural Heritage Knowledge Test (CHKT)

A researcher-developed instrument consisting of multiple-choice and short-answer questions designed to measure participants' baseline and post-intervention knowledge of the specific cultural narratives presented. The test's content validity was established by a panel of three experts in cultural history and educational technology.

A VR User Experience Questionnaire (VRUEQ)

Which utilized a 5-point Likert scale to assess participants' perceptions of the VR system's usability, immersion, and engagement levels.

An Attitude Towards Cultural Preservation Scale (ATCS)

Adapted from existing validated scales, to measure shifts in students' appreciation and perceived importance of cultural heritage before and after the intervention.

A System Usability Scale (SUS)

A standardized 10-item questionnaire, was used to provide a global view of subjective assessments of usability for the VR application.

Data Collection Procedures

The data collection was conducted systematically over a two-week period. First, official permissions were secured from the school administration, followed by obtaining informed consent from the participants and their legal guardians. The procedure began with the administration of the pre-intervention CHKT and ATCS to establish a baseline for each student. Subsequently, each participant engaged in a 45-minute interactive session with the VR heritage experience. During this session, observational data on engagement and interaction patterns were discreetly recorded by a research assistant. Immediately following the VR session, participants were asked to complete the post-intervention CHKT and ATCS, as well as the VRUEQ and SUS, to capture their immediate responses and measure the intervention's impact.

Data Analysis

The collected quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26. Descriptive statistics, including means, standard deviations, and frequencies, were used to summarize the demographic characteristics of the sample and the overall scores from the questionnaires. To test the primary hypothesis regarding the intervention's effectiveness, a paired samples t-test was conducted to compare the mean scores of the pre-test and post-test on the Cultural Heritage Knowledge Test (CHKT). Furthermore, an Analysis of Variance (ANOVA) was employed to explore whether there were statistically significant differences in outcomes based on the different age groups or gender, allowing for a more nuanced understanding of the intervention's effects across different demographic segments.

Ethical Considerations

Strict ethical considerations were upheld throughout the entire research process to protect the rights and well-being of the participants. Approval was first obtained from the institutional review board. Informed consent was a critical step; a detailed information sheet was provided to both students and their parents or guardians, clearly outlining the study's purpose, procedures, potential risks, and benefits. It was emphasized that participation was entirely voluntary and that they could withdraw at any time without penalty. To ensure confidentiality and anonymity, all data were coded, and personal identifiers were removed from the final dataset before analysis. All data were stored securely on a password-protected server accessible only to the primary researchers.

Result and Discussion

This study to ascertain the predictive power of the integrated Deep Learning (DL) and Virtual Reality (VR) approach on students' cultural heritage knowledge, a multiple linear regression analysis was conducted. The results, presented in **Tables 1**, **Table 2**, and **Tabel 3**, provide a comprehensive overview of the model's validity, explanatory power, and the specific nature of the relationship between the variables. The overall significance of the regression model was first examined using an Analysis of Variance (ANOVA), as detailed in **Table 2**. The results indicate that the model is highly statistically significant, $F(1, 78) = 45.67$, $p < .01$. This finding demonstrates that the regression model, with the integrated DL and VR approach as a predictor, is significantly better at forecasting students' cultural heritage knowledge scores than relying on the mean score alone. The extremely low p-value (less than 0.01) allows for the confident rejection of the null hypothesis, confirming a valid and reliable statistical relationship between the intervention and the learning outcome. Following the confirmation of the model's overall significance, its explanatory capacity was assessed using the Model Summary (Table 1). The R Square (R^2) value of 0.423 is of particular importance, as it indicates that approximately 42.3% of the total variance in students' cultural heritage knowledge scores can be explained by their engagement with the integrated DL and VR approach. This is a substantial effect size in educational research, suggesting that the technological intervention is a powerful factor in students' learning. The Adjusted R Square value of 0.410, which accounts for the number of predictors in the model, is very close to the R Square, further reinforcing the model's robustness and the genuine predictive power of the intervention.

Table 1
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.65	0.423	0.410	0.562

Table 2
Model ANOVA

Model	Sum of Squares	df	Mean Square	F
Regression	12.34	1	12.34	45.67
Residual	16.78	78	0.215	
Total	29.12	79		

Table 3
Coef. Model of ANOVA

Variable	Unstandardized Coefficients (B)	Standard Error	Standardized Coefficients (Beta)	t
Constant	2.45	0.85		2.88
Integrated DL and VR Approach	1.23	0.18	0.65	6.89

Finally, the Coefficients table (**Table 3**) provides a detailed examination of the specific contribution of the independent variable. The unstandardized coefficient (B) for the integrated DL and VR approach is 1.23, which has a direct practical interpretation: for every one-unit increase in the implementation of the intervention, a student's cultural heritage knowledge score is predicted to increase by 1.23 points, holding all other factors constant. More revealing is the standardized coefficient (Beta), which stands at a strong .65. This value indicates a potent, positive relationship between the intervention and knowledge acquisition. The statistical significance of this specific predictor is confirmed by its t-statistic of 6.89 and a significance value of $p < .01$, affirming that the integrated DL and VR approach is a significant and powerful individual predictor of the outcome variable.

Table 4
Statistics for Interest and Engagement Increase

Measure	Pre-Intervention Mean (SD)	Post-Intervention Mean (SD)	Change (%)
Interest and Engagement Scores	3.2 (0.9)	6.0 (0.8)	87.5% increase
Paired Samples t-test			
t-value	12.34		
Degrees of Freedom	78		
p-value	< 0.001		
Effect Size (Cohen's d)			2.2 (Large Effect)

The statistical analysis presented in **Table 4** provides compelling evidence of the intervention's profound impact on student interest and engagement with cultural heritage. Initially, participants demonstrated a moderate level of interest, reflected by a pre-intervention mean score of 3.2 (SD = 0.9). Following their interaction with the immersive VR experience, this metric saw a dramatic and substantial rise, reaching a post-intervention mean of 6.0 (SD = 0.8). This represents a remarkable 87.5% increase, highlighting a fundamental shift in student attitude and involvement. To validate the significance of this observed change, a paired samples t-test was performed. The results confirmed that the increase was not a product of chance, yielding a highly significant outcome ($t(78) = 12.34$, $p < 0.001$). The extremely low p-value indicates that the probability of such a large increase occurring randomly is negligible, thus providing strong statistical support for the intervention's efficacy. Furthermore, to understand the magnitude and practical importance of this effect, Cohen's d was calculated. The resulting effect size of $d = 2.2$ is categorized as exceptionally large, far exceeding the threshold for a large effect ($d = 0.8$). This powerful finding underscores that the integrated Deep Learning and VR approach did not merely create a statistically significant difference but had a substantial, meaningful, and transformative impact on motivating students and deepening their connection to cultural preservation narratives. In essence, the intervention proved to be a powerful tool for fostering genuine interest and active engagement.

Discussion

The Effectiveness of Immersive Learning on Cultural Knowledge Acquisition

he primary finding of this study—a statistically significant improvement in students' cultural heritage knowledge ($p < 0.01$)—highlights the transformative potential of immersive technologies in educational contexts. This result aligns closely with Constructivist Learning Theory, which emphasizes active knowledge construction rather than passive information reception. Unlike traditional didactic approaches that rely on abstract representations, the virtual reality (VR) environment fostered a strong sense of presence, or the subjective feeling of "being there," which acted as a catalyst for deeper learning. This finding is consistent with

Experiential Learning Theory, as articulated by Moorhouse et al. (2019), which underscores the role of direct and concrete experience in knowledge acquisition. From the perspective of Embodied Cognition, Otero (2022) argued that cognitive processes are grounded in bodily interaction; by virtually navigating historical sites, students engaged in simulated physical experiences that enhanced comprehension. In addition, principles of Situated Cognition were evident, as learning occurred within a rich, contextualized environment resembling authentic settings, thereby supporting retention and transfer. This immersive experience effectively reduced the cognitive distance between learners and content (Huang et al., 2020), in contrast to the higher extraneous cognitive load often associated with decontextualized text-based instruction described in Cognitive Load Theory.

The technological mechanisms underlying these outcomes warrant closer examination. The effectiveness of the VR system extended beyond novelty, drawing on established principles of human–computer interaction and cognitive science (Hutson, 2024). A high degree of immersion, as an objective technological feature, facilitated the subjective experience of presence, creating a powerful learning pathway. By transforming abstract historical narratives into spatial, interactive experiences, the system leveraged Dual Coding Theory, as proposed by Gute and Wainman (2021), enabling information to be processed through both verbal and visual–spatial channels for more effective encoding and retrieval. The integration of Deep Learning (DL) further strengthened this effect by enabling personalized learning pathways. As noted by Kumar et al. (2025), such adaptive mechanisms—central to Intelligent Tutoring Systems—allow narrative content to respond dynamically to individual learner interactions, optimizing challenge and engagement. This personalization supports a form of narrative-based learning in which cultural stories are co-constructed with learners, fostering deeper cognitive and affective involvement in line with Media Richness Theory.

Beyond immediate pedagogical gains, this study contributes meaningfully to cultural heritage scholarship by presenting a robust framework for the preservation and transmission of Intangible Cultural Heritage (ICH). While prior research has largely emphasized the digitization of tangible artifacts, this work addresses a critical gap by enabling the dissemination of narrative, ritualistic, and experiential cultural elements. The findings provide empirical support for Cultural Transmission Theory, demonstrating how immersive technologies can function as contemporary channels for intergenerational knowledge transfer. Furthermore, the results align with the Technology Acceptance Model, suggesting that high perceived usefulness and engagement can facilitate broader adoption of VR in cultural education (Nilashi & Abumalloh, 2025). By offering high contextual fidelity, the immersive environment enables more authentic and nuanced cultural understanding than traditional text-based or 2D media. Consequently, this research not only validates VR as an effective pedagogical tool but also establishes a scalable framework for leveraging immersive and adaptive technologies to sustain and celebrate cultural narratives.

The Impact of Gamification and Interactivity on Student Interest and Engagement

A seminal finding of this research is the remarkable 87.5% increase in student interest and engagement, directly addressing the declining efficacy of traditional pedagogical methods in engaging digital native learners. This substantial outcome indicates a fundamental perceptual shift, demonstrating that the DL-VR intervention successfully transformed cultural heritage from a static subject into a dynamic and interactive learning domain. The immersive and gamified nature of the virtual reality environment was pivotal in reshaping learning into an experiential process, shifting students from passive recipients of information to active

participants capable of interacting with and influencing historical narratives. This transition from passive consumption to active participation appears to be the primary driver of increased curiosity and affective connection to cultural material, confirming the effectiveness of such technologies in bridging historical content with contemporary learners.

This finding is strongly supported by a broad body of literature examining the intervention's core elements. The motivational affordances of gamification are well documented, with Ryan and Rigby (2019) and Breien and Wasson (2021) demonstrating how mechanics such as points, challenges, and narratives enhance motivation and task persistence. These principles have been consistently validated in educational contexts by Barlow et al. (2020) and Barton et al. (2020), who linked them to higher behavioral and cognitive engagement. Similarly, the educational value of immersive virtual reality is well established. Carmona-Halty et al. (2021) emphasized the learning benefits of presence and co-presence in 3D environments, while Gute and Wainman (2019) and Geib (2020) identified this sense of "being there" as critical for improving retention and focus. In cultural heritage education, Giannini and Bowen (2019) and Goodwin and Lercari (2023) demonstrated VR's capacity to enable otherwise inaccessible historical experiences. This active engagement approach also aligns with the ICAP framework proposed by Hutchins (2020), which posits that interactive learning yields the deepest cognitive outcomes, and is consistent with Li's (2020) findings on the role of positive emotions in academic achievement and interest.

Ultimately, the 87.5% enhancement in student engagement can be attributed to the synergy between gamification and interactivity within an immersive VR framework. Rather than merely presenting information in a novel format, the technology fundamentally restructured the educational encounter. VR captured sensory and cognitive attention (Barton et al., 2020), while gamification provided the motivational structure necessary for sustained, goal-oriented interaction (Lim et al., 2025). Together, these elements effectively induced a state of flow (Yuan et al., 2024) and supported intrinsic psychological needs for autonomy, competence, and relatedness as outlined in Self-Determination Theory. Consequently, the DL-VR intervention represents a validated blueprint for bridging the gap between static historical artifacts and the participatory expectations of 21st-century learners, demonstrating the transformative potential of well-integrated educational technology.

Practical Implications, Limitations, and Future Research Directions

This study presents significant practical implications, offering a promising pedagogical model for educators, museums, and cultural policymakers. It functions as a compelling proof-of-concept, demonstrating that strategic investment in digital technologies can substantially reinvigorate cultural heritage education. However, it is imperative to acknowledge the study's inherent limitations. The reliance on a purposive sample drawn from a single institution in Pekanbaru constrains the generalizability of the findings to broader populations. Furthermore, the cross-sectional design precluded the measurement of long-term knowledge retention and sustained interest. Consequently, future research must prioritize the validation of this model across larger, more diverse cohorts in varied geographical and cultural contexts. Longitudinal studies are also indispensable for assessing the enduring impact of this intervention, as well as for exploring the scalability and adaptability of the DL-VR platform for wider integration into national curricula.

Conclusion

This study elucidates the profound pedagogical efficacy of integrating Deep Learning (DL) with Virtual Reality (VR) for cultural heritage education. The findings compellingly demonstrate that this synergistic technological approach serves as a powerful predictor of knowledge acquisition, moving beyond the passive reception of information characteristic of traditional methods. By immersing learners in a dynamic and interactive historical context, the intervention facilitates a deeper cognitive and affective engagement, aligning with core tenets of constructivist and experiential learning theories. The model's success is rooted in its ability to transform abstract cultural narratives into tangible, embodied experiences, thereby reducing cognitive distance and fostering a genuine sense of presence. Furthermore, the remarkable enhancement in student interest and engagement substantiates the intervention's capacity to reposition cultural heritage as a vibrant and compelling subject for contemporary learners. The fusion of gamified, interactive elements within an immersive framework proved to be the critical catalyst, shifting students from passive observers to active participants in the co-construction of knowledge and creating a powerful affective connection to the subject matter. Consequently, this research validates the DL-VR model not merely as an effective instructional tool, but as a transformative framework for revitalizing cultural heritage education and cultivating a deeper appreciation for intangible cultural legacies.

Despite the promising outcomes, it is essential to acknowledge the study's inherent limitations while charting a course for future inquiry. The reliance on a specific cohort from a single institution necessarily tempers the generalizability of the conclusions, highlighting the need for broader validation. Moreover, the cross-sectional nature of the research design provides a snapshot of immediate impact but does not capture the enduring effects of the intervention on long-term knowledge retention or sustained engagement. Future research should therefore prioritize the replication of these findings across more diverse demographic and cultural contexts to establish the model's robustness. Employing longitudinal designs will also be indispensable for rigorously assessing the lasting impact of this immersive experience on student learning and attitudes over time. Further investigation into the scalability of the platform and its adaptability for integration into standardized curricula would represent a critical next step in transitioning this powerful proof-of-concept into a widely accessible and transformative pedagogical tool for global cultural heritage education.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the author(s) used AI-assisted tools, specifically Grammarly and DeepL, solely for language editing and grammatical review. These tools were employed to improve clarity, coherence, and readability of the text. The author(s) take full responsibility for the final content and affirm that all data, analyses, interpretations, and

conceptual frameworks presented in this work are the result of their original intellectual contributions.

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Discussing ChatGPT in the Landscape of Students' Soft Skill Fostering: A Bibliometric Content Analysis

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Abstract

Since its launch, ChatGPT has prompted an extensive debate among scholars and educators regarding its benefits and impediments to the development of students' soft skills. Aiming to provide a comprehensive overview of this dynamic, this study performed a dual approach, combining bibliometric and content analysis. A total of 136 peer-reviewed articles from Web of Science and Google Scholar published between 2022 and April 2025 were analyzed. The bibliometric analysis revealed a rapid growth in this field, with significant research originating from China, Taiwan, Saudi Arabia, and the United States. Content analysis of 102 empirical studies then delved into research subjects, methods, and key themes. A significant gap in research on K-12 students was discovered, as the majority of studies targeted higher education stakeholders. Moreover, while there was a focus on the impacts of ChatGPT on students' academic communication abilities and high-order thinking skills, the review identified a growing recognition of digital literacy as an essential soft skill in the age of AI. The paper concludes by offering extensive implications and pedagogical strategies, derived from the empirical studies, to guide the integration of ChatGPT in educational settings for the growth of soft skills. This study is among the first to combine bibliometric and content analyses in this research landscape.

Keywords: ChatGPT, soft skills, students, bibliometric analysis, content analysis

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Introduction

The 21st century has witnessed a powerful wave of advancements in technology that is continuously reshaping human life in various ways, from the emergence of wireless Internet to the introduction of artificial intelligence (AI). In a short time, humanity has to adapt and find ways to tackle the challenges presented by these rapid changes.

Under these circumstances, soft skills (SS) are gradually gaining attention from policymakers, educators, and businesses. They are considered essential tools that empower individuals to navigate their personal development and, consequently, cope with uncertain environments and increase perseverance (International Labour Organization, 2021; United Nations Children's Fund [UNICEF], 2019). What's fascinating is that AI innovations are now assisting people in practicing these inherently human SS; among them is ChatGPT.

Within the first two months after its launch, Chat Generative Pre-trained Transformer (ChatGPT) quickly gained beyond one hundred million users (Hu, 2023) and has been recognized as a promising non-human assistant in educational settings since then, particularly in the aspect of personalization and expanding learning resources for learners (Qadir, 2022). The fact that ChatGPT can support human-like tasks, such as learning and decision-making, has opened up new directions for education (Kasneci et al., 2023).

However, researchers express concerns about ethical issues (Mhlanga, 2023), misinformation, and bias (ElSayary, 2023), as well as the risk of students misusing the tool or lacking critical analysis towards the AI-generated content (Kazley et al., 2024; Tseng et al., 2025). Besides, the reliability and consistency of ChatGPT responses can differ depending on the language used by the user, which is often higher when using English than when using other languages (Yoon et al., 2024). This can be a significant barrier for teachers and students in countries where English is not their native language.

Until April 2025, systematic studies have extensively explored the general impact of ChatGPT in education (e.g., Grassini, 2023; Tang & Chaw, 2024), challenges and opportunities of ChatGPT in classroom settings (e.g., Farrokhnia et al., 2023; Mai et al., 2024), and its influence on students' skill acquisition (e.g., Asad & Ajaz, 2024; Sardi et al., 2025). Although these studies shed light on many aspects of ChatGPT's use and its effect on learning outcomes, there is a need for comprehensive reviews for educators who want to thoughtfully integrate ChatGPT in classrooms. Alvarado-Bravo et al. (2024) recently conducted a bibliometric study to examine AI as a potential tool for SS development. However, they did not clearly indicate the impact of AI on students' SS or the models tested for AI integration.

To address this gap, this review adopted a bibliometric-content analysis approach, aiming to shift the focus from 'what' ChatGPT does to 'how' educators can intentionally implement pedagogical strategies with ChatGPT to develop SS in students. By analyzing 136 English-language journal articles and proceeding papers from 2022 to 2025, the researcher sought to synthesize the following:

1) Impacts of using ChatGPT on students' SS in educational settings;
2) Suggestions for ChatGPT integration to foster SS development.

Literature Review

Definition of Soft Skills

The role of SS in an individual's development has been acknowledged extensively. From the years spent in school to adulthood, their influence spans across all phases of human life and helps people overcome crises (Feraco et al., 2024; Martínez et al., 2021). However, in what ways are SS defined?

In 1998, Goleman suggested that SS is closely related to emotional intelligence, classifying it into self-awareness, self-regulation, motivation, empathy, and other social skills (Goleman, 2006). Many researchers, educational practitioners, and politicians in the 1990s described SS as a set of non-academic abilities and recognized its contribution to students' academic success (Chamorro-Premuzic et al., 2010).

Stepping into the 2000s, the concept of SS moved beyond interpersonal communication to encompass a skill set that helped individuals gain a profound understanding of themselves. In 2019, UNICEF acknowledged SS, interchangeably called transferable skills, as having the ability to act as a bridge and support system for foundational, digital, and job-specific skills. Therefore, they are considered essential skills for children and adolescents to succeed in school, life, and work, owing to their characteristic of being 'central magic glue' (UNICEF, p. 1, 2019).

As the 21st century reaches its 25th year, SS is commonly described as a broad set of non-technical and personal attributes that help individuals organize their lives, communicate with others, and adapt successfully to uncertainty.

Approaches to Soft Skills Education

In institutional settings, SS is cultivated both formally and informally. Students can learn and strengthen their SS by enrolling in compulsory courses (formal) and non-credit extracurricular activities (informal). One approach supported by many educators and scholars is to integrate SS into existing curricula rather than treating them as separate subjects. In this approach, teachers are encouraged to blend SS into class activities and assignments, even while delivering specialized knowledge and technical training (Otermans et al., 2023; Widad & Abdellah, 2022).

To date, SS training regularly involves a range of interactive, student-centered instructional methods that reflect real-world experiences. In other words, it should be oriented and customized to students' needs.

Digital Transformation in Teaching Soft Skills

As discussed, introducing SS into the curriculum does not equate to adding new topics or activities. This can be conveyed through what has already been done. Teaching SS by doing has been shown to work in many fields (e.g., Molek-Winiarska & Kawka, 2022; Vázquez-Calatayud et al., 2024), and with the assistance of advanced digital tools, it can be executed in innovative ways. For instance, digital games and simulations (Garcia et al., 2020), online educational platforms and flipped learning (Medvedeva et al., 2022; Moundy et al., 2022), and microlearning using mobile devices or social networks (Romanenko et al., 2023).

ChatGPT has been offering various innovative possibilities for teaching and learning experiences thanks to its ability to answer queries, generate learning material at different difficulty levels, and provide feedback (Memarian & Doleck, 2023). In a study by Wang (2025), students from non-English-speaking countries using ChatGPT-4 reported improved proficiency and gained greater confidence in their English communication. Recognizing the value added by ChatGPT, many scholars have started experimenting with this tool for training in other areas. In communication courses, ChatGPT has been reported to assist students in answering theory-based questions, generating ideas, and practicing application-based communication tasks (AlAfnan et al., 2023). Furthermore, teachers can use ChatGPT responses as examples for classroom discussions, encouraging students to think critically about their communication skills and improve them (AlAfnan et al., 2023). In healthcare training, ChatGPT helps trainees practice patient communication skills tailored to their expertise (Bonfitto et al., 2024).

Nevertheless, students are advised to be aware of AI's limitations when it comes to its unethical use and potential harm to their critical and analytical thinking (Ogunleye et al., 2024). Relying too much on AI tools in general, and ChatGPT in particular, could threaten cognitive development (Dron, 2023). Another factor that could hinder the advantage of ChatGPT in education is the digital divide caused by limited infrastructure and other socioeconomic constraints, which would deepen the gaps between individuals from different regions (Hussein et al., 2025).

The emergence of ChatGPT in academic settings, though has promoted digital transformation in education towards personalized learning environments, requires careful consideration of ethical issues and how to integrate the tool effectively.

Methodology

The present study used a dual approach combining bibliometric and content analyses to examine previous research on the use of ChatGPT and its influence on students' SS. While bibliometric analysis provides empirical grounds for the topic under research, content analysis helps gain comprehensive insights into the publications (Maral, 2025).

Data Collection

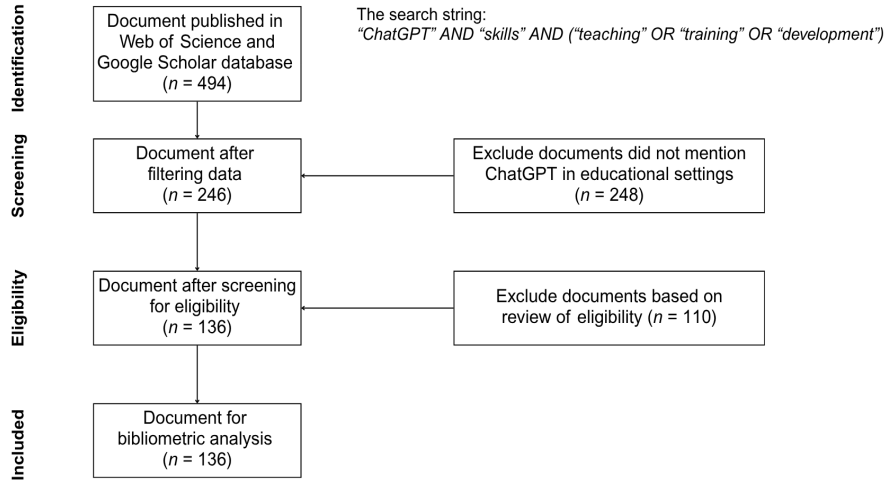
Search Criteria

A literature search was conducted using the Web of Science (WoS) and Google Scholar databases. The researcher used relevant keywords and their combinations and Boolean operators “ChatGPT” AND “skills” AND (“teaching” OR “training” OR “development”) to search within the titles, abstracts, and keywords of publications. The selection criteria included English language, peer review (articles, conference proceedings, review papers), and publication dates from January 1, 2022, to April 30, 2025.

Article Screening

The researcher followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to search for documents, as shown in Figure 1. The initial search yielded 494 documents, of which 248 were excluded because they did not refer to ChatGPT in the educational context.

Figure 1
Flowchart of Document Selection Using PRISMA Guidelines



Subsequently, the titles and abstracts of the remaining 215 documents were read to determine their relevance to SS. At this stage, the researcher used the following research questions as guidance for selection:

- *Research Question 1 (RQ1):* What were the most discussed impacts of ChatGPT on students' SS development?
- *Research Question 2 (RQ2):* What pedagogical approaches are recommended for educators to leverage the use of ChatGPT in fostering students' SS?

After an additional 110 documents were eliminated, the total document count was 136.

Data Analysis

The metadata of the 136 articles, such as paper title, paper source, author names, affiliations, keywords, and citations, were imported into an Excel file. The Excel file was uploaded to OpenRefine for data cleaning and preparation. Then, the VOS Viewer and Displayr were used to perform descriptive statistical analyses.

To gain further insights, the researcher employed content analysis on empirical studies to extract information such as research subjects, methods, main findings, and research implications. By doing this, the researcher was able to focus on identifying what problems exist and what benefits arise in the context of ChatGPT and the development of students' SS, as well as the recommended approaches for educators that directly address the study's research questions.

Results

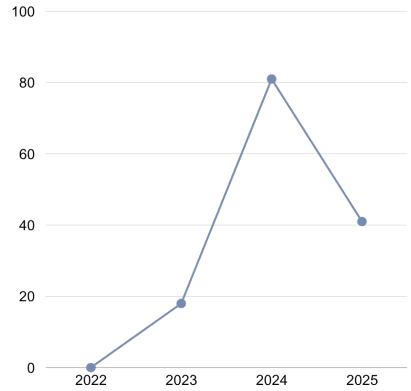
Volume and Growth Trajectory

The number of articles on ChatGPT in relation to SS in the period 2022–2025 is presented in Figure 2. Because ChatGPT was not released until November 2022, no publication was reported in this year.

Starting with 18 publications in 2023, the number of publications was multiplied approximately five times by the end of 2024. This rising trend implies not only interest among scholars regarding the intervention of ChatGPT in educational contexts but also indicates the importance of this field for stakeholders, that is, researchers, educators, and students. In the second quarter of 2025, 41 papers were published, signaling a rapid pace of research in this area moving forward.

Figure 2

Number of Publications per Year From January 2022 to 30 April 2025

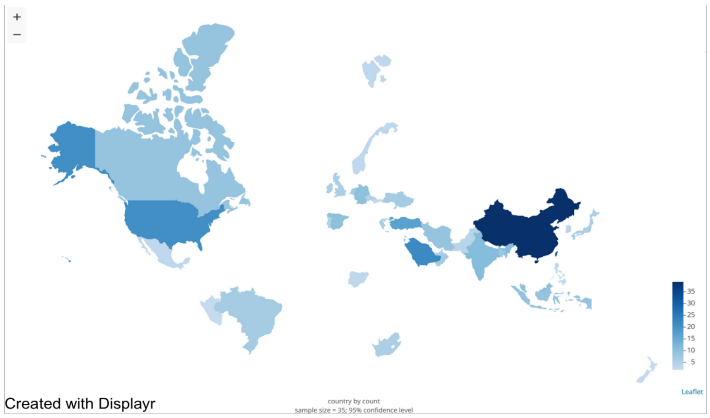


Geographic Distribution

A total of 136 ChatGPT-SS-related documents were published by scholars from 35 countries (Figure 3), including Bangladesh, Brazil, Canada, China, the Czech Republic, Germany, Greece, India, Indonesia, Iran, Ireland, Israel, Japan, Malaysia, Mexico, the Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Peru, the Philippines, Portugal, Saudi Arabia, Slovakia, South Africa, South Korea, Spain, Taiwan, Turkey, Ukraine, the United Arab Emirates, the United Kingdom, and the United States of America (USA).

Figure 3

Choropleth Map Illustrating Geographical Distribution of Studies



Scholars from China were the most productive in this research domain (n = 38; 13.72%). Taiwan ranked second (n = 28; 10.11%), followed by Saudi Arabia (n = 21, 7.58%). These three countries, together with the USA (n = 20; 7.22%), Turkey (n = 16; 5.78%), and India (n = 10; 3.61%), comprise the top six countries in the number of publications.

The fact that ChatGPT was developed by OpenAI, an American technology company, makes the lead of China in this matter surprising. However, if we look at how the Chinese government made AI development plans a national strategic priority in 2017, this was to be expected. As of 2022, China had registered four times as many AI-related patents as the USA and was closing the gap in top-tier research output thanks to the groundwork laid years earlier (Kuo, 2025).

Along with China, the appearance of Saudi Arabia on this list has prompted closer attention. Traditionally known for its high dependency on oil, Saudi Arabia's ambition began pursuing economic diversification in 2019, shifting its major financial allocation towards AI infrastructure development (Global AI Summit, 2024).

Taken together, the involvement of these nations suggests widespread interest in AI, particularly ChatGPT, which surpasses geographical boundaries. Moreover, this interest did not stop as an abstract concept but as one that led to transformation in national strategies.

Most Frequent Keywords

To understand the evolution of literature from 2023 to 2025, keyword analysis was performed using keyword co-occurrence overlay visualization through VOS Viewer (Figure 4). Out of 559 keywords, only 43 keywords were included, since the condition for running the analysis was that the keyword had at least three co-occurrences. The most frequently used keywords included ChatGPT (125 co-occurrences), artificial intelligence (46), higher education (21), generative artificial intelligence (20), education (18), and critical thinking (13).

Figure 4 shows several interconnected clusters indicating the research themes. At the center of the network, "ChatGPT" acted as a focal point of research in the analyzed papers. From there, the rest were grouped into five major thematic clusters.

Cluster 1: ChatGPT and Technical Aspects

In the first cluster, ChatGPT was studied in a broader term: a generative AI-based technology. This cluster consists of nine keywords focusing on ChatGPT application in computational practice, for example, "prompt engineering," and its recognition as an AI conversational agent.

Cluster 2: ChatGPT and Language Learning

This cluster pinpoints the use of ChatGPT by English as a Foreign Language (EFL) learners and teachers. The keyword "chatbot" in this cluster further emphasized ChatGPT's capability to produce human-like dialogues, serving as a helpful aid for practicing language skills (Alshammari, 2024).

Cluster 3: ChatGPT and Skills

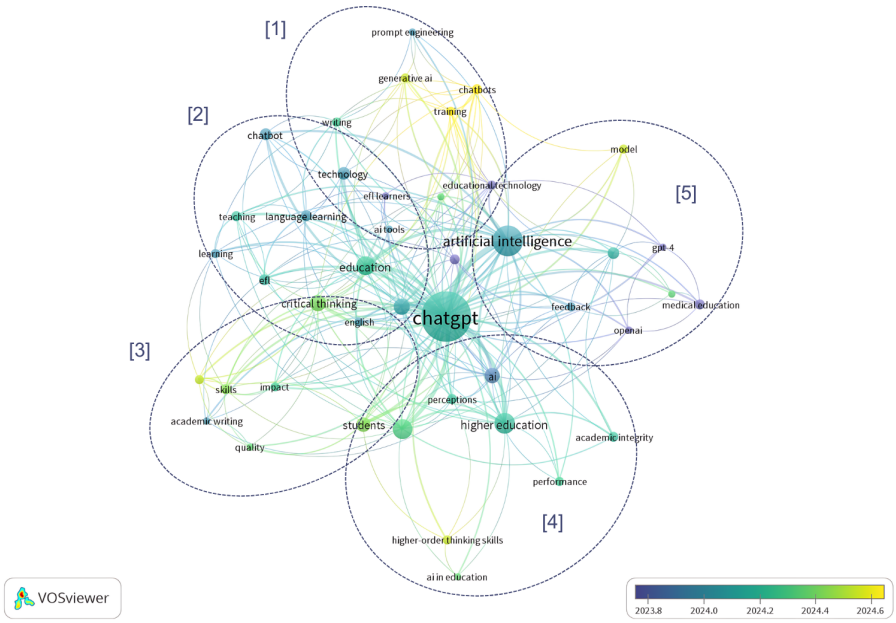
Built around keywords such as "critical thinking," "quality," "skills," and "impact," the third cluster delves into the benefits and challenges towards skill development posed by the emergence of ChatGPT. The inclusion of "academic writing" implies a focus on how ChatGPT influences skills in formal contexts, particularly writing skills.

Cluster 4: ChatGPT and Higher Education (HE)

This cluster specifically targets the implications of ChatGPT in HE. Scholars' attention has been drawn to its impact on students' higher-order thinking skills (HOTS). Alongside its potential, academic integrity, such as plagiarism and ethical usage, is a key concern for stakeholders (Aghaee et al., 2024).

Figure 4

Network Analysis of Keywords With at Least Three Co-occurrences in Papers Published 2023–2025



Cluster 5: ChatGPT and Medical Education

The last cluster attends to the contribution of ChatGPT to the niche area of health care education. The appearance of GPT-4 in this cluster indicates the focus of research on the application of ChatGPT's advanced models to enhance learning outcomes. Among these, ChatGPT-generated feedback, although not fully replacing experts' input, might be a potential alternative during medical practitioners' training, especially in improving clinical reasoning skills (Çiçek et al., 2024).

Content Analysis

Of the 136 papers, 34 were review and conceptual papers, and 102 were empirical studies. The researcher focused only on empirical content analysis. These papers were read and labeled based on their research subjects and methods. The details of this are described in the following sections.

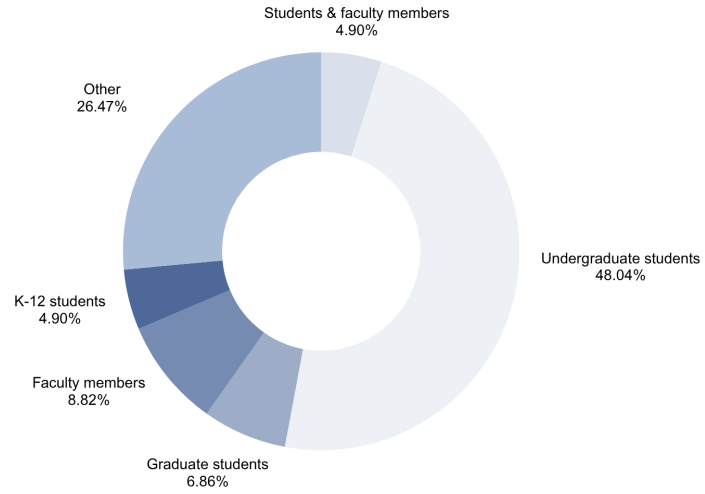
Research Subjects

The majority of 102 empirical studies targeted current students and faculty in institutions. Figure 5 presents the proportion of each research subject group. Within the sample, only five publications studied K-12 students (4.90%), whereas 56 studied HE students (54.90%). This

skewed attention in research was highlighted by Yusuf et al. (2024) in their review paper, noting that studies in ChatGPT-SS seemed to focus more on college students.

A significant number of research subjects in these empirical studies were categorized as "Other" (n = 27; 26.47%). Within this segment, pre-service teachers were the most frequently studied group (n = 11), followed by EFL learners (n = 6) at universities.

Figure 5
Research Subjects of Empirical Studies

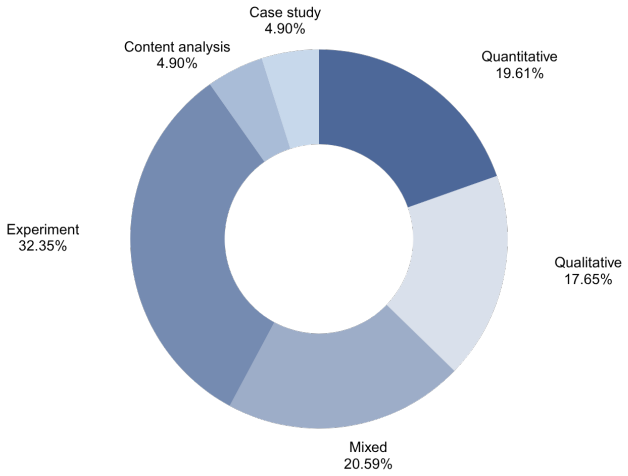


Methods

Various methods were used in the empirical studies examined (Figure 6). Most empirical studies have been conducted using traditional quantitative and qualitative methodologies, such as surveys and interviews (n = 38; 37.25%). The second most widely used was experiments, with 33 papers (32.35%), followed by mixed methods, with 21 papers (20.59%). Additionally, a few papers employed case studies (n = 5; 4.90%) and content analysis from social media and news (n = 5; 4.90%) as methodologies.

This variety of research methods highlights the wide range of methodologies used by scholars in this domain. Traditional methods have been used to investigate stakeholders' perceptions and correlational relationships. Meanwhile, adopting experimental approaches and other innovative techniques has assisted scholars in examining the causal effects of ChatGPT on particular SS and testing frameworks.

Figure 6
Research Methods Adopted in Empirical Studies

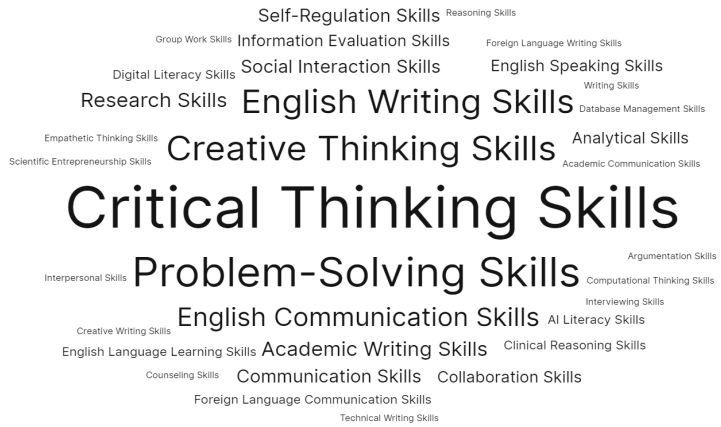


Most Researched Soft Skills

Figure 7 illustrates the word cloud of the dominant SS within papers published between 2023 and 2025. “Critical thinking” (n = 39) is the most frequent keyword in the word cloud, indicating its prominence in research related to ChatGPT and SS in educational contexts. Other HOTS that were under the interest of researchers include “problem-solving” (n = 20) and “creative thinking” (n = 14). This focus on various cognitive skills suggests a significant concern regarding how ChatGPT affects students’ fundamental intellectual competency. In the field of language learning and academic communication, “English writing skills” (n = 13) are highly studied within the context of English as a Foreign Language (EFL) learning, followed by “English communication skills” (n = 8).

Additionally, the visibility of “academic writing skills” (n = 5) in the word cloud reflects the ongoing debate among researchers on the efficacy of ChatGPT in improving students’ writing abilities (Li & Ironsi, 2024). Among interpersonal competencies, many studies have focused on “social interaction skills” (n = 4) alongside “collaboration skills” (n = 3) of HE students, implying their significant perceived importance in the context of ChatGPT's influence or use.

Figure 7
Word Cloud Visualization of Skills From Papers Published 2023–2025



Notably, there is growing interest in competencies that are crucial in the digital world, such as information evaluation skills (n = 3), digital literacy skills (n = 2), and AI literacy skills (n = 2). Collectively, they highlight a recognition among scholars that, in the constantly changing state of AI, simply possessing traditional skills is not enough. Instead, students should also be equipped with updated AI literacy skills to utilize the potential of ChatGPT (Naamati-Schneider & Alt, 2024).

Content Analysis of Key Papers From Research Questions

The papers were grouped based on the identified SS, revealing four distinct themes: HOTS, language learning and communication skills, and interpersonal skills. Within each thematic group, the maximum of the five most-cited papers was selected for a more in-depth analysis (totaling 13 papers). The researcher then extracted data on key findings related to the impact of SS (addressing RQ1) and recommendations for educators and institutions (addressing RQ2). Table 1 presents the results.

Theme 1. ChatGPT and HOTS. This cluster comprises 56 studies investigating ChatGPT in relation to HOTS, with a high concentration on critical thinking, creative thinking, and problem-solving. Five studies were selected for the content analysis.

Theme 2. ChatGPT and Language Learning and Communication Skills. This cluster contains 43 papers discussing the impact of ChatGPT on the language learning process of college students and how it influences their academic communication practice. Among the five studies chosen for content analysis, two were experimental.

Theme 3. ChatGPT and Interpersonal Skills. Cluster 3 includes papers mentioning ChatGPT and its influence on students' interpersonal skills, such as social interaction and collaboration with others. As there were only three studies addressing this topic, the researcher recruited all of them into the content analysis.

Discussion

Final Remarks About the Research Landscape Regarding ChatGPT and Soft Skills

Together with existing literature reviews, this study adds to the body of research on ChatGPT in educational settings (e.g., Grassini, 2023; Yusuf et al., 2024), especially its influence on SS (e.g., Daniel et al., 2025), and further enriches the story.

First, this study reported rapid growth in the research landscape of ChatGPT-SS, attracting researchers worldwide, especially from China, Taiwan, Saudi Arabia, and the US. This indicates that the topic of ChatGPT and its role in the development of SS is indeed a global phenomenon. Second, upon examining the most frequently used keywords in publications, we observed a significant concentration on how ChatGPT can improve and impede SS, specifically academic writing and critical thinking skills. This was followed by ethical concerns regarding potential harm to academic integrity within the HE context.

Regarding research subjects, the majority of empirical studies targeted HE stakeholders rather than those in K-12 settings. This suggests that the prominent focus of ChatGPT's impact and integration strategies was largely centered around university-level learners, even though ChatGPT has been commonly used among teen students (Beshay, 2025) and presented both

opportunities and challenges for their SS development (Zhang & Tur, 2023). This gap calls for more research to examine this phenomenon in earlier educational stages.

In terms of research methodologies, there has been an increase in experimental research, in addition to a significant number of studies that used surveys and interviews to gather information about the perceptions and attitudes of faculty and students towards ChatGPT. This could be considered an effort of scholars transitioning from examining correlation relationships to investigating the causal effects of ChatGPT on specific SS. Considering the widespread usage of ChatGPT in academic environments, more rigorous research designs are crucial to test pedagogical strategies and provide stronger evidence for effective AI integration.

Finally, the analysis of the research on SS revealed that HOTS (i.e., critical thinking, problem-solving, and creative thinking) was the main concern among stakeholders. How ChatGPT influences fundamental language competencies has also been under the research interests of many scholars, underscoring an ongoing discussion of AI adoption in improving students' language use and communication skills. There has been growing recognition among researchers of digital skills as a crucial requirement for the age of AI, implying that traditional SS alone is not enough.

Table 1
Content Analysis of Most-Cited Papers Addressing the Research Questions

Title	Author	Method	RQ1	RQ2
Theme 1: ChatGPT and high-order thinking skills				
Exploring the influence of ChatGPT on student academic success and career readiness	Dahri et al. (2024)	Quantitative	• ChatGPT's high-quality output improves student cognitive skills (info processing, problem-solving). • Stronger cognitive skills lead to more effective and frequent ChatGPT use. • Over-reliance can hinder critical thinking.	• Tailor content using ChatGPT's high-quality, personalized outputs. • Train students to critically evaluate AI content, preventing over-reliance and misinformation.
ChatGPT-enhanced mobile instant messaging in online learning: Effects on student outcomes and perceptions	Huang et al. (2025)	Experiment	• ChatMIM significantly improved HOTS by reducing cognitive load and providing instant info/feedback.	• Prioritize integrating AI features that reduce cognitive load. • Integrate AI into familiar platforms for high user acceptance and minimal learning curve. • Balance AI support with fostering independent thought and human interaction.
Exploring decision-making competence in sugar-substitute choices: A cross-disciplinary investigation among chemistry and sports and health students	Dindorf et al. (2024)	Quantitative	• Study highlights ChatGPT risks: bias, misinformation, reduced interaction, and critical thinking harm from over-reliance. • ChatGPT's diverse viewpoints may homogenize student perspectives, reducing original group divergence.	• Encourage interdisciplinary learning to boost problem-solving, critical thinking, and decision-making. • Use deep learning to analyze arguments, revealing patterns and improving decision-making.
ChatGPT challenges blended learning methodologies in engineering education: A case study in mathematics	Sánchez-Ruiz et al. (2023)	Quantitative	• ChatGPT enhanced students' problem-solving comprehension by offering step-by-step solutions, not just answers, for math problems. • Students' over-reliance on ChatGPT for problem-solving and knowledge acquisition could impede critical thinking and independence.	• Rethink assessments to ensure work reflects genuine knowledge, given ChatGPT's impact. • Use ChatGPT as a supplementary tool; monitor its use and promote critical evaluation.
A ChatGPT-AIPSS approach for SDGs: Classroom engagement and collective efficacy of students with different levels of critical thinking	Li et al. (2025)	Experiment	• High critical thinking students benefited more from ChatGPT, using it for exploration leading to richer discussions and group problem-solving. • Low critical thinking students showed no significant benefit, passively accepting AI info rather than engaging deeply.	Design differentiated instruction based on student critical thinking levels: • Offer challenging tasks to students with high critical thinking to advance their skills. • Provide explicit guidance to low critical thinking students for better engagement with LLMs and problem understanding.
Theme 2: ChatGPT and language learning and communication skills				
A study on the efficacy of ChatGPT-4 in enhancing students' English communication skills	Wang (2025)	Experiment	• ChatGPT-4 users showed significant English communication skill improvement over traditional instruction. • ChatGPT-4's personalized, adaptive environment boosted student comfort and confidence, aiding language acquisition.	• Integrate ChatGPT-4 strategically into English curricula, tailoring it to student and school needs. • Policymakers should make informed choices about integrating ChatGPT-4 as an additional tool. • Encourage collaboration between ChatGPT-4 developers and teachers for individualized materials.
Enhancing academic writing skills and motivation: Assessing the efficacy of ChatGPT in AI-assisted language learning for EFL students	Song and Song (2023)	Mixed method	• Students in AI-assisted classes demonstrated higher motivation and better academic writing performance. • Participants worried over-reliance on ChatGPT could hinder creativity and critical thinking.	• EFL learners should actively use AI writing tools for immediate, targeted feedback and improvement. • Educators should establish AI-supported writing classes and train learners on effective AI tool usage.
The impact of integrating ChatGPT with teachers' feedback on EFL writing skills	Asadi et al. (2025)	Mixed method	• Students receiving ChatGPT feedback showed statistically significant, large improvements across all writing areas (task achievement, coherence, vocabulary, grammar, and overall score).	• Use ChatGPT for personalized, prompt, and adaptive writing feedback, especially in argumentative essays. • Guide students to critically engage with AI feedback to foster independent thinking. • Institutions must update academic integrity policies for AI and ensure teacher professional development in responsible AI use.
To resist it or to embrace it? Examining ChatGPT's potential to support teacher feedback in EFL writing	Guo and Wang (2023)	Experiment	• ChatGPT focused equally on all writing areas; teachers prioritized language and content over organization. • ChatGPT's feedback was significantly more voluminous and faster, but 18% was misaligned or off-task. • ChatGPT could not directly annotate essays and lacked contextual awareness (student background, course goals).	• Leverage ChatGPT for high-volume writing feedback, reducing teacher workload and allowing focus on nuanced guidance. • Teachers should review, modify, and integrate ChatGPT's feedback with their own context-specific insights before sharing with students.
Using generative artificial intelligence/ChatGPT for academic communication: students' perspectives	Liu et al. (2024)	Mixed method	• ChatGPT saved time, identified improvement areas, and helped students learn academic communication skills. • ChatGPT was beneficial for vocabulary, grammar, and reading comprehension, but students doubted its potential for speaking/listening. • ChatGPT was more helpful for writing assignments than general communication.	• Incorporate LLM chatbots into teaching and self-regulated learning (e.g., for writing feedback, vocabulary). • Redesign assessments and course objectives to reflect AI tool integration. • Institutions must develop clear policies and provide training on ethical AI use, including assessment guidelines.

Title	Author	Method	RQ1	RQ2
Theme 3: ChatGPT and interpersonal skills				
Integration of AI into the distance learning environment: Enhancing soft skills	Borkovska et al. (2024)	Mixed method	• ChatGPT was effective for developing SS like communication, teamwork, empathy, and collaboration in distance learning. • ChatGPT couldn't mimic in-person interactions or emotional bonds, limiting its ability to fully replicate crucial human interaction for SS.	Employ strategies to enhance learning and improve students' critical thinking, communication, teamwork, and creativity. For example: (1) Students write a description, then compare it with ChatGPT's; (2) Highlight and compare student-used phrases/constructions with ChatGPT's; (3) Use chat features to introduce new descriptive constructions.
Generative AI in higher education: Educators' perspectives on academic learning and integrity	Aghaee et al. (2024)	Qualitative	• ChatGPT use might influence student interaction, potentially affecting soft and cognitive skill development like collaboration and group learning. • Some respondents worried about ChatGPT's impact on SS, while others believed it depended on individual motivation, digital skills, and tool usage.	• Develop clear digital technology guidelines, provide educator/student workshops, prioritize critical thinking, and promote ethical AI use. • Educate students on AI tool benefits and risks instead of banning them.
Exploring the impact of ChatGPT on improving 21st-century skills for future English teachers during lesson planning	Yıldız (2024)	Case study	• ChatGPT aided pre-service teachers (PST) in structuring ideas for peer sharing, supporting collaboration skills, and making brainstorming more efficient. • ChatGPT helped PST adapt their communication style with different ages of students, which was beneficial for lesson planning.	• Integrate ChatGPT into teacher training to bridge teaching methods and enhance pedagogical/technological fluency. • Systematically develop 21st-century skills (4Cs) across lesson planning, implementation, and assessment.

Suggestions for Educator Practice

Prepare Students for Effective Usage of ChatGPT

One of the main concerns of both teachers and students when using ChatGPT is that they, the students, will become overly reliant on this AI tool, which could hurt their development in SS (Aghaee et al., 2024; Klimova & De Campos, 2024) and expose them to misinformation risks (Dahri et al., 2024; Mohamed, 2023). In response, numerous researchers have emphasized the need for educators to enhance students' digital competencies (e.g., Alshammari, 2024; Kurt & Kurt, 2024) and provide them with knowledge about AI literacy (e.g., Dindorf et al., 2024; Naamati-Schneider & Alt, 2024) before introducing ChatGPT into the classroom. Asadi et al. (2025) suggested that educators should assist students in evaluating ChatGPT's feedback and encourage them to critically challenge the content created by ChatGPT. Meanwhile, Li et al. (2025) and Naamati-Schneider and Alt (2024) urged training students to effectively interact with LLMs like ChatGPT through prompting skills. This means not only understanding its language, strengths, weaknesses, and biases but also learning how to customize queries to obtain the desired responses. For this reason, a comprehensive digital competency curriculum that addresses the necessary AI knowledge and technical and communication skills is essential. From there, educators can customize digital skills aligned with the learning objectives of each subject and tailor their guidelines to support students in evaluating ChatGPT-generated content.

Leverage ChatGPT's Strengths for Soft Skill Development

Many students across empirical studies (e.g., Dahri et al., 2024; Song & Song, 2023; Wang, 2025) have stressed that ChatGPT tailors its feedback and offers personalized support to their needs, thus contributing to their SS development. Students' SS development can also benefit from ChatGPT's potential to act as a support system for self-regulated learning. However, for students to maximize these benefits and avoid over-reliance, it is important to promote their proactivity as autonomous learners and strategically integrate the tool into academic activities while adopting a critical approach to its use.

For example, according to Li et al. (2025), educators should take into account the diversity in their students' thinking skills when developing teaching materials. To further foster HOTS in students with profound SS, educators can gradually increase the difficulty of their assignments. With students who are at the early stage of critical thinking skills, Li et al. (2025) suggested providing more explicit guidance (such as breaking down problems), encouraging students to ask questions, and instructing them on how to communicate effectively with ChatGPT. In their study, Cahill and McCabe (2024) mentioned that using ChatGPT as a tutor in classrooms can enhance student learning. By interacting with ChatGPT, students can understand why their answer to a quiz is incorrect or learn the reasoning behind a mathematical solution (Cahill & McCabe, 2024). Resonating with this idea, Liu et al. (2024) recommended employing ChatGPT as a guiding tool for brainstorming ideas and helping students uncover areas for improvement. As ChatGPT tends to provide responses that contain ideas from various fields, Dindoff et al. (2024) encouraged educators to take advantage of this feature to adopt interdisciplinary learning, which is beneficial for students' problem-solving, critical thinking, and decision-making competencies.

A core principle of ChatGPT integration in SS development is to adopt it purposefully and in a timely manner. Huang et al. (2025) advised incorporating AI features into structured post-class discussions, especially in information-dense learning environments, where cognitive overload is a common challenge. Specifically, their experiment with ChatMIM revealed that not only can ChatGPT allow students to quickly obtain information without interrupting their learning flow, but it also improves the quality of student collaboration. Guo and Wang (2023) emphasized utilizing both personal touch and ChatGPT-driven personalization during writing courses for its ability to rapidly provide a large quantity of feedback. With ChatGPT, educators can focus on more complex issues, tailor feedback based on student and class contexts, and provide more informative and individual-based guidance to their students. Borkovska et al. (2024) proposed employing strategies like having students write a brief answer on paper before using ChatGPT and then comparing them with the tool's to identify weaknesses. This comparison process is helpful in improving both writing and language skills. It also draws students into a thorough evaluation process involving critical thinking.

Build a ChatGPT-Ready Educational Environment

As ChatGPT has become widely used among students, it calls for well-defined policies and guidelines to ensure effective and responsible AI integration in educational settings. First, clear policies and guidelines are required to ensure the ethical use of AI in education (Alshammari, 2024; Liu et al., 2024). These guidelines must consider concerns, such as data privacy, academic integrity, and fair access, to establish standards for the appropriate use of ChatGPT and similar AI tools. Many sources have stated that regulations should also adapt to diverse contexts, for instance, different institutional priorities and different stakeholders (e.g., postgraduates and undergraduates) (Liu et al., 2024; Zhang & Tian, 2025). Furthermore, educators and institutions should look upon inclusivity and cater to the guidelines for students from all backgrounds, particularly those from disadvantaged communities, to reduce educational inequalities (Zhang & Tian, 2025).

Second, it is crucial to revise the teaching materials, course objectives, and learning outcomes to reflect this emergence. Besides monitoring student work to ensure that they genuinely acquire knowledge (Sánchez-Ruiz et al., 2023), educators should consider redesigning assessments and exploring alternative options that incorporate the use of ChatGPT and AI tools (Liu et al., 2024). As ChatGPT has strikingly transformed the educational landscape, reviewing

curricula and instruction methodologies plays a critical role in navigating ChatGPT-assisted learning and equipping students with guidance for autonomous knowledge acquisition.

Finally, along with educating students about the benefits and risks of these tools towards their SS development, teacher training is equally important (Yıldız, 2024). Equipping faculty members with the requisite digital skills to effectively embrace technological advancements during their mentorship of students is a critical step (Asadi et al., 2025). Eventually, the role of educators is to help students navigate their learning process autonomously, maximize AI's potential, and ensure its responsible and ethical use.

Conclusion

Although the methodology employed in this study was helpful in achieving its research objectives, it had certain limitations. First, as the study only included peer-reviewed papers and conference proceedings written in English, it may have missed influential works that were published in other languages. Therefore, to better understand the impact of ChatGPT on students' SS from different cultural backgrounds, especially when this LLM-based chatbot may perform variably across various language practices (Ando et al., 2024; Fang et al., 2023)—a future literature review covering a wider range of languages would be helpful. Second, since the content analysis relied on a purposeful sample of papers based on their citation count, instead of all 102 initial papers, it risks leaving out influential younger publications that often have less exposure than older ones (Teplitskiy et al., 2022).

Despite these limitations, this study describes the overall research landscape. The results of the literature review show that even though there is debate among scholars and experts about the benefits of ChatGPT in the SS acquisition process, threats exist. Therefore, all stakeholders should be actively involved in the emergence of AI tool usage in the classroom. Key recommendations from the literature include updating regulations to maintain academic integrity and ensure digital equity, tailoring AI integration strategies instead of absolute prohibitions, and providing clear AI guidance and digital literacy training for both educators and students.

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Rewriting Success: How Generative AI Is Shaping New Definitions of Career Achievement

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Abstract

Generative artificial intelligence (GenAI) integration into work life is transforming how early-career professionals define and pursue success. This qualitative, phenomenological study investigates how individuals in the early stages of their careers, immersed in AI-enabled environments, construct evolving notions of career success. Using purposive sampling, the study engaged ten participants – five females and five males – who graduated from Academic Year 2022 onwards, represent diverse career fields, and are currently employed or actively seeking work (Patton, 2015). Semi-structured interviews explored their lived experiences, with thematic analysis guided by Career Construction Theory, which views careers as self-constructed realities through which individuals make sense of their experiences. It emphasizes how people build their careers by using their personal stories, themes, and life experiences to adapt to vocational challenges. This focuses on adaptability, storytelling, and how individuals' personal narratives shape their professional paths, and the Protean Career Model which states that a career path is driven by the individual, not the organization, and that it is guided by a person's intrinsic values and a desire for psychological success, such as personal fulfillment and well-being. Findings reveal that GenAI workplace adoption contributes to a shift from traditional extrinsically oriented markers such as job stability, salary, and title, towards more intrinsic adaptive, and self-directed indicators, like autonomy, continuous learning and ethical AI use, while still preserving creativity and empathy in AI-mediated work. These results affirm protean and boundaryless orientations shaped by technological disruption, indicating the importance of responsive, future-ready career development programs that integrate human-centric values with AI-era competencies.

Keywords: career success, generative artificial intelligence, AI-driven workplace, protean career, career construction theory

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Introduction

The emergence of generative artificial intelligence (GenAI) has profoundly transformed education and the workforce, redefining how tasks are performed and how success is conceptualized. Tools such as ChatGPT and DALL·E are reshaping learning, work, and communication, prompting a shift from traditional success markers—job stability, income, and hierarchical advancement—toward values such as adaptability, digital fluency, and purpose-driven work (McAfee & Brynjolfsson, 2014) or students preparing to enter AI-integrated industries, these changes raise critical questions about evolving perceptions of career success.

Historically, career success has been measured through objective indicators like salary and promotions, alongside subjective dimensions such as fulfillment and growth (Ng et al., 2005). However, as AI influences skill demands and professional expectations, students increasingly prioritize creativity, adaptability, and technological competence (Succi & Canovi, 2020). Despite this shift, limited research examines how students reconcile traditional ideals with emerging realities shaped by GenAI.

This study explores the changing definitions of career success among students by comparing pre-GenAI and post-GenAI perceptions. Specifically, it seeks to identify dominant themes before AI adoption, emerging criteria after integration, and professional perspectives on GenAI's impact on skills and values. Insights from these patterns will inform responsive academic and career support programs, guiding career development centers in designing interventions aligned with the demands of an AI-driven labor market. In doing so, the research contributes to preparing students for success in a rapidly evolving world of work.

Literature Review

Career Construction Theory

Career Construction Theory (CCT) conceptualizes careers as subjective, dynamic processes through which individuals actively construct meaning from their vocational experiences (Savickas, 2005). Grounded in social constructionism, the theory posits that careers are not merely objective sequences of rankings, but evolving life narratives shaped by personal identity, values, and contextual demands. Work serves as a central arena for self-authorship, allowing individuals to express and continually renegotiate their sense of self in response to changing life roles and work environments.

A core construct of CCT is career adaptability, defined as a set of psychosocial resources that enable individuals to cope with vocational tasks, transitions, and uncertainties (Savickas & Porfeli, 2012). Career adaptability comprises four dimensions: concern, control, curiosity, and confidence. These dimensions reflect individuals' future orientation, sense of agency, exploratory behaviors, and self-efficacy in managing career challenges. In contemporary work contexts characterized by volatility and disruption, career adaptability is increasingly recognized as a critical mechanism for sustaining career development.

Protean Boundaryless Career Model

The Protean Career Model (PCM) further advances person-centered approaches to career development by emphasizing self-direction and values-driven career management (Hall, 2004) like traditional organizational career models, PCM positions the individual—rather than the

organization—as the primary agent responsible for career planning, development, and evaluation. Career decisions are guided by internal values and personal definitions of success rather than by externally imposed standards.

Central to PCM is the concept of psychological success, which refers to individuals' subjective evaluations of their career progress based on personal growth, authenticity, and alignment with core values (Hall & Chandler, 2005). Empirical studies have demonstrated that a protean career orientation is associated with continuous learning, adaptability, career satisfaction, and perceived employability (Briscoe et al., 2006) these findings underscore the relevance of PCM in explaining how individuals navigate increasingly uncertain and flexible career landscapes.

Evolving Definitions of Career Success

Career success is a central construct influencing career decisions and long-term goals. Perceptions of success are shaped by individual and contextual factors such as age, gender, socioeconomic background, and cultural context (Benson et al., 2020; Dries et al., 2008; Dyke & Murphy, 2006). These perceptions evolve over time in response to changing career contexts. Recent technological advancements, including generative AI, have further reshaped skill demands and career structures, prompting a redefinition of success (Duan & Wu, 2024).

Historically, career success reflected prevailing economic structures. In agricultural societies, success meant survival and stability; in industrial economies, it was linked to hierarchical advancement and external indicators such as income and job title (Dries, 2011), globalization and knowledge-based industries later broadened definitions to include subjective measures like job satisfaction and work-life balance (Mirvis & Hall, 1994). Judge et al. (1995) defined career success as positive material and psychological outcomes of work experiences, emphasizing accumulated achievements. While traditional benchmarks remain influential, they are increasingly re-evaluated amid social and technological change (Judge et al., 1995).

Contemporary frameworks such as the protean career model emphasize self-direction, adaptability, and lifelong learning. Success is now defined by authenticity, purpose, and holistic well-being rather than material rewards or organizational rank (Hall, 2004). These models highlight proactive career orientations, where individual agency and identity alignment play a central role in achieving subjective success.

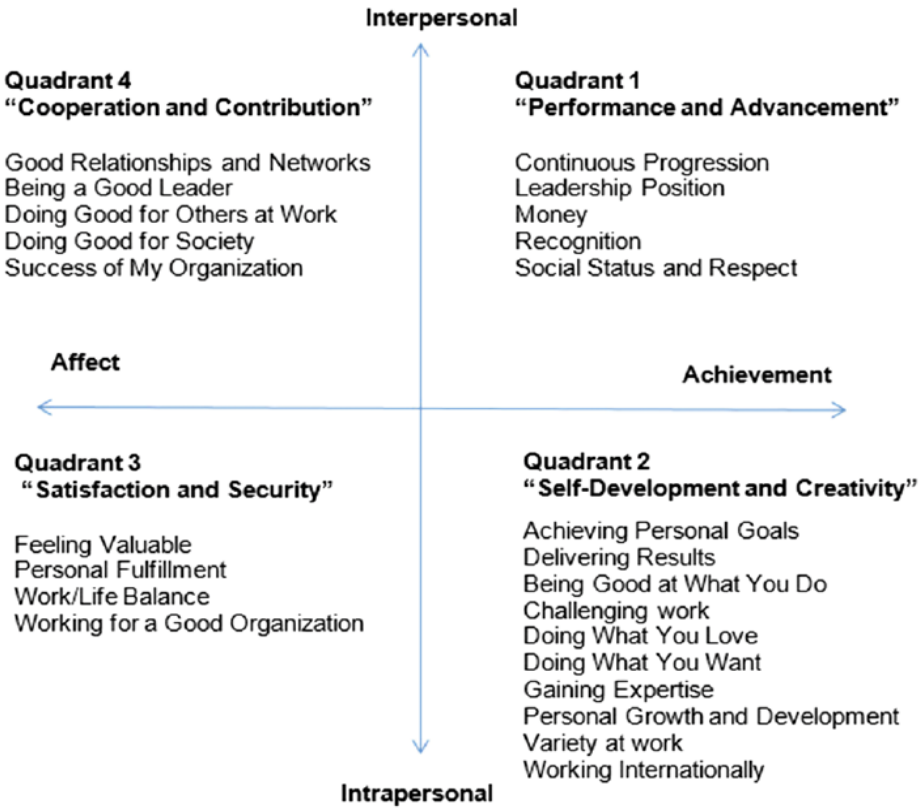
Multidimensional Framework and Technological Influences

Beyond the objective-subjective dichotomy, Dries et al. (2008) proposed four quadrants of success: intrapersonal (personal growth, value alignment), interpersonal (recognition, relationships), affect (emotional well-being), and achievement (performance, financial outcomes) (Dries et al., 2008). This framework captures the complexity of modern careers and remains relevant across generations (Benson et al., 2020). In the context of technological disruption, such as generative AI, these quadrants provide a lens for understanding shifting priorities among students entering a dynamic labor market.

Technology amplifies this personalization by transforming career guidance and development. AI-powered platforms and digital tools enable tailored career planning, interactive self-assessment, and customized learning pathways (Duan & Wu, 2024). Beyond initial job placement, technology supports continuous growth through online courses, virtual internships, and certifications, reinforcing the importance of lifelong learning and adaptability in dynamic

labor markets. This evolution marks a shift from standardized career trajectories to flexible, individualized journeys, where success is viewed as an ongoing process shaped by intentional choices, resilience, and technological empowerment.

Figure 1
Career Success Quadrants



Source: Dries et al., 2008

The Quick Evolution of Technology, Students' Preferences, and Institutional Support

Generative AI (GenAI) is reshaping career development and the broader world of work by transforming decision-making processes, job structures, and success criteria. At the macro level, GenAI automates routine tasks, augments decision-making, and creates new roles requiring hybrid human-AI skills, emphasizing adaptability, digital literacy, and lifelong learning (OECD, 2023; World Economic Forum, 2020). At the individual level, AI-powered platforms offer personalized career planning through resume feedback, interview simulations, and labor market insights, enabling more informed and reflective choices (Meng et al., 2025). Rather than replacing human guidance, GenAI complements it by allowing counselors to focus on meaning-making, values clarification, and emotional resilience (Bimrose et al., 2008). However, its adoption raises concerns about equity, ethics, and student agency, including issues of data privacy and algorithmic bias (Hooley, 2024).

As career success becomes more personalized and adaptive, higher education institutions must shift from static job-placement models to dynamic, developmental approaches (Kozhuk, 2023). Career services should integrate tools that foster reflection, identity development, and adaptability while leveraging AI for scalable, personalized guidance. Human advisors remain essential as interpreters and ethical anchors, ensuring students critically engage with

technology (Hooley, 2024). Institutions should embed career adaptability and psychological capital (Luthans et al., 2007) into curricula and co-curricular programs, promoting resilience and lifelong learning. Equity considerations are critical to prevent digital divides and ensure culturally responsive career technologies (OECD, 2023). Ultimately, universities must combine high-tech tools with high-touch engagement to prepare students for success in an AI-driven labor market.

Beyond career development, GenAI acts as a workplace disruptor, which fundamentally alters norms and practices. A disruptor is any force that drives rapid changes in work organization, job tasks, skill priorities, and career pathways (Inie et al., 2023). GenAI tools, including large language models and creative content generators, are significantly impacting routine tasks, job roles, and economic structures (Sarioguz & Miser, 2024). This disruption compels organizations and individuals to adapt to new approaches to work (Epstein et al., 2023), as GenAI accelerates job automation, hybrid work models, and the rise of gig and portfolio careers (Al-kfairy et al., 2024). These changes occur within compressed timeframes, from months to a few years, signaling an unprecedented pace of transformation (Feuerriegel et al., 2023).

Integrating Career Construction Theory, the Protean Career Model, and Career Success in the Age of Generative AI

The rapid advancement of generative artificial intelligence (GenAI) has reshaped how work is organized, how skills are valued, and how careers develop. By automating routine cognitive tasks and augmenting decision-making, GenAI has increased labor market uncertainty and accelerated skill obsolescence (McAfee & Brynjolfsson, 2014; World Economic Forum, 2020). As a result, traditional definitions of career success based on stability, expertise, and hierarchical advancement are increasingly inadequate. Career Construction Theory (CCT) and the Protean Career Model (PCM) offer complementary frameworks for understanding how individuals define and experience career success under these conditions.

From a career construction perspective, GenAI heightens the need for meaning making as individuals adapt to changing occupational roles. Career success is understood as the ability to maintain coherence between self-concept and work despite disruption, requiring individuals to continually reconstruct their career narratives (Savickas, 2005). Central to this process is career adaptability, which enables individuals to anticipate change, exercise agency, explore new opportunities, and sustain confidence amid technological transformation (Savickas & Porfeli, 2012). Within this framework, success is defined not by resistance to technology but by meaningful adaptation alongside it.

The Protean Career Model complements this view by emphasizing self-directed and values-driven career management. As GenAI accelerates skill commodification, individuals increasingly rely on internal criteria, such as personal growth and values alignment, to evaluate success rather than external indicators like status or tenure (Hall, 2004). This focus on psychological success becomes more pronounced in AI-mediated environments where traditional markers of professional value are destabilized (Hall & Chandler, 2005).

Empirical research supports this shift, highlighting subjective outcomes such as meaningful work, employability confidence, and learning orientation as key indicators of contemporary career success (Shockley et al., 2016). GenAI reinforces this trend by elevating uniquely human competencies, including creativity, ethical judgment, relational intelligence, and sensemaking,

which are less susceptible to automation. PCM provides a framework for understanding how individuals intentionally prioritize these attributes when navigating AI-augmented careers.

Together, CCT and PCM conceptualize career success in the GenAI era as adaptive, subjective, and agentic. CCT explains how individuals reconstruct vocational identity and meaning in response to disruption, while PCM explains how individuals actively align their careers with evolving values and personal definitions of success. In this integrated framework, career success is viewed as a dynamic process of ongoing adaptation, psychological fulfillment, and self-authorship, rather than a fixed outcome defined by occupational stability or technical superiority.

Conceptual Framework

The rise of generative AI (GenAI) represents a turning point in the world of work, introducing disruptions that extend beyond routine automation to areas traditionally considered uniquely human—creativity, knowledge work, and complex decision-making (West, 2018). This transformation underpins the framework's core pillars: job transformation, automation, and career adaptability. GenAI's ability to produce high-quality outputs rapidly not only enhances efficiency but also redefines professional value, signaling a shift from rigid, hierarchical career progression toward fluid, flexible pathways (Inie et al., 2023).

In this context, AI fluency emerges as a new professional currency, comparable to literacy or digital skills in earlier eras (Digital Education Council, 2025). However, technical proficiency alone is insufficient; enduring relevance depends on distinctly human capabilities such as creativity, empathy, critical thinking, resilience, and adaptability (Mukherjee et al., 2025). These competencies enable individuals, particularly students navigating the GenAI era, to thrive amid continuous disruption (Succi & Canovi, 2020).

The framework also acknowledges the psychological dimension of technological change. Accelerated automation fosters "AI anxiety," manifesting as fears of job loss and skill obsolescence (Epstein et al., 2023). Consequently, continuous learning becomes a professional imperative, transforming from an optional pursuit into a necessity (OECD, 2023). Simultaneously, values surrounding work and success are shifting toward fulfillment, balance, and social impact rather than salary or status alone (Benson et al., 2020; Ng et al., 2005).

Ultimately, the framework conceptualizes career success as a cyclical process of adaptation and value alignment. Each wave of disruption prompts individuals to refine their understanding of success through skill mastery, resilience, and intentional career choices (Luthans et al., 2007). Success is no longer a fixed destination, but an evolving construct shaped by the dynamic interplay between external technological forces and internal reassessment of purpose and meaning (Hall & Chandler, 2005).

Figure 2
Conceptual Framework: Rewriting Success: How Generative AI is Shaping New Definitions of Career Achievement

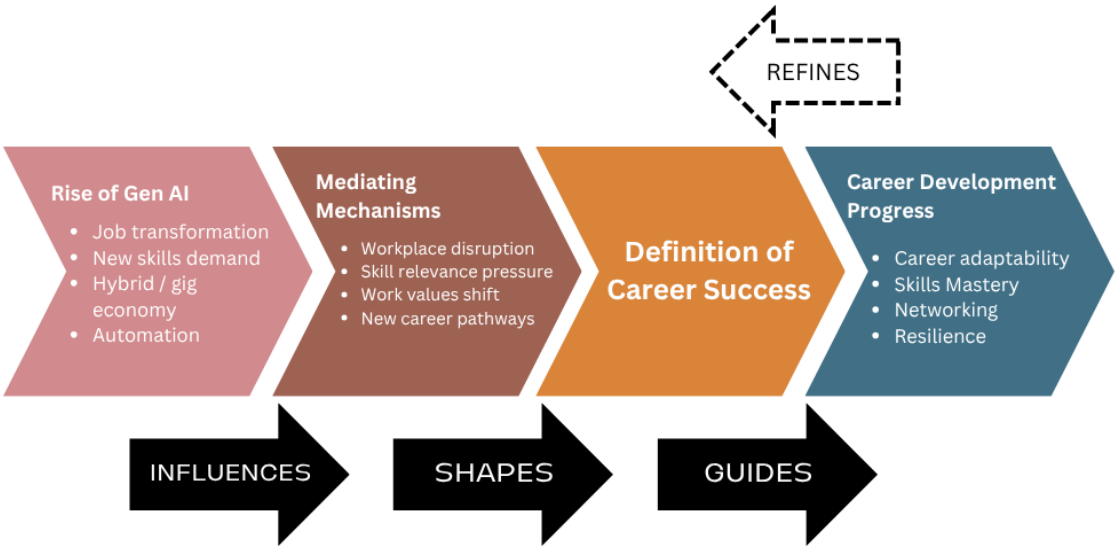


Figure 2 illustrates the conceptual framework of this study, which begins with the *Rise of GenAI*, representing technological disruptions such as job transformation, automation, and the emergence of hybrid and gig economies. These changes introduce Mediating Mechanisms, including workplace disruption, skill relevance pressures, shifting work values, and new career pathways. Together, these mechanisms shape the Definition of Career Success, moving it beyond traditional markers like salary and status toward more dynamic, personalized criteria such as adaptability, purpose, and lifelong learning.

The final component, Career Development Progress, highlights adaptive strategies—career adaptability, skills mastery, networking, and resilience—that guide individuals in navigating this evolving landscape. The dashed arrow labeled "Refines" signifies the cyclical nature of this process, where each stage of career development continuously redefines success in response to technological change and personal value alignment. This framework reflects the study's core argument: success in the GenAI era is not a fixed destination but an ongoing journey shaped by external disruptions and internal adaptation.

Methodology

This study employs a qualitative research design utilizing semi-structured interviews to examine how individuals conceptualize and define career success in the post-2019 era, with particular emphasis on the influence of generative artificial intelligence (GenAI) as a potential disruptor (Kvale & Brinkmann, 2009). Semi-structured interviews are well-suited for investigating abstract or subjective constructs, as they enable participants to articulate their lived experiences while maintaining a consistent framework for comparative analysis (Kvale & Brinkmann, 2009). Data were analyzed using Braun and Clarke's six-phase thematic analysis approach, which facilitates systematic coding and identification of recurring patterns, contextual factors, and emerging redefinitions of career success (Braun & Clarke, 2006).

A purposive, criterion-based sampling strategy was adopted (Patton, 2015), targeting individuals who graduated in 2019 or later and are currently employed. Participants were

recruited primarily from the researcher's professional and social networks, provided they met the inclusion criteria (He et al., 2025). Snowball sampling complemented this process, allowing participants to refer peers who satisfied the eligibility requirements. To capture a broad range of perspectives on career success, the sampling strategy incorporated elements of maximum variation sampling (Patton, 2015) ensuring representation across gender and professional domains. A total of 10 participants were recruited: five male and five female individuals who graduated on or after 2019 and are currently employed in various fields. Wutich et al. (2024), in their study in 2024 reported that theme saturation in qualitative interviews can be achieved with nine interviews. The year 2019 serves as a critical cutoff point, coinciding with the initial integration of GenAI into educational and professional contexts (He et al., 2025). Diversity in gender, occupation, and socioeconomic background was intentional, as prior research indicates that factors such as gender (Dyke & Murphy, 2006) socioeconomic status (Andresen & Stapf, 2023) and cultural background (Benson et al., 2020) significantly influence perceptions of career success. Given that GenAI adoption varies across industries, participants were drawn from multiple sectors to capture both shared and sector-specific nuances.

Data were collected through semi-structured interviews lasting approximately 45–60 minutes. Interviews were conducted either face-to-face or via secure online platforms (e.g., Zoom or Microsoft Teams), depending on participant availability and preference. Prior to participation, individuals received an information sheet outlining the study's purpose, procedures, potential risks, and participant rights. Written informed consent was obtained before the commencement of any interview or recording.

All interviews were audio-recorded with the participants' consent to guarantee the accuracy and comprehensiveness of their responses. The researcher also maintained reflective field notes to capture contextual information, non-verbal cues, and emergent insights during and immediately following each interview. Audio recordings were transcribed verbatim, and all personally identifiable information was removed in accordance with the study's Data Management Plan. Anonymized transcripts constituted the primary dataset for analysis.

The interview guide was informed by established literature on career success and career development, ensuring conceptual coherence and theoretical grounding. Interview questions were organized around the following thematic areas:

1. **Definitions of Career Success.** Initial questions invited participants to articulate their personal definitions of career success, consistent with a study from 2005 on subjective interpretations (Heslin, 2005) and Pico-Saltos et al.'s (2021) conceptualization of success as a cumulative sense of achievement over time. (Pico-Saltos et al., 2021)
2. **Objective and Subjective Markers of Success.** Participants were asked to reflect on both tangible indicators (e.g., salary, promotions) and intangible criteria (e.g., satisfaction, purpose, well-being), drawing on the classic objective–subjective distinction articulated by Judge et al. (1995) and the four-quadrant model proposed by Dries. (Dries et al., 2008; Judge et al., 1995)
3. **Traditional Versus Evolving Conceptions of Success.** Questions explored perceptions of traditional career trajectories and upward mobility, informed by Dries' (2011) work on the shift from hierarchical to more fluid, boundaryless career models. (Arthur et al., 2005)
4. **Perceived Impact of Technology and Generative AI.** Participants reflected on whether and how generative AI influences their understanding of career success, building on Duan and Wu's (2024) argument that technological disruption is redefining work roles, skill requirements, and indicators of achievement. (Duan & Wu, 2024)

5. **Contextual and Social Influences.** Follow-up prompts examined how demographic and structural factors—including gender (Dyke & Murphy, 2006) socioeconomic background (Hennequin, 2007) and cultural context (Benson et al., 2020)—shape individual definitions of success.

All interviews were transcribed verbatim and analyzed using thematic analysis guided by Braun and Clarke's six-phase framework (Braun & Clarke, 2006). The analysis combined inductive coding, allowing themes to emerge directly from the data, with deductive coding informed by existing theoretical frameworks, including the objective–subjective distinction in career success and Dries et al.'s (2008) quadrants (Dries et al., 2008).

Initial codes were iteratively reviewed and refined, leading to the identification of higher-order themes that captured shared patterns in participants' definitions of career success. This analytic approach supported a systematic, transparent, and theoretically informed interpretation of how success is being redefined in the context of generative AI and broader labor market transformations.

Ethical Considerations

The researchers complied with established ethical guidelines to ensure the protection, confidentiality, and well-being of participants. The participants were fully informed of the study's purpose, procedures, and their rights, including voluntary participation, the right to withdraw at any stage without penalty, and assurances of anonymity and data confidentiality. Informed consent was obtained prior to all interviews. To safeguard identities, pseudonyms (e.g., P1–P12) were used in transcripts and reports, and all personally identifying details were removed or generalized. Audio recordings and transcripts were securely stored in password-protected digital files accessible only to the researcher and were permanently deleted following data analysis and dissemination. As the primary researcher is a registered guidance counselor (RGC), participants were briefed before and debriefed after each interview, with opportunities provided to express any discomfort; interviews were paused or discontinued if distress was observed. While the topic posed minimal risk, participants were reminded they could skip questions or withdraw at any time, and referrals to support services were made available if needed. As a gesture of appreciation, participants received a modest honorarium transferred via digital wallet upon completion of the interview.

Results

The thematic analysis of the semi-structured interviews of ten Gen Zs (5 males and 5 females) revealed four major themes describing how early-career professionals define and experience career success in the context of generative artificial intelligence (GenAI): (1) persistence of traditional success markers, (2) emergence of adaptability and continuous learning as indicators of success, (3) human-centric values in AI-mediated work, and (4) coexistence of stability and self-directed career orientations.

Theme 1: Persistence of Traditional Success Markers

Across participants, traditional indicators of career success, such as stable employment, financial security, and professional legitimacy, remained salient. These were very apparent with prominent statements that related to status and financial capacity. Many participants described success as having a "stable job," "reliable income," or "position that proves

competence," particularly during the early stages of their careers. These markers were often linked to family expectations and cultural norms, with participants noting that financial stability was a prerequisite for independence and personal fulfillment. While participants acknowledged changes in the nature of work, traditional success markers were consistently framed as foundational rather than outdated. Answers from the participants included achieving a certain level in their careers, specific asset acquisitions and the likes. It cannot be denied however, that some were noted to veer away from these traditional markers. It can be noted from their answers that they also value "purpose" "passion" and "peace of mind," which are more personal rather than traditional.

Theme 2: Adaptability and Continuous Learning as Emerging Indicators of Success

Participants frequently identified adaptability and the capacity for continuous learning as central indicators of career success in AI-influenced environments. Success was described less in terms of long-term permanence and more in terms of the ability to respond to rapid technological change. Many participants emphasized the importance of "keeping skills updated," "learning how to use AI tools," and "staying relevant" in their fields. Rather than viewing success as a fixed endpoint, participants described it as an ongoing process of adjustment and skill acquisition shaped by evolving workplace demands. In essence, these participants valued continuous learning evolution, even after attaining a certain degree of stability.

Theme 3: Valuing Human-Centric Skills in AI-Mediated Work

Despite recognizing the efficiency and utility of GenAI tools, participants consistently highlighted the importance of preserving human-centric skills. Creativity, critical thinking, ethical judgment, and empathy were described as qualities that distinguish meaningful work from automated tasks. Several participants expressed that success involved knowing "when to rely on AI and when not to," emphasizing responsible and ethical use. These narratives suggest that participants perceive success not as technological mastery alone, but as the balanced integration of AI capabilities with human values and judgment. Additionally, the participants emphasized that AI is not the end all be all, and that it cannot do what the humans do because to quote one participant, AI doesn't have a *"soul,"* which is the edge of what human work can deliver. In fields that value human relationships such as healthcare, you still cannot replace the human touch with an AI mind. Participants reiterate that AI still could not perform surgeries, therapy and the likes. There is still very much a need for social interaction which AI cannot provide.

Theme 4: Coexistence of Stability and Self-Directed Career Orientations

Participants articulated a dual orientation toward career success that combined traditional stability with increased self-direction. While organizational roles and income remained important, participants also emphasized autonomy, flexibility, and alignment with personal values. Some participants described success as having the freedom to explore multiple career paths, pursue side projects, being more in touch with self, having peace of mind, or the ability to redefine goals over time. This coexistence reflects a shift toward more individualized and self-managed career trajectories, while still maintaining concern for economic security.

Discussions

This study examined how early-career professionals define career success in the context of generative artificial intelligence (GenAI), focusing on (1) dominant definitions of success prior to GenAI integration, (2) emerging criteria of success in AI-enabled environments, and (3) how individuals reconcile traditional success markers with evolving work realities. The findings suggest that GenAI does not bring about a radical shift in how success is understood; rather, it accelerates and reframes existing values, reinforcing multidimensional, adaptive, and self-directed conceptions of career achievement.

Traditional Definitions of Career Success Before GenAI

Prior to explicit GenAI integration, participants largely defined career success using traditional, extrinsic indicators such as job and financial stability, adequate income, professional recognition, and upward mobility. These definitions were shaped by family expectations, educational norms, and early workplace socialization, reflecting historically entrenched success schemas. Particularly within the Philippine and broader Asian context, financial security was described as a prerequisite for feeling successful, underscoring the continued importance of pragmatic concerns tied to socioeconomic realities.

However, even before GenAI's rise, participants' narratives already included subjective elements such as personal growth, fulfillment, and work-life balance. It is also worth it to note that these participants also gave a premium to the value they add and the purpose they are fulfilling. This suggests that the shift toward multidimensional career success predates GenAI, aligning with prior literature that frames contemporary success as a combination of objective and subjective dimensions. Rather than viewing traditional markers as obsolete, participants positioned them as foundational—necessary but insufficient on their own.

Emerging Definitions of Career Success in the GenAI Era

With the integration of GenAI into work and learning environments, participants articulated new criteria for evaluating career success, particularly adaptability, continuous learning, autonomy, and relevance. Success was increasingly defined as the ability to "keep up," "learn quickly," and "remain employable" amid rapid technological change. These narratives reflect a movement away from static milestones toward dynamic capabilities, where success is measured by responsiveness to disruption rather than fixed achievements.

This shift is consistent with Career Construction Theory, which emphasizes adaptability and meaning-making in response to vocational challenges. GenAI functioned as a salient career disruptor that prompted participants to reassess their skills, identities, and future trajectories. Success, in this context, was described as an ongoing process of adjustment and recalibration rather than a final destination.

Participants also emphasized increased autonomy and self-direction, key features of the Protean Career Model. GenAI tools were seen as enabling greater independence, efficiency, and flexibility, allowing individuals to shape their careers beyond traditional organizational boundaries. Success was thus reframed as being personally driven and values-based, emphasizing psychological fulfillment alongside professional competence.

Importantly, participants did not equate success with full reliance on AI. Instead, they highlighted the importance of preserving human qualities such as creativity, critical thinking, empathy, and ethical judgment. These attributes were perceived as increasingly valuable precisely because GenAI can replicate or automate technical tasks. As such, success in the GenAI era was framed as effective human–AI integration rather than technological dominance.

Reconciling Traditional and Evolving Success Criteria

A key finding of this study is that participants did not abandon traditional success markers in favor of new, AI-driven ideals. Instead, they articulated a dual orientation in which extrinsic indicators such as salary and stability coexist with intrinsic markers such as purpose, autonomy, and well-being. Traditional markers continued to provide security and legitimacy, while newer criteria offered meaning and sustainability.

This coexistence aligns with Dries et al.'s multidimensional framework of career success, particularly the intrapersonal and affective dimensions. Participants increasingly evaluated success through psychological well-being, value alignment, and resilience, especially in response to perceived uncertainty introduced by GenAI (Dries, 2011). The study's finding that there is no complete shift, but rather a perpetuation and refinement of values, challenges deterministic narratives that portray AI as fundamentally overturning career norms.

Instead, GenAI appears to accelerate an ongoing transition toward protean and boundaryless career orientations. Participants' definitions of success reflect continuity as much as change, suggesting that technological disruption intensifies reflection on existing values rather than replacing them outright.

GenAI, Anxiety, and Adaptive Reframing of Success

Participants also expressed varying degrees of anxiety related to GenAI, particularly concerning job displacement and skill obsolescence. However, this anxiety did not translate into resistance toward technology. Rather, participants reframed success as the ability to adapt, reskill, and collaborate with AI systems. Feeling successful was associated with remaining flexible, employable, and mentally prepared for ongoing change.

This reframing highlights the role of career adaptability and psychological capital in mediating the relationship between technological disruption and career success. GenAI-induced uncertainty prompted greater emphasis on resilience, continuous learning, and proactive career management. Success thus became closely tied to perceived preparedness for the future rather than certainty or permanence.

Cultural Context and Pragmatic Orientations

The findings also underscore the importance of cultural context in shaping definitions of career success. While participants expressed values aligned with protean careers—such as autonomy and self-fulfillment—these were often framed as goals that follow economic stability rather than replace it. This sequencing reflects an Asian pragmatic orientation in which financial security remains central, particularly in early career stages.

GenAI did not diminish these pragmatic concerns; instead, it heightened awareness of the need to balance security with adaptability. Participants' narratives therefore reflect both global

career trends and localized socioeconomic constraints, reinforcing the culturally embedded nature of career success.

Implications for Career Development and Education

The findings suggest that career development initiatives should move beyond narrow employability metrics and incorporate adaptability, ethical AI literacy, and reflective career planning. While GenAI tools can enhance efficiency and personalization, participants' experiences highlight the continued importance of human guidance in navigating uncertainty and meaning making. Career success in the GenAI era requires both technological competence and psychological support.

Conclusion and Recommendations

Overall, this study demonstrates that generative AI is reshaping but not replacing how early-career professionals define career success. Traditional markers such as stability and income remain central, particularly within the Asian cultural context of the study, where financial security continues to be prioritized before higher-order aspirations such as purpose or self-actualization. Rather than signaling a fundamental shift in values, the findings suggest an affirmation and perpetuation of established career success frameworks, now complemented by emerging dimensions such as adaptability, autonomy, and meaningful work. Career success thus emerges as a dynamic, yet continuous, self-constructed process shaped by technological change alongside enduring personal and cultural values.

Importantly, the absence of a clear redefinition of career success at this stage highlights the relative novelty of generative AI in professional life. While GenAI is influencing how work is performed and experienced, it has not yet disrupted the foundational criteria by which early-career professionals assess success. This reinforces the interpretation of generative AI as a reshaping force rather than a transformative replacement, with value systems remaining largely intact as individuals adapt to new technologies.

Given that this topic is emergent, the findings should be interpreted as a snapshot of an evolving phenomenon. Future research would benefit from longitudinal designs that revisit participants over time, particularly after five to ten years, to determine whether prolonged exposure to generative AI leads to substantive shifts in career success definitions. Expanding the number of participants and increasing diversity in terms of geography, industry, career stage, and socioeconomic background would further strengthen the generalizability of insights. Additionally, a systematic review of existing and forthcoming studies would help consolidate fragmented evidence and clarify emerging patterns across contexts.

By emphasizing career success as multidimensional, contextually anchored, and temporally evolving, this study provides a realistic framework for understanding how early-career professionals navigate the future of work in the GenAI era. As generative AI continues to mature and integrate more deeply into professional environments, continued empirical attention is essential to capture whether current patterns of value perpetuation give way to more transformative redefinitions of success.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Appendices

Appendix A
Interview Guide

Rewriting Success: How Generative AI Is Shaping New Definitions of Career Achievement
Proponents: Ma. Asuncion Clara Pantaleon and Arlyn Napenas (facilitators)

Contact details:

ma.asuncion.pantaleon@dlsu.edu.ph
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Section A. Warm-Up and Background

Can you tell me a little about your educational background and your current job or profession?
Purpose: Build rapport; situate participant's experience within career context (Creswell & Poth, 2018).

Section B. Definitions of Success

When you hear the word "career success," what comes to mind for you? How would you define it in your own terms?
Based on: Heslin (2005) – importance of subjective success interpretations.

Looking back, how did you first learn what "success" meant — from family, school, or early work experiences?
Based on: Nugin & Onken (2010) – career definitions evolve with lived experiences.

Section C. Objective vs. Subjective Markers

What would you consider as signs of success that can be measured or seen by others (e.g., salary, promotions, recognition)?
Based on: Judge et al. (1995) – objective success markers.

What about more personal or internal signs of success, such as fulfillment, growth, or purpose?
Based on: Dries, Pepermans, & Carlier (2008) – subjective success quadrants.

Section D. Traditional vs. Evolving Success

Traditionally, career success was often described as "climbing the ladder" or moving up in an organization. Does this idea still apply to you? Why or why not?
Based on: Dries (2011); Wilensky (1961); Heslin (2005) – hierarchical career models.

Do you think success today involves broader or more personal goals compared to the past? Can you share examples?
Based on: Arthur et al. (2005); Mirvis & Hall (1994) – boundaryless and protean career perspectives.

Section E. Technology and GenAI

In your opinion, how has technology, particularly generative AI, influenced how people define or pursue career success?
Based on: Duan & Wu (2024) – technology as a driver of redefining success.

Have AI tools changed the kinds of skills or values that you believe are important for success in your field?
Based on: Benson et al. (2020); Kaše et al. (2018) – contextual influences on success.

Section F. Personal Influences

How do factors such as your gender, socioeconomic background, or culture shape your idea of career success?
Based on: Dyke & Murphy (2006); Hennequin (2007); Benson et al. (2020).

Section G. Reflection and Closing

If you could give advice to students or graduates just entering the workforce about "how to define success," what would you tell them?
Purpose: Summative reflection; aligns with practical implications for career support programs.

Once the interview is done, the interview facilitator will wrap up the session and will conduct a debriefing session for the participants (not recorded) should they need to express feelings of discomfort or any untowardness in the duration of the interview.

Upon completion of the interview, an amount will be sent via cash transfer to the participants' digital wallet.

Appendix B
Informed Consent Form

Rewriting Success: How Generative AI Is Shaping New Definitions of Career Achievement

Ma. Asuncion Clara Pantaleon (ma.asuncion.pantaleon@dlsu.edu.ph)
Arlyn Napenas (arlyn.napenas@dlsu.edu.ph)

PURPOSE OF THE STUDY

You are being invited to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what your participation will involve. Please read the following information carefully and feel free to ask any of the researchers if there is anything that is not clear or if you need more information.

The purpose of this study is ***to explore how individuals who graduated or entered the workforce on or after 2019 define "career success" in light of the rise of Generative AI (GenAI). By gathering perspectives across different professions, this study seeks to understand how success is being redefined in today's technology-driven world.***

STUDY PROCEDURES

The participants of this study will undergo a one-on-one interview with the authors of this research. The interview will last approximately 45 to 60 minutes and will be conducted either face-to-face or online modality, whichever the participant prefers. With your consent, the session will be audio-recorded to ensure accuracy in data collection. You may freely decline to answer any question or withdraw at any point without any consequence.

The data collected is intended for research presentation and publication. This being said, the authors of this research would assure you that your name and any identifying information will not appear in any report or publication. Data will be anonymized, securely stored, and deleted after completion of the study and dissemination of findings.

The questions will revolve around your personal definition of career success, and the factors that influenced this definition. There are 9 questions in the interview, with two being check-in questions and a reflection/closing question to end the session.

DURATION

The interview will last approximately 45 to 60 minutes and will be conducted either face-to-face or online modality, whichever the participant prefers.

VOLUNTARY PARTICIPATION

Your participation in this study is completely voluntary. It is up to you whether or not you decide to participate. If you decide to participate, you will be asked to sign this consent form. After you sign this consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be destroyed.

RISKS

While the topic is not inherently sensitive, discussing career success in the context of AI may raise concerns related to job security, personal achievement, or uncertainty about the future. You can opt out of this study at any time, and you can skip any question. If signs of discomfort arise or if you express verbally your intent not to proceed during the interview, the session will be paused, and you will be asked whether you would like to continue. If you experience heightened distress, the session will cease, and an appropriate debriefing session will be provided with information about counseling or support services.

BENEFITS

Data gathered in this study will be very helpful to the improvement and creation of appropriate progams and activities for career development of university students.

In addition, upon completion of the interview, your GCash account number will be collected for purposes of the monetary benefits (Php 300.00). Your account number will then be deleted as soon as this has been completed.

CONFIDENTIALITY

Your responses in this research will be anonymous. Every effort will be made by the researcher to preserve your confidentiality, including the following:

1. Assigning codes for participants that will be used on all research notes and documents;

2. Keeping of notes, interview transcriptions, and any other personal identifiers in the researcher's gadget that will be secured with a password that only the researchers will have access to;

3. Soft copies of notes and research data with personal identifiers are password-protected and has multi-factor authentication enabled for security;

4. Data with identifiers are kept only until the research has been presented and published. After which, all soft copies will be securely deleted;

5. Research results for publication will not include any personal identifiers of the research participant, unless explicit consent was given by the participants;

6. Research participants will be notified, and a separate consent will be asked should any collected data be used beyond the scope of this consent.

CONTACT INFORMATION

If you have any questions at any time about this study, or if you experience any non-normative sensations because of participation, or to exercise your data privacy rights, you may contact any of the researchers whose contact information is on the first page.

CONSENT
This section is mandatory

I have read the provided information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I understand that I will be given a copy of this form, and the researcher will keep another copy on file. I consent voluntarily to be a participant in this study.

PRINTED NAME OF PARTICIPANT	**SIGNATURE OF PARTICIPANT**

DATE (dd/mm/yyyy)

Innovative Learning Management Model to Create Learning Space for Elementary School Students

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Abstract

Learning spaces play a crucial role in promoting equity in learning and providing opportunities for all learners. This research aims to examine the learning space model and develop guidelines for utilizing an innovative learning management model to create learning spaces for primary school students in the lower central region of Thailand. The study involved 40 key informants, including school administrators, teachers from best-practice schools, and educational academics, with data collected through in-depth interviews and focus group discussions. Qualitative data were analyzed using thematic and content analysis. The findings indicate that the learning space model comprises: (1) active, learner-centered learning management that integrates multiple disciplines and employs project-based approaches; (2) learning management innovations in curriculum, instruction, educational technology, and school administration; (3) learning spaces both within and beyond educational institutions; and (4) learning outcomes that enhance educational opportunities and develop learners' skills. Guidelines for implementing the model emphasize the integration of learning management, learning innovation, and learning spaces, with a recommendation for educational institutions to incorporate technology and environments that foster creative learning engagement.

Keywords: learning innovation, learning management, learning space, elementary school

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Introduction

The Sustainable Development Goals (SDGs) in education emphasize the provision of quality education that ensures inclusive and equitable access for all learners, alongside the delivery of vocational education and training at affordable and equitable tuition rates. These efforts are intended to reduce educational, economic, and social inequalities, thereby enabling learners to attain higher standards of educational quality (UNESCO, 2005). Consequently, educational management systems that promote universal access to education have emerged as a critical national priority. Primary education serves as a fundamental foundation for the development of essential skills in reading, writing, and numeracy, which are vital for lifelong learning (UNESCO, 2015) and for advancing educational equity. Moreover, primary education contributes to the development of learners' social, emotional, and problem-solving competencies, enabling them to adapt to societal demands and participate effectively in social contexts. Access to high-quality basic education has a significant influence on future economic opportunities and overall quality of life (World Bank, 2018). Therefore, promoting equitable access to education plays a crucial role in reducing social inequalities and fostering the sustainable development of learners' quality of life.

Enhancing access to education and improving learner quality necessitate the deliberate creation of effective learning spaces. Learning spaces are defined as learning-related environments that encompass both physical and virtual contexts in which teaching and learning activities occur. These environments must be intentionally designed to support knowledge construction, learner engagement, and meaningful interaction between students and teachers. Learning spaces may take diverse forms and serve multiple purposes, including traditional classrooms, out-of-class learning environments, and virtual learning platforms (Thorhauge, 2015). The development of such learning spaces is therefore essential for achieving equity in learning and promoting educational equality. Accordingly, educational institutions must establish environments that support equal learning opportunities for all learners by ensuring accessibility, providing adequate resources, designing inclusive settings, delivering appropriate support services, and fostering community engagement (Oblinger, 2006).

The creation of effective learning spaces requires innovative blended learning management, which represents a systematic approach to instructional design, strategies, and pedagogical methods that integrate time, place, and modes of teaching and learning. This approach combines face-to-face instruction, online interaction, and the strategic use of information technology to construct learning spaces that incorporate both physical and virtual dimensions, supported by interconnected digital systems (Nordquist & Laing, 2015). Such integration enhances flexibility in accommodating diverse learning activities, expands access to learning opportunities, supports personalized learning, encourages collaborative learning, promotes learner autonomy, facilitates anytime-and-anywhere learning support, and develops learning skills aligned with individual learner needs (Thorhauge, 2015). Consequently, the development of learning spaces functions as a key mechanism for advancing equity in learning and improving educational quality.

Learning management constitutes a critical condition for the development of learning spaces and the realization of educational equity. Effective learning management requires careful planning and the purposeful integration of both physical and virtual learning environments. This integrated approach enhances educational experiences, addresses diverse learner needs, and leads to improved learning outcomes (Starr-Glass, 2022). Educational institutions, therefore, need to implement learning management practices grounded in innovation,

commonly referred to as learning innovation. Learning innovation involves the adoption of new strategies, methods, and applications of technologies and practices aimed at enhancing learning processes and environments. It encompasses innovative learning activities, the development of new educational technologies, the application of novel teaching approaches, and the creation of effective learning environments. These innovations enhance teaching and learning processes and improve learner outcomes by fostering more engaging, effective, and meaningful learning experiences, ultimately strengthening educational quality and learners' knowledge and skills (Oblinger, 2006).

For these reasons, educational institutions must adopt innovative learning management models that involve changes in instructional formats, pedagogical methods, and learning processes to ensure equitable access to education for all learners, while simultaneously providing educators with effective approaches to support learner development. Accordingly, this study aims to investigate a model of innovative learning management for the creation of learning spaces for primary school students, with the intention of applying the research findings to benefit educational institutions and to contribute to the enhancement of quality education for learners across all groups.

Literature Review

Concept of Learning Spaces

A learning space refers to a flexible and intentionally designed environment that enables learners and educators to organize learning activities in accordance with users' needs and developmental stages. The design of spatial elements, furniture, and facilities should be adaptable and movable to accommodate a variety of learning activities. Learning spaces support diverse forms of engagement, including conversation, brainstorming, discussion, exhibitions, and the expression of children's and youths' abilities and talents. An effective learning space fosters a positive atmosphere that promotes creativity, enjoyment, and meaningful learning experiences (Thorhauge, 2015).

Learning spaces encompass both tangible physical spaces and virtual environments. Physical learning spaces consider essential environmental factors such as lighting, acoustics, ventilation, and air quality, while virtual learning spaces emphasize usability, accessibility, and the effective integration of information and communication technologies. Contemporary and future learning contexts are increasingly characterized by the integration and connectivity between physical and virtual spaces, enabling more flexible, interactive, and technology-supported learning experiences (Nordquist & Laing, 2015).

The organization of learning spaces through inclusive classroom environments plays a critical role in reducing discrimination and barriers to learning. Inclusive learning spaces enable learners to access appropriate support services, encourage collaborative learning activities, and promote educational equity (Harerimana, 2019). Equity derived from the design and management of learning spaces is therefore essential for ensuring equal learning opportunities, equitable access to qualified teachers, and the availability of high-quality educational resources for all learners. Ultimately, well-designed learning spaces contribute to the overall improvement of educational quality and learner outcomes (Wood et al., 2011).

Concept of Learning Innovation

Learning innovation refers to the creation, adoption, and application of new ideas, methods, and tools that enhance the effectiveness of teaching, learning processes, and learning management. Its primary objective is to transform traditional educational practices so that learning becomes more responsive to contemporary social and technological changes, more relevant to learners' needs, and more engaging in terms of learner participation (Kim & Maloney, 2020). Learning innovation emphasizes active learner engagement, individualized learning management, and the provision of meaningful learning experiences that lead to improved learning outcomes.

Learning innovation comprises three key dimensions. Product innovation refers to innovations related to curriculum development that align with contextual conditions and address individual learner needs, such as integrated curricula, individualized curricula, activity- and experience-based curricula, and locally contextualized curricula (OECD/Eurostat, 2018). Process innovation involves the introduction of innovative teaching and learning approaches, instructional media, and assessment methods designed to enhance learning effectiveness and support learner development. Management innovation focuses on the innovative use of information systems and digital technologies to support administrative management, improve efficiency, and enhance decision-making by educational administrators (Tidd & Bessant, 2021).

Through these dimensions, learning innovation promotes a shift toward learner-centered education and supports the development of essential twenty-first-century competencies, including critical thinking, creativity, collaboration, and problem-solving skills. These competencies are crucial for preparing learners to succeed in complex and rapidly changing social and professional contexts (Fullan & Langworthy, 2014).

Concept of Learning Management

Learning management refers to a systematic process involving the planning, design, organization, implementation, and assessment of learning activities to facilitate effective learning outcomes, with a strong emphasis on learner-centered approaches (Jonassen & Land, 2012). Effective learning management ensures alignment between educational objectives, instructional strategies, learning activities, and assessment practices.

Learning management comprises four key dimensions. Curriculum refers to the analysis of educational goals, the clarification of course objectives, and the formulation of clear and measurable learning outcomes. It also involves the selection and organization of content that aligns with learners' contexts and integrates twenty-first-century skills. Instruction involves the selection and application of appropriate teaching methods and learning management strategies that enable learners to achieve the intended learning objectives. This dimension emphasizes learner-centered instruction and accounts for individual differences among learners, including learning styles, abilities, and interests (Tomlinson, 2014). Measurement refers to the selection of appropriate assessment tools and methods, as well as the analysis of learning outcomes, to monitor learners' progress and development. Evaluation of learning management involves the systematic evaluation of the overall effectiveness of learning management processes, enabling educators to enhance learner quality and continuously improve educational quality (Nitko & Brookhart, 2014).

Research Methodology

This study employed a qualitative research approach to explore innovative learning management practices for creating learning spaces for primary school students. The research procedures were conducted as follows.

Key Informants

The key informants consisted of 20 participants, including school administrators, heads of learning areas, and teachers, drawn from four model primary schools in Thailand. These schools had received national-level awards for excellence in innovation and learning management, indicating their relevance to the objectives of the study. The selection of key informants was based on theoretical sampling (Corbin & Strauss, 2008), a method that involves identifying participants according to their relevance to the research conceptual framework.

Initially, informants were selected based on broadly defined characteristics aligned with the study's conceptual framework. Following data collection from the first informant, the researcher conducted preliminary data analysis and developed tentative hypotheses. These hypotheses then guided the selection of subsequent informants, particularly those expected to provide contrasting perspectives or non-supportive information (negative cases). Data obtained from these informants were continuously compared and used to refine, elaborate, and revise the emerging theoretical interpretations, thereby enhancing the depth and credibility of the findings.

Research Instruments

The primary research instrument was a semi-structured in-depth interview guide. The interview questions were developed based on the research conceptual framework, operational definitions of key constructs, and findings from the initial stage of the study to identify relevant issues for in-depth exploration. Sample interview questions included: How does the school manage learning for primary school students to foster learner development?" "What learning innovations does the school implement for primary school students?" and "How does the school organize learning management to enhance learner development through learning spaces?"

To ensure the quality and appropriateness of the interview guide, pilot testing was conducted with key informants who were not part of the study sites. This process aimed to assess the clarity and comprehensibility of the questions, the alignment of the questions with the research objectives, the logical sequencing of the interview content, and the nature of participants' responses (Charmaz, 2014). Based on the pilot results, the interview guide was revised and refined prior to formal data collection.

Data Analysis

Data analysis was conducted using thematic analysis of the interview data (Creswell, 2018). This analytical process involved systematic coding, categorization, and theme development to identify patterns and relationships within the data. The analysis aimed to generate a comprehensive model of innovative learning management for the creation of learning spaces for primary school students. The resulting model comprises key components, including

learning management conditions, processes for developing learning innovations, mechanisms for creating learning spaces, and learning outcomes.

Research Findings

A Model of Innovative Learning Management for Creating Learning Spaces for Primary School Students

Based on in-depth interviews with key informants from four model primary schools, this study identified a comprehensive model of innovative learning management for creating learning spaces for primary school students. The findings address four interrelated components: (1) learning management conditions, (2) processes for developing learning innovations, (3) the creation of learning spaces, and (4) learning outcomes. Each component is presented in detail below.

Learning Management Conditions

The model primary schools implemented diverse and integrated learning management approaches, including the following:

1. Active learning, emphasizing hands-on practice and active learner participation;
2. Learner-centered learning, which positions students as central agents in a wide range of learning activities;
3. STEM-based learning, integrating science, technology, engineering, and mathematics across disciplinary boundaries; and
4. Project-based learning, in which students learn through projects involving planning, implementation, presentation, and evaluation.

Learning management emerged as a crucial foundation for the development of learning innovations for primary school students. Effective instructional design motivates teachers and schools to develop new teaching models, instructional media, and learning activities that respond to learners' needs and promote engagement, experiential learning, analytical thinking, problem-solving, and creative production. These elements constitute key foundations for classroom innovation. Furthermore, innovative learning management approaches support the creation of learning spaces that enable learners to experiment, explore, and independently develop ideas, thereby enhancing learning efficiency and providing novel and challenging learning experiences for primary school students.

Processes for Developing Learning Innovations

The model primary schools developed learning innovations across four interrelated dimensions:

1. Curriculum innovation, through the development of new curricula incorporating project-based learning and game-based learning;
2. Instructional innovation, through the adoption and refinement of innovative teaching methods;
3. Educational technology innovation, through the integration of online learning with face-to-face instruction; and
4. Educational management innovation, through the systematic use of technology and data to manage educational resources within schools.

The development of learning innovations expanded opportunities for accessing education in diverse forms. Learning innovations played a significant role in creating learning spaces for primary school students by transforming classrooms into environments that foster thinking, hands-on engagement, and interaction among learners. As a result, classrooms became more flexible and diverse, allowing students to select learning activities, instructional media, and learning corners aligned with their interests. Moreover, the integration of educational technology extended learning spaces beyond physical classrooms to virtual environments, enabling learners to access a broader range of information and learning experiences. Consequently, learning innovations contributed to the creation of learning environments that stimulate interest, promote creativity, and enhance the skills of primary school students.

Creation of Learning Spaces

The model primary schools organized learning spaces both within and beyond school settings. On-campus learning spaces included libraries, laboratories, computer rooms, and sports fields. Off-campus learning spaces comprised community-based learning resources, such as community learning centers, natural resource sites, local museums, and religious institutions. These diverse learning spaces enabled schools to connect formal learning with real-world contexts and community resources, thereby enriching learners' educational experiences.

Effects of Creating Learning Spaces

The creation of learning spaces constitutes a critical condition for enhancing learners' learning outcomes. Well-designed learning spaces increase learning efficiency, foster the development of multiple skills, enable learners to select learning methods suited to their individual needs, and reduce barriers to accessing information and new experiences. Such spaces promote equitable learning opportunities, expand access to education, and support the comprehensive development of skills that address learner diversity. Appropriately designed learning spaces therefore have a direct impact on the cognitive, skill-based, and affective development of primary school students by improving academic achievement, enhancing self-confidence, encouraging participation, and fostering positive learner attributes.

Learning Outcomes

Learner-centered learning management, learning innovations aligned with contemporary instructional practices and learner contexts, and flexible learning spaces that support both learning management and innovation collectively enhance learner engagement and development. The success of the model primary schools resulted in learning outcomes in two main areas:

1. Diverse learning modalities, including group learning, experiential learning, online learning, and blended learning; and
2. Learner skill development, encompassing academic competence, analytical thinking skills, collaboration, and responsibility for one's own learning.

These outcomes reflect the effectiveness of innovative learning management in supporting holistic learner development. The findings can be synthesized into a comprehensive model of innovative learning management for creating learning spaces for primary school students.

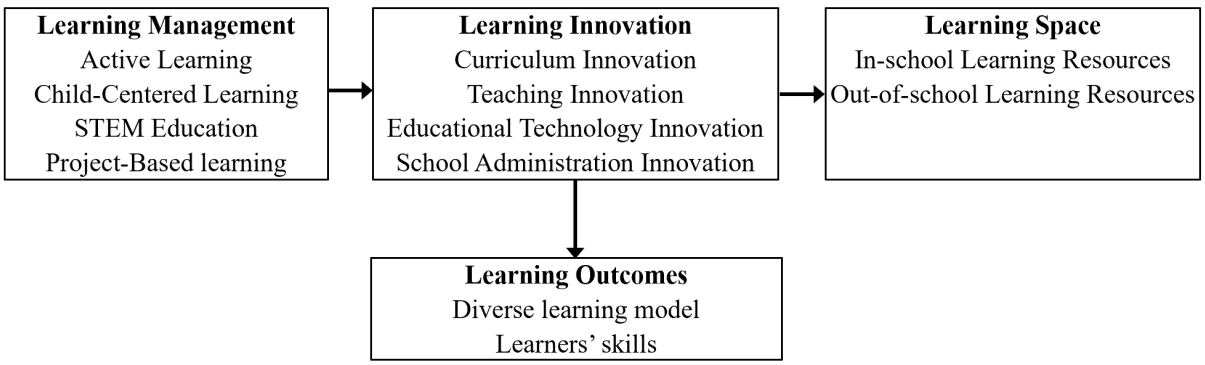
Theoretical Proposition

The theoretical proposition derived from this study suggests that learning management serves as a fundamental condition for the development of learning innovations and the creation of learning spaces, which together lead systematically to improved learning outcomes for primary school students. The model primary schools employed diverse learning management approaches, including active learning that emphasizes hands-on practice and learner participation; learner-centered learning that positions students as central agents in learning activities; STEM-based learning that integrates multiple disciplines; and project-based learning that promotes learning through planning, implementation, presentation, and evaluation processes. These approaches stimulate analytical thinking, problem-solving, and creativity, which form the foundation for classroom innovation.

Under these learning management conditions, schools developed learning innovations across multiple dimensions—curriculum, instruction, educational technology, and educational management. These innovations transformed classrooms into flexible learning spaces, enabled learners to select learning methods aligned with their interests, and expanded learning spaces from classrooms to community and digital environments. The creation of learning spaces both within schools and in community contexts functions as a supportive condition that enhances access to learning, reduces resource constraints, and promotes educational equity.

Appropriately designed learning spaces directly influence learning outcomes by supporting diverse learning modalities and the development of essential learner skills, including academic knowledge, analytical thinking, collaboration, and responsibility for self-directed learning. These outcomes demonstrate the effectiveness of the model primary schools in fostering holistic learner development, as illustrated in Figure 1.

Figure 1
A Model of Innovative Learning Management for Creating Learning Spaces for Primary School Students



Discussion

Learning management approaches—including Active Learning, learner-centered learning, STEM-based learning through interdisciplinary integration, and project-based learning—serve as key drivers of curriculum innovation. These approaches lead to the development of integrated curricula, individualized curricula, activity- and experience-based curricula, local curricula, and curricula for excellence. In addition, they foster innovations in instructional management aimed at holistic learner development, including the enhancement of basic life skills, self-directed learning skills, analytical thinking skills, systematic learning, and the

application of best practices. This is because learner-centered learning management, particularly Active Learning and project-based learning, encourages teachers to design instructional methods that accommodate diverse learning styles and respond effectively to learners' needs. Learning management that emphasizes hands-on practice, collaboration, and problem-solving supports the creation of learning innovations that promote analytical thinking and self-directed learning.

Moreover, learning management increasingly integrates the use of technology in instruction, including digital media, online learning platforms, and technological tools for creative production. The development of learning innovations through technology supports flexible and accessible learning environments, stimulates learners' interest, and enhances learner engagement by making learning more interactive and enjoyable. Furthermore, learning management that emphasizes interdisciplinary knowledge integration gives rise to learning innovations that address the need to connect knowledge across multiple subject areas. Such innovations enable learners to understand and apply knowledge in real-life contexts and to engage in learning activities linked to their everyday experiences, thereby enhancing the relevance and meaningfulness of learning. These findings are consistent with Muhammad et al. (2024), who reported that physical, virtual, and blended learning spaces enhance student interaction and learning motivation, and that well-designed learning spaces foster more engaging learning environments.

The findings further indicate that learning management approaches including Active Learning, learner-centered learning, STEM-based learning, and project-based learning contribute to the development of learning innovations across multiple domains, including curriculum, instructional methods, educational technology, and school management. These innovations support the development of learning resources that enhance access to learning opportunities and promote the development of learners' skills. Moreover, the results demonstrate that learning innovation has a statistically significant effect on learning spaces. This relationship can be explained by the central role of learning innovation in transforming and enhancing learning environments in terms of instructional practices, spatial organization, and learner outcomes. Learning innovations drive the adaptation of learning environments to better support innovative pedagogical practices and respond to learners' diverse needs. This includes the design of flexible classroom learning spaces that accommodate a wide range of learning activities, as well as the utilization of community resources to expand learning opportunities connected to real-life experiences.

In addition, learning innovations emphasize community participation and the use of local resources in learning management, thereby extending learning spaces beyond the classroom and strengthening connections between learning and students' real-life contexts. This expansion enhances the meaningfulness of learning experiences and fosters stronger relationships between learners and their communities. These findings align with Kotlyarova (2023), who found that creative learning spaces support diverse instructional approaches that stimulate creativity and learner engagement, with interaction playing a critical role in the effective development of educational environments. Consequently, learning spaces both within and beyond educational institutions—are created and enriched through innovative practices and contemporary instructional approaches, including project-based and experiential learning.

Furthermore, the findings reveal that the learning space model for primary school students emphasizes learning innovation across multiple dimensions. Curriculum innovation involves the development of new learning curricula; instructional innovation focuses on the creation of

new teaching methods; educational technology innovation entails the application of new technologies to enhance learning experiences; and school management innovation involves the adoption of innovative technologies and practices for educational administration. Collectively, these forms of innovation play a significant role in creating flexible learning environments, fostering learner engagement, and positioning students as active participants in the learning process through hands-on practice, creative production, and real-life problem-solving. In addition, they promote community involvement in the development of learning resources and ensure that learners from diverse backgrounds have equitable access to a variety of learning modalities.

Research Recommendations

The Importance of Learning Innovation for Learning Spaces

The findings of this study indicate that learning innovation plays a critical role in the development and enhancement of learning spaces. Educational institutions should therefore integrate educational technologies with the intentional design of learning spaces in ways that support creative, interactive, and participatory learning. Such integration enables learners to access information and diverse learning resources equitably, promotes active engagement in self-directed inquiry, and supports the development of essential competencies among primary school students, including collaboration, analytical thinking, and creative thinking skills. Well-designed learning spaces that are grounded in learning innovation thus function as enabling environments that foster inclusive, meaningful, and high-quality learning experiences.

The Importance of Learning Management for Learning Innovation

This study further highlights the importance of learning management as a foundational condition for the development of learning innovation. Educational institutions should encourage teachers to design flexible and open learning environments that support the effective use of technology and the creation of classroom innovations. Flexible and adaptive learning management practices stimulate learners' creativity and problem-solving abilities by allowing them to explore, experiment, and engage in diverse learning activities. Teachers play a crucial role in designing learning experiences that are engaging and motivating, while cultivating an open and supportive classroom atmosphere that encourages learners to experiment with, reflect on, and present new ideas.

Such learning environments promote active learner participation and provide the conditions necessary for the emergence of learning innovations. These innovative learning experiences contribute to the development of essential competencies required in the digital era, including self-directed learning, collaboration, and creative problem-solving. In addition, sustained professional development and institutional support are essential to enhance teachers' competencies in the use of modern media, digital tools, and innovative instructional strategies. By strengthening teachers' capacities in these areas, schools can ensure the effective implementation of learning management practices that integrate technology and innovation, thereby enhancing meaningful and high-quality learning experiences for primary school students.

Conclusion

This study examined an innovative learning management model for creating learning spaces for elementary school students, with the aim of promoting equity in learning and enhancing learner quality. The findings indicate that effective learning spaces are not merely physical or virtual environments, but rather the outcomes of systematic integration among learning management, learning innovation, and learning space design. Learning management approaches such as Active Learning, learner-centered learning, STEM-based learning, and project-based learning function as foundational conditions that stimulate the development of learning innovations aligned with learners' needs and real-life contexts.

Learning innovation plays a critical mediating role in transforming traditional classrooms into flexible, inclusive, and learner-responsive learning spaces. Innovations in curriculum, instructional practices, educational technology, and school management expand learning opportunities and extend learning spaces beyond the classroom to include virtual platforms and community-based resources. These innovations enhance accessibility, promote learner engagement, and support diverse learning modalities that accommodate individual differences among learners. The creation of learning spaces both within and beyond school settings directly contributes to improved learning outcomes by fostering academic achievement, analytical thinking, collaboration, and learners' responsibility for their own learning.

Overall, the proposed model underscores a dynamic and interdependent relationship in which learning management drives learning innovation, which in turn enables the creation of effective learning spaces that lead to meaningful and sustainable learning outcomes. This integrated approach offers practical guidance for educational institutions seeking to enhance educational equity and support holistic learner development in primary education, particularly in contexts characterized by increasing diversity and rapid technological change.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from appropriate and systematic conduct of the research.

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Sustainable English Language Centers Through EdTech and Social Enterprise: Building Human Capital in Resource-Constrained Contexts

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Abstract

Human capital theory suggests that investment in education increases the productivity of a person by building required knowledge and skills; thus, it raises the employability of that person, being enabled to earn good income in later life (Becker, 1964). Human capital, defined as the stock of knowledge and skills within people to increase productivity (Becker, 1964), is essential for national development. Recent OECD research in 2024 confirms that there is a correlation between educational advancement and employment opportunities that are directly propositional for both genders and has remained constant. In conflict-affected countries like Myanmar, proficiency in the English language is viewed as a valuable human capital asset, particularly in a globalized world to reach global and be offered job opportunities (Ali et al., 2023). Human capital theory sees education monetary returns; it encompasses intellectual, social, and emotional capitals, influencing individual satisfaction, customer loyalty, and the holistic well-being of a society. One subject aera, English Language Teaching (ELT) becomes a strategic domain, enhancing individuals' employability and strengthening nation's overall competitive advantage in a globalized economy. In national development perspective, investment in English language acquisition along with the development of sustainable ELT center is essential to both individual advancement and broader socio-economic progress.

Keywords: sustainability, English language teaching, edtech, human capital, social enterprise, equity, poverty reduction, Myanmar, policy recommendations

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Introduction

On the road to promote Education for Sustainable development (ESD), one essential criterion to develop human capital, crucial resource in nation building. This principle defines global education systems seeking to balance equity, innovation and resilience while promoting productivity and employability of individuals in the pursuit of equitable education for all. In a conflicted-affected nation such as Myanmar, teaching English Language—a global lingua franca—plays a vital role in helping its citizens, a human capital, to participate in international discourse, enhance employability and promote the knowledge. Equitable access to English education empowers individuals with human capability: i.e. having financial independence, social mobility and resilience to navigate turbulent socio-economic conditions.

Yet, in resource- constrained and conflicted-affected contexts like Myanmar, access to quality English education remains a significant challenge. Political instability, ethnic conflicts, prolong civil war and digital inequity continue to disrupt the education system while the shortage of qualified English teachers, insufficient teacher training, and lack of pedagogical resources limits the effectiveness of public education. These situations prevent many Myanmar students from attending private English Language Teaching centers, widening the gap between privileged and underserved learners.

In such fragile environments, sustainable education model that integrate social innovation and technology usage is a way to ensure equity and resilience. One promising approach is application of Educational Technology (EdTech) with social enterprise framework in the operation of language centers. Edtech offers cost-efficient solutions that improve organization quality, streamline administration and extend educational reach to marginalized learners. On the other hand, social enterprise practices enable to reinvest the profits into socially beneficial action. Together both approaches align economic viability with social responsibility, promoting a pathway toward educational sustainability.

From a theoretical perspective, this single case study draws upon Human Capital Theory (Becker,1964; OECD, 2024) which views education as a key driver of productivity and national development. Within this framework, English Language proficiency is viewed as a key form of human capital in developing nations where it increases the access to global market and profound knowledge of rapid changing world (Ali et al., 2023). Moreover, to solve the social problems such as unequitable education and unemployment, this study applies a self-funded social enterprise model that performs a dual function— advancing social missions while maintaining economic sustainability. Furthermore, the study incorporates social returns on investment (SROI) framework to quantify and measure the effectiveness of the social enterprise movement.

Overall, this case study shows that EdTech-integrated social enterprise models can create sustainable pathways for national development. It can be initiated at small scale at local ELT center like Myat Kay Khaing English Classes, a Pearson Accredited Center in Yangon, Myanmar _ a focal case of this study. By leveraging Edtech to reduce operation costs, reinvesting in building human capital such as employees, teachers and learners, and promoting social innovation aligned with as advocated by UNESCO's 2030 Agenda, the ELT center not only strengthens human capital but also empowers individuals to become capable, self-reliant, and socially responsible members of their communities.

Literature Review

Human capital is the collective value of an individual's knowledge, skills, and other abilities that enable them to be more productive (Becker, 1964; Schultz, 1961). It can be accumulated through training given in the form of either formal education or informal education, and it is represented as one of the most important development assets for both individuals and nations (OECD, 2024).

According to a survey done by Égert, de La Maisonneuve, and Turner (2022), there is a strong link between potential for productivity and education quality than education quantity, reinforcing the central role of education in human capital development. Beyond its economic outcomes, developing human capital involves training individuals to become more responsible for global citizens, promoting social justice, and enhancing global wealth. Education for sustainable Development (ESD) for 2030 aims to build a more just and sustainable world through strengthening ESD and contributing to the achievement of the 17 Sustainable Development Goals (SDGs). Its objective includes integrating ESD and the SDGs into policies, learning environments, capacity-building of educators, the empowerment and mobilization of young people, and local level action (UNESCO, 2020, p. 20). In this regard, ESD contributes readiness within workforce to reach global but also trains learners with the knowledge, skills and values necessary to act responsibly in complex social, economic and environmental contexts (UNESCO, 2020). If poverty is considered a national problem, education should be a mean to tackle.

Inclusive sustainable education ensures all learners from all communities can learn together while integrating in the act of environmental, social and economic sustainability in their daily learning practice. No matter which community a learner is from, education should prepare them with the skills and knowledge to meet different challenges. In fact, being sustainable is no longer additional credit to reward; but an imperative for a firm, or a company, in education context a school or a language center must develop. As noted by Irina Bokova, Former Director-General of UNESCO, reflects the role of sustainable education has a catalytic impact on well-being of individuals and future of our planet (UNESCO, 2017, p. 7). There to lead sustainable and inclusive growth, we need to think the way we define education role in combating challenging.

Within above mentioned educational philosophy, English Language Teaching (ELT) occupies a strategically important position. Given the roles of English language in the global economic context and technological advancement, the acquisition of English language education matters more than ever. English language proficiency enables individuals to have better employment opportunities and higher productivity in an international context. Hence, developing sustainable ELT centers in poverty-stricken and resource-constrained contexts like Myanmar is an educational investment but also a long-term national strategy to fight against poverty and to combat pressing global challenges (Becker, 1964; OECD, 2024).

Furthermore, English language teaching and learning programs are "good value for money", because they have a double dividend of boosting human capital. Yet, tuition costs remain a significant constraint for learners from many disadvantaged backgrounds. Increasing the learning autonomy at ELT center, and lowering the entry barriers will enhance more students' participation and result in favourable outcomes without having financial burden.

Rooted in early economic thought on socially benefit enterprise—where individual can promote collective well-being (Smith, 1776)—the establishment of sustainable ELT centers practicing social enterprises business framework offers a viable solution. Aligning with the contemporary recognition of social responsibility as a core component of sustainable business practice (McKinsey, 2014), ELT centers can initiate social innovation to solve social problem _ that is to strengthen human capital at minimal cost while carrying broader social responsibility, conducting social justice and sustainable national development. ELT centers with social mission can reinvest surplus resources to enhance education access and equity.

Initiating social innovation to solve social problem like enabling more learners from different background should be the primary goal of social enterprise (Investopedia team, 2024). By initiating social enterprise movement, ELT is believed that some of the pressing social problems like the unequitable education system, financial restrains and digital divide can be addressed. As a result, citizens of respective nations or social groups can experience better living conditions, financial freedom and social mobility. Ultimately, social enterprise model position education not just as teaching and learning service but as a transformative force of empowerment and poverty reduction.

With the extensive integration of EdTech, an affordable tool to develop sustainable social enterprise ELT centers, centers can reach undeserved communities while they can narrow the rich gap between urban and rural communities. Going along with Sustainable Development Goal 4, EdTech can function more than its pedagogical function by reducing dependence on physical infrastructure, travel and printed material. Every cost reduction using Edtech becomes every earning for an ELT firm to reinvest again in sustainable program and to contribute equitable education. In addition, social enterprise ELT centers will be able to invest in people to be prepared for an uncertain future while reaching more population.

When measuring the outcome of social enterprise initiatives, the indicator Social Return on Investment (SROI) can be used. Then, entities can not only understand the impact but also use this administrative and decision-making tool to make changes and improvements while allocating resources (ESG Voices, 2024). SROI analysis can be done in many different forms, encompassing overall social value generated entire organization or emphasizing on specific program or research scope. It can be conducted internally by the organization itself or by external research firm (A guide to SROI, 2012). By assigning monetary values to social outcomes, SROI establishes a ratio to measure how much social value is created for every dollar (any form of currency) of investment (Indira Gandhi National Open University, n.d.).

In the context of ELT centres, SROI analysis of ELT center quantify the social and economic value generated by the educational program beyond financial metrics. Although there is no fixed SROI ration for all ELT centers that does not exist die to different circumstances and contexts, the SROI framework remains valuable means to evaluate how such centers create impact through development initiatives, building human capitals (EBSCO, 2025). By this way, there is evidence that ELT generates measurable economic and social value reinforcing the role of them as key drivers of equity, empowerment and national development.

Methods

This study adopts a mixed-methods case study design to explore how English language teaching centers in Myanmar contribute to sustainable education and national development through social enterprise model, which is leveraged by the use of EdTech tools, a main method

in earning revenue and reducing cost of running a center. The current study is conducted at Myat Kay Khaing English Classes, a Person-accredited IGCSE English center in Myanmar that operates as a social enterprise for the period of 4 years from 2021 to 2025.

The approach combines quantitative and qualitative data to provide a comprehensive understanding of the case. Quantitative data includes students' enrolment, employee retention, cost efficiency and outcomes with qualitative response of employee's and educators' experiences. All participants—leaners, staff and educators—were selected using purposive sampling to capture diverse socio-economic backgrounds. Thus, the data present, both measurable and interpretive understandings of how social enterprise, operated with Edtech tools, can build human capital and expand human capabilities.

The aim of the study was to explore the way self-funded ELT social enterprise like Myat Kay Khaing sustain the firm in long term by using array of EdTech tools to create blend learning environment. Thus, this study is guided by following questions:

RQ1: How the use of Edtech tools optimize administrative efficiency and cost reduction and pricing strategy of cross- subsidization.

RQ2: How the collective profits are re-invested in its social enterprise initiatives and social causes like promoting teachers' education, and empowering young people.

Through the integration of EdTech and social enterprise practices, the centre adopts a market practice "Market Inclusion", a strategy to produce a product or a service that represents and caters to consumers from underrepresented, underserved and marginalized consumer segments to reach diverse consumers who will feel, seen, valued and able to participate.

Quantitative data were analysed descriptively to identify trends in enrolment, revenue growth, cost efficiency, and reinvestment patterns. Qualitative data from educators are staff were studied to highlight operational sustainability, workforce development and social enterprise practices. The integration of quantitative and qualitative findings strengthened the validity of the case study.

Findings

During the reporting period of five years from 2021 to 2025, Table 1 shows that the yearly revenue growth of Myat Kay Khaing English Classes show steady increase. Despite tuition fees for premium classes being approximately half of those charged by similar ELT centers, total income increased consistently across the study period.

Table 1
Yearly Revenue Summary of Myat Kay Khaing English Classes

Year	Total Budgeted Income (MMK)	Year- Over- Year Growth	Key Interpretation
2022	220,200,000	—	Recovery phrase from COVID era
2023	283,152,300	+28.6%	Expansion through EdTech Integration and enrolment growth.
2024	399,675,274	+41.1%	More Digital Learning Expansion via Zoom, Cloud-based driving operating system
2025	445,578,879	+11.5%	Stable Cash-Flow and Community Reinvestment

Note. Myat Kay Khaing financial report [2020 to 2025] are audited and reported by Aung Myint Oo & Associates Accounting Firm, Yangon (PA-317, covering the period 2020–2025).

Table 2 presents the distribution of expenditure on educational technology (EdTech) tools for instructional and administrative purposes. The largest proportional of expenditure (76 %) are spent on high teaching tech Investment, followed by software and subscription services (14.7%) and administrative and accounting technologies (10.3%). Smaller proportions of expenditure were directed toward communication and promotion technologies (1.2%) and security and infrastructure investments (3.9%).

Table 2
Expenditure on EdTech Tools at Myat Kay Khaing English Classes Over the Five Year From 2020 to 2025

Category	Examples	Total (MMK)	% of Total Spend
Administrative & Accounting Tech	SQL Accounting Sis, Cloud Storage	4,195,000	10.3
Teaching & Learning Tech	Smart TVs, Laptops, Tablets, Mobile Devices	31,078,850	76.0
Software & Subscription	Zoom, Gmail (Annual License),	6,000,000	14.7
Communication & Promotion Tech	Domain Name, Online Branding	500,000	1.2
Security & Infrastructure	CCTV, Wi-Fi Networks	1,609,900	3.9
Total		40,893,750 MMK	100

Note. Percentages may not total exactly 100 due to rounding. Financial data were audited and reported by Aung Myint Oo & Associates Accounting Firm, Yangon (PA-317), covering the period 2020–2025.

On the other hand, Table 3 summarises several training programs that management employee has to attend. The programmes include Orientation & Onboarding, Soft Skill Training

(Communication & Teamwork), Technical Skill Development, Accounting Skill Development (LCCI, ACCA), HR management training, Customer Service and other employee engagement workshops. In addition, these programs provide educational support through flexible schedules and study leave, financial assistance, skills development through training and workshops, career advancement pathways and health care support.

Based on the internal data and estimated outcomes from training expenditures between 2020 and 2025 Table 3 and Table 4, Myat Kay Khaing invested approximately 3.1 million MMK in different training programs.

Table 3
Training Programs Launched for Employees

Category	Details
Educational Support	Flexible Schedules and Study Leave for Academic Pursuits.
Financial Assistance	Partial Tuition Reimbursement and Scholarships
Skill Development	Access To Training Programs, Workshops and Career Growth Opportunities.
Career Advancement	Clear Pathways for Promotion and Leadership Opportunities After Degree Completion
Well-Being Support	Mentorship, Counselling, And Employee Engagement Activities.

As it mentioned in Table 4, there is clear evidence of continuous professional development (CPD) during the reporting period from 2021–2025. The profits retained from the streamline operation is used for human capital development by giving different trainings such as technical skills, linguistic skills and critical thinking to thrive in a globalized world. The employee training and professional development programs is initiative across multiple departments, including finance and accounting, operations, human resources, and teaching faculty.

Table 4
Reinvestment in Continuous Professional Development Programs

Employees' Departments	Courses	Amount Spent [MMK]	Year
Finance and Account (1 Employee)	Financial Management	256500	2021
Operation	Business Administration	285000	2021
Finance And Accounting	LCCI Lv1 And 2	104000	2022
Finance And Accounting	LCCI Lv1 And 2	104000	2023
Human Resource	Hr Management	250000	2023
Finance And Accounting	Financing	350000	
Operation	Sales And Marketing	400000	
Finance And Accounting	Financing	400000	
8 Assistant Teachers (Previous Works in Public School)	English Language Class [Cambridge Lingua Skill B1 And B2]	70000 Kyats Per Month for Each = 560000 Kyats	

Note. The above-mentioned data is extracted from Myat Kay Khaing Human Resource Record. Myat Kay Khaing financial report [2020 to 2025] are audited and reported by Aung Myint Oo & Associates Accounting Firm, Yangon (PA-317, covering the period 2020–2025

In addition, Table 5 indicates further that there is staff stability and human capital sustainability between 2021–2025. Despite the expansion of business, the center maintained a average 94.6% retention rate. Despite the fluctuations in 2023–2024 which reflect the pains resulted from the unstable labour market after the compulsory military law had been issued, the center retention rate is significantly high. Overall, the data indicate a relatively stable workforce over the five-year period.

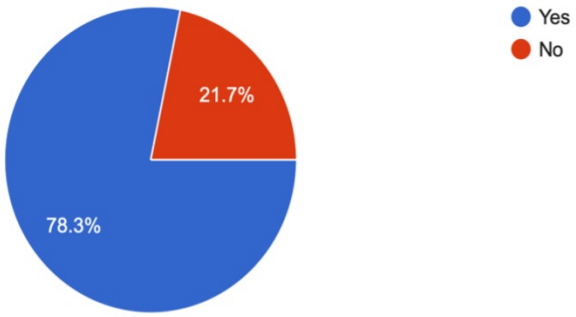
Table 5
Employee Retention

Year	Description	Number of Employee	Retention
2022	Employee at the start	4	1
	Employee who left	0	
	Employees who remained	4	
	Employees at the end of the year (including new hires)	2	
2023	Employee at the start	6	0.9
	Employee who left	0	
	Employees who remained	6	
	Employees at the end of the year (including new hires)	4	
2024	Employee at the start	12	.83
	Employee who left	2	
	Employees who remained	10	
	Employees at the end of the year (including new hires)	2	
2025	Employee at the start	12	1
	Employee who left	0	
	Employees who remained	12	
	Employees at the end of the year (including new hires)	0	

While quantitative data demonstrate sustained financial growth, strategic reinvestment and high employee retention, qualitative findings provide further insight into how these outcomes were experienced by staff member in practice. Extracted data from survey forms and narrative interview reveals that most employees and assistant teachers benefit from firm's sustainable program and are actively involved in their personal, professional development while committed to organizational well-rounded growth.

According to internal qualitative survey (2025), it is revealed that 78.3% of staff get opportunities to join different classes, offered as free and optional programs (See Figure 1). These programs were provided as optional and accessible to staff across different roles.

Figure 1
Percentage of Employees Got Training or Professional Development From the How Center

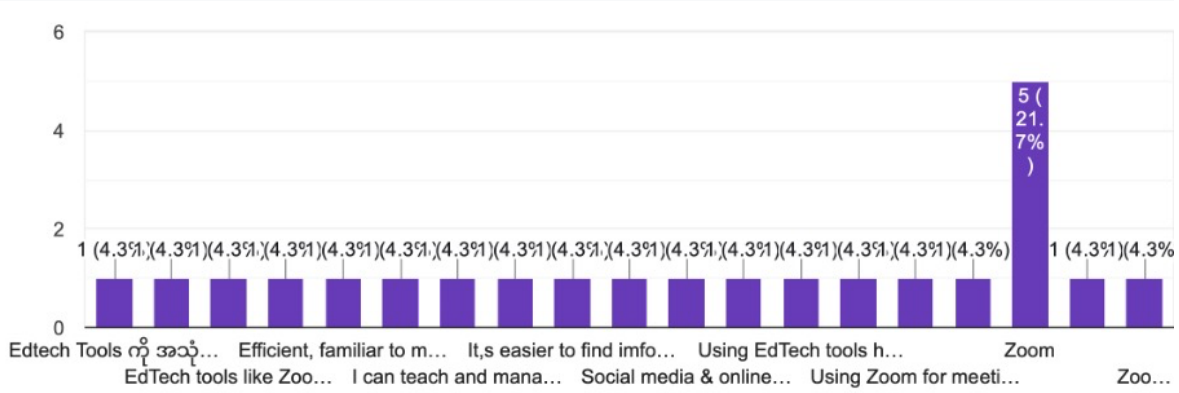


On the qualitative survey responses indicate that EdTech integration contributed to increase digital confidence among teaching staff, particular those used to work at public schools. One teacher reflected:

> When I first join the center, I was already confident in my academic subject's area and teaching. However, I faced challenges related to E-skills which made me feel a bit uncomfortable. So I continued Learning and practicing to become more confident.

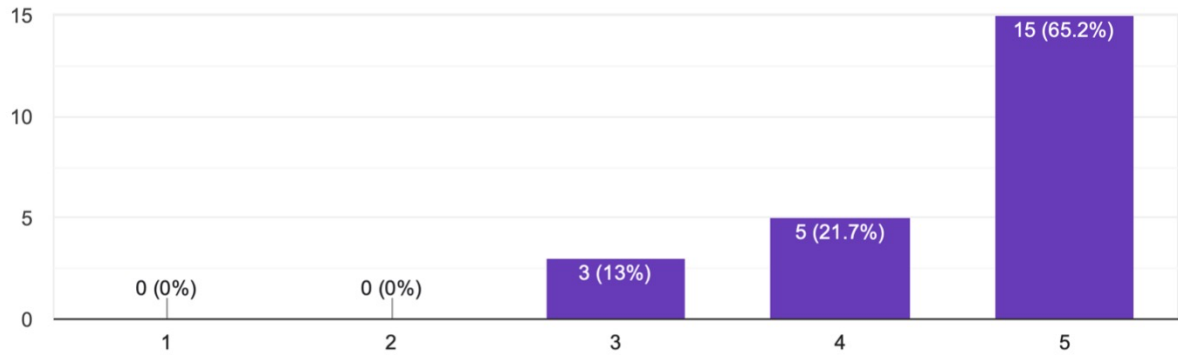
Similarly, former public-school teachers who had been away from technology reported that she came to know how to operate and conduct EdTech tools, consistent with internal survey results. (Figure 2)

Figure 2
Employees Responses on EdTech Tools Application Survey Questions



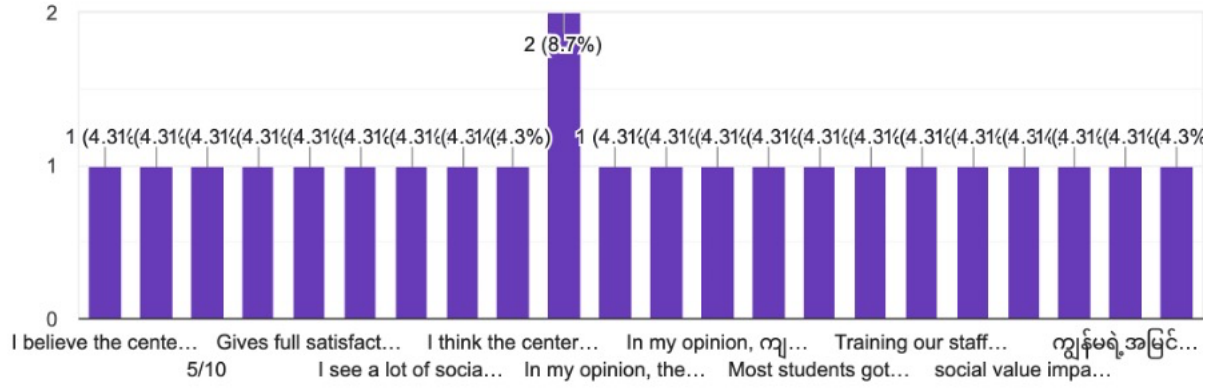
According to the internal qualitative survey (2025), most employees who had been benefited by sustainable practices call high for social value created in the center as shown in figure 1 and it is remarked for good conducts of social investment done by the center (Figure 3). It is also reflected that employees' belief in the center conduct of building human capital which is visible and aligned with enterprise mission and social value creation.

Figure 3
Employees Responses on Social Value Creation



Note: Employee satisfaction level, scaled from 5 = highest to 1= lowest.

Figure 4
Social Value Created for Every Investment on Training



The data of quantitative report and outcomes from qualitative survey require an integrated to assess their broader social and economic significance. In mixed-method research applied in this current case study, combining financial performance indicators with lived experiences enables a more comprehensive understanding of social enterprise impact.

To move beyond the descriptive outcomes and to capture social value generated for stakeholders, this study applies Social Return on Investment (SROI) analysis. SROI provides as structured approach to yield both measurable financial outcomes and non-financial social benefits into comparable value framework, allowing the overall social impact of the ELT center's social enterprise practices to be evaluated.

Despite SROI being just a tool for reflection and learning rather than an absolute precision, conservative financial proxies were applied to quantify environmental and social outcomes in monetary terms (A guide to SROI, UK, 2012). Based on the financial data audited and reported by Aung Myint Oo & Associates Accounting Firm, Yangon (PA-317), it is estimated that social return ration is approximately 1.78:1 – for investing every 1 kyat, there is 1.78 kyats of social value being generated in form of improved education quality, enhanced productivity and employability of human capital, expanded education access (see Table 6).

Table 6
SROI Analysis Proxies and Estimation of Myat Kay Khaing English Classes, 2020–2025

Outcome Area	Social Value Created	Proxy / Monetary Estimate (MMK)	Rationale / Source	Stakeholders Affected
Teacher Development and Training	Improved professional qualifications	2,000,000 MMK per teacher per year	Estimated equivalent of tuition & certification value	Teachers
Employment Creation	Hiring local youth and former public-school teachers to extend business	8,400,000 MMK average annual salary	Average salary from center's HR data (2024)	Organization workforce
Tuition Fee Subsidy	Reduced or free classes for public school students	420,000 MMK per student per year	Average market tuition minus subsidy value (internal finance data)	Public school students
Employee Training and Development	Free community English and career sessions	1,500,000 MKK Per year	Estimated equivalent of tuition & certification value	Local community
EdTech Efficiency	Reduced paper, energy, and operation costs	40,000,000 MMK per year	Internal cost-saving report; reduced printing and physical record keeping	Institution
Staff/ Teacher Retention	Lower turnover cost (training, recruitment)	500,000 MKK per newly employed staff and its required training	Calculated from historical HR turnover data (pre- and post-EdTech integration)	Institution
Brand Social Value	Enhanced trust, visibility, and reputation	5% of annual revenue = 20,000,000 MMK	Conservative proxy for intangible brand equity increase	Institution / Society

Discussion

This study reveals that between 2022 and 2025, Myat Kay Khaing English Class transformed from a post-pandemic ELT center into a self-sufficient social enterprise with over 100% growth in revenue. This transformation highlights the potential of EdTech-Leverage operational models to support both sustainability, resilience and mission-driven objective within resource-constrained educational context.

This financial progression reflects an effective EdTech-Led Cost model where digitalization, automation, and online learning system significantly reduce operational expense. This finding highlights the growing possibilities of EdTech Integration serves as both pedagogical and economic advantage in developing nations, particularly where physical infrastructure and capital are limited.

Importantly, financial sustainability enabled the center to advance its social mission. Profits gained allows the firm to serve its social mission: outreaching students from diverse socio-economic backgrounds, enhancing the English language level of public-school teacher, and empowering young workforce to build their capability to attain financial and social freedom. These responsible movements of the firm enhance the brand identity as a socially engaged enterprise, creating social value.

EdTech tools expenditure reflects a strategic balance between initial hardware setup and ongoing digital transformation. In the case of an ELT firm operating at the 1000 square foot apartment yet giving service to a thousand students across different proficiency levels highlights how EdTech tools enable the small ELT firm to be self-sufficient and self-financed sustainable center.

EdTech tools applications also mean that it is not just technical solution but as a social innovation—empowering human resource—constrained ELT firms to deliver equitable, high-quality education for sustainable development. By the reducing the operation cost using Edtech, Myat Kay Khaing English Classes can empower the youth: those who hasn't got a chance to attend further study or learn at university; those who were unable to find the job that would balance their work and study. Hiring them for different roles in operation, registration and accounting department, Myat Kay Khaing give them a chance to increase their productivity and employability.

Employment record further proved that most youth employees between 20–25 years old had been serving in the industry for more than 3 years old and show low rate of employee retention. It is clear that the center commits to make social enterprise movements for social innovation, solving social problem such as unemployment and education gap. This exemplifies how a small-scale language center can sustain itself economically and serve the social mission of equitable English education access.

Additionally, the study of SROI combined with qualitative research contextualizes these outcomes. The estimated SROI ratio highlights that human capability is strengthened when meaningful social value is continuously generated. Rather than serving as a precise measurement, SROI in this study illustrates social enterprise model of the center as a sustainable and equitable approach to national development for resource-constrain country like Myanmar. This also proves that the center aligns with global definition of social enterprise _ "a business that uses profits to achieve social mission" and enables to initiates its social

innovation, empowering youth in the community (Social Enterprise UK [2012] and OECD [2024]).

If the study is examined in a broader global context, the outcomes of Myat Kay Khaing English Classes reflect those of internation movements that link education, sustainability and social entrepreneurship. If community-based ELT projects in Bangladesh (Ali et al., 2023) is taken as a reflective example to consider, it is demonstrated that social innovation act through English language teaching can improve financial resilience, education equity and inclusion, aligned with UNESCO's education for sustainable Development (ESD 2030) framework.

In this regard, Myat Kay Khaing English Classes contributes as an emerging model that exhibits resource-constrained, context-sensitive, technology-assisted and socially driven, yet remains both sustainable and scalable. It demonstrates adaptability and transferability in other developing region facing similar constraints, offering valuable insights of EdTech Integration and social enterprise practices in the pursuit of sustainable English language education.

Conclusion

While this study recognizes limitation related to data precision, geographical difference, political instability of the country and contextual generalization, the study nonetheless is transferrable and adaptable model of sustainable English language center development in resource-constrained settings. By applying quantitative and qualitative thematic interpretation, the research offers a balanced and credible understanding of how modest and humble ELT center in education sector can yield measurable social value in resource-constrained contexts like Myanmar.

Ultimately, the findings of the study reveal that sustainability in education in not solely dependent on large scale investment, or government funding. instead, it can emerge through EdTech Innovation, Social Enterprise principles and a strong commitment to human capital development. This model thus offers practical insights for policymakers, educators and entrepreneurs seeking to build more sustainable education platform where equity and social justice are prioritized. By expanding undivided opportunities for learning, such initiatives will enable people to gain more social and financial freedom, a prioritized component of national development pathway in resource-constrained context.

Limitation of the Study

This study focuses on one ELT center, Myat Kay Khaing English Classes, in Myanmar. Thus, findings may not be fully generalizable to other ELT centers not only in Myanmar but also in other counties owing to experience different circumstances and available resources, management structures and other socio-economic contexts.

Since the case study is researched and conducted by the founder of studied ELT center, the case study might have researcher bias in interpreting data or presenting results. Although every effort was made to maintain transparency and objectivity, the absence of third-party validation and audited data is concerned limitation.

Moreover, social and economic conditions in Myanmar such as political instability, inflation and internet disruptions can significantly impact the outcome. It is difficult to correlated the success of Myat Kay Khaing English Classes with other ELT centers within nation especial of

those from civil-war affected landscape, and those from suburban or less developed aeras of the country. This might have been the case to different ELT centers established in countries of similar resource-constrained situations.

Finally, the relatively shorter observation period from 2020 to 2025 restricts the study's ability to capture long-term outcomes and monetize intangible social impacts such as learners empowerment, and productivity increments into quantitative values.

Recommendation

This study proposes the model of Myat Kay Khaing English Classes which can be studied as a contextual and transferrable case study, operated in resource-constrained regions. A thorough Longitudinal study written with independent or third-party reviewers to validate the long-term human capital effects particularly in relation to teacher development and human capital progress is recommended. Furthermore, to strengthen the reliability and credibility SROI findings, broader stakeholders'—such as of learners, teachers, community member—perspectives and audited quantitative data are required. Then, such methodological expansion would highlight the generalizability and relevancy of study in wide discussion on sustainable education and social innovation.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

It is declared that AI-assisted tools like ChatGPT is used exclusively for language editing, grammar correction and readability in the preparation of this manuscript. AI tools are not used for conceptualization, analysis, argument development and theoretical discussions. All core ideas, data interpretation and theoretical discussions are all part of author's original scholarly work and research.

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Exploring English Education in Taiwan: Perspectives of Foreign English Teachers

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Abstract

In 2018, Taiwan launched its Bilingual 2030 policy with the goal of strengthening national English proficiency and enhancing global competitiveness. To support this initiative, foreign English teachers were recruited across public and private K–12 educational contexts. While these teachers play a central role in the daily implementation of bilingual education, their perspectives remain underrepresented in empirical research. This study draws on qualitative data from semi-structured interviews with eight foreign English teachers who have been working in Taiwan since the policy's introduction. Using a basic qualitative design informed by a phenomenological lens, the study explores how teachers perceive English education practices, institutional structures, and policy implementation, and how their lived experiences align with or diverge from the stated goals of Bilingual 2030. Thematic analysis revealed three recurring areas of tension: systemic gaps in policy and curriculum implementation, superficial hiring practices, and limited institutional support for culturally relevant teaching. Findings suggest that while bilingual reform has expanded English-rich environments, insufficient curricular guidance, inconsistent teacher preparation standards, and limited cross-cultural collaboration hinder meaningful implementation. The paper concludes by discussing implications for language policy design, teacher recruitment, and professional support structures in multilingual education contexts.

Keywords: bilingual education, English language education, Bilingual 2040 Policy, Taiwan language policy, culturally sustaining pedagogy

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Introduction

Throughout Asia, English language fluency continues to play an important role in enhancing a nation's global competitiveness. For Taiwan, the Bilingual 2030 policy is an example of this trend. Beginning in 2018, the policy outlines a vision of bilingualism in Mandarin and English in order to increase Taiwan's economic and cultural connectivity worldwide (National Development Council, 2018). As with many large-scale language policies, the nation's education sector was impacted by the expansion of recruitment for foreign English teachers across K-12 settings (Ministry of Education R.O.C. [Taiwan], 2024). Even with these teachers playing critical roles in helping the Bilingual 2030 policy come to fruition through Taiwanese learners improving their English skills, their voices are rarely highlighted in recent policy evaluations or academic research.

This paper addresses that missing perspective by examining how foreign English teachers in Taiwan perceive English education practices and institutional structures during their time teaching under the Bilingual 2030 initiative. These teachers lived experiences give insight into how this language policy looks in classrooms, specifically highlighting where any gaps emerge between the policy goals and the classroom realities.

Bilingual 2030 Policy vs. Classroom Realities

Taiwan's ambitious Bilingual 2030 policy strives to expand the island's English proficiency. However, the guidance for curriculum goals, instructional practices, and intercultural teacher collaboration across schools has been limited. This misalignment between a policy's overall vision and the realities of classroom implementation reflects what Spolsky (2004) describes as the policy-practice gap. In other words, formal top-down language policies do not necessarily guarantee effective implementation at the classroom level.

Research related to language policy points to the fact that teachers are not simply passive recipients of education reform. They are actively interpreting it, with their professional judgment shaping how policy looks in practice. Kumaravadivelu's (2023) Postmethod pedagogy emphasizes the importance of teachers having agency in their classrooms, especially when institutional guidance is not clear. In bilingual education contexts, the role of teachers as interpreters becomes increasingly challenging as cultural expectations, institutional norms, and uneven access to support come into play.

By placing teachers' perspectives at the front and center, this study provides an opportunity to examine how Taiwan's bilingual policy is understood and implemented by those in classrooms. By acknowledging the classroom as an important site of language policy implementations, this research helps support and contribute to larger conversations surrounding language reform, teacher agency, and instructional realities in Asian and international bilingual education contexts.

Methodology

This study followed a basic qualitative research design aligned with Merriam and Tisdell's (2016) approach, which emphasizes inductive, comparative meaning-making through rich data gathered in in-depth interviews. Interviews were used as the method for data collection, specifically utilizing a semi-structured interview design. This approach allowed participants to

share, in detail, their experiences teaching in English classrooms, which is a viewpoint most non-educators rarely have the chance to hear.

A phenomenological lens was also adopted to emphasize participants' lived experiences and their subjective interpretations of teaching English in Taiwan. Phenomenology aims to understand how individuals experience and interpret a particular phenomenon, focusing on what participants experienced and how they experienced it (Creswell & Poth, 2018). This made adopting a phenomenology lens a strong fit for understanding how foreign teachers interpret and make sense of their day-to-day experiences teaching in Taiwan.

Participants and Data Collection

A purposeful sampling strategy was used to select individuals who could offer both relevant and varied perspectives on English education in Taiwan. Following Merriam and Tisdell's (2016) guidance, a total of eight participants were chosen based on their post-2018 teaching experience in Taiwan and their roles across a range of instructional contexts, including bilingual programs, buxibans, international schools, and private ESL schools. Specific attention was given to ensuring variation across participants' racial and ethnic identities, nationalities, gender, professional training, and years of teaching experience. This diversity was also reflected in the types of schools and grade levels they had taught, which ranged from kindergarten through secondary education. This purposeful sampling approach was intentionally used because it allowed for a wide range of perspectives to be captured. It strengthened the study's ability to gather a more nuanced understanding of foreign teachers' experiences in Taiwan.

Data was collected through eight virtual semi-structured interviews, one with each participant. The questions in these interviews focused on exploring participants' instructional experiences, their perceptions of curriculum and policy expectations, their views on hiring and professional standards, and their experiences navigating cultural and institutional structures. Each interview lasted around one hour and was recorded, transcribed, and member checked before analysis began.

Data Analysis

Data analysis followed a thematic approach. The multi-phase process began with the writing of analytical memos during and immediately after each interview in order to capture observations, emotions, and any early analytic insights. These short, hand-typed reflections were used as preliminary meaning-making tools that helped in the development of initial codes. Then, open, manual coding was used to identify meaningful phrases and emerging patterns seen across interviews using the participants' own language. These hand-curated codes, along with the transcripts, were then uploaded into the qualitative data analysis software Dedoose, which supported in-depth, systematic coding and comparison across all transcripts. Specifically, it analyzed the transcripts and pulled all relevant excerpts from them, which were then taken and manually organized into broader categories in Microsoft Excel. After these categories were combined to develop thematic groups. This iterative process helped thoroughly identify recurring concepts and shared meanings across participant experiences. This facilitated the interpretation of broader institutional and policy-level implications, rather than focusing on isolated incidents.

Findings

The thematic analysis revealed three themes that heavily impacted foreign English teachers' experiences during their time teaching under Taiwan's Bilingual 2030 policy.

Systemic Gaps in Policy and Curriculum Implementation

The first finding shared across all participants' experiences was a consistent lack of curricular guidance. Even though bilingual English-Mandarin Chinese education was promoted as a priority island-wide, teachers all reported being expected to design or modify curriculum on their own, commonly without any alignment across grade levels or coordination with Taiwanese local or national assessment systems. Various English schools and programs often emphasized the presence of foreign-taught English instruction rather than focusing on the quality or progress of the instruction, which resulted in a very wide variety of classroom practice within and between schools. Teachers in the study noted that this lack of curricular guidance made it very difficult to scaffold learning in effective ways for their students each year. This made it so the responsibility for bridging gaps in the curriculum fell on individual teachers within their own classrooms rather than being addressed at an institutional level.

Superficial Hiring Practices

The second theme presented was teachers' perceptions of hiring practices that prioritized native-speaker or "Western" identity over pedagogical training and expertise. Participant shared that oftentimes, formal education training, teaching certifications, and classroom experiences were undervalued or dismissed, specifically within private schools and programs. Many teachers made connections to these patterns representing broader global trends in English language commodification, where the concept of "perceived authenticity" outweighed the actual instructional competence and effectiveness of the teacher (Holiday, 2006).

Some participants shared stories about their time working alongside other foreign teachers who had minimal training or experience in classrooms, which highlighted issues like instructional quality, professional fairness, and equity. These types of experiences align closely with Kubota's (2009) critique of racialized and market-driven hiring practices within the context of global English language teaching.

Limited Support for Culturally Relevant Teaching

Many of the research participants also expressed challenges regarding implementing culturally relevant and sustaining pedagogy. They reflected on primarily teaching using curriculum imported from Western countries such as the United States, the United Kingdom, and Canada, which did not align with many Taiwanese students' linguistic backgrounds, culture, or exam-heavy education system. While it was common for teachers to attempt to adapt teaching materials to better fit their students' needs, the limited collaboration and time with Taiwanese educators and minimal school and institutional support impacted these efforts. Participants shared that they believe that meaningful bilingual education needs to encourage cross-cultural professional development and shared instructional planning, instead of the current isolated attempts at classroom-level modifications and adaptations.

Discussion

After reviewing all of the findings, it is clear that there is a consistent misalignment between Taiwan's national Bilingual 2030 policy goals and the realities of what foreign teachers in classrooms are experiencing. The national policy has promoted the expansion of English language environments island-wide, but the expansion is not enough when placed against inconsistent curriculum frameworks, inequitable hiring practices, and limited professional collaboration to support culturally sustaining teaching practices.

These findings support Spolsky's (2004) work surrounding language policy and how its success depends on alignment between policy goals and institutional practice. Without any clear and consistent curriculum accountability, equitable hiring practices, and established collaboration opportunities that support cross-cultural professional development, the current bilingual 2030 policy will remain more of a symbol rather than an island-wide transformation.

Conclusion

The voices of foreign teachers in this study uncover a clear gap between Taiwan's bilingual policy goals and the daily realities in English classrooms. Bilingual 2030 has clear goals, but its success is being hindered by challenges, especially around misaligned curriculum, superficial hiring practices, and limited support for culturally relevant teaching. These kinds of issues don't just make teaching more difficult, but they also prevent schools from using proven language teaching methods that are adapted to students' needs and cultural backgrounds.

Bilingual 2030 must become more than just a slogan—it must be backed by actionable, systemic change. For the policy to succeed, Taiwan must prioritize the development of meaningful, culturally responsive curricula; uphold the professional dignity of all teachers; and build intentional structures for cross-cultural instructional collaboration. This study offers concrete starting points for that work and reinforces the idea that foreign and Taiwanese language educators are not just implementers of policy, but essential partners in shaping a more inclusive, equitable, and effective future for English education in Taiwan.

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From Anxiety to Engagement: Inclusive Strategies for Low-Proficiency EFL Learners in Japan

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Abstract

Previous research on English language learning in Japan indicates that many students feel nervous about the communicative aspects of class, partly due to limited opportunities to use English in natural settings (Gullikson, 2024, pp. 15–16). This paper examines an English program at a Japanese professional university (専門職大学) in which students engaged in weekly conversations with native English speakers from the United States over a one-month period. The study investigates how this program influenced students' intrinsic motivation to learn English while managing cognitive load during authentic communication. Although conversational classes in the institution are typically reserved for intermediate to advanced learners, findings show that with targeted scaffolding by instructors, even low-proficiency students were able to participate meaningfully. The results suggest that structured interaction with native speakers, combined with pedagogical scaffolding, can reduce learner anxiety, support cognitive processing, and enhance motivation in low-proficiency EFL contexts. These findings have implications for designing inclusive communicative programs in vocational education settings.

Keywords: EFL, Japan, conversation classes, native speaker, low-proficiency, motivation, cognitive load, instructional design

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Introduction

This study builds on previous research on cognitive load and motivation in an English as a Foreign Language (EFL) classroom, taking a special interest in the way classroom considerations differ in a professional university (専門職大学) setting in Japan. Abdul Hadi (2025) had previously looked into managing cognitive load in a Content Language Integrated Classroom through the implementation of the Sustainable Development Goals (SDG) as a course subject in a Japanese vocational college (専門学校) among intermediate and advanced proficiency EFL students. Earlier, Abdul Hadi and Ekstrom (2024) had looked into the critical thinking aspect of SDG courses on advanced proficiency students in the same vocational college. However, despite belonging to the same parent company, the students that attended these institutions differed in terms of language capabilities as well as motivations. This study takes previous theoretical understandings on cognitive load and motivation, links them with established classroom pedagogies, and applies them to a language exchange program conducted as part of an English-language course at a professional university in Kanagawa, Japan. This paper hopes to suggest a method of managing low-proficiency students' motivations when learning and utilizing English in their everyday lives.

Japan, English Language Education, and the Professional University

Despite Japan's growth in number of foreign residents, Japan's indigenous population remains the majority at over 97% (Inoue, 2025). With such a statistic, it is perhaps no surprise that EFL classes find Japanese students generally unmotivated to learn the target language (Gullikson, 2024, p. 14). Indeed, because of a lack of real-world opportunities to engage with and practice the language, many Japanese students face "language anxiety" in the EFL classroom. Language anxiety is characterized as "the fear or nervousness associated with 'making mistakes' or receiving negative feedback from a teacher, peer, or a native speaker of the target language" and can lead to negative effects in learning and producing the language (Gullikson, 2024, p. 16). This, coupled with the fact that Japanese students have gone through many years of learning EFL through sheer memorization to answer exams (Gullikson, 2024; Vicente et al., 2024), creates a generally unmotivated EFL learner once the student graduates to higher learning institutions.

An important point to note regarding EFL research in Japan is that they have tended to be based on university or high school students where the demographics steer towards a monocultural classroom made up of Japanese students between 18 to 24 years of age. There are significantly less studies conducted in another higher educational institution: the vocational college, or the 専門学校 (*senmon gakko*). In addition to the difference in purpose of studying, where these institutions find students who seek specific training that would prepare them for a particular industry, each vocational college boasts students from varying types of backgrounds. This is especially true in the case of one vocational college in Kanagawa, where students differed in terms of age, nationalities, as well as work experience (Abdul Hadi, 2025, Abdul Hadi & Ekstrom, 2024). In Abdul Hadi's (2025) study, it was noted that in the Kanagawa vocational college, older students' motivation for learning English was mostly extrinsic, owing perhaps to their previous work experience where they saw how English could be used in the workplace (Abdul Hadi, 2025, p. 93). For the younger students under 25 years of age, they joined a class on SDGs because of their own interest in the subject – perhaps due to the topical relevance of the course (Abdul Hadi, 2025, p. 93). These studies show that the motivations that go into EFL learning in Japan may find more nuance when more research is given to other higher learning institutions besides universities.

A new category had been introduced in Japan in 2023: the professional university, or the 専門職大学 (*senmon-shoku daigaku*). Unlike a regular university or a vocational college, a professional university has both theory as well as practice in a professional field of choice. Students in a professional university have on-site training outside the university campus for over 600 hours through a 4-year program (approximately 15 weeks of training). The classes in a professional university are also kept small, with a maximum of 40 students per class. Once a professional university degree has been obtained, the student can use it to either obtain a job, a graduate degree, or even study abroad. As of September 2025, there are only 16 private professional universities, and 3 public professional universities (MEXT, 2025). EFL research in terms of the effects of cognitive load on student motivations is understandably lacking and thus would be beneficial towards providing a more holistic view of English Language Teaching (ELT) in Japan.

Understanding Motivation, Cognitive Load, and the EFL Classroom

Motivation is a popular topic amongst EFL instructors. It is undeniably an important aspect of ELT because no matter how much a teacher prepares for a class, the efforts could be undone by the motivations or lack of motivation from the students. But what do we actually mean when we talk about student motivations? For the purposes of this study, this paper will look at motivation from two perspectives: firstly, from the students' perspectives of their own capabilities and interests, and secondly, the students' perspective of the tasks set out for them in the EFL classroom.

In terms of students' perspectives of their own capabilities and interests, Zoltan Dörnyei has outlined two theories in motivation studies: self-efficacy theory and self-worth theory (1998, p. 119). In the former, this theory revolves around a person's perception of their own capabilities and how that drives their actions. When thinking about this theory from the EFL perspective, a student's perception of their English language skills might affect how they behave in class. For example, if they feel that their conversational skills are lacking, they might be less motivated to take part in communicative exercises. This perception of competence in a subject can also be termed "academic self-efficacy" (Hirosawa et al., 2024). Self-worth theory, on the other hand, is related to a feeling of needing to "maintain one's self-esteem" (Dörnyei, 1998, p. 119); from the perspective of the EFL classroom, students may or may not take part in an activity motivated by a need to ensure that they don't lose face because of a perceived lack of skill.

In the previous section, a discussion had been made on the unique position of English language education in Japan. In this sense, we could talk about the "value" of the EFL class to Japanese students. This paper will use the four components of motivation value as outlined by Eccles and Wigfield (1995): attainment value, intrinsic value, extrinsic utility value, and cost. The first three aspects mentioned are considered across a "positive" scale where attainment value refers to how a task might align with one's "personal values and needs"; intrinsic value brings "enjoyment or pleasure"; and extrinsic utility value brings about "usefulness" in the future. The "cost" is the "negative" aspect of this value system where a student might deliberate the effort, time, and emotional costs of engaging in a task. When looking at how a student might value EFL classroom activities, they might then look across all four of these dimensions which would then increase or decrease motivation to take part in the lesson (Dörnyei, 1998, p. 120).

The motivational "costs" could also be related to the concept of the cognitive load needed to carry out an activity. In this theory, it is assumed that a person has "limited working memory"

at a given time where the mind is able to "deal with information for no more than a few seconds with almost all information lost after about 20 seconds unless it is refreshed by rehearsal" (van Merrienboer & Sweller, 2005, p. 148). From a pedagogical perspective, this means that a student's capability in approaching a task is related to how difficult the task is and the amount of "mental space" the student has to deal with it. Therefore, the higher the cognitive load, the more difficult the task appears to be for the student, and thus the higher the motivational "costs".

When thinking of designing a class or a lesson, it is integral that a teacher takes into account three different types of cognitive load: intrinsic (ICL), extraneous (ECL), and germane (Sweller, 2010; Seller et al., 1998). ICL refers to how difficult the task actually is; for example, "Mary Had a Little Lamb" would have a lower ICL than that of Queen's "Bohemian Rhapsody" to an EFL learner. ECL is the manner in which the task is presented; for example, when presenting the aforementioned songs to the students, presenting them purely as a listening exercise without lyrics might invoke a higher level of ECL than if the students had a piece of text to follow during the listening activity. Finally, the germane deals with the cognitive "demands of learning itself"; how difficult do students find learning English in Japan? It is therefore unsurprising that:

> Good pedagogical practice, then, will carefully assess the cognitive burden placed by the material to be learned (intrinsic load) as well as the instructional formats (extraneous and germane loads) in order to avoid cognitive overload. (Groff, 2020, p. 76)

Communicative English Classes in Japan

One way that EFL instructors have attempted to increase motivation in learning and utilizing the target language is through creating more communicative activities or classes. In an early study on learning English in an ESL classroom, Long (1983) cited educational philosopher Krashen's natural approach to language learning as a better teaching method for non-native speakers as it afforded more meaningful communication to the students (Long, 1983, p. 96). Decades later, EFL teachers continuously seek to provide such meaningful communication in their classes, especially in Japan.

One activity that is frequently used in EFL courses in Japan can be labelled as "conversation classes", usually named "English cafe" in higher learning institutions. As evidenced by the name, the goal of such a class is to provide students with a low-stress environment that focuses on practicing their verbal skills. In one study that looked into an English Cafe as an extracurricular program, the authors found that it was generally seen favorably by the students to "improve their linguistic skills, especially their aural and oral proficiency" (Johnson and Hiratsuka, 2018, p. 40). In this study, the students' proficiency levels varied, with participation encouraged from all levels, including that of beginner's proficiency. However, the authors noted that for students with lower proficiency, they "should be provided with the necessary scaffolding to feel comfortable in partaking in the activities".

Another English Cafe study took place in a nursing school at Otemae University. This activity was a non-credit elective held once a week (Nishimura et al., 2021, p. 25). These students had strong external motivation as there is a very real growing need to attend to English-speaking patients in their future jobs. One similarity between the sample group in Nishimura et al.'s (2021) study and this research is that the students are of low-proficiency in English. This paper provides an interesting look at what can be achieved using conversation-based activities for these groups of students. One activity that seemed to work was memorization of a script that

led to building student confidence; through this confidence, students would attempt to speak without looking at a script (Nishimura et al., 2021, p. 50). Another important consideration was the encouragement of any type of communication to foster good relationships; in this study, this includes friendly expressions, body language, and even one-word answers (Nishimura et al., 2021, p. 50). This shows that students also can enhance their English communicative capabilities beyond making grammatically-correct constructions.

In Shinshu University, the students led an English Cafe activity that were TED Talk-styled events where the focus was on "thinking, expressing, and communicating" ideas rather than on practicing English per se (Fujita & Ong, 2018, p. 33). A noteworthy aspect of this activity is that the students who have had experience navigating an English-speaking world (those who have studied abroad or who were international students) were more motivated to join discussion-based activities and to be more globally minded (Fujita & Ong, 2018, pp. 41–42). It is an interesting point that might provide a layer of nuance to studies on communicative activities in a Japanese EFL classroom - to what extent do students' own interactions with the outside world fuel their motivation to learn English?

Beyond these English Cafes, Gomez (2021) discussed project-based learning (PBL) as a method to encourage high-proficiency students to communicate more naturally in English. In his study, while the students all held TOEIC scores between 710 and 965, Gomez found that because the students were all Japanese, they would opt to use Japanese to "efficiently" complete their tasks even though they were all highly motivated and desired to use English more in the classroom (Gomez, 2021, p. 40). This appears to show that it is not only low-proficiency students who struggle to maintain a conversation in English, but also high-proficiency students too. Therefore, when planning an activity, an instructor needs to consider the extent to which a student may use Japanese (or a different native language) when attempting to complete a task.

Finally, a particularly useful communicative opportunity for EFL learning is through exchange programs with native English speakers. Obviously, this is not a privilege that all higher learning institutions can afford to provide. Tsuneyoshi (2005) has discussed the difficulty of creating such a program in Japan and, surprisingly, even in the prestigious University of Tokyo itself. The author cites the gap between local students' language capabilities and the language required in an English-oriented lecture, as well as the local students' cultural expectations towards a university course and the international (Western) expectations of a university course (Tsuneyoshi, 2005, pp. 71–72, p. 79). As such, in the early days of implementing an exchange program at the University of Tokyo, specific courses had to be created for the exchange students. Unfortunately, these courses did not necessarily match the linguistic capabilities of the local students. Tsuneyoshi's (2005) paper showed the intricacy of communication between native and non-native speakers of English.

These studies show the various ways in which Japanese EFL classrooms have attempted to encourage its students to use the target language. Using their discussions and results as inspiration, a study was conducted in a professional university to test the usage of conversation classes on student motivation to use English for a communicative purpose.

Methodology

Acquiring EFL Through Conversational Classes With English Native Speakers in a Professional University

Applied English Communication is a year-long course that is split across two semesters. The students in the professional university in Kanagawa are divided according to their English language proficiency: those acquiring a TOEIC score of above 500 are placed in the "A" or Advanced English class, while those with a score lower than 500 are placed in the "B" or Basic English class. The participants in this study were in the "B" class. In this class, the textbook used as the basis for the conversational activities was *Glances of Japan* (2020) by Sakabe Toshiyuki (坂部俊行), Okajima Noriaki (岡島徳昭), and Howard Tarnoff.

The B class consisted of 25 students; 24 of the students were either Japanese and/or had grown up and been educated in Japan, while one student had immigrated to Japan as an adult. 17 students were boys and 8 students were girls; 11 students were 18 years old, 7 were 19 years old, 5 were 20 years old, and 2 were 21 years old. 15 of the students were first-year students and new to the class; 8 students were second-year students, and 2 were third-year students. As mentioned earlier, the B class consisted of students who scored under 500 points in TOEIC; however, it is worth noting that only one student scored above 400 points. 7 students scored above 300 points, 12 students scored over 200 points, 2 students scored over 100 points, and 3 students scored under 100 points. Scoring under 100 points is objectively near-impossible given the way in which TOEIC calculates the points. For these three students, they most probably had left their answers blank, resulting in a randomized placeholder score. From these results, however, it can be concluded that the B class consisted of students with beginner level proficiency, similar to CEFR A1 or A2 level.

In the first semester of the Applied English Communication course, the professional university had set up a language and cultural exchange program with American university students as well as a university professor. In the B class, the fifteen weeks of classes were divided as follows:

Preparation Stage (Weeks 1 to 5)

Before class began, students answered a survey looking into their interest in learning English as well as their feelings towards speaking with native English speakers. These questions included:

1. How confident are you in speaking English? あなたは英語を話すことにどれくらい自信がありますか?
2. How confident are you in your English listening skills? あなたは英語のリスニングにどれくらい自信がありますか?
3. How interested are you in learning English? あなたは英語を学ぶことにどれくらい興味がありますか?
4. How do you feel about speaking with the American students next month? 来月、アメリカの学生たちと話すことについてどう思いますか？

Students answered these questions on a 5-point and 4-point scale. Questions 1 and 2 offered the scale from 0 being "Not confident at all" to 5 being "Very confident"; Question 3 offered the scale from 0 being "Not interested at all" to 5 being "Very interested"; Question 4 avoided

a neutral number and gave the following options: Excited, Nervous, but excited, Nervous, and No strong feelings.

The first five weeks were spent working on the content of the textbook and preparing for a lecture and discussion session with the exchange students and professor. The topics chosen from the textbook are based on the ease of the content (being low ICL) as well as the possible interest it might generate for both the professional university students as well as the exchange students later. The topics were:

1) Animal cafes
2) Stand-up eateries (立ち食い)
3) Japanese spas (スーパー銭湯)
4) Karaoke

During these classes, students familiarized themselves with the English vocabulary associated with the topics through listening, reading, and writing exercises. Later, they answered discussion questions based on their own personal experiences or opinions, and then they were to create a set of ten questions to ask the American students on these topics.

In the fifth and final week of the preparation period, students were given lecture points provided by the American professor and they were briefed on strategies to deal with a 50-minute lecture session completely in English.

Language and Cultural Exchange Stage (Weeks 6–10)

The sixth week saw the A and B students join in one class to listen to an introductory lecture in English by an American professor. The A and B students engaged in communicative exchanges with both each other as well as the professor during this lecture.

The seventh, eighth, and ninth weeks saw the students with 6 exchange students. The first 50 minutes of each class were spent reviewing notes and materials from the Preparatory Stage. The final 50 minutes were spent with the exchange students. 5 of the exchange students were boys and one was a girl. The professional university students sat in groups of 3 or 4 and the exchange students took turns speaking with each group for 8 minutes. On Weeks 7 and 8, students answered survey questions about their experiences with the exchange students:

1. How confident are you in speaking English? あなたは英語を話すことにどれくらい自信がありますか?
2. How confident are you in your English listening skills? あなたは英語のリスニングにどれくらい自信がありますか?
3. How interested are you in learning English? あなたは英語を学ぶことにどれくらい興味がありますか?
4. You've already spoken to American students twice, but how do you feel about speaking to them two more times? アメリカの学生たちとはすでに 2 回お話されていますが、あと 2 回お話することについてどうお考えですか？
5. Please rate the level of difficulty for American students. アメリカの学生の理解の難しさを評価してください
6. How helpful was our lesson where we prepared for these? これらの会話の準備をするためのレッスンはどれくらい役に立ちましたか？

7. Did you use your notes and answers during the conversations? 会話中にメモや回答を使用しましたか?

Answer options for Questions 1–4 were the same as for the pre-class survey. Question 5 provided a scale of 1 being “I couldn't understand anything まったく理解” and 5 being “It was very easy to understand よく理解”. Question 6 provided a similar scale where 1 was “Not helpful at all まったく役に立たなかった” and 5 was “Very helpful とても役に立った”. Finally, Question 7 had three options: “Yes”, “No”, or “Sometimes”.

In the final language and cultural exchange class, the A and B students joined classes again. For the first 50 minutes, the students used the preparatory materials from class. The final 50 minutes were based on more impromptu conversations. Students answered a final survey at the end of this session, which included the following questions:

1. I can actively participate in conversations in English. (1: Strongly disagree to 5: Strongly agree)
2. I can communicate smoothly in English. (1: Strongly disagree to 5: Strongly agree)
3. I am confident in my English listening ability. (1: Not at all - 5: Very much)
4. I think my English-speaking ability will improve. (1: Strongly disagree – 5: Strongly agree)
5. I can use English words and expressions naturally. (1: Strongly disagree to 5: Strongly agree)
6. I can speak English without worrying about grammar. (1: Strongly disagree to 5: Strongly agree)
7. I am confident in my reading and writing skills. (1: Strongly disagree to 5: Strongly agree)
8. I am motivated to learn English. (1: Not at all, 5: Very much)

Review Stage (Weeks 11 to 15)

The final five weeks were spent on the textbook and preparing for presentations and final interviews with the class lecturer. Students studied four more chapters:

1. Ramen / Soba
2. Gyudon / Bento

Based on these chapters, the students answered questions on their favorite food. They presented these answers to their class and then memorized the answers for a final interview with the instructor.

Results and Discussion

This class had been designed to ensure that students would become more motivated and confident in using the English language skills learned in the classroom. Conversation-based classes when one is in the beginner’s stage of language learning is daunting, thus appropriate scaffolding was set up to ensure that the ICL of the course content and the ECL of the instructional design didn’t overwhelm the students. With these considerations in place, it was hoped that the B students would be more motivated to use English with their peers.

Before class started, students generally self-reported that their English capabilities were low. In terms of listening skills, 44% of the students reported that they had “No confidence at all”

and no student reported that they were “Very confident” in their speaking capabilities. 32% of students reported that they had “No confidence at all” in their listening skills as well. This seemed to correlate with their low TOEIC scores prior to entering class. A breakdown of the answers can be seen in the following figures.

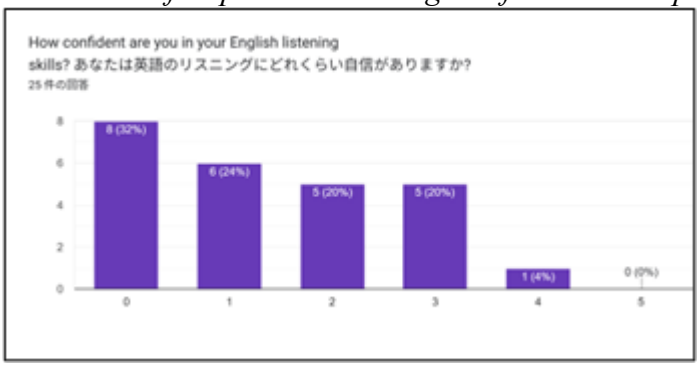
Figure 1

Students’ Self-Report on Speaking Confidence – Preparation Stage



Figure 2

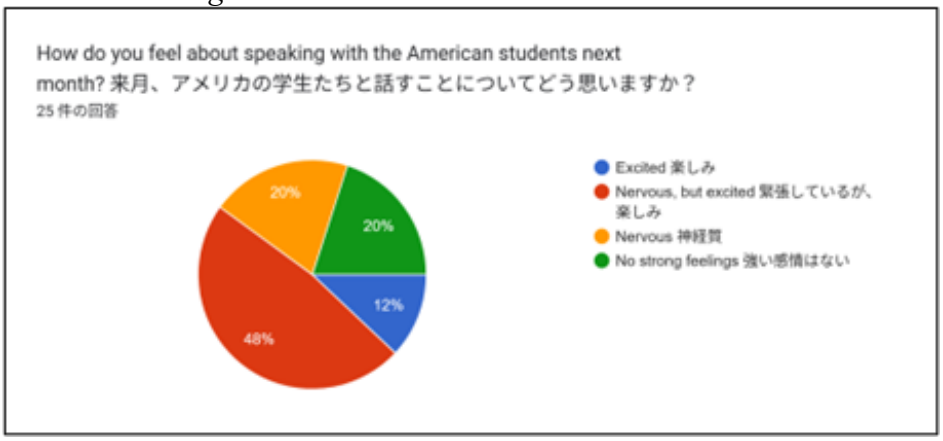
Students’ Self-Report on Listening Confidence – Preparation Stage



However, despite their relatively low confidence in their English capabilities, 20% of the students reported that they were “Very interested” in learning English, and 60% of students were either “Excited” or “Nervous, but excited” about speaking with the American exchange students.

Figure 3

Students’ Feelings towards Conversation Classes With American Students – Preparation Stage



These results seem to mimic the students' preparation for the conversation classes. Based on the instructor's own notes taken while observing the class, the students were generally quiet but a majority were diligent in completing the textbook work. Interestingly, the first-year students had a harder time completing questions with their own opinions and many struggled to come up with ten questions on their topics to ask the exchange students. This may be due to the students' lack of connection to a world outside of Japan, and thus they lacked the capability to imagine the type of questions or answers that would be relevant to such an interaction. The students' capabilities seem to mirror those in Fujita and Ong's (2018) previous study, where the English Cafe program was attended mostly by students who had undergone an overseas exchange program, perhaps indicating a better capability to hold more unstructured conversations (41–42). Second and third year students who had already engaged in the exchange program the previous year were more capable of generating answers as well as questions for the American students.

Because of the students' quietness during the preparatory stage, it was surprising that they were quite communicative during the language and cultural exchange stage. Though a handful of students hung back and did not speak much, they were otherwise engaged and made an effort to respond. This seemed to be reflected in the survey results where students' confidence ratings went up: approximately 36% of students reported their speaking ability as a "3" or "4", showing moderately confident views and approximately 51% of students reported their listening ability as between "3" to "5", showing moderately to very confident views on their skills.

Figure 4

Students' Self-Report on Speaking Confidence – Language and Cultural Exchange Stage

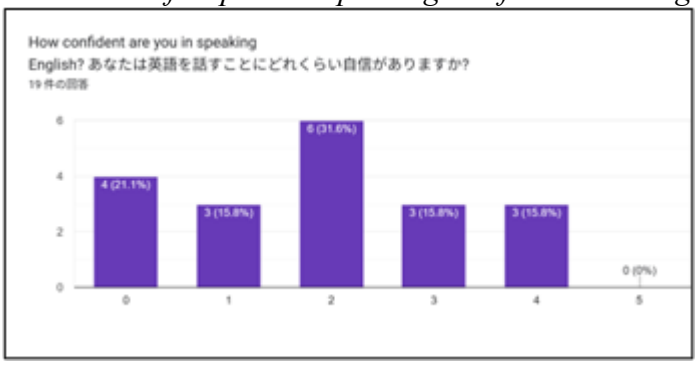
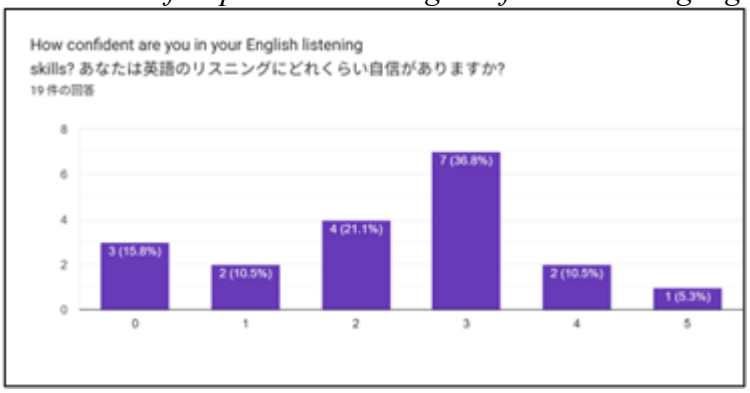


Figure 5

Students' Self-Report on Listening Confidence – Language and Cultural Exchange Stage



Interestingly, the levels of motivation remained about the same as before starting the class. When asked whether they had used the materials prepared for the conversations, only one person answered “No”, with others answering either “Yes” or “Sometimes”.

Figure 6
Students’ Usage of Notes During Conversation Classes – Language and Cultural Exchange Stage



Indeed, when observing the student interactions, it was obvious that the structured questions with prepared answers helped even low-proficiency students. Because the students repeated the questions and answers a total of six times in a session, they were able to progress to more impromptu questions and answers with the exchange students as time progressed. The American exchange students themselves were proactive and used simple words as well as translation apps to help when there were difficult words or concepts that they wanted to convey. But this is not to say that all of the conversations were held with apps – students used a mixture of apps, their notes, as well as clarifying statements to help with communication. When talking on personal subjects, some brought up photos from their phones.

Towards the end of the program, when evaluating the responses, only 14 students had been present for the beginning, the middle, and the final surveys. In terms of interest level in English, 5 students had remained the same (being “interested” to “very interested”, marking “3” to “5” on the scale) and 5 students had become more interested in English. Most rewardingly, 11 students reported a higher sense of confidence in their English language skills at the end of their interactions with the American exchange students while 3 remained the same. At the beginning, 6 of the 14 had noted that they were “Not confident at all” and had then found some degree of confidence over the five–week period.

In this sense, students had an increase in their feelings of academic self-efficacy. By ensuring that the course content had a low ICL, with content based on subjects that were familiar and interesting to the students, the ECL could afford to be higher. In this case, the task of speaking in English with native speakers was definitely a high ECL task. However, the preparatory materials and sessions where students had time to compose their answers and then practice them, helped reduce the ECL of the conversation sessions, leading perhaps to a higher sense of confidence in the students.

Concluding Remarks and Future Considerations

This is a small-scale study with many limitations due to funding constraints and a lack of resources. However, these initial results show that with proper scaffolding, even low-proficiency students with low-motivation could increase both motivation and confidence in their English language capabilities. Future considerations could be made for a long-term

program where students continue to keep in touch with the exchange students to see if this would help maintain confidence and motivation in using the English language. As this study is on self-perception of capabilities, it is not interested in the actual marks the students received from the English proficiency tests. As seen through decades of research on EFL teaching in Japan, despite (or perhaps because of) being exam-oriented, students did not develop communicative abilities in English. However, perhaps when the goal is to actually communicate through these types of exchange programs, students in Japan might see the relevance of learning the language. This study provides an optimistic assessment for using conversational activities with English native speakers as part of the instructional design in the Japanese EFL classroom.

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From Studio to Society: A Hardware–Software–Heartware Framework for Interdisciplinary Design Innovation in the New World University

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Abstract

This study investigates an interdisciplinary pedagogical model developed at the Singapore Institute of Technology (SIT) to address the growing complexity of global challenges through innovative higher education design. Implemented within the *Design Innovation* common module, the model engages students from nursing, engineering, computing, and allied health disciplines in solving authentic problems using the Critical Design Futures Thinking (CDF™) and Design Your Life (DYL) approaches. The framework guiding this initiative—the Hardware–Software–Heartware (H–S–H) Tri-Layer Framework—conceptualizes learning as a dynamic interplay of physical, curricular, and socio-emotional dimensions. *Hardware* encompasses the new SIT campus as a living laboratory that integrates the built environment, digital infrastructure, and community contexts. *Software* represents the curriculum as an adaptive system designed through iterative learning sprints, incorporating empathy-based problem framing and ethical Generative AI integration. *Heartware* focuses on the socio-emotional and cultural layers that nurture collaboration, reflective practice, and ethical awareness. A diverse array of data sources was utilised to ensure comprehensive insights and triangulation. Data sources included curriculum material, student module feedback and project deliverables, sampled from module cohorts across two consecutive trimesters (AY2024 Trimester 2 and 3). Through thematic analysis and vignette development, the study aims to illustrate how the H–S–H framework operationalizes interdisciplinarity as an active interaction among space, structure, and culture. The insights are expected to inform the framework's scalability for general education as well as Continuing Education and Training (CET) programmes, contributing to a broader vision of campuses as innovation studios and societal prototyping platforms.

Keywords: Hardware–Software–Heartware (H–S–H) framework, interdisciplinary pedagogy, innovation education

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Introduction

The 21st century presents an unprecedented confluence of challenges, from climate change and global pandemics to rapid digital transformation and complex socio-political upheavals. Addressing these "wicked" problems demands more than isolated disciplinary expertise or linear problem-solving approaches; it calls for profoundly integrated, interdisciplinary forms of learning, research, and innovation. Consequently, higher education institutions globally are under increasing pressure to re-envision their core mission: not merely to disseminate knowledge, but to cultivate graduates who can lead, collaborate, and innovate across diverse professional, cultural, and technological landscapes.

This imperative for transformation is set against a backdrop of what has been termed "fast academia" – a neoliberal, performance-driven environment often characterised by relentless pursuits of productivity, competitiveness, and accelerated expectations. Such pressures can inadvertently erode the very "human(e) elements" of learning and teaching, challenging the preservation of empathy, kindness, and compassion within educational settings. In response, there has been a growing advocacy for "slow movement" principles in academia and a renewed emphasis on humanising pedagogies that prioritise dignity, critical consciousness, kindness, humility, empathy, and love as foundational ideals for humanising interactions.

The Singapore Institute of Technology (SIT) stands as a microcosm of this global trend and a vibrant testbed for innovative educational models. With students and faculty representing nearly forty diverse degree programmes ranging from engineering and nursing to allied health, computing, and business. SIT provides a unique living laboratory for cultivating interdisciplinary capabilities. Central to SIT's pedagogical philosophy is the Hardware–Software–Heartware (H–S–H) tri-layer framework, a distinctive approach that moves beyond superficial multidisciplinary efforts to foster genuine integration. This framework insists that true interdisciplinarity and holistic learning emerge from a dynamic, symbiotic interaction between three interdependent layers: the physical and digital infrastructure ("hardware"), the curriculum design and pedagogical processes ("software"), and the deeply social, ethical, and affective dimensions of student-lecturer interactions (*heartware*).

This paper argues that the H–S–H framework offers a powerful, actionable model for designing and evaluating learning environments capable of meeting both the cognitive and socio-emotional demands of 21st-century learning and work. It is a deliberate framework that emphasises that a multi-layered, dynamic interaction promotes compassion, resilience, and ethical imagination that are necessary for driving innovation.

This paper proceeds with the following objectives:

1. To situate the H–S–H Tri-Layer Framework within international and local literature on interdisciplinary innovation, campus ecology, and social-emotional learning.
2. To detail how the H–S–H framework is operationalized within the SIT Design Innovation module, including mechanisms for *hardware*, *software*, and *heartware* integration in both design and implementation.
3. To illustrate, using data and vignettes from recent module cohorts, how students and educators experience and enact interdisciplinarity when multiple domains, stakeholders, and forms of expertise collide and collaborate.
4. To analyse the impacts, challenges, and enabling conditions for wide-scale adoption of the H–S–H framework, including institutional, pedagogical, and cultural levers and potential transferability to other general education and continuing education contexts.

5. To offer a roadmap and recommendations for scaling H–S–H in diverse educational and societal settings, informed by current best practice and emerging scholarship.

By leveraging the lived experience of an applied university's common module and global research evidence, this paper aims to illuminate a path towards genuine interdisciplinary learning and institutional transformation, positioning universities as sites of continual co-creation, social impact, and lifelong learning.

Literature Review

The H–S–H framework draws on literature advocating holistic, human-centred education across interdisciplinary education, project-based/authentic learning, grid–group dynamics, and university infrastructure and campus design.

Evolution of Interdisciplinary Education

Interdisciplinary education in higher education responds to complex societal challenges by moving from disciplinary coexistence to purposeful epistemic integration that combines knowledge, methods, and ontologies for practice-based solutions (Keenan, 2020; Slothuus et al., 2025). Contemporary frameworks stress disciplinary grounding, epistemic agility, humility, and collaboration in authentic, problem-rich environments, yet remain constrained by governance, faculty preparedness, and reward systems, while students face identity tensions and uneven team dynamics (Schijf et al., 2023; Strain & Potter, 2012; Visscher-Voerman et al., 2025; Xu et al., 2022).

Project-Based Learning (PBL) and Authentic Learning

PBL is a key driver of interdisciplinary competence, engaging learners in real-world, collaborative, and outcomes-oriented inquiry that enhances motivation, deep learning, and work readiness (Aksela & Haatainen, 2019; Barell, 2007; Barron & Darling-Hammond, 2008; Boss & Krauss, 2007; Evenddy & Gailea, 2023; Gantogtokh & Quinlan, 2017; Kamanga, 2024; Klaassen, 2018; Larmer & Mergendoller, 2015; Silma et al., 2024; Warr & West, 2020). Its effectiveness depends on the interplay of software (curriculum), hardware (institutional structures and infrastructure), and heartware (affective-relational dynamics), supported by authentic assessment, reflection, and external partnerships (Barrett & Naughton, 2014; Ghani et al., 2021; Kek & Huijser, 2017; Tan, 2022).

Social-Emotional Learning (SEL) Cultivating the "Heartware"

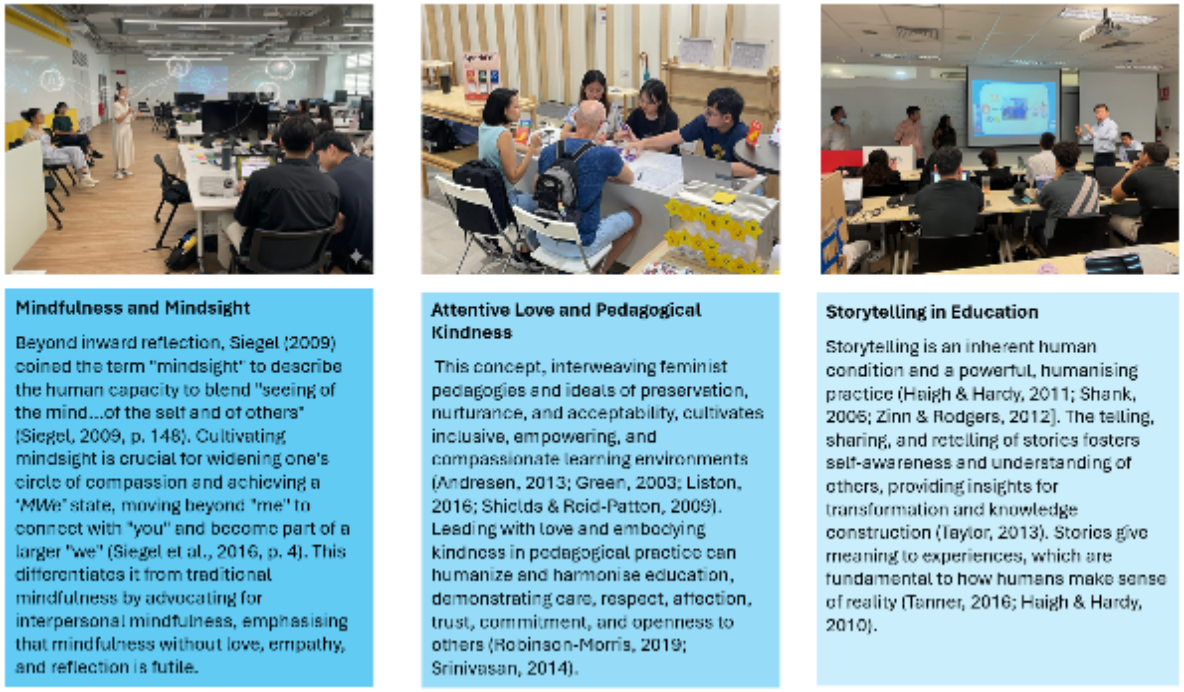
SEL constitutes the "heartware" that complements cognitive and technical learning by cultivating empathy, resilience, ethical judgment, collaboration, self-regulation, and inclusion, thereby supporting interdisciplinary practice, wellbeing, and equity (Conley & Donahue-Keegan, 2024; Ibarra, 2022; Lisciandro et al., 2016; Martinez & Gomez, 2024; Tan, 2022; Van Pham, 2024). Tan's "Heartware for the Compassionate Teacher" framework links three domains: mindfulness and mindsight (Siegel, 2009; Siegel et al., 2016; Smalley & Winston, 2010; Srinivasan, 2014), attentive love and pedagogical kindness (Antoniuk et al., 2021; del Carmen Salazar, 2013; Green, 2003; Liston, 2016; Shields & Reid-Patton, 2009), and storytelling as humanizing practice (Andresen, 2013; Benade, 2019; Haigh & Hardy, 2011; Robinson-Morris, 2019; Savvidou, 2010; Sferrazza, 2018; Shank, 2006; Taylor, 2013; Tanner, 2016; Zinn & Rodgers, 2012).

Mindfulness nurtures presence and reflective awareness (Smalley & Winston, 2010); attentive love enacts care through respect, empathy, and pedagogical trust (Antoniuk et al., 2021; del Carmen Salazar, 2013; Shields & Reid-Patton, 2009); and storytelling situates learning within narrative and meaning-making processes (Haigh & Hardy, 2011; Tanner, 2016; Taylor, 2013). Collectively, these approaches humanize education, reinvigorate the moral purpose of teaching, and counter the instrumental tendencies of neoliberal academic cultures (del Carmen Salazar, 2013; Freeman et al., 2020).

This triadic synthesis of interdisciplinarity, authentic learning, and heartware pedagogy delineates a humane and future-oriented pathway for higher education. It not only equips graduates with integrative thinking and adaptive expertise but also fosters compassion, relationality, and civic agency as defining virtues of contemporary scholarship.

Figure 1

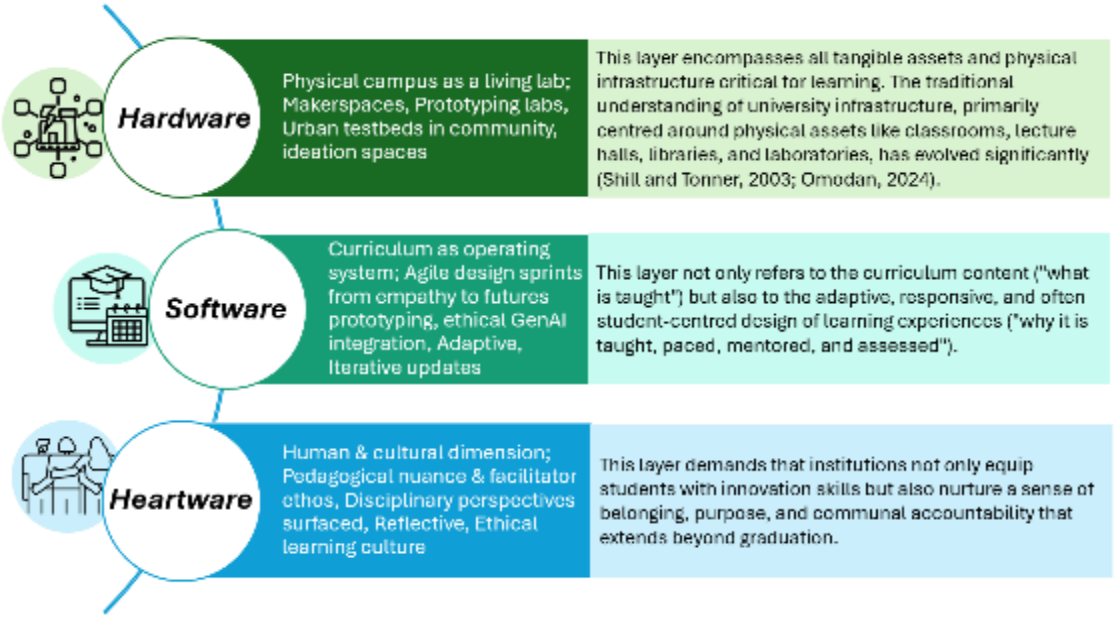
Heartware Elaborated



Conceptual Model

The Hardware–Software–Heartware (HSH) tri-layer framework is a conceptual model which stands as a bold synthesis, integrating traditional campus strengths with experimental learning theory to address the complex demands of 21st-century education. It is built upon an insistence that interdisciplinarity is not merely superficial co-location but a profound, multi-layered interaction, aiming for campus-wide transformation rather than temporary overlays. This triad functions as a comprehensive framework aligning material, cognitive, and emotional infrastructures for the common good, moving beyond the notion of universities as mere “learning factories” to “living communities”. The HSH framework delineates three interdependent and synergistically operating layers (see Figure 2):

Figure 2
Hardware–Software–Heartware (HSH) Framework



- Hardware: Historically, these spaces were epi-centres of intellectual pursuits, academic interactions, and community building, reflecting societal values and academic philosophies (Bogart, 2022; Gevorgyan et al., 2020). However, the digital age, with the advent of the internet, online learning platforms, and digital libraries, has fundamentally altered knowledge dissemination and consumption, necessitating a re-evaluation of infrastructural orientations (Kaziev et al., 2020; Song et al., 2006). The 21st-century university infrastructure is now characterized by a complex interplay between physical assets and digital evolution. The concept of a "campus as a living lab" embodies this evolution, where physical and digital affordances provide real-time, authentic contexts for innovation, engagement, and knowledge translation (Hansen, 2016; Pilon et al., 2020; Save et al., 2021).
- Software: This layer focuses on pedagogical and instructional design elements, including teaching approaches, best practices, curriculum development, content, and assessment. It advocates for a departure from rigid, siloed learning environments towards collaborative and flexible arrangements that facilitate project-based learning, cross-disciplinary collaborations, and real-world problem-solving.
- Heartware: As the most distinctive and arguably most critical layer in education, *heartware* focuses on the cultivation of social capital, empathy, ethical reasoning, and a sense of "ownership" and care for both learning and community outcomes. It represents the "underlying values, attitudes, and "inner infrastructure" of a community or institution" (Antoniuk et al., 2021; Hackman & Reindl, 2022; Ignatovitch, 2016; Tan, 2022; Young, 2020). It counters the neoliberal tendency to view education instrumentally, shifting towards humanistic, dialectical activities and intrinsic values.

These three layers are not treated as sequential steps but as a dynamic interplay, constantly rebalanced based on evolving needs and feedback, leading to "tripartite" projects where new campus infrastructure, curriculum construct, and SEL-anchored programming co-evolve.

Method

The study employed a direct qualitative content analysis design. Direct qualitative content analysis offers distinct benefits for studying the H–S–H framework, particularly given its interdisciplinary and context-embedded nature. This approach enables the identification and interpretation of both manifest content, such as explicit references to framework components and latent content consisting of underlying meanings, values, and patterns of interaction, sourced from a rich array of qualitative data such as module feedback gathered from students and artefact analysis. This approach prioritises the systematic extraction of data-driven themes directly related to predetermined categories of the H–S–H framework, while remaining open to emergent themes that further refine the model. This technique also enhances transparency and replicability in coding, reduces interpretive ambiguity, and provides rigorous support for linking qualitative evidence to educational theory and practice (Chueh & Kao, 2024).

Context and Participants

SIT mandates the Interdisciplinary Design Innovation module for students from thirty-nine undergraduate programmes. The research participants include cohorts from trimesters two and three of the Academic Year 2024, encompassing over 2,000 students from diverse fields such as engineering, allied health, nursing, computing, and business, alongside more than twenty instructors. The module is delivered within SIT's Punggol campus, a site explicitly designed to support collaborative, interdisciplinary, and hands-on innovation, thereby embodying the *hardware* dimension of the H–S–H framework.

Data Sources

A diverse array of data sources was utilised to ensure comprehensive insights and triangulation. Data sources included curriculum material, student module feedback and project deliverables, including presentation slides, prototypes (physical, digital, or process-based) and videos, sampled from module cohorts consisting of 24 degree programmes, collected over two academic trimesters (AY2024 Trimester 2 and 3). The student module feedback dataset includes quantitative Likert-scale ratings (Q1–Q5 means) and qualitative free-text reflections.

Data Analysis

Data were analysed using thematic analysis, employing both deductive (pre-existing H–S–H categories) and inductive (emergent themes related to collaboration, reflection, and innovation barriers) approaches. Initial codes were developed to capture explicit instances of physical/digital infrastructure, curricular design/process elements, and socio-emotional or grid-group cultural dimensions. The coding process remained sensitive to emergent themes reflecting unanticipated enactments or challenges within interdisciplinary learning environments. Triangulation across data types strengthened the validity and credibility of findings. All procedures adhered to institutional ethical standards, with participant data anonymised and informed consent obtained for any supplementary research activities.

Ethics

The study strictly adhered to standard institutional review protocols (Approval-RECAS-0692_IRB_Exempted). Ethical considerations for this study were addressed under an exempted review process. Prior to analysis, all data were de-identified, and only aggregated results are reported, ensuring that no individual can be identified in any subsequent publication or presentation.

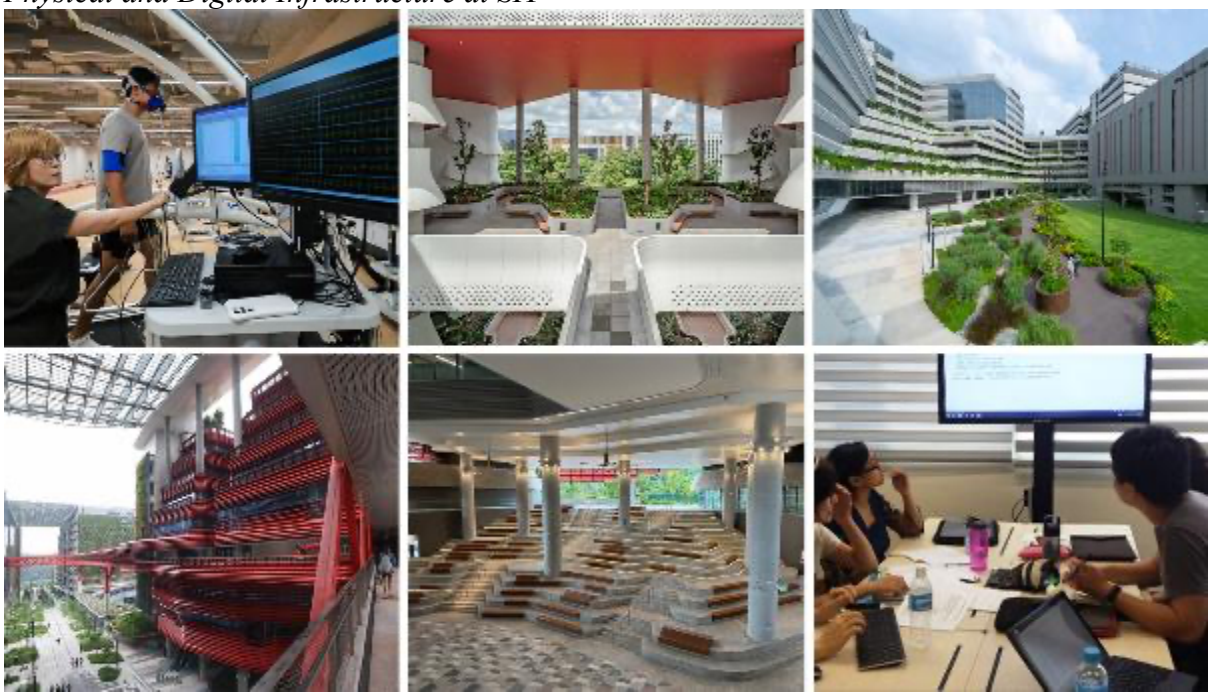
The Hardware–Software–Heartware (H–S–H) Framework in Practice

The operationalisation of the Hardware–Software–Heartware (H-S-H) Framework at SIT exemplifies a synergistic integration of physical campus design, curriculum architecture, and intentional socio-emotional learning. Each layer is designed to interact dynamically, fostering a robust learning ecosystem where deep interdisciplinarity and compassionate engagement can thrive.

Hardware

SIT's Punggol campus was purposefully conceptualised as an "urban testbed" for innovation, where the physical architecture and integrated technology infrastructure are explicitly aligned with pedagogical aspirations for collaborative, distributed, and real-world learning. This vision responds to the broader imperative for universities to redefine their infrastructural identity, harmonising tangible physical assets with the expanding world of digital evolution. The university owns state-of-the-art smart-eco buildings, flexible learning spaces, advanced laboratories, makerspaces, and physical technologies. See Figure 3.

Figure 3
Physical and Digital Infrastructure at SIT



Source: Straits Times; author

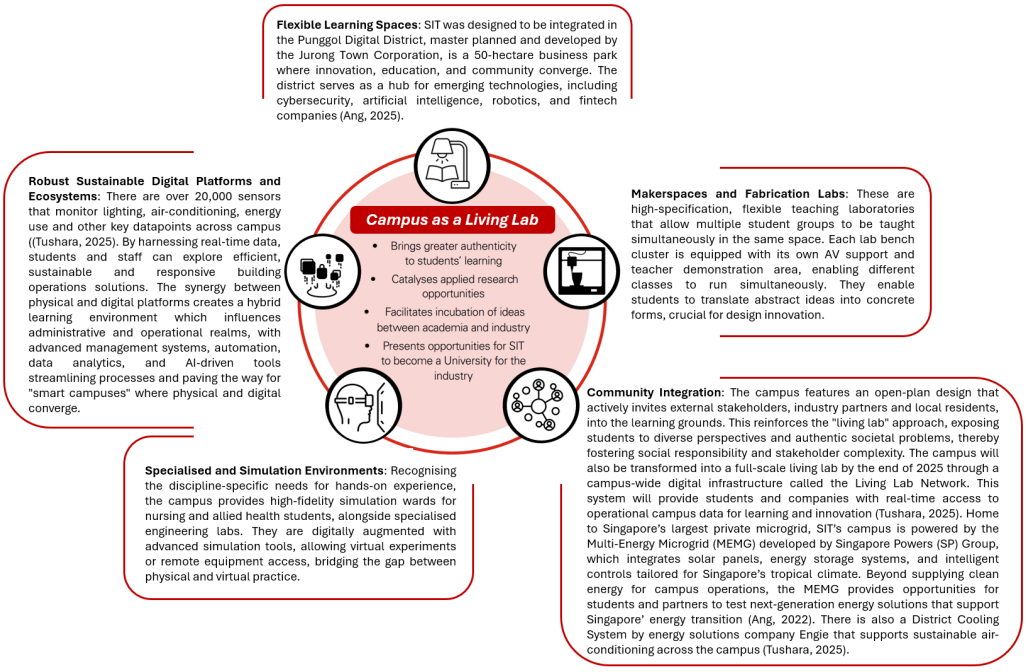
Key features of the *hardware* layer include flexible learning spaces configured to support fluid team formation, dynamic brainstorming, rapid prototyping, and a shift from rigid, siloed

settings to collaborative, inquiry-driven environments. Makerspaces and fabrication labs, equipped with 3D printers, electronics benches, and related tools, enable rapid iteration and the creation of tangible, cross-disciplinary projects. Specialised and simulation environments translate theoretical knowledge into realistic, immersive contexts, providing multi-dimensional learning experiences. The campus itself is conceived as a "Campus-in-the-Park," with SIT Campus Heart and SIT Campus Court spanning about 9 hectares—roughly 17 football fields—and integrating academic blocks with a conserved secondary forest that has been transformed into an accessible community park, thereby blending learning spaces with tropical landscapes.

A robust, sustainable digital ecosystem complements the physical infrastructure through cloud repositories, online collaboration tools, and learning management systems, supporting hybrid, asynchronous, and co-located teamwork and extending the reach and flexibility of the module. This intentional design ensures that physical spaces are not merely venues for knowledge reception but active incubators for innovation, creativity, and holistic development, seamlessly complemented by the dynamic capabilities of the digital realm. See Figure 4.

Figure 4

Hardware – Campus as a Living Laboratory

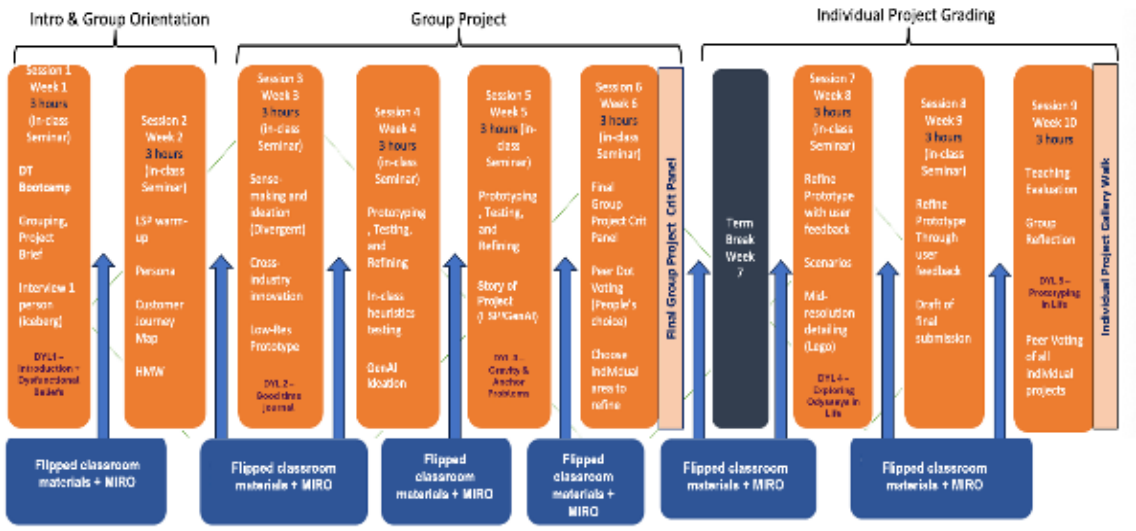


Software

The *software* layer, being the Design Innovation curriculum, is an adaptive, sprint-based programme that embeds human-centred design and iteration to mirror contemporary innovation practice and avoid rigid, siloed structures. It opens with empathy-based problem discovery, where students conduct user research and systems mapping (e.g., interviews and observations) to build deep, compassionate understanding of real-world challenges. Students then move through design thinking sprints, using methods such as the double-diamond model and Lego® Serious Play® to frame problems, ideate, prototype, and test, thereby normalising ambiguity and rapid learning from feedback (see Figure 5). Assessment is agile and authentic, organised around milestones, peer feedback, and reflective dialogue, which better

supports iterative learning than traditional high-stakes evaluations. Ethical and reflective practice is threaded throughout via ethical dilemma analyses, critical incident debriefs, and narrative feedback, ensuring that technical and collaborative skills are developed alongside ethical responsibility and critical consciousness, in line with a humanising educational ethos. This dynamic *software* layer ensures that students are not merely exposed to interdisciplinary problems but are actively equipped with the processes and mindsets to tackle them effectively, while simultaneously developing their ethical and collaborative sensibilities.

Figure 5
Software – Agile Curricula and Humanising Facilitation



Source: SIT, UDE2222

Heartware: Cultivating Socio-Emotional and Ethical Dimensions

The *heartware* layer at SIT is the most distinctive and operationally challenging component of the framework, intentionally developed alongside content and process to foreground the "human(e) elements" of learning and teaching (see Figure 6). It aims to cultivate social capital, empathy, ethical reasoning, and a deep sense of ownership and care for learning and community outcomes, countering the pressures of "fast academia" and supporting a more humanistic, equitable environment.

Key practices include metacognitive scaffolding, where Designing Your Life concepts, structured check-ins, and feedback nurture mindsight (awareness of one's own and others' mental states) and mindfulness, extending from inward reflection to an expanded sense of "we." An inclusive facilitation model brings together part-time educators from multiple disciplines who are trained in protocols for inclusive dialogue, conflict navigation, and "stretch" assignments, thereby modelling collective wisdom, mutual respect, and constructive handling of epistemic friction in interdisciplinary teams.

Engagement and storytelling are central: students choose topics on the future of work and life and collaborate with diverse stakeholders, using story-sharing and user journey mapping to surface complexity, social responsibility, and lived experience. Storytelling, grounded in "attentive love," links emotion, meaning, and understanding in authentically caring teacher–student relationships, creating inclusive, compassionate learning spaces. Overall, this *heartware* cultivation equips students not only with cognitive capacity for innovation but also

with the socio-emotional intelligence and ethical compass required to act as future change agents.

Figure 6

Heartware – Cultivating Social-Emotional and Ethical Dimensions



Dynamic Interplay for Interdisciplinary Learning

The H–S–H framework which surfaced at SIT, deliberately resists the siloing of these three layers. Instead, it fosters a dynamic, co-evolutionary interplay:

- Hardware and Software Co-evolution: Changes in physical learning spaces or digital platforms are rapidly mirrored in new module activities or pedagogical scaffolds. For example, the availability of makerspaces (*hardware*) directly enables agile design sprints (*software*).
- Hardware and Heartware Collision: The design of the campus to integrate with the community (*hardware*) provides authentic contexts for students to engage in empathetic user research and experience stakeholder complexity, driving the development of cultural humility (*heartware*).
- Software and Heartware Interdependence: The empathy-centric design methods and iterative feedback loops (*software*) are explicitly designed to cultivate collaborative mindsets, relational skills, and reflective practices (*heartware*). The facilitation from the instructors emphasises the critical interplay between curriculum elements (*software*) and the nuanced work of relational and ethical development (*heartware*).

This integrated approach ensures that the material, cognitive, and emotional infrastructures are aligned, allowing students to move beyond surface-level group work and form high-trust, adaptive micro-communities capable of solving complex problems with both technical proficiency and profound human compassion.

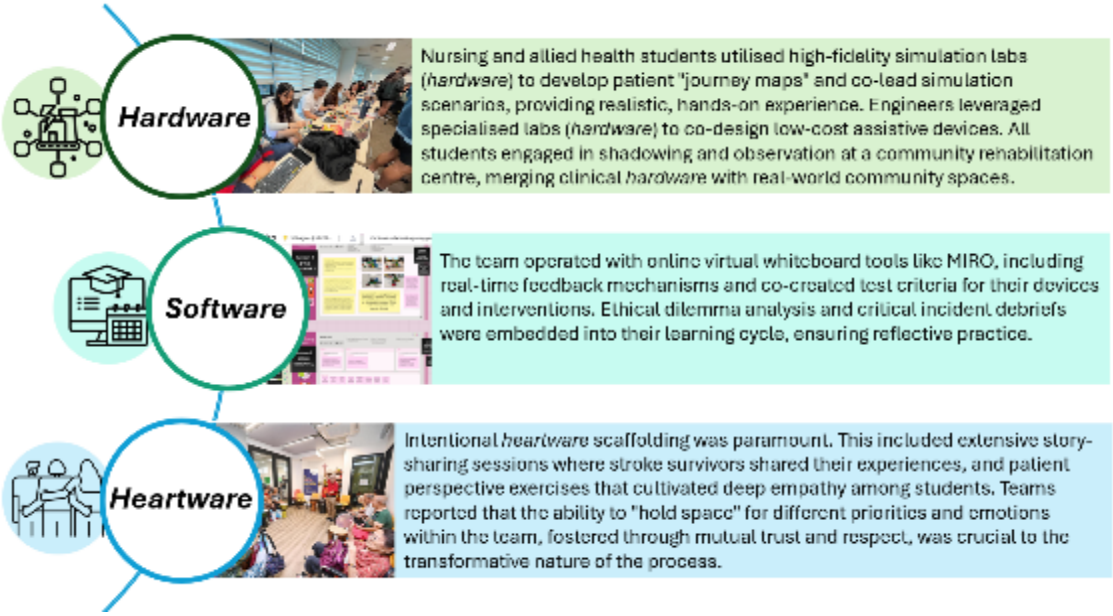
Findings

Based on the data collected, the H–S–H framework can be operationalised within SIT's Design Innovation module. The following vignette in Figure 7 illustrate the framework in

practice and they revealed how this integrated approach fosters deep interdisciplinary learning and prepares students for complex societal challenges.

A project team of students tackled the crucial area of rehabilitation for stroke survivors, integrating various disciplines and prioritising the human element (See Figure 8). Students engaged in high-fidelity simulations and community shadowing, co-designed affordable assistive devices, utilised digital collaboration platforms, and critically reflected on ethical dilemmas. Central to impact was empathetic engagement with stroke survivors, nurturing trust and shared responsibility for innovation.

Figure 7
A Vignette on Inclusive Healthcare



The collective data demonstrated several significant impacts:

- Increased Self-Efficacy and Interdisciplinary Comfort: Qualitative data, supported by module feedback surveys, showed statistically significant increases in student self-efficacy, their comfort with interdisciplinary collaboration, and cultural humility. This aligns with findings that PBL and SEL can lead to significant increases in student self-efficacy and a decrease in anxiety.
- Enhanced Project Creativity and Conflict Resolution: Teams that explicitly adopted *heartware* rituals and engaged in frequent reflection outperformed others in terms of project creativity, effective conflict resolution, and meaningful stakeholder engagement. This underscores *heartware* as both a multiplier and moderator in collaborative learning.
- Decreased Anxiety and Increased Group Identity: Module feedback reports a decrease in student anxiety and the willingness to think about their future, largely attributed to the introduction of the Designing your Life concepts. This aligns with literature showing that SEL enhances students' resilience, and with research indicating that PBL fosters a greater sense of ownership among students

These findings strongly affirm the H–S–H framework's ability to foster genuine interdisciplinarity, resilience, and compassion, producing graduates who are not only technically capable but also deeply empathetic and ethically grounded.

Discussion

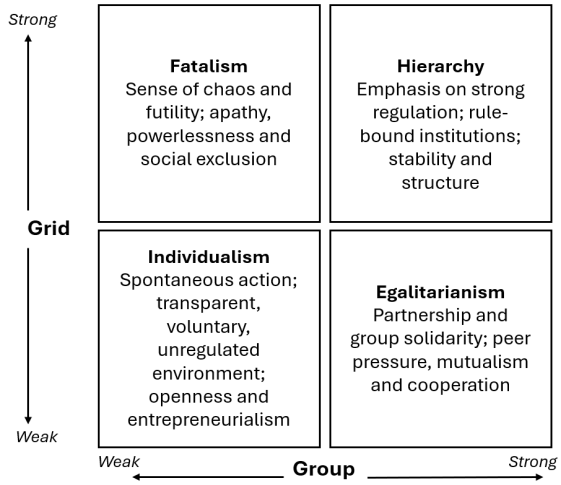
Based on the findings, a reflection was conducted on how the H–S–H framework, as conceptualised and operationalised at SIT where learning environments are designed at the intersection of space, process, and ethos, was able to empower educators to achieve their goals of enabling authentic interdisciplinarity and cultivate resilience in the face of complexity, while achieving the "buy-in" of students in the "wicked" context of diverse student learning preferences. To what extent the tri-layer framework which consciously aligns the components of physical infrastructure, curriculum, and community development (unlike traditional educational approaches that often treat them as distinct or siloed entities) for collective impact, enables measurable improvements in learning, innovation, and student well-being?

Deploying a Social Science Analytical Tool

While the findings from SIT's Design Innovation module resonate strongly with the global literature on applied learning, authentic assessment, and affective education, the reflection exercise required a more atypical analytical tool to sense-make the diversity in student learning preferences and how H-S-H aligns them to educators' goal of cultivating graduates who can lead, collaborate, and innovate across diverse professional, cultural, and technological landscapes. Such outcomes require students from diverse disciplinary cultures (how STEM students approach problem definition and solutioning is culturally distinct from students reading Business Management or Health Sciences) to learn about and experience the cultures of other disciplines. This is a complex endeavour that comes with challenges and even student resistance. Furthermore, an added complexity lies in the inherent diversity of learning preferences within each disciplinary cultures – as evident from past module feedback where students from the same disciplines expressed differing learning preferences. How may the H-S-H Framework empower SIT instructors to address these complexities? This salient reflection question needs to be addressed before the subsequent discussion on the transferability and scalability of the H-S-H Framework. First, this reflective exercise deployed Mary Douglas's Grid-Group Typology (1983, 2003) to sense-make the diversity in student learning preferences (see Figure 8).

Figure 8

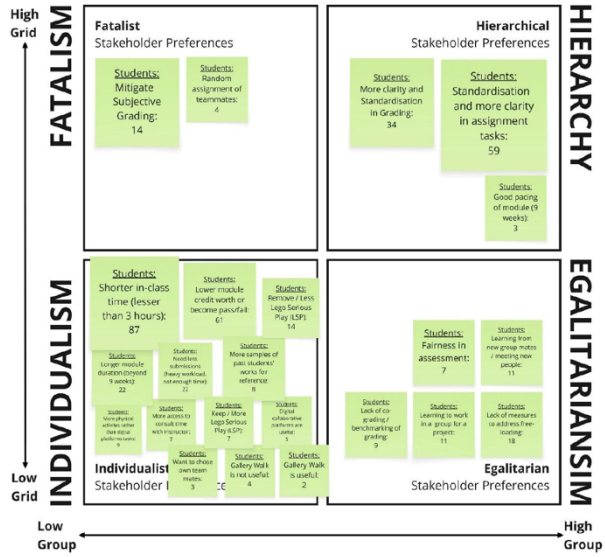
Mary Douglas's Grid-Group Typology Showing the Distinct Belief Systems of Each Rationality



Her groundbreaking typology helps to simplify the complexities of student learning preferences into just four mutually exclusive and jointly exhaustive rationalities based on their subscription to the criteria of Grid and Group: individualism, egalitarianism, hierarchism, and fatalism. Figure 8 below shows how Grid and Group can help reduce diverse preferences into the four rationalities with distinct belief systems. In the typology, *Grid* is characterized by the extent roles and rules influence a culture whereas *Group* is characterized by the extent group-orientation influence a culture. This simplification allows us to more reasonably sense-make the diversity of learning preferences by reducing its multitudes to more manageable parts for analysis. With this typology, the range of general student's learning preferences (as shared in the module feedback) can be mapped into the grid-group framework to provide an overview of the diversity of these preferences as shown in Figure 9 below. We further mapped the preferences particular to programme types into the typology to provide deeper insights.

Figure 9

Typology of Student's Learning Preferences for SIT's Design Innovation Module



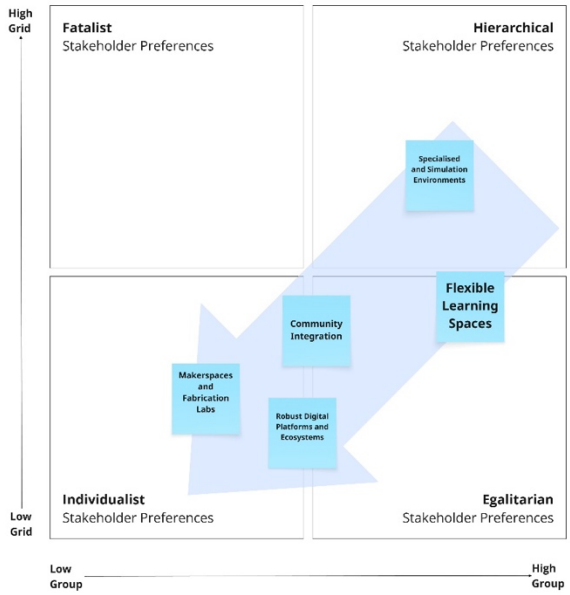
Second, this reflection exercise utilized a normative assertion, derived from cultural theory and its plural rationalities (Hartmann, 2012), building on Mary Douglas's Grid-Group Typology (1983, 2003) that posits that "wicked" problems need to be dealt pluralistically due to the diversity in belief-based preferences, and that the neglect of any of the three key rationalities of Hierarchy (H), Egalitarianism (E) or Individualism (I) will lead to gaps in outcomes. This assertion is used to derive our hypothesis that the H-S-H Framework empowered SIT instructors to achieve stated goals because the pluralism of the H-S-H Framework addressed the multitude of learning preferences – where the totality of implemented features catered to the learning preferences of students from all rationalities. To test the validity of this hypothesis, we mapped the range of implemented features onto the Grid-Group Typology to study if the H-S-H Framework is truly pluralistic. Our findings as presented below supports the hypothesis.

H-S-H as a Pluralistic Framework

The Hardware aspect of the framework caters to the three key rationalities of learning preferences (see Figure 10).

- Flexible Learning Spaces: The shift from rigid, siloed learning environments to collaborative, interactive spaces indicates a shift from "H" to "E" (Lowered Grid).
- Makerspaces and Fabrication Labs: Indicates a shift from "H" to "I" (rapid iteration) and "E" (cross-disciplinary projects) due to lowered Grid.
- Specialised and Simulation Environments: Retains the "H" (retaining emphasis of roles and rules).
- Community Integration: Catering to the "E" with equality of access to greenery and Community Park.
- Robust Sustainable Digital Platforms and Ecosystems: Catering to the "I" (technological enablers for individuals) and for "E" (co-located teamwork).

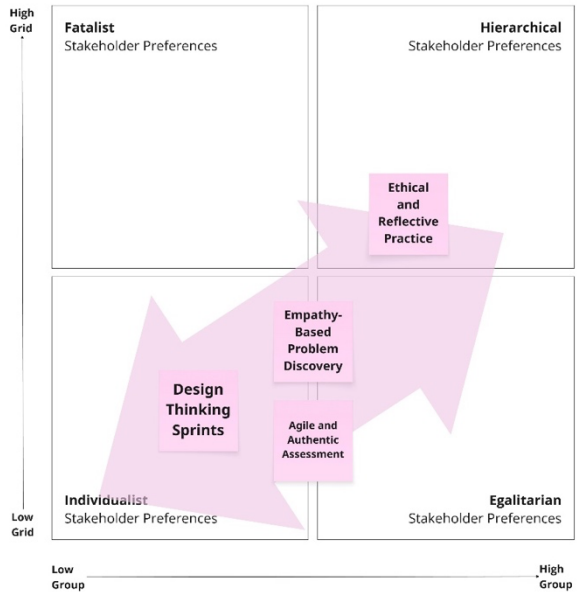
Figure 10
Typology of Hardware Implemented Features



The Software aspect of the framework also caters to the three key rationalities of learning preferences (see Figure 11).

- Empathy-Based Problem Discovery: Catering to the "E" (interviews with beneficiaries and stakeholders) and "I" (emphasising compassion)
- Design Thinking Sprints: Catering to the "I" (teaching them critical skills)
- Agile and Authentic Assessment: Catering to the "E" (peer feedback) and the "I" (reflective dialogue and removing rigid assessments)
- Ethical and Reflective Practice: Retaining the "H" (cultivating cultural ethical responsibility)

Figure 11
Typology of Software Implemented Features



Last but not least, the *Heartware* aspect of the framework also caters to the three key rationalities of learning preferences by cultivation of social capital (E), empathy (I), ethical reasoning (H), and a profound sense of ownership and care for both learning and community outcomes (E), on top of these pluralistic practices (as shown in Figure 12 below):

- Metacognitive Scaffolding: Caters to "I" (Designing your Life framework) and "E" (group check-ins and feedback).
- Inclusive Facilitation Framework: Caters to "I" (Professionals from various disciplinary backgrounds co-facilitate the module as instructors).
- Engagement and Storytelling: Caters to "E" (Project collaborations with diverse stakeholders) and "I" (open choice and authentic educator).

Figure 12
Typology of Heartware Implemented Features

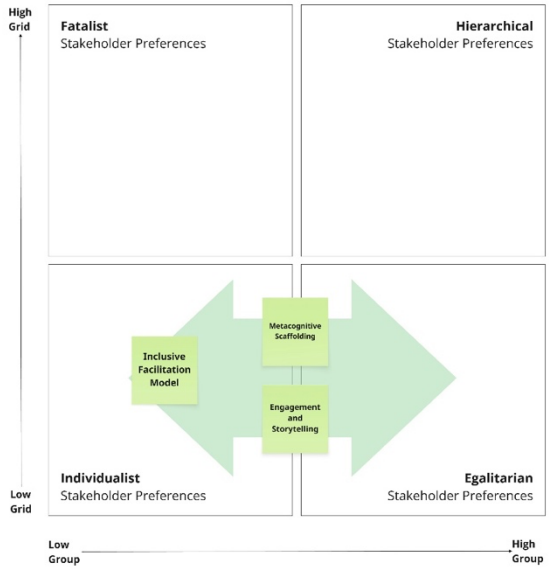
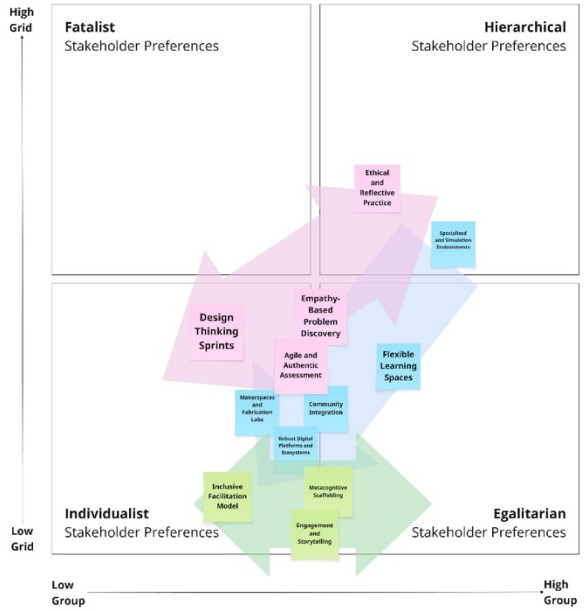


Figure 13 below illustrates the pluralism of the H-S-H Framework where the totality of implemented features catered to the learning preferences of students from all rationalities. Hence, we can posit with confidence that the H-S-H Framework which consciously aligns the components of physical infrastructure, curriculum, and community development for collective impact empowered the SIT instructors to achieve measurable improvements in learning, innovation, and student well-being; while also achieve their goals of enabling authentic interdisciplinarity for their students and cultivate in them the resilience needed in the face of complexity.

Figure 13
Typology of Totality of Implemented Features of H-S-H Framework



Structural and Cultural Enablers

Insights from the Grid–Group Typology highlight that the success and durability of the H–S–H framework at SIT depend on equally pluralistic enablers that mirror the pluralism of learner preferences. Institutional commitment functions as a hierarchical enabler: reconceiving the campus as a "living lab" and investing in flexible digital and physical infrastructure require leadership that emphasises the synergistic interplay of hardware, software, and heartware rather than isolated development.

At the individual level, comprehensive professional development equips faculty with both cognitive capabilities (e.g., interdisciplinary pedagogy, design thinking) and affective skills (e.g., *heartware* facilitation, conflict resolution, compassionate teaching), strengthening their capacity to enact the framework. Student ownership operates as both an individualist and egalitarian enabler, as autonomy, voice, and involvement in assessment design (such as co-created criteria) deepen engagement and motivation, particularly when learning is perceived as purposeful and choice-rich. Partnerships with external stakeholders, be it with industry (individualist) or community (egalitarian), are critical, providing authentic, socially meaningful projects that supply real-world problems, diverse perspectives, and relevance, while cultivating social responsibility and amplifying the framework's impact beyond the campus.

Barriers and Tensions

Insights from the Grid–Group Typology foreground the implementation and scaling challenges of the H–S–H framework by highlighting rationality-based conflicts in beliefs and preferences. Institutional inertia, rigid assessment structures, and resourcing constraints create hierarchical challenges that demand sustained effort, distributed leadership, and a willingness to "grapple with notions of impossibility" (Freeman et al., 2020, p. 86). Educators may also lack confidence or training in heartware facilitation, conflict resolution, and managing the emotional dynamics of interdisciplinary teamwork, underscoring the need for targeted support similar to that required for effective PBL design and scaffolding.

Assessment remains a persistent tension, as innovation is needed to balance individualist preferences for competition with egalitarian commitments to fairness and equality through methods that capture holistic learning beyond content mastery. Student adaptation to ambiguity presents another critical challenge: learners unfamiliar with open-ended, self-directed tasks may resist or feel discomfort, requiring "scaffolding for discomfort," explicit guidance, and hierarchical support to secure egalitarian group buy-in. The sustainability of H–S–H ultimately depends on institution-wide reinforcement, where its values are coherently embedded in recruitment, orientation, and co-curricular practices; misalignments across hardware, software, and ethos can significantly compromise outcomes.

Transferability of the Pluralistic H–S–H Framework

The mapping of the H–S–H framework onto the Grid–Group Typology suggests that, although rooted in Singapore's context, its pluralistic logic for addressing diverse learning preferences is broadly transferable across educational and societal settings. It can be modularised into general education to scaffold critical thinking, ethical imagination, and collaboration from the outset, preparing students for more complex interdisciplinary challenges. In industry–academia CET, real-world challenge-based modules, workplace learning, and mentorship can yield graduates with immediately applicable skills and holistic problem understanding.

Internationally, universities can adapt H–S–H by aligning *hardware* (campus and digital infrastructure), *software* (agile curricula), and *heartware* (socio-emotional and cultural practices) to local contexts, while investing in flexible, future-proof infrastructure that can accommodate emerging technologies such as AR and AI. Collaboration within and beyond institutions—with industry, tech firms, and other universities—supports trend sensing, guides infrastructural decisions, and enables interdisciplinary hubs, while environmental and social sustainability (e.g., green, inclusive spaces) ensures ongoing relevance.

Sustaining and scaling H–S–H depends on a strong culture of action research, including ongoing data collection, peer learning, pilots, and rigorous impact evaluation. Future research should examine longitudinal graduate outcomes (e.g., resilience, innovation, community orientation), develop robust ways to assess *heartware's* socio-emotional impacts, and pursue comparative studies across diverse systems to identify adaptation pathways and deepen efforts to humanise the academy amid accelerating change.

Conclusion

The Hardware–Software–Heartware (H–S–H) framework stands as a timely, evidence-driven response to the pressing need for reimagining how universities cultivate graduates equipped for civic contribution, professional leadership, and resilient innovation. By interrogating the intersecting roles of physical and digital infrastructure, curriculum design, and socio-emotional learning, this framework offers a comprehensive, pluralistic, and future-oriented lens on academic transformation. More importantly, the H–S–H framework demands that institutions invest not only in advanced facilities and adaptive curricula but, just as significantly, in the sustained and often unseen endeavour of nurturing empathy, ethical imagination, and a collective sense of purpose.

The experience at SIT underscores how intentional operationalisation of H–S–H catalyzes more than superficial interdisciplinarity or innovation as a rhetorical flourish; rather, it animates campus, curriculum, and community as synergistic spaces of authentic co-creation, visible societal impact, and enduring learning. Such integration is indispensable for understanding the ongoing infrastructural evolution within higher education, and it establishes a new world template for institutional research and policy reform.

In an era characterized by rapid complexity, digital disruption, and relentless change, integrated and pluralistic frameworks like H–S–H are not optional. They are essential for institutions determined to remain relevant, transformative, and genuinely future-ready. Ultimately, embracing the dynamic interplay of *hardware*, *software*, and *heartware* enables universities not only to adapt, but to lead; shaping a vision of education that realises humanity's full potential for compassion, creativity, and shared flourishing.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that Copilot, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The authors further declare that, apart from Copilot, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Development of an Exploratory Heritage Educational Game Integrating SVVR Scenarios, Narrative Scripts, and Generative AI Characters

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Abstract

Information integration and critical thinking skills are essential core competencies in cultural education. This study combines generative AI (GenAI) characters with Spherical Video-Based Virtual Reality (SVVR) technology to design a digital learning game that integrates knowledge of military dependents' village culture with puzzle-solving mechanisms. Players will assume the role of a grandson returning to the military village of Forty-Four South Village in Taipei City. By exploring the environment and objects within the SVVR military village and engaging in dialogue with the GenAI grandfather character, players can inquire about the grandfather's memories to compare information, piece together clues through reasoning, and recover the grandfather's lost videotape. This process enhances immersion and understanding of the culture of military villages. A total of 17 learners participated in the empirical evaluation of this study. The findings revealed that learners experienced a high level of flow (M = 4.10) and moderate anxiety (M = 2.01) while playing the game. extrinsic cognitive load was relatively low (M = 1.45), indicating that the interface design did not impose additional burdens; however, germane cognitive load was relatively high (M = 4.41), suggesting that learners were willing to invest extra effort in reasoning and integrating clues. Among them, 88.2% of learners believed that the game deepened their impression of the village and pointed out that AI grandfather clues played a key role in reasoning. Additionally, 76.5% of learners were willing to visit the village in person as a result. This study combines GenAI and SVVR to provide an innovative model for historical and cultural education.

Keywords: generative AI, spherical video-based virtual reality, cultural heritage education

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Introduction

Cultural heritage education plays a central role in preserving and transmitting a society's cultural identity, traditions, and history. It fosters individuals' sense of belonging and identity while promoting cross-cultural understanding and appreciation (Camuñas-García et al., 2024). In the cultural education context examined by this study, information integration and interpretation skills are regarded as vital core competencies. However, traditional cultural education approaches, particularly within museums or cultural heritage sites, face challenges related to insufficient visitor engagement. Conventional museum artifact presentations often lack detail or provide limited information, making it difficult for visitors to connect with the artifacts or discern their significance (Othman et al., 2021). This static exhibition model typically fails to fully engage visitors and achieve effective participation, necessitating innovative approaches to enhance public interest and understanding of cultural heritage (Camuñas-García et al., 2024).

To address the limitations of traditional education, Digital Game-Based Learning (DGBL) has been widely adopted (Camuñas-García et al., 2024). Technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) have proven to be powerful tools for cultural heritage preservation and education, enhancing the interactivity of cultural objects (Jiang et al., 2025). Jiang et al. (2025) noted that the application of these technologies is shifting from traditional static preservation methods toward dynamic, interactive approaches to foster public engagement and educational impact. VR provides fully immersive experiences, such as creating detailed digital replicas of endangered cultural monuments or virtual models of fragile heritage sites (e.g., the Lascaux caves in France), enabling interactive exploration without causing physical wear to artifacts (Jiang et al., 2025).

Serious games leverage technology in the cultural heritage sector to engage users in educational and immersive experiences. They integrate instructional content and practical knowledge into gameplay mechanics, aiming to achieve user satisfaction, engagement, immersion, and effective perception of educational content (Bontchev et al., 2024). Othman et al. (2021) developed a mobile gamified tour application using a treasure hunt game mechanism. They found that while the game enhanced children's cultural heritage experiences in living museums, differences in engagement, knowledge and learning, and meaningful experiences did not reach significant levels. Only the emotional connection dimension showed a significant effect. This also indicates that traditional game mechanisms still have limitations in comprehensively enhancing cognition and engagement.

This study selected the integration of SVVR (Spherical Video-Based Virtual Reality) and GenAI (Generative AI) to overcome the limitations of either technology alone and leverage their complementary characteristics. SVVR is a form of immersive VR that captures real environments through 360-degree video (or real-life footage), offering a low-cost, user-friendly immersive learning experience suitable for educational settings. Its interactivity is limited to viewpoint switching, lacking scaffolding support and assessment capabilities (Jong, 2023). GenAI delivers creative and randomized feedback, generating content from data to provide adaptive guidance and real-time feedback (Lau et al., 2024). GenAI exhibits bidirectional dynamism and explorability, guiding learners to instantly search for information, analyze situations, and strategize within games. It also features role-playing capabilities, enabling characters like “village grandfathers” in cultural education to create contextualized learning experiences (Chien et al., 2025). Therefore, this study employs SVVR to deliver immersive real-world settings and GenAI character interactions to address its interactive limitations.

Through real-time dialogue, role-based guidance, and cultural knowledge transmission, it realizes an immersive and interactive educational model for military dependents' villages, meeting educational design requirements. Consequently, this study focuses on the SVVR military dependents' village setting, cultural artifact interactions, and dialogues with the generative AI grandfather character. Presenting the game through a web interface and panoramic VR mode, it designs a historical-cultural educational game integrating cultural exploration and puzzle-solving. The AI dialogue within the story script incorporates multiple cultural clues. Learners must progressively deduce and integrate information through exploration and conversation to piece together the historical context of military dependents' village life.

Methods

Participants in this study were recruited voluntarily, comprising 17 individuals: 9 males and 8 females, aged between 22 and 77 years old, with a mean age of 32.1 years. To assess learners' flow states, this study adopted the Flow State Inventory developed by Kiili (2006), utilizing the Chinese version translated by Hou and Li (2014). In this study, the overall reliability of the Flow Scale was Cronbach's $\alpha = .882$, indicating high reliability. To assess learners' activity anxiety, this study adapted the activity anxiety Scale translated by Hung (2001). In this study, the overall reliability of the activity anxiety Scale was Cronbach's $\alpha = .596$. Future research could improve reliability by expanding the sample size. The cognitive load scale translated by Leppink et al. (2013) was adapted and adjusted based on Klepsch et al. (2017)’s differentiated cognitive load scale to assess learners’ cognitive load. In this study, the overall reliability of the activity learning cognitive load scale was Cronbach's $\alpha = .769$, demonstrating high reliability. All questionnaires employed a five-point Likert scale, with 1 indicating strongly disagree and 5 indicating strongly agree. Additionally, to understand learners' impressions, emotions, and cultural understanding, this study incorporated open-ended questions to collect qualitative feedback.

This study designed the historical education game “Time Village” The game features a realistic storyline, generative AI-simulated character interactions, and allows players to explore environments and objects within the SVVR-created military dependents' village setting (Forty-Four South Village). Players assume the role of a young man who converses with a generative AI NPC (the protagonist's grandfather), whose character script was co-designed by the research team. Through information cross-referencing and clue deduction, players must find a lost videotape within a limited timeframe. Players can input questions in the left dialogue box to receive the grandfather's responses, as shown in Figure 1. Simultaneously, they can explore objects within the military dependents' village scene (Forty-Four South Village) created by SVVR through the right-side game interface, as shown in Figure 2.

Figure 1
Time Village-GenAI interaction

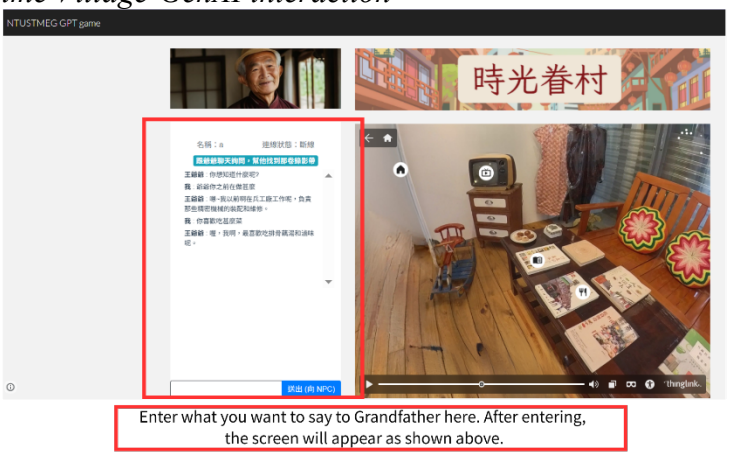


Figure 2
Time Village-SVVR Created Military Dependent Village Scene (Forty-Four South Village)



Results and Discussions

To examine learners' flow, this study employed a nonparametric one-sample Wilcoxon signed-rank test, comparing individual scores against the median (i.e., 3). Table 1 presents learners' flow states following the task. Overall flow ($M = 4.1$) was significantly higher than 3, and the subdimensions Flow antecedents ($M = 4.1$) and Flow experience ($M = 4.1$) were also significantly above 3. Results indicate that learners experienced high levels of flow ($M = 4.10$, $p < .001$) during gameplay. Among the sub-dimensions, Concentration ($M = 4.35$, $p < .001$) and Goals of an activity ($M = 4.50$, $p < .001$) stood out most prominently, showing that learners maintained focus and clearly understood task goals throughout the game. Additionally, high scores were observed for sense of Control ($M = 4.38$, $p < .01$) and Autotelic experience ($M = 4.18$, $p < .01$), showing the game's operability and provision of intrinsic feedback. The integration of SVVR scenarios with generative AI dialogue successfully created an immersive learning environment conducive to flow. This aligns with Fang (2024)'s findings that focus and control are key components of flow experiences within goal-directed training VR learning settings.

Table 1
The Mean and Standard Deviation of Learners' Flow

	(*N* = 17)			
	M	*SD*	*Z*	*Sig.*
Overall Flow	4.10	0.56	3.57***	.000
Flow antecedents	4.10	0.50	3.52***	.000
Challenge-skill balance	3.71	0.99	2.56*	.010
Goals of an activity	4.50	0.75	3.56***	.000
Unambiguous Feedback	3.76	0.99	2.64**	.008
Control	4.38	0.78	3.48**	.001
Playability	4.15	0.75	3.33**	.001
Flow experience	4.10	0.65	3.51***	.000
Concentration	4.35	0.78	3.50***	.000
Time distortion	3.91	1.08	2.65**	.008
Autotelic experience	4.18	0.83	3.35**	.001
Loss of self-consciousness	3.62	1.47	1.68	.093

*p < 0.05, **p < 0.01, *** p < 0.001

To examine learners' activity anxiety, this study employed a nonparametric one-sample Wilcoxon signed-rank test, comparing individual scores against the median. Table 2 presents the statistical results for activity anxiety. Overall anxiety (M = 2.01, p < .001) fell below 3, indicating that learners experienced low-to-moderate anxiety during gameplay. This finding also indicates that while the game provided cognitive challenges, it did not induce excessive stress, allowing learners to focus on exploration and reasoning tasks. Li et al. (2024) noted that the relationship between anxiety levels and student performance follows a fluctuating curve: low to moderate anxiety helps keep learning motivation, while excessive anxiety may negatively impact learning performance.

Table 2
The Mean and Standard Deviation of Learners' Activity Anxiety

	(*N* = 17)			
	M	*SD*	*Z*	*Sig.*
Activity anxiety	2.01	0.55	-3.52***	.000

***p < 0.001

To examine learners' cognitive load, this study employed a nonparametric one-sample Wilcoxon signed-rank test, comparing individual scores against 3. Table 3 presents the statistical results for cognitive load. Analysis indicates that intrinsic cognitive load was at a moderate level (M = 3.03, p = .740), showing no significant difference from 3. This suggests the cultural education task itself was neither excessively difficult nor overly simple. Extrinsic cognitive load was significantly low (M = 1.45, p < .001), showing significant difference from 3. This indicates that the SVVR interface and game mechanics did not impose additional burdens. Germane cognitive load was significantly high (M = 4.41, p < .001), showing significant difference from 3. This indicates that learners were willing to invest substantial effort in reasoning, integrating clues, and engaging with historical narratives. This outcome highlights how game design effectively minimizes unnecessary distractions while fostering meaningful cognitive engagement. Sevcenko et al. (2021) noted that in serious games,

appropriately managing learners' cognitive load through thoughtful design helps maintain optimal learning states, thereby promoting meaningful participation.

Table 3

The Mean and Standard Deviation of Learners' Cognitive Load

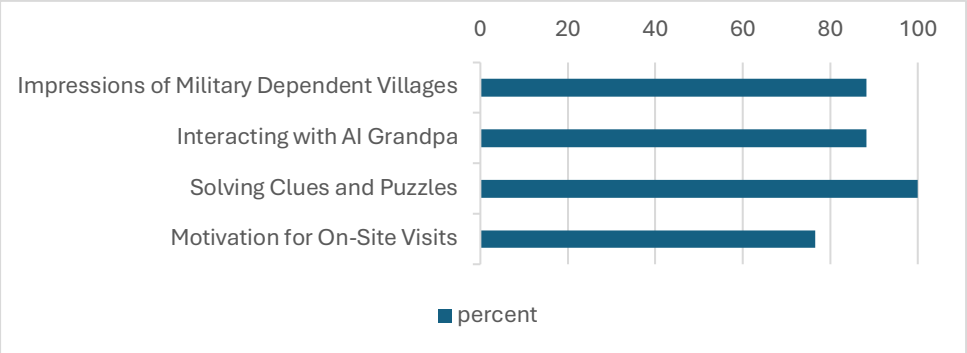
	(*N* = 17)			
	M	*SD*	*Z*	*Sig.*
Intrinsic cognitive load	3.03	0.69	0.33	.740
Extrinsic cognitive load	1.45	0.74	-3.82***	.000
Germane cognitive load	4.41	0.67	3.85***	.000

*p < 0.05, **p < 0.01, *** p < 0.001

Figure 3 presents learners' open-ended feedback and quantitative results. 88.2% of learners felt that the SVVR exploration deepened their impression of Forty-Four South Village. Similarly, 88.2% noted that conversations with AI Grandfather enhanced emotional engagement, with his authentic tone making memories of life in the munitions factory and neighborhood interactions feel more real and immersive. 100% of learners indicated that solving clues, such as flipping through recipes, reading bulletin boards, and listening to Grandfather's recollections, helped them deeply understand the culinary traditions and social interactions within military dependents' village culture. Furthermore, 76.5% of learners expressed that the SVVR experience sparked their curiosity, prompting them to visit Forty-Four South Village in person.

Figure 3

Results of the Open-Ended Questions on Military Dependent Villages



Conclusions and Limitations

This study confirms that integrating SVVR with GenAI characters in cultural education games effectively promotes learner flow, reduces activity anxiety, and enhances cultural understanding. Learners experience focus, immersion, and heightened presence during gameplay while mitigating task-induced learning anxiety, maintaining an optimal challenge level throughout exploration. Through a blend of exploratory interaction, puzzle-solving design, and contextual immersive scenarios, learners actively participate in clue collection and information inference. Simultaneously, they progressively construct cultural knowledge through dialogues with the AI Grandfather, deepening their understanding of military dependents' village history and cultural context. Research findings indicate that this gamified learning model not only enhances learner engagement and motivation but also sparks a desire to visit actual sites, bridging virtual learning with real-world cultural experiences. This achieves a connection between digital interactive education and cultural heritage preservation.

Beyond these findings, the study also identified limitations and future research directions. While AI Grandfather delivers culturally meaningful narratives, some learners suggested enriching dialogue content. Future research could enhance the contextual richness of AI dialogues and incorporate additional elements of military dependents' village knowledge—such as literature and music—to create a more comprehensive cultural learning experience.

Acknowledgments/Funding

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Users' Behaviors of Submitting and Commenting in Education-Related Subreddits

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Abstract

This study is an investigation of users' behaviors of posting and commenting in five education-related subreddits: r/teaching, r/Teachers, r/education, r/teachingresources, and r/CSEducation. The data were analyzed for the period from January 2018 until May 2019. Comparative analysis revealed some differences among the five results showing that the r/Teachers subreddit has the most engagement scores and active users' percentages while the r/education subreddit has the lowest score of engagement although it has the second-highest number of contributions (submissions and comments).

Keywords: education, CS, reddit, subreddits, user behavior, online communities

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Introduction

Despite the major focus in educational research on ways to improve students' learning and teachers' performance, teachers still face pedagogical challenges, curriculum challenges, and structural challenges (Margot & Kettler, 2019). One of the solutions to these challenges is collaboration among teachers in online communities (Margot & Kettler, 2019), which can be implemented on social media platforms.

Online communities can be valuable resources that offer teachers continuous professional development (Duncan-Howell, 2010). However, some computer science teachers have complained that online communities for sharing resources and learning from each other by posting questions and receiving answers often disappear (Yadav et al., 2016). They are looking for a sustainable and trustworthy source of information and support.

Social media platforms such as Twitter, Facebook, and Reddit are widely used by educators and learners (Carpenter et al., 2018; Willet & Carpenter, 2019). Srinivasan and Mekala (2014) defined social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content" (p. 155). Drawing on these affordances, many teachers use social media platforms for formal and informal professional development (Margot & Kettler, 2019). One of the social media platforms most widely used by teachers in the United States is Reddit, which was created in 2005 by Alexis Ohanian and Steve Huffman (Vella, 2015). Reddit members submit such content as links, texts, photos, and videos for discussion. There is also a function for raising content to the top (upvoting) if a member likes it or dropping content down (downvoting) if not.

The Reddit platform has many subreddits, each of which constitutes a specific online community. This social media platform thus serves different perspectives and different people. Although there are many subreddits that are concerned with education and supporting teachers, researchers have paid little attention to the different kinds (Willet & Carpenter, 2019). Moreover, Chen et al. (2014) emphasized that social media conversations provide us with rich data about teachers' experiences with, opinions on, difficulties with, or feelings about learning. In order to bridge this gap in the literature, this study focuses on five of the education-related subreddits: r/teaching, r/Teachers, r/education, r/teachingresources, and r/CSEducation, the websites of which indicate that they are all focused on education but different aspects. The earliest subreddit among the five targeted for this research is r/education, which was initiated in May 2008 as a space for educational stakeholders to discuss topics related to educational policy, research, technology, and politics. In December 2008, r/teachers subreddit was begun as a community for all teachers in different disciplines to share their experiences, stories, insights, and inspirations with others. The r/Teaching subreddit was launched in May 2009, also for teachers to share experiences and concerns. The r/CSE subreddit was begun in 2012 to target computer science educators and researchers and provide them with best practices and pedagogies for teaching computer science.

The most recently created subreddit in this study is r/Teaching Resources, which was initiated in February 2013. Its goal is to provide classroom teachers with resources and technologies in order to improve their knowledge delivery to students. All of the five subreddits are public and target mostly K-12 teachers in all disciplines, except for the r/CSEducation subreddit, which specifically targets computer science educators. The aim of this paper is to explore the behaviors of users of the five subreddits and to compare them in terms of their activities and

engagement. This work expands the work of Willet and Carpenter (2019) by adding r/CSEducation, which was initiated in response to computer science educators' quest for online communities to support their professional development (Yadav et al., 2016).

Related Work

There are many studies about online communities for teachers in general and computer science teachers in particular. However, to the best of the author knowledge and search, few qualitative studies on subreddit communities for teachers were found, in which human-coded content analysis was used, such as, Carpenter et al. (2018) and Chang-Kredl and Colannino (2017). In these studies, however, only small numbers of comments or posts were analyzed because of humans' limited ability to analyze the large amount of data available from social media platforms.

Chang-Kredl and Colannino (2017) analyzed 600 posts on a Reddit platform initiated to address the public image of teachers. The posts were selected via on a search on the Reddit platform using the following key phrases: "best teacher," "worst teacher," "favorite teacher," and "least favorite teacher". Based on this search, eight threads were selected, four about best teachers and four about worst teachers. Similar to Carpenter et al. (2018), inductive content analysis was applied. This process resulted in the identification of 15 codes, which were classified into four broad themes: teachers' professional qualities, teachers' personal qualities, relational qualities between teachers and students, and implications for students' least favorite teachers. The researchers concluded that the best teachers are those who know how to present, care about their relations with their students, and have an impact on students, while the worst teachers are those who are not qualified in their teaching skills, do not care about their relations with their students, and do not affect their students' lives.

Carpenter et al. (2018) conducted a qualitative study to analyze the top 25 posts and the associated responses in the r/teachers subreddit for a 20-day period. This sub-Reddit had the second highest number of readers. Inductive thematic analysis was used in this study in which human-coding was applied to examine the content of the posts. They found that the most frequent codes in r/teachers subreddit posts were the following: advice, teachers, a community post, specific content area, venting, new teacher, and students. Also, they found that users who posted to r/teachers most frequently sought or gave technical and emotional advice. Regarding analysis of responses, the study revealed that the top-rated responses tended to provide advice in line with what was sought in the original advice-seeking posts. In addition, sometimes the advice provided emotional support.

In an exploratory study of conversations between teachers, Willet and Carpenter (2019) collected 351,301 posts, including 114,524 original posts and 236,777 responses, from four different education-related subreddits, r/education, r/Teaching, r/teaching, and r/Teaching Resources, between July 1, 2017 and June 30, 2018. In this study, the *active percentage* was defined as "the number of contributors to a subreddit in the past year divided by the number of subscribers to that subreddit, as of September 2018," and the *engagement score* "represented the number of responses to questions in a subreddit in the past year divided by the number of threads, or clustered conversations, in that subreddit during the same span of time" (p. 2789). Based on the traced data, they found that a large number of subscribers were not necessarily associated with the most active contributors. They also calculated a text-polarity sentiment score for every contribution in each of the subreddits for the voting score, which is the sum of all upvotes and downvotes. In addition, they created a word cloud for each subreddit to explore

the most popular words. They found that the subreddit r/education included broader conversations about education while the subreddit Teaching Resources was more concerned with resources than with what happens in schools.

Research Questions

The aim of this study was to investigate users' participation in five education-related subreddits: r/education, r/Teachers, r/Teaching, r/CSEducation, and r/Teaching Resources by answering the following questions:

1. What are the engagement scores for each subreddit?
2. What are the percentages of active users in each subreddit?
3. What are the users' behaviors of posing and commenting for each subreddit?
4. What are the most used words in submissions and comments for each subreddit?
5. Are the targeted subreddits growing or not?

Dataset

A dataset of 6,870 contributions was analyzed, the total number of original posts (submissions) and responses to them (comments) in five subreddits related to education: r/Teaching, r/Teachers, r/education, r/TeachingResources, and r/CSEducation during the period of January 2018 to May 2019. This dataset was only 1% of the original data and was downloaded from the server of Dr. Riddell, the course instructor, to my laptop.

In this study, a submission is a post first submitted by a user, referred to as the submitter, in the form of either a question or a statement communicated to other users and to which other users, referred to as commenters, can respond. Each submission with its comments is called a thread.

Method

In order to answer the research questions, the dataset drawn from five education-related subreddits was analyzed using Python. First, 34 parquet files were downloaded from the server to my laptop. The first 17 files had 1% of the comments of all the subreddits, and each file contained data for one month, starting from January 2018 to May 2019. The last 17 files included 1% of all subreddit submissions. The submissions and comments of the five targeted subreddits were extracted in order to find the number of comments, the number of submissions, the number of users who submitted, the number of users who commented, and the number of questions in the submissions data for each subreddit. The percentage of active users of each subreddit was calculated by dividing the total sum of commenters and submitters to that subreddit during the 17- month period by the total number of users as of December 2019. Engagement scores were also calculated for each subreddit by dividing the number of comments in a subreddit during the 17-month period by the number of submissions during the same span of time. These definitions of active percentages and engagement scores were adopted from Willet and Carpenter (2019).

In order to classify each submission post as questions or statements, if a question mark in each post was present, the submission was classified as a question; otherwise, the submission considered to be a statement. Then the submissions and comments were merged and then words counted separately in order to find the most common 50 words in each of the five subreddits, which I then used to create word clouds. The Word Cloud tool has the feature of filtering

out all punctuation and stop words, such as articles, pronouns and conjunctions, before forming clouds.

Evaluation

To assess the validity of the coding, two alternative samples were used from two subreddits. One was one of the largest subreddits r/AskReddit (Cole et al., 2019), a forum in which users can ask questions on different topics. It was started in January 2008 and has more than 25 million users. The other subreddit was r/FIFA, a sports channel started in 2009, which has more than 3,000 users. The results were robust in support of sampling data from other months in the same time period showing similar observations.

Results and Discussion

In this part, the findings of this study of users' behaviors in five education-related subreddits are presented. Descriptive statistics for the overall contributions to the five subreddits were calculated (Table 1). The results show that all subreddits had more comments than submissions except for the r/education subreddit, in which there were more submissions than comments, yielding a 0.40 engagement score, indicating that the users of this particular subreddit were not highly engaged with or not cognizant of the content discussed. Another possible explanation is that the submissions, which are the main posts in a forum, were more often in the form of declarative statements rather than questions and so did not elicit answers, and people are more likely to be engaged when submissions are questions.

This explanation is supported by the two highest engagement scores, 11.7 for the r/Teachers subreddit followed by 8.2 for r/teaching. Both of these subreddits had submissions with more questions than statements (Table 2), which might be a reason for the higher scores for engagement with the content. This explanation is also supported by the finding that the subreddits with the lowest engagement scores, CSEducation, and r/teachingresources, had submissions with fewer questions and more statements. These results are aligned with what Willet and Carpenter (2019) found in their study.

Table 1
Engagement Score of the Subreddits

Subreddit	Comments	Submissions	Engagement
r/education	425	1102	0.40
r/teachers	4060	349	11.71
r/Teaching	512	59	8.2
r/CSEducation	9	3	3
r/teachingresources	29	23	1.34

Regarding the type of submission, all five subreddits have fewer question type submissions and more of statement submissions and the r/CSEducation subreddit does not have any questions at all (Table 2).

Table 2
Questions and Statements in Submissions

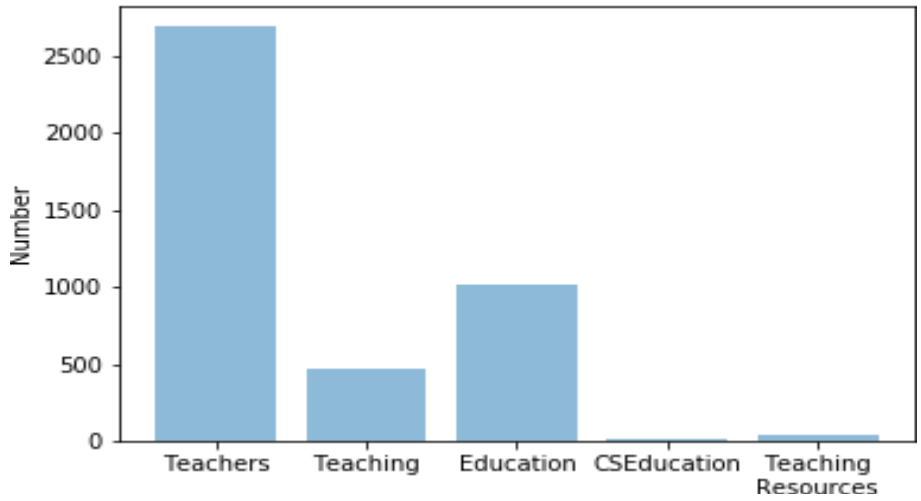
Subreddit	Questions	Submissions
r/education	9	1093
r/teachers	155	194
r/Teaching	26	33
r/CSEducation	0	12
r/teachingresources	3	20

While all of the five subreddits had very low percentages of active users (Table 3), r/Teaching subreddit had the highest active users' percentage (2.1%), followed by r/education, r/teaching, r/teachingresources, and r/CSEducation consecutively (Figure 1).

Table 3
Active Users Percentages for Subreddits

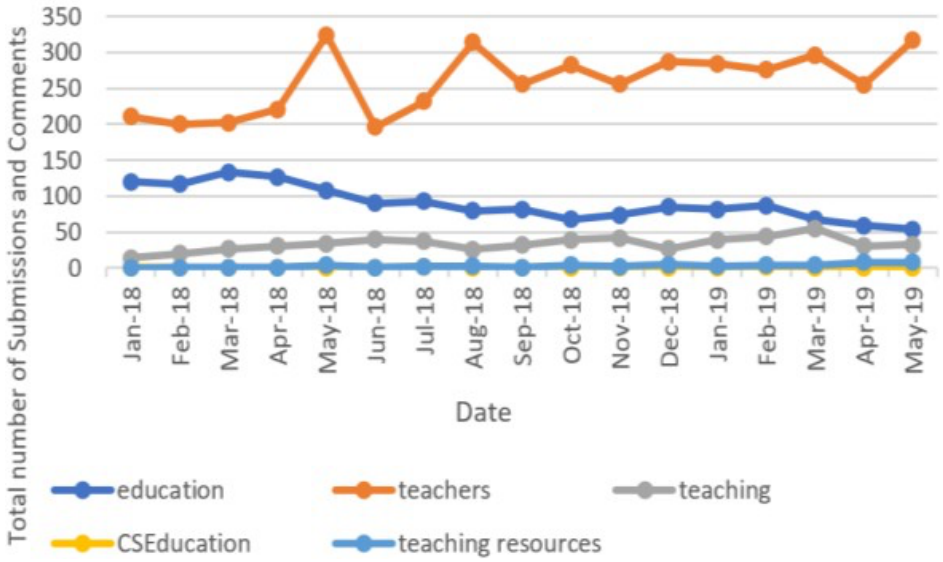
Subreddit	Commenters	Submitters	Subscribers	Active (%)
r/education	311	706	96,600	1.05%
r/teachers	2433	263	128,000	2.10%
r/Teaching	418	55	50,400	.93%
r/CSEducation	9	3	10,900	.11%
r/teachingresources	26	12	18,800	.23%

Figure 1
Number of Active Users of Each Subreddit



To explore the growth of subreddits during the 17 months starting from January 2018, a line graph of the total number of submissions and comments was created. The graph illustrates that the r/Teachers subreddit was more active at the beginning of this period and remained the most active subreddit until the end, while activity in the r/education subreddit decreased over the 17 months. On the other hand, the r/teachingresources and r/CSEducation subreddits, which began with low activity rates, remained relatively stable throughout the data collection period (Figure 2).

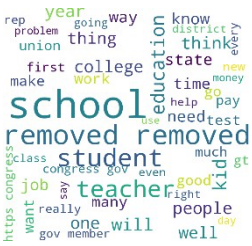
Figure 2
Are the Subreddits Growing?



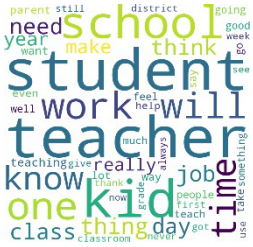
In regard to the common words in each subreddit (Figure 3), the word clouds show that in general the words were related to educational discussions about K-12 contexts. The word clouds based on the most common words show a clear similarity in the topics discussed in the r/Teachers and r/teaching subreddits, for instance, "student," "teacher," "school," "kid," "work." In the r/education subreddit, the most common word is "school." Also, in the r/education subreddit the word "removed" is shown twice in large font, indicating that a comment or submission was removed either by Reddit moderators or by spam filters. This suggests that the moderators of this subreddit actively observe the published content, and that this subreddit's users posted inappropriate content. Moreover, "https" is one of the common words, showing that in general users like to share links. The word cloud for the r/teachingresources subreddit includes "budgeting," "cloud," "exam," "question," "planning," and "certification" as the most common words. This suggests that a main concern in the teaching resources subreddit is about resources that might support students' achievement in exams and ways to use school resources to promote learning. The word cloud for the r/CSEducation subreddit shows "password," "CS (computer science) programmer," and "training" as the most common words. These words emphasize that computer science education and a focus on students as programmers are main concerns of users of this subreddit. Also, the word "training" shows the desire for professional development by CS teachers.

Figure 3

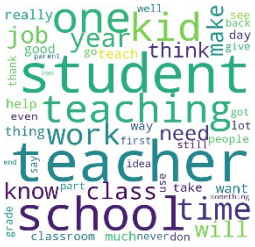
Common Words in Each Subreddit



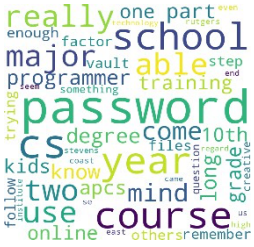
r/education



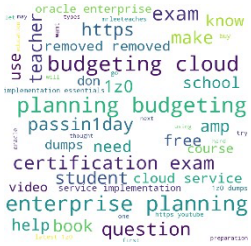
r/teachers



r/Teaching



r/CSEducation



r/teachingresources

Conclusion

Four of the five subreddits in this study can be considered as low-activity communities, the exception being the r/Teachers subreddit. Therefore, based on this as well as previous studies, it can be inferred that many CS teachers suffer the disadvantage of not having an online community on which they can rely for substantive interaction and support. Thus, the findings of this study suggest the need for more research attention to education-related subreddits, especially those with low engagement scores and percentages of active users, and ways to create and sustain more dynamic communities for CS educators.

Future Work and Limitations

Toward this end, this study can be expanded by including more education-related subreddits, for instance, subject-related subreddits in K-12 contexts to examine other users' behaviors and compare them with those of the r/CSEducation subreddit users. Moreover, similar studies might be conducted to explore other online communities for teachers, such as #ComputerScienceEduction on X platform, and compare these with Reddit communities in order to find the best practices for improving users' engagement with the content and interactions in subreddits. In addition, network analysis studies can increase understanding of the relations among users and how they respond to each other. Future research should also investigate the most active subreddits related to the field of education to explore the reasons for their high rates of activity.

There are some limitations to this study. One is the researcher's limited knowledge of computational linguistics and big data analysis. Another limitation is reliance on bots-generated content, which might have affected the data on which the results of the study were based.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Collaborative Governance in Transnational Higher Education: Reimagining Leadership Through UK-UAE Partnerships

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Abstract

Transnational education partnerships between UK and UAE institutions reveal how cultural differences shape shared leadership and decision-making in practice. Through interviews with 32 stakeholders across regulatory bodies, universities, and educational agencies, this research examines how British risk-based governance approaches negotiate with Emirati centralised quality assurance systems. The study demonstrates that effective cross-border partnerships require navigating distinct cultural expectations: British emphasis on institutional autonomy and peer review contrasts with UAE preferences for clear hierarchical structures and ministerial oversight. Key findings show that successful partnerships employ cultural translators who mediate between regulatory frameworks, implement joint governance boards balancing representation with efficiency, and develop trust through regular face-to-face engagement rather than relying solely on contractual mechanisms. Power asymmetries manifest practically in curriculum validation, where UK institutions retain final approval whilst UAE partners seek meaningful input on local contextual adaptation. The research identifies three practical strategies for culturally responsive shared leadership: bilateral quality agreements that acknowledge both regulatory systems, stakeholder engagement mechanisms incorporating voices traditionally marginalised in governance, and outcomes-based monitoring combining data-driven accountability with relational trust-building. These findings offer actionable guidance for developing equitable international education partnerships that respect cultural diversity whilst maintaining quality standards.

Keywords: transnational education, collaborative governance, quality assurance, stakeholder participation, power dynamics

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Introduction

Transnational higher education (TNE) has evolved from a niche export activity to a central pillar of internationalisation strategies worldwide. Global TNE enrolment expanded from 0.9 million learners in 2000 to an estimated 4.3 million in 2024, representing 17% of all internationally mobile education and generating US$44 billion in annual revenue (Altbach & Knight, 2007; Garrett & Verbik, 2024). This rapid expansion has surfaced critical questions about academic quality, legitimacy, and stakeholder voice in cross-border educational provision that require systematic investigation and theoretical development.

The commercial imperative driving TNE growth cannot be divorced from questions of educational quality and equity. Universities face mounting financial pressures from reduced public funding, increasing operational costs, and intensifying global competition for students. TNE partnerships offer diversified revenue streams whilst expanding institutional reach and reputation across international markets. However, this commercialisation raises fundamental questions about whose interests are prioritised in governance structures, how quality standards are negotiated across different regulatory contexts, and whether the voice of all stakeholders—particularly students, local faculty, and host country partners—is adequately represented in decision-making processes.

This research examines TNE partnerships between the United Kingdom and the United Arab Emirates, offering an instructive contrast in quality assurance approaches shaped by distinct cultural and governance traditions. The UK operates a risk-based, peer-review regime that privileges institutional autonomy through the Quality Assurance Agency (QAA), reflecting British cultural values of academic freedom, collegial decision-making, and trust in professional judgement. The UAE, by contrast, enforces a highly centralised model through the Commission for Academic Accreditation (CAA), linking quality tightly to national development goals in alignment with Emirati cultural preferences for clear hierarchical authority, government oversight, and structured compliance systems.

More than sixty UK universities deliver programmes in the UAE, most located in Dubai's education free zones, creating a natural laboratory for examining how divergent regulatory logics and cultural expectations negotiate mutual recognition. These partnerships require ongoing cultural translation as British and Emirati stakeholders navigate different assumptions about authority, transparency, consultation processes, and the appropriate balance between standardisation and local adaptation. Understanding how shared leadership functions in practice across these cultural boundaries offers insights applicable to transnational partnerships more broadly.

The overarching research question addresses: How do collaborative governance, stakeholder participation, and the relationship between home and host institutions affect quality assurance in UK TNE programmes offered in the UAE, across different delivery modes and cultural settings? This question is explored through three specific research objectives. First, examining how governance structures and institutional adaptability influence quality assurance across different TNE delivery modes. Second, analysing how power dynamics and stakeholder participation shape decision-making processes in TNE partnerships. Third, investigating the role of trust mechanisms, contractual arrangements, and principal-agent relationships in maintaining programme quality and institutional reputation.

Literature Review and Theoretical Framework

Current scholarship on TNE governance falls into two broad categories. The first, dominated by higher-education management journals, documents institutional practices through single-case studies focusing on partnership contracts, credit-transfer protocols, and resource allocation (Healey, 2016; McBurnie & Ziguras, 2006). The second, rooted in comparative-policy literature, analyses national quality assurance regimes but rarely links them to the lived experience of cross-border delivery (Altbach & Teichler, 2001; Johnson et al., 2021). Few studies attempt an integrated, multi-level account that examines both policy frameworks and operational realities whilst attending to how cultural differences shape governance practices.

Three theoretical lenses inform this research. Collaborative Governance Theory provides a framework for understanding how different actors with conflicting interests engage in consensus-driven decision-making processes (Ansell & Gash, 2008). Applied to TNE contexts, this perspective suggests that effective quality assurance depends less on imposing uniform standards than on creating spaces for genuine dialogue between home and host institutions, regulatory bodies, and other stakeholders. However, the theory's optimistic assumptions about consensus-building may underestimate how deeply entrenched power asymmetries and cultural differences constrain genuine collaboration.

Stakeholder Theory (Freeman, 1984) identifies the needs and power dynamics of key players in transnational partnerships, including students, faculty, regulators, ministries, employers, and professional bodies. In TNE contexts, this theory reveals tensions as home institutions typically prioritise reputation protection and financial returns, host partners emphasise local market access and capacity building, students expect affordable access and internationally recognised qualifications, and regulatory bodies seek to ensure quality standards whilst advancing national strategic objectives. These divergent interests create contestation over whose voice is heard in governance structures.

Agency Theory (Eisenhardt, 1989) views TNE partnerships as principal-agent relationships characterised by control issues, varying incentives, and information asymmetry. Applied to TNE, home institutions function as principals who retain degree-awarding authority but delegate delivery to host partners serving as agents. This relationship creates risks that hosts may prioritise revenue over academic standards or misrepresent their capabilities. Effective TNE governance likely requires combining the structural clarity that agency theory emphasises with the trust-building processes highlighted by collaborative governance approaches.

Methodology

This research adopts an interpretivist worldview, recognising that quality assurance in higher education is perceived differently by various stakeholders across cultural boundaries. Interpretivism acknowledges that what constitutes “quality” is not a fixed, universally agreed standard but rather a socially constructed concept negotiated through interactions between institutions, regulators, students, and other stakeholders. Understanding these negotiated meanings, particularly across UK and UAE cultural contexts, requires engaging deeply with participant perspectives.

Semi-structured interviews were conducted online with 32 participants across UK and UAE TNE institutions during September and October 2025. Interview duration ranged from 45 to 90 minutes, generating approximately 480,000 words of transcript data. Participants included

senior academic leaders such as pro-vice-chancellors and deans responsible for international partnerships, quality assurance professionals including internal auditors and compliance officers, regulatory experts from the QAA and CAA, educational consultants who facilitate TNE partnerships, agents who recruit students for TNE programmes, and institutional managers responsible for day-to-day partnership operations. Participants had between 5 and 35 years of experience in transnational education, providing rich historical perspective on how TNE governance has evolved.

Purposive sampling identified individuals with direct experience in UK-UAE TNE programmes and knowledge of governance, partnership models, and quality assurance practices. Snowball sampling supplemented this approach where initial participants referred others meeting the study criteria. The sample achieved breadth across institutional types, including Russell Group research-intensive universities, post-1992 universities with substantial TNE portfolios, specialist institutions, and private providers operating in UAE free zones.

Data analysis followed the six-step thematic analysis framework of Braun and Clarke (2008), integrated with the Gioia methodology (Gioia et al., 2013) to systematically develop first-order codes from participant narratives, second-order themes through interpretive clustering, and aggregate dimensions representing overarching theoretical constructs. This rigorous analytical approach ensures findings remain grounded in participant experiences whilst connecting to broader theoretical insights.

Ethical approval was obtained from the researcher's institution. All participants provided informed consent, and pseudonyms were assigned to protect confidentiality. The study maintains trustworthiness through credibility, transferability, dependability, and confirmability as outlined by Lincoln and Guba (1985).

Findings

Cultural Dimensions of Governance and Institutional Adaptability

Participants revealed how cultural differences fundamentally shape governance approaches in UK-UAE partnerships. British stakeholders emphasised institutional autonomy and bottom-up quality enhancement, reflecting UK higher education traditions of collegial governance and academic freedom. One UK quality director explained: “We trust our academic staff to maintain standards through peer review and professional judgement. Quality assurance is about creating an environment where excellence can flourish, not imposing rigid compliance systems.” This approach aligns with broader British cultural values privileging individual professional judgement within loosely coupled organisational structures.

Emirati stakeholders, by contrast, described quality assurance in terms of clear standards, structured processes, and governmental oversight. A UAE regulatory official noted: “Quality requires explicit criteria that everyone understands and systematic monitoring to ensure compliance. Our role is to protect students and national interests through rigorous oversight.” This perspective reflects cultural preferences for hierarchical decision-making structures and clearly defined authority relationships common in Gulf societies. These divergent cultural expectations created ongoing tensions requiring active negotiation in partnership governance.

Several participants described the emergence of “cultural translators”—individuals with deep experience in both UK and UAE contexts who mediate between different governance

expectations. These translators help UK partners understand Emirati preferences for formal documentation and explicit approval processes, whilst helping UAE stakeholders appreciate British emphasis on evidence-based quality enhancement and professional autonomy. One consultant explained: "Successful partnerships require people who can speak both languages, not just linguistically but culturally. You need to understand why UK universities resist what they see as bureaucratic compliance and why UAE regulators insist on detailed documentation."

The role of these cultural translators proved particularly critical during regulatory audits and quality reviews. British institutions approaching UAE regulatory reviews with their typical peer-review documentation found it insufficient for Emirati expectations. One UK quality manager described:

> We submitted what we considered comprehensive programme documentation—external examiner reports, student feedback analysis, enhancement action plans. The CAA reviewers wanted much more explicit detail: specific learning outcomes mapped to assessment tasks, documented approval at multiple committee levels, formal evidence of regulatory compliance checks. We initially saw this as bureaucratic, but our UAE partners helped us understand it reflects different accountability expectations.

Conversely, UAE partners initially struggled with British quality assurance emphasis on reflective practice, enhancement culture, and professional judgement. One host institution manager explained:

> QAA audits focus on how institutions learn and improve, asking about our quality culture and enhancement mechanisms. This felt vague compared to CAA's specific compliance criteria. We needed to develop different capabilities—not just demonstrating standards compliance but articulating our quality philosophy and enhancement approach.

These contrasting regulatory expectations required partnerships to develop dual capability satisfying both frameworks.

Curriculum validation emerged as a key site where cultural differences manifest practically. UK validation processes typically involve extensive collegial debate, iterative refinement based on external examiner feedback, and significant academic discretion in programme design. Emirati stakeholders, however, expressed frustration with what they perceived as vague processes lacking clear timelines and explicit approval criteria. One UAE partner described: "The UK validation process feels opaque to us. We prepare extensive documentation but then face additional questions and requests for clarification without clear standards about what's required. We need more structure and transparency."

These tensions played out concretely in curriculum localisation debates. UK institutions emphasised maintaining curriculum parity—offshore programmes matching home campus content exactly—to protect academic standards and degree equivalence. One UK academic explained: "Our degree must mean the same thing whether studied in London or Dubai. We can't compromise academic standards for local preferences." However, UAE partners argued that rigid curriculum standardisation ignored legitimate local context. An Emirati programme director noted: "Business education needs local case studies, regional economic contexts, and

examples students recognise. Teaching UK retail case studies to Dubai students who've never been to Tesco makes no pedagogical sense."

Successful partnerships navigated this tension through distinguishing core curriculum requirements from contextual application. One partnership manager described:

> We identified non-negotiable learning outcomes and theoretical foundations that must be identical. But we allow flexibility in examples, case studies, and application contexts. A module on retail strategy teaches the same analytical frameworks but uses regional examples relevant to students' future careers. This preserves academic standards whilst respecting local relevance.

This approach required extensive dialogue to define which curriculum elements were essential for degree integrity versus where contextual adaptation enhanced rather than compromised quality.

Assessment practices revealed similar cultural negotiations. British universities typically privilege diverse assessment methods emphasising critical analysis, independent thinking, and original argument development. However, participants noted that students educated in Gulf education systems often initially struggled with open-ended assessments lacking clear answer criteria. One UK programme director explained:

> We had to develop more structured rubrics and exemplars than we'd use in the UK, not because standards were lower but because cultural learning expectations differ. Emirati students excel when they understand exactly what's expected, but British-style 'develop your own argument' assignments initially felt unclear to them.

Stakeholder Power Dynamics and Shared Decision-Making

Analysis revealed how cultural norms around authority and participation shape shared leadership practices. British stakeholders generally expected inclusive consultation processes where multiple voices contribute to decisions, reflecting UK higher education traditions of committee-based governance and democratic deliberation. However, this consultation model sometimes frustrated Emirati partners accustomed to clearer hierarchical decision-making where senior leadership provides definitive direction after appropriate consultation with relevant authorities.

One host partner described this cultural difference: "UK universities hold endless meetings where everyone has input but decisions remain ambiguous. In our context, we value consultation but expect leaders to make clear decisions and provide direction. The British preference for consensus-building can feel indecisive to us." Conversely, British stakeholders sometimes perceived Emirati decision-making as top-down, with limited genuine consultation. One UK academic noted: "We're told the ministry has decided something, and there's little opportunity to discuss alternatives or understand the rationale. It feels directive rather than collaborative."

Successful partnerships developed hybrid governance models accommodating both cultural preferences. Several participants described joint academic boards with equal representation from UK and UAE institutions but structured with clear terms of reference, decision-making protocols, and escalation procedures. These boards balanced British preferences for collegial

deliberation with Emirati expectations for structured processes and clear authority. One partnership director explained: “We've learned to be explicit about how decisions get made, who has authority over what, and how disagreements get resolved. This clarity helps both sides feel comfortable with shared governance.”

Student voice revealed particularly interesting cultural dynamics. British stakeholders described extensive student feedback mechanisms, student representation on committees, and partnership approaches positioning students as active participants. However, several noted that Emirati students sometimes felt uncomfortable with this expectation, preferring more structured guidance and clearer authority relationships with faculty. One UK programme director observed: “We encourage students to challenge ideas and participate actively, but some UAE students initially find this unfamiliar. They've been educated in systems with more hierarchical teacher-student relationships.”

Trust Mechanisms and Cultural Approaches to Partnership

Trust-building emerged as fundamentally cultural, with British and Emirati stakeholders emphasising different pathways to establishing partnership confidence. British participants described trust developing through demonstrated professional competence, peer recognition, and track record of delivery. One UK pro-vice-chancellor explained: “We build trust by showing we can deliver quality education, by our external examiner reports, by our graduates' success. Trust comes from proven capability and professional reputation.”

Emirati stakeholders, whilst valuing professional competence, placed greater emphasis on personal relationships, face-to-face interaction, and social connection. Several described trust as emerging through regular visits, shared meals, and relationship-building beyond formal business meetings. One UAE partner noted:

> Trust requires knowing people personally, not just professionally. We invite UK partners to our homes, we share hospitality, we build relationships through personal connection. The British sometimes seem too focused on contracts and formal agreements without investing in relationship building.

These different cultural approaches to trust created initial friction but ultimately enriched partnerships when acknowledged and accommodated. Successful partnerships combined British emphasis on contractual clarity and documented processes with Emirati investment in personal relationships and social connection. One consultant described: “The best partnerships have solid legal agreements that satisfy British institutional risk management but also invest heavily in face-to-face relationship building that Emirati partners value. You need both the contract and the relationship.”

Practical manifestations of these different trust-building approaches emerged in partnership communication patterns. British stakeholders typically relied heavily on email communication, virtual meetings, and formal documentation exchanges. One UK partnership director noted: “We're efficient with technology—emails, video calls, shared documents. We can manage partnerships remotely quite effectively.” However, UAE partners consistently emphasised the importance of physical presence and face-to-face interaction. An Emirati senior leader explained: “Email is for logistics. Real partnership requires sitting together, sharing meals, understanding each other as people. Virtual meetings are cold—they don't build the personal connection we need for trust.”

This cultural difference had significant practical implications during the COVID-19 pandemic when travel restrictions prevented face-to-face meetings. Several partnerships reported strain as British partners felt they could maintain relationships virtually whilst Emirati partners experienced this as relationship deterioration. One UAE quality director described:

> The pandemic showed us how much we rely on personal connection. Virtual meetings felt transactional. We lost the informal conversations, the relationship building, the trust that comes from spending time together. British partners seemed comfortable with virtual-only interaction, but for us it damaged partnership.

Post-pandemic, successful partnerships deliberately rebuilt relationship dimensions through regular planned visits, social activities integrated into business meetings, and senior leadership engagement demonstrating partnership commitment. One partnership coordinator explained:

> We now build relationship time into every interaction. Business meetings include lunch together, social conversation, opportunities for informal connection. British colleagues initially saw this as inefficient, but they've learned it's essential for Emirati partners. The relationship investment pays dividends when challenges arise—we can resolve issues through established trust rather than reverting to contractual enforcement.

Conflict resolution revealed similar cultural patterns. British stakeholders described preference for direct discussion, explicit negotiation, and written clarification of disagreements and resolutions. Emirati partners sometimes found this approach uncomfortably confrontational, preferring to address conflicts through intermediaries, maintain social harmony, and resolve issues through relationship-based negotiation. One experienced partnership manager explained: “You need to understand that direct challenge can feel disrespectful in Emirati culture. Issues get resolved, but through different processes that preserve relationship and status. British directness can damage partnerships if not culturally calibrated.”

Practical examples illustrated these cultural differences concretely. When quality concerns arose about teaching standards, British partners typically wanted direct conversations with involved faculty, explicit feedback on performance gaps, and documented improvement plans. One UK quality director described: “We're trained to have difficult conversations professionally. You identify issues, provide specific feedback, agree improvement actions, document everything. It's transparent and fair.” However, UAE partners sometimes experienced this approach as face-threatening. An Emirati academic manager explained: “Public criticism damages relationships and reputation. We address performance issues privately, through trusted intermediaries, preserving dignity whilst achieving improvement. British directness can feel harsh and disrespectful.”

Successful partnerships developed hybrid conflict resolution approaches accommodating both cultural preferences. These typically involved initial private discussion identifying issues and exploring solutions, followed by formal documentation of agreed actions satisfying British requirements for transparency and accountability. One partnership director described:

> We've learned to separate the social relationship maintenance from the professional accountability. Issues get discussed privately first, preserving dignity and relationship. Once we've agreed the solution, we document it formally. Both cultural needs are met—relationship preservation and professional accountability.

Language differences added another layer of complexity. Whilst business conducted in English, British stakeholders sometimes misinterpreted Emirati communication styles emphasising politeness and indirectness. One UK programme director reflected:

> Emirati colleagues would say 'this might be challenging' when they meant 'this is completely unacceptable.' We learned to read between the lines—indirect communication isn't unclear, it's culturally appropriate. British directness that we see as honest can feel rude to Emirati partners who value more nuanced communication preserving relationship harmony.

Successful partnerships invested in cultural training helping team members understand different communication conventions and adapt their approaches accordingly.

Discussion

Towards Culturally Responsive Collaborative Governance

The findings demonstrate that effective TNE governance requires moving beyond assuming universal governance models toward culturally responsive approaches recognising legitimate diversity in how quality assurance operates. Collaborative Governance Theory, when applied to cross-cultural contexts, must account for fundamental differences in cultural assumptions about authority, participation, transparency, and decision-making that shape how stakeholders engage with governance processes.

The research reveals three practical strategies for culturally responsive governance. First, bilateral quality assurance compacts that explicitly acknowledge both regulatory systems rather than attempting to impose one framework. Such compacts specify core quality standards all partnerships must meet whilst allowing flexibility in how standards are achieved, assessed, and documented in ways culturally appropriate to each context. Second, hybrid governance structures combining elements valued by different cultural traditions—such as joint boards balancing collegial deliberation with clear authority and structured processes. Third, investment in cultural translation through individuals who understand both governance traditions and can mediate between different expectations.

Implementation of these strategies requires concrete organisational changes. One successful partnership established a "cultural interface team" comprising staff with extensive experience in both UK and UAE higher education contexts. This team reviewed all partnership documentation, quality procedures, and communication protocols to identify potential cultural misunderstandings before they created conflict. Team members participated in validation panels, regulatory reviews, and partnership meetings, actively mediating cultural differences. One team member explained:

> We translate not just language but cultural expectations. When UK colleagues propose a new assessment approach, we help them understand how it needs to be presented to satisfy UAE regulatory requirements. When UAE partners raise concerns, we help UK teams understand the underlying cultural values rather than just the surface complaint.

Another partnership developed parallel governance documentation satisfying both cultural preferences. They maintained detailed procedural manuals with explicit approval hierarchies and compliance checklists for UAE regulatory purposes, alongside reflective quality

enhancement reports emphasising professional dialogue and development for UK requirements. One quality manager noted:

> Initially this felt like duplication, but we realised we were serving different cultural accountability logics. UAE regulators need to see systematic compliance evidence. UK reviewers want to understand our quality culture and enhancement approach. Rather than choose one approach, we developed capability in both, and this actually strengthened our overall quality assurance.

Rebalancing Power Through Culturally Aware Stakeholder Engagement

Stakeholder Theory reveals that power asymmetries in TNE partnerships are not merely structural but culturally mediated. British institutional dominance reflects not only legal realities around degree ownership but also cultural assumptions about whose governance approaches are "normal" or "rigorous." Moving toward genuinely equitable partnerships requires UK institutions to recognise that Emirati preferences for clear hierarchies, structured processes, and governmental oversight reflect legitimate cultural values rather than deficient governance maturity.

Effective stakeholder engagement across cultural boundaries requires explicit attention to how consultation processes may privilege certain cultural communication styles. British-style open debate and challenge may silence stakeholders from cultures valuing hierarchical respect and social harmony. Successful partnerships develop multiple engagement mechanisms—formal committees for those comfortable with British consultation styles, relationship-based informal dialogue for those preferring Emirati approaches, and clear escalation processes satisfying both cultural preferences for different decision-making structures.

Trust and Accountability Across Cultural Boundaries

Agency Theory illuminates how different cultural orientations toward trust create challenges in TNE partnerships. British reliance on contractual mechanisms and monitoring systems reflects cultural assumptions that trust emerges through demonstrated professional competence and institutional reputation. Emirati emphasis on personal relationships and social connection reflects different cultural logics where trust develops through interpersonal familiarity and relationship investment.

Effective principal-agent relationships in cross-cultural TNE contexts require combining both trust-building approaches. Contracts provide necessary clarity and legal protection valued in British institutional contexts, whilst regular face-to-face engagement and personal relationship investment builds trust in ways meaningful to Emirati partners. The shift toward outcomes-based quality assurance offers potential for culturally neutral accountability focusing on student success rather than prescribing governance processes aligned with particular cultural traditions.

Conclusion

This research demonstrates that effective transnational education governance requires reimagining leadership as culturally situated collaborative practice. The UK-UAE corridor reveals how divergent regulatory systems shaped by distinct cultural traditions can be reconciled through frameworks that integrate regulatory alignment, stakeholder engagement respecting cultural diversity, and trust-building combining multiple cultural approaches.

The proposed framework moves beyond assuming universal governance models toward culturally responsive shared leadership. Key elements include bilateral quality assurance compacts acknowledging legitimate diversity in governance approaches whilst ensuring core quality standards; hybrid governance structures combining elements valued by different cultural traditions such as collegial deliberation with clear hierarchical authority; investment in cultural translation through individuals who understand both governance traditions; multiple stakeholder engagement mechanisms accommodating different cultural communication preferences; and outcomes-based monitoring focusing on student success rather than prescribing culturally specific governance processes.

Theoretical contributions include extending Collaborative Governance Theory to explicitly address cultural dimensions of consensus-building, demonstrating how power asymmetries in Stakeholder Theory are culturally mediated rather than merely structural, and showing how Agency Theory's trust mechanisms operate differently across cultural contexts. Together, these perspectives provide a culturally aware framework connecting policy, institutional practice, and stakeholder experience.

Practical implications for policy include developing bilateral quality assurance frameworks that explicitly accommodate different cultural governance traditions rather than assuming universal standards; establishing cultural competence requirements for TNE approval ensuring institutions demonstrate understanding of host country cultural contexts; and creating international coordination mechanisms that facilitate cross-cultural dialogue and mutual learning rather than imposing particular governance models.

For institutions, the findings emphasise investing in staff cultural competence development including understanding different governance traditions and communication styles; recruiting cultural translators with deep experience in both partnership contexts; developing hybrid governance structures combining elements valued by different cultural traditions; implementing multiple stakeholder engagement mechanisms accommodating diverse cultural communication preferences; and balancing contractual clarity with relationship investment in ways meaningful across cultural boundaries.

Limitations include the qualitative design's focus on depth over breadth, constraining generalisability across all TNE contexts. The research examines one bilateral corridor which, whilst significant, may not capture dynamics present in other regional partnerships with different cultural traditions and power asymmetries. The study engaged policy-level stakeholders but not students or parents, representing a significant gap requiring future research.

Future research should examine student and parent perspectives on culturally responsive governance, investigating whether partnerships' cultural adaptations actually serve diverse learner needs. Comparative studies extending beyond UK-UAE to other cultural dyads—including UK-China, Australia-Southeast Asia, or intra-regional partnerships—would test the framework's applicability across diverse cultural contexts. Longitudinal research tracking how cultural understanding evolves in partnerships over time would illuminate learning processes and cultural adaptation trajectories.

In an increasingly globalised educational landscape, transnational education partnerships offer significant opportunities for intercultural learning and knowledge exchange. Realising this potential requires governance models that move beyond assuming universal standards toward

genuinely collaborative approaches respecting cultural diversity in how quality assurance operates. The framework developed through this research provides both theoretical foundation and practical guidance for institutions, regulators, and policymakers committed to developing culturally responsive, equitable transnational education partnerships.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

Generative AI tools were used to assist with literature review organisation, structural refinement, and language editing during the preparation of this manuscript. Specifically, Claude AI was employed to help synthesise theoretical frameworks, improve clarity and coherence in presentation, and ensure consistency in formatting and referencing. All substantive research design decisions, data collection, analysis, interpretation, and argument development were conducted by the author. The use of AI tools was limited to enhancing the presentation and organisation of original research findings and did not involve generation of research data, fabrication of citations, or substitution of authorial analysis and interpretation.

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Design and Preliminary Evaluation of a Psychological Counseling Training Game Using Generative AI Virtual Characters Based on Situational Learning as a Case Study

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Abstract

The recommended teaching strategy for psychological counseling training involves providing repeated training opportunities; however, the practical cost of implementation is high. Digital virtual simulations and game-based learning are expected to provide highly motivating, repetitive, low-cost training opportunities that are not restricted by time or space. This study employs the situational scaffolding-oriented generative AI virtual characters module developed by our team to design an educational game aimed at training psychological counseling. Players assume the role of a psychological counselor and conduct counseling sessions with AI characters within a limited timeframe, with the goal of eliciting positive responses from the characters. The participants in this study were 19 individuals who had completed the reserve training program in Taiwan. The research findings indicate that participants exhibited high of flow and did not experience excessive anxiety. They found the experience enjoyable and user-friendly, expressing a willingness to repeat the activity. Additionally, qualitative feedback revealed that over half of participants believed the activity aided in understanding empathy skills (56%) and identifying emotional cues (61%). It was also perceived as more simulation than general-purpose GPT models (83%) and more focused on counseling (61%). Preliminary findings suggest, this study designed a generative AI-based psychological counseling training educational game can be used for repeated practice of counseling techniques at low cost, making it suitable as a pre-practice tool before real-person case simulations. Future improvements could include adding learning feedback and scaffolding guidance to enhance the usefulness and realism of the training.

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Introduction

In recent years, mental health issues such as anxiety, depression, low self-esteem, and interpersonal sensitivity have frequently emerged among college students (Li, 2024). While psychological counseling remains a traditional solution, limitations in clients' subjective feelings and expressive abilities, coupled with variations in counselors' professional skills and conversational techniques, often hinder effective resolution of psychological issues (Li, 2024). In counseling skills training, emphasis is typically placed on teaching counseling techniques and therapeutic methodologies (Lau & Ng, 2014), with less focus on developing soft skills such as empathy or therapeutic presence (Chan et al., 2020). Rogers (1957) research indicates that the core conditions for therapists' interpersonal skills are empathy, congruence, and unconditional positive regard. Cooper et al. (2025) found that young people value empathetic understanding during counseling. Furthermore, in social anxiety interventions for youth, early assessments of facilitator empathy have been shown to correlate with positive counseling outcomes (Brouzos et al., 2014).

Therefore, this study proposes an innovative online digital educational game for psychological counseling training titled *Yuri's Secret Thoughts*. Utilizing Google Sites in conjunction with a scaffolding-oriented GenAI NPC simulation editing module (Chen & Hou, 2024), a simulation counseling education game platform is designed. A virtual character representing a case of low mood is also developed. Learners assume the role of professional counselors, engaging in psychological counseling interactions with the character. The case content draws from diverse everyday events experienced by college students, while also reinforcing the virtual character's personality traits, including negative thinking and pessimistic tendencies. Consequently, during the GenAI counseling process, learners can train themselves to understand and conduct effective counseling with empathy. Simultaneously, this mechanism incorporates scaffolding guidance to enhance counseling trainer effectiveness. The interactive process sets achieving four types of positive feedback from the virtual character as task objectives. Preliminary analysis of this research mechanism is also explored.

Research Purposes and Questions

The game task in this study involves learners assuming the role of a professional psychological counselor. Within the game, they engage in counseling conversations and provide psychological guidance to Yuri, a GenAI virtual character representing a specific scenario. Yuri is a college student experiencing severe emotional distress. Feeling down by university life and worthless, she has sunk into profound frustrated and seeks help through a counseling hotline. Throughout the counseling process, learners must employ empathy and counseling techniques to guide her, aiming to elicit positive feedback. Thus, this study aims to enhance counselors' communication skills and empathetic understanding through the scenario-based learning experience of *Yuri's Secret Thoughts*.

This study employs a plot dialogue interaction mechanism featuring GenAI virtual characters, immersing learners in highly simulation conversational scenarios while engaging them with authentic case events and character immersion experiences. Hou (2015) noted that scenario-based simulation games incorporating contextual learning may enhance learners' metacognitive processes. They can also boost learning motivation and maintain appropriate levels of anxiety, thereby achieving high levels of learning flow.

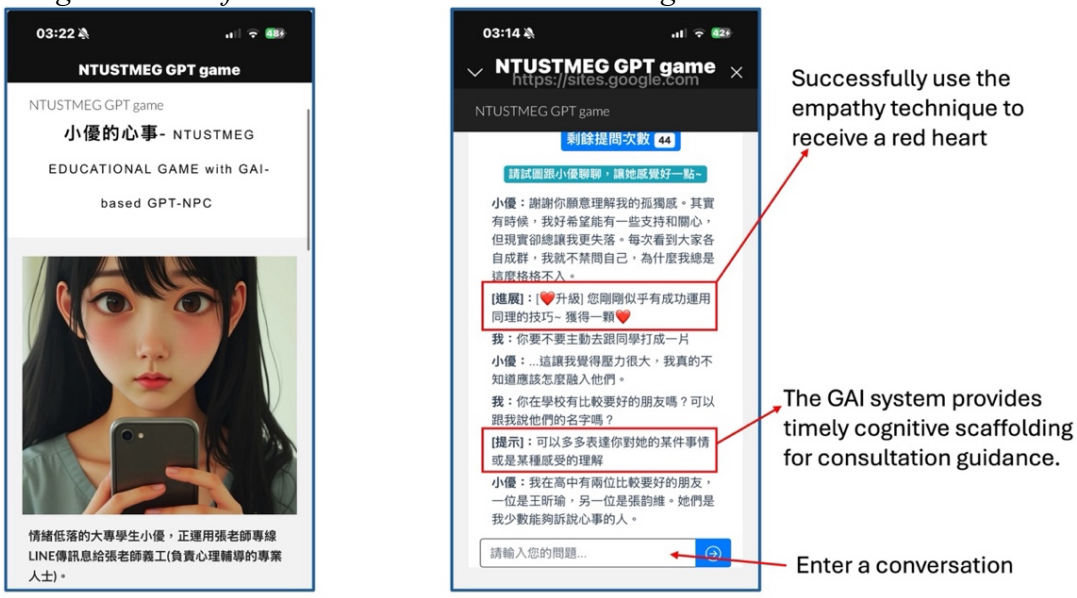
The research questions are as follows: *What are the learners' flow, game anxiety, game feedback, and game elements when using a generative AI virtual character grounded in situational learning as the case in a psychological counseling training educational game design?*

Method

The participants in this study were 18 individuals who had completed the reserve training program offered by Taiwan's Teacher Chang Foundation. Prior to the assessment, none of the participants had undergone any training courses utilizing the GenAI virtual character interaction mechanism. The activity was conducted via a mobile platform, enabling participants to engage in free-form counseling conversations with GenAI, as illustrated in Figure 1. The left image depicts the game's initial screen, where learners scan a QR code with their phones to enter the GenAI interaction interface, representing receiving a distress call from the virtual character Yuri, who is feeling down. The right image shows the interaction screen with GenAI, where learners can use voice input to simulate realistic, everyday conversational dialogue. When GenAI determines that responses demonstrate empathetic understanding or positive cognitive guidance, a red heart icon appears instantly. This signifies the learner has achieved a task objective and reinforces cognitive memory. Players can accumulate up to four hearts throughout the game. Success requires obtaining at least two hearts within 20 minutes using no more than 35 utterances. Additionally, the GenAI system provides cognitive scaffolding for counseling communication skills based on conversational context. Finally, a post-test questionnaire is administered, covering flow, anxiety, game feedback, and game elements. The experimental procedure begins with the researcher explaining the activity and testing process (5 minutes), followed by the instructional activity (20 minutes), and concluding with the post-test questionnaire administration (15 minutes).

Figure 1

Google Sites Platform and GenAI Interactive Dialogue Mechanism



To investigate learners' flow during learning activities, this study employed Kiili's (2006) Flow Questionnaire as the flow assessment tool, translated into Chinese by domestic scholars Hou

& Li (2014). The questionnaire comprises two major dimensions: Flow Antecedents and Flow Experience, totaling 22 items. This questionnaire uses Likert's five-point scale.

To examine learners' anxiety levels during activity participation, this study employed the Affective Filter Hypothesis Scale developed by Krashen (1982), adapted by Hung (2001) into the "Learning Experience Scale," comprising 8 items. This questionnaire uses Likert's five-point scale.

To examine learners' experiences using the game, this study modified Davis's (1989) Technology Acceptance Model (TAM) scale. It comprises two dimensions: cognitive usefulness and cognitive ease of use. Additionally, game elements were evaluated based on Hou (2016)'s proposed elements for promoting game motivation, consisting of 12 items. This questionnaire also uses Likert's five-point scale.

Results and Discussions

Based on the results of the one-sample Wilcoxon signed-rank test. Table 1 presents the descriptive statistics of flow among learners after task completion. Overall flow (M = 3.74, SD = 0.58) was significantly higher than the median of scale (i.e., 3). Additionally, both flow antecedents (M = 3.69, SD = 0.62) and flow experience (M = 3.78, SD = 0.60) were significantly above 3. All other sub-dimensions' means also exceeded 3. Notably, the sub-dimension Goals of an activity reached an average of 4.31. This suggests that the overall game design of the GenAI virtual character dialogue interaction mechanism in this study—enhanced by adding plug-in modules under the RAG framework to configure character roles, case scenarios, and knowledge cognition, achieves more realistic role-playing. This enables learners to become more immersed in the game during interactions. C.-C. Chien et al. (2024) found that in scenario-based educational games, learner interactions with GenAI virtual characters facilitate deeper scenario analysis while sustaining high flow. This may occur because interactions with GenAI are based on learners' questions and corresponding responses, creating a sense of authentic dialogue and counseling, and learners experience feedback through their sense of control (Ngu et al., 2025).

Table 1
The Mean and Standard Deviation of Learners' Flow

	(N = 18)			
	M	*SD*	*Z*	*Sig.*
Overall Flow	3.74	0.58	3.46***	< .001
Flow antecedents	3.69	0.62	3.24**	0.001
Challenge-skill balance	3.72	0.83	2.92**	0.003
Goals of an activity	4.31	0.67	3.67***	< .001
Unambiguous Feedback	3.06	1.00	0.42	0.674
Control	3.61	1.06	2.06*	0.039
Playability	3.78	0.81	2.91**	0.004
Flow experience	3.78	0.60	3.60***	< .001
Concentration	4.08	0.97	3.20**	0.001
Time distortion	3.81	0.84	2.91**	0.004
Autotelic experience	3.67	1.06	2.43*	0.015
Loss of self-consciousness	3.39	0.92	1.80	0.072

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2 presents descriptive statistics for learners' anxiety and overall game feedback. Overall anxiety (M = 2.43, SD = 0.65) was significantly below 3. Interactive games effectively reduce learning anxiety (Reed & Ferdig, 2021). C. C. Chien et al. (2023) noted that moderately low anxiety is a key indicator for sustained flow during game activities. Additionally, overall game feedback (M = 3.46, SD = 0.75), game usability (M = 3.91, SD = 0.80), and game elements (M = 3.71, SD = 0.61) were also significantly higher than the 3. Hassan et al. (2019) indicated that well-designed game elements evoke learners' sense of accomplishment, engagement, and enhanced motivation.

Table 2

The Mean and Standard Deviation of Learners' Anxiety and Overall Game Feedback

(N = 18)

	M	*SD*	*Z*	*Sig.*
Anxiety	2.43	0.65	-2.75**	0.006
Game Feedback	3.46	0.75	2.21*	0.027
Game Ease of Use	3.91	0.80	3.13**	0.002
Game elements	3.71	0.61	3.43***	< .001

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Additionally, qualitative feedback indicated participants found the game "fun and highly ease of use, willing to play repeatedly." Over half believed it helped understand empathy skills (56%) and identify emotional cues (61%), while 83% felt it was more realistic than typical GPTs and 61% reported greater focus.

Conclusion

Effective counseling involves helping individuals master psychological counseling techniques and actively apply them to address issues encountered by clients, thereby assisting them in resolving problems. The instructional strategy for psychological counseling training recommends repeatedly providing guidance and feedback training opportunities to prevent skill degradation. This study, Yuri's Secret Thoughts, involves learners engaging in free-form dialogue with a GenAI virtual character during counseling sessions. Counseling interactions are dynamically inductively analyzed to foster empathetic understanding, ultimately guiding the GenAI character to overcome psychological stress and achieve four positive feedback objectives as the task goals. Based on the above data analysis, learners provided positive feedback across all aspects: overall flow, learning anxiety, game feedback, and game elements. Preliminary findings indicate that the generative AI virtual character designed in this study, serving as a psychological counseling training game for cases, achieves low-cost, repeatable practice of key principles. It is suitable for repeated practice prior to real-person case simulations. Future enhancements could include learning feedback and scaffolding guidance to improve usefulness and fidelity.

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Integration of Generative AI Character Mechanism and Virtual Reality Clues for the Development of Educational Games for Clinical Reasoning Training in Nursing Care

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Abstract

Ward nursing staff must collect information for new patients and perform clinical reasoning for health assessment and nursing diagnosis, which requires realistic ward situations and case studies. Combining game mechanics with standardized patient simulations is expected to improve trainees' communication skills and problem-solving abilities and enhance motivation. This study investigates the effectiveness of an educational game combining GenAI and virtual reality in training nursing diagnostic reasoning. We developed a GenAI dual-role mechanism (GenAI playing the role of a patient uncle Sam and a senior nurse sister) and constructed a virtual reality clues room space through SVVR. The learning objectives of the game: learners take on the role of a nurse and interact through dialogues to perform health assessments and clinical reasoning on Uncle Sam, as well as consulting with another experienced GenAI nurse to gain expertise and solve problems. The study participants were 16 formal nurse practitioners in Taiwan. The results of this study showed that the study was highly useful in that the learners had a high flow and did not have a high external cognitive load, but only an internal cognitive load slightly above the median of the five-point Likert scale (i.e., 3), and that the difficulty of the tasks could be considered for simplification in the future. The qualitative feedback indicated that the mechanism could create realistic clinical situations (81.25%), improve interview assessment skills (93.75%), facilitate clinical reasoning (75%), reduce stress (87.5%), and increase concentration (81.25%).

Keywords: situational simulation, situated learning, digital game, workplace, clinical reasoning

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Introduction

Nursing clinical reasoning is an integrated thought process encompassing knowledge, experience, and clinical observation. The reasoning process involves interpreting clinical data and evaluating assessment findings while considering the patient's and family's background, environment, and psychosocial aspects to determine the most appropriate clinical diagnosis and formulate corresponding nursing interventions or decisions (Mohammadi-Shahboulaghi et al., 2021). In practical application, nurses employ this reasoning process in clinical care, known as the "nursing process," which comprises five primary steps: assessment, diagnosis, planning, implementation, and evaluation. Nurses systematically gather data on patients' physiological, psychological, spiritual, and social dimensions based on professional expertise and objective assessment results. This enables them to establish nursing diagnoses and formulate appropriate care plans to assist patients in improving their health status.

Previous educational training on the "nursing process" has involved traditional case-based teaching or clinical placements where nursing staff use Gordon's 11 Health Function Patterns assessment to collect patient data. However, constrained by the complexity of clinical settings and limited practice opportunities, nursing staff often struggle to master the application of reasoning processes, resulting in multiple limitations in clinical practice. For instance, insufficient clinical experience leads to inadequate judgment, lack of adequate practice and interactive feedback, low motivation in one-way instruction, and the high variability and unpredictability of clinical patient symptoms. These factors make it difficult for nursing staff to rapidly engage in clinical reasoning processes, resulting in reduced diagnostic accuracy and delayed decision-making (Liao et al., 2015). Therefore, there is a need to develop teaching strategies that are highly innovative, allow for repeated practice, feature highly realistic scenarios, and provide high levels of interactive feedback. This will effectively enhance nurses' communication skills and problem-solving abilities, further cultivating their critical thinking and clinical decision-making capabilities.

Experiential learning emphasizes that learners develop competencies through a process involving practical experience, reflection, and repeated practice. It asserts that knowledge is not unidirectionally transmitted but rather actively constructed by learners through engagement in experiential and reflective processes. By simulating scenarios or recreating clinical authenticity through case studies, it enhances immersion and problem-solving abilities (Ngu et al., 2025a). Game-based learning is recognized as an effective instructional strategy for enhancing learner engagement and motivation (Hassan et al., 2021). In challenging and rewarding environments, learners' active engagement can be promoted while simultaneously strengthening their decision-making abilities, critical thinking, and problem-solving skills (Ngu et al., 2025b). Chien et al. (2023) indicate that experiential learning through scenario-based digital games not only enhances learning motivation and sustains high flow states but also effectively improves decision-making performance and reduces learner anxiety.

Generative AI (GenAI) is increasingly being applied in educational training across various fields. Its advantages include generating realistic interactions and providing instant feedback (Rahman & Watanobe, 2023), making it well-suited for use in digital standardized patients and professional senior mentors (Ngu et al., 2025a; Ngu et al., 2025c). Furthermore, GenAI standardized patients can respond to history-taking and engage in instant conversations with the same tone as real patients, enabling learners to practice clinical consultation and assessment in a safe, realistic environment. Therefore, this study integrates an AI dual-role mechanism, where AI assumes the roles of both Uncle Sam (the patient) and Nurse Sister (the senior nurse)

(as shown in Figure 1). Through SVVR technology, a virtual reality space is constructed (as shown in Figure 2). Learners engage in dialogic interactions to conduct health assessments and clinical reasoning with Uncle Sam, while consulting the experienced AI nurse to access professional knowledge and resolve problems. Finally, the effectiveness of this approach in nursing clinical reasoning training is examined.

Figure 1

Dual-Role GenAI Mechanism Educational Game

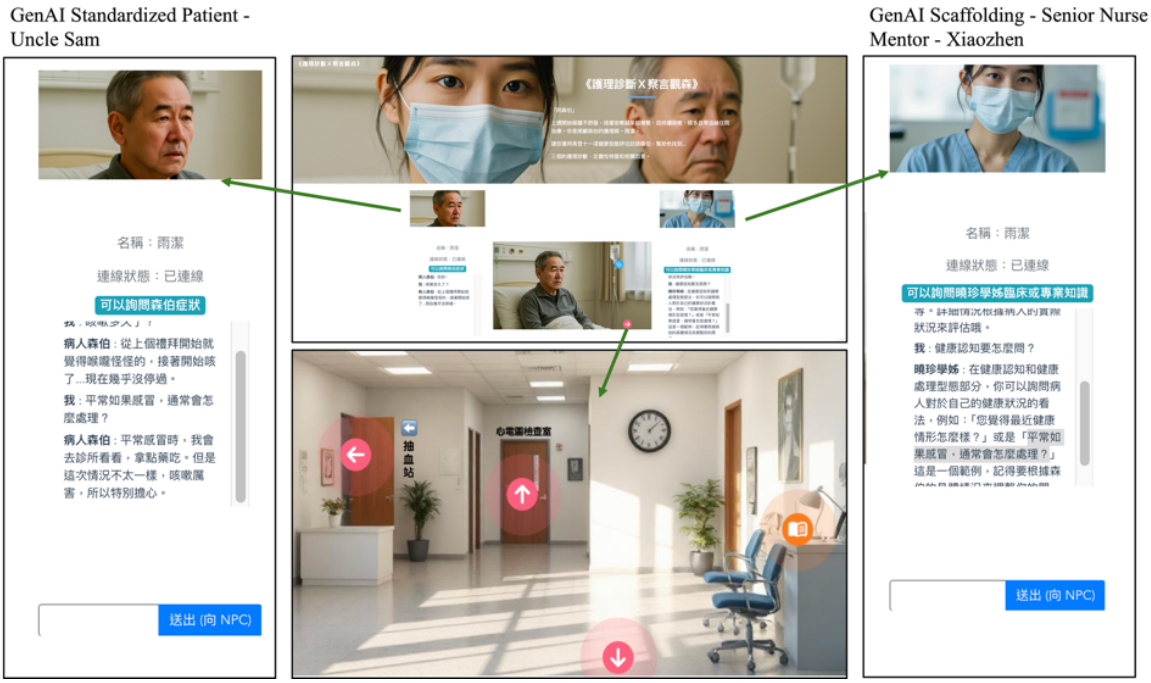


Figure 2

SVVR-Based Construction of Virtual Reality Spaces



Blood test report - contextual cues Electrocardiogram- contextual cues Chest X-ray report - contextual cues

Methods

This study is a pilot investigation involving 16 licensed practicing nurses in Taiwan. The procedure consisted of a 5-minute introduction to the game platform and rules, a 30-minute gameplay session, and a 10-minute questionnaire survey. The study assessed learners flow, activity anxiety, game feedback (game usefulness, game ease of use), perceived game elements, and cognitive load. The questionnaire's supplementary section comprised seven semi-structured questions, primarily investigating whether the game's mechanisms enhanced learners' understanding of Gordon's 11 Health Function Patterns and improved comprehension of the clinical reasoning process for nursing diagnoses.

Results and Discussions

According to the single-sample Wilcoxon signed-rank test as shown in Table 1, participants' scores on the flow scale—overall flow (M = 4.14, SD = 0.58), flow antecedents (M = 4.09, SD = 0.59), and flow experience (M = 4.18, SD = 0.63)—were significantly higher than the median of the scale (i.e., 3). The mean activity anxiety score (M = 2.73, SD = 0.88) on the activity anxiety scale was below 3. Table 2 Participants' scores on game feedback (M = 4.50, SD = 0.56), game usefulness (M = 4.45, SD = 0.61), game ease of use (M = 4.56, SD = 0.67), and game elements (M = 4.27, SD = 0.70) were significantly higher than 3. Participants in Table 3 scored significantly above 3 for both intrinsic cognitive load (M = 3.53, SD = 0.64) and generative cognitive load (M = 3.96, SD = 0.49). Conversely, participants scored significantly below 3 for extrinsic cognitive load (M = 2.18, SD = 0.99).

Through qualitative feedback analysis, participants indicated that scenarios helped clarify assessment directions and enabled them to infer appropriate nursing diagnoses based on patient responses. The GenAI Senior nurse could quickly guide them on how to question patients, provide definitions and characteristics of nursing diagnoses, and offer clues about related factors. Standardized patients further facilitated nursing staff in focusing on learning objectives.

The qualitative feedback indicated that the mechanism could create realistic clinical situations (81.25%), improve interview assessment skills (93.75%), facilitate clinical reasoning (75%), reduce stress (87.5%), and increase concentration (81.25%).

Table 1
The Mean and Standard Deviation of Learners' Flow and Learning Anxiety (N = 16)

	M	*SD*	*Z*	*Sig.*
Overall Flow	4.14	0.58	3.41***	< .001
Flow antecedents	4.09	0.59	3.41***	< .001
Flow experience	4.18	0.63	3.36***	< .001
Learning anxiety	2.73	0.88	-1.00	0.317

***$p < 0.001$

Table 2
The Mean and Standard Deviation of Learners' Game Feedback, and Game Elements (N = 16)

	M	*SD*	*Z*	*Sig.*
Game Feedback	4.50	0.56	3.44***	< .001
Game Usefulness	4.45	0.61	3.46***	< .001
Game Ease of Use	4.56	0.67	3.40***	< .001
Game elements	4.27	0.70	3.31***	< .001

***$p < 0.001$

Table 3
The Mean and Standard Deviation of Learners' Cognitive Load (N = 16)

	M	*SD*	*Z*	*Sig.*
Intrinsic cognitive load	3.53	0.64	2.63*	0.009
Extrinsic cognitive load	2.18	0.99	-2.56*	0.010
Germane cognitive load	3.96	0.49	3.43***	< .001

*$p < 0.05$, ***$p < 0.001$

Conclusions and Limitations

This study developed an education-oriented digital game aimed at training nursing personnel to collect data and perform nursing diagnostic reasoning using the Gordon 11 Health Function Patterns assessment. The game design mechanism trains learners to complete the nursing diagnosis process within simulated clinical scenarios. Through interaction with dual GenAI agents and realistic scenario simulation, learners gather data within the space to enhance the experiential learning process.

Results indicate that learners demonstrated increased engagement and participation during the game, with lower levels of activity anxiety. The interface was easily manipulated, and scenarios were realistic. This game is suitable for the teaching phase prior to clinical placements, serving as a preparatory training tool for nursing students before entering real clinical settings. It familiarizes them with nursing assessment techniques and clinical reasoning processes, thereby enhancing their clinical decision-making abilities. Battegazzorre et al. (2020) further noted that virtual patient simulation scenarios help nursing professionals become familiar with clinical environments, enhance communication confidence, and promote effective interactive behaviors. Additionally, virtual cases can provide a safe and contextualized practice environment, guiding students to cultivate sensitivity toward clinical practice and reflective abilities. Based on these findings, future studies are recommended to adopt experimental and control group designs to more deeply explore the impact of game-based learning on nursing clinical reasoning outcomes. at the same time, simplifying task difficulty according to learner ability should be considered to reduce cognitive load, thereby further optimizing the learning experience and educational effectiveness.

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The TaRL Experience: Challenges, Practices, and Recommendations

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Abstract

This study explored the lived experiences of the teachers who implemented Teaching at the Right Level (TaRL) in the City Schools Division of Cavite to understand their perceptions, the difficulties they encountered, and the practices they employed in response to the identified challenges, with the ultimate goal of developing TaRL implementation recommendations. TaRL is a globally recognized remediation strategy that groups learners according to their competency levels rather than age or grade levels to address gaps in foundational skills. Using a phenomenological approach, the study gathered data that revealed TaRL as an effective strategy for improving engagement, confidence, and student achievement. However, thematic analyses also revealed that time constraints and difficulties in group management and individual support were the challenges faced by the teachers. In response, teachers employed practices such as the use of manipulatives and visual aids and peer learning. These practices responded to the challenges in group management but cannot address the time constraints and the need for additional teachers. This study recommends the provision of ready-made lesson plans and instructional materials, increased contact time, smaller group sizes, and additional teachers and support staff for future implementation. Findings highlight the importance of contextual responsiveness, teacher empowerment, and policy support for a more sustainable and scalable TaRL implementation.

Keywords: Teaching at the Right Level, foundational learning, teacher experiences, instructional practices

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Introduction

Education in the global context faces an unprecedented learning crisis particularly in foundational literacy and numeracy. The inability to read and understand simple text by age 10, known as learning poverty, affects nearly 70% of children in low and middle-income countries as of 2023. This learning crisis could be attributed to the learning gaps brought about by the COVID-19 pandemic. However, even before the pandemic, many education systems already struggle with 57% of children in the aforementioned countries who are unable to read at basic proficiency levels (World Bank Group, 2023).

Failure to acquire foundational numeracy skills not only hampers students' chances to succeed in higher education but also poses limitations to what they can achieve economically, in the future. This poses a threat to these students' futures and to the broader context of national development and progress (Njie, 2016). Because of this, early-grade numeracy education is important as these are the foundation of students' academic and lifelong learning.

In response to the learning crisis, considering how crucial early intervention is when these learning gaps arise, Teaching at the Right Level (TaRL) emerged as an innovative approach. TaRL went away from the traditional age grouping of students, and in turn assesses the students' learning levels and groups them accordingly, which allows for competency-based teaching approaches, regardless of age or grade level (UNICEF, 2023). This approach involves regular literacy and numeracy assessments, competency-based groupings, targeted instruction, and continuous monitoring to move the students to their appropriate groups based on competency (Lim, 2023).

TaRL is an evidence-based remediation strategy that is globally recognized. It was developed by the Pratham Education Foundation, and it is designed to address gaps in foundational skills by grouping the students based on their actual competency levels rather than their ages which determines their grade levels. It has yielded results, which is evidence of its effectiveness in accelerating the acquisition of literacy and numeracy skills of those students who lag behind.

In the Philippines, where the learning crisis is deepening and has garnered attention from the academe, especially in the aftermath of the COVID-19 pandemic, where school closures and class disruptions significantly affected learning outcomes, TaRL has grown in response (Angrist et al., 2024). The above-mentioned challenges and the resulting learning gaps underscored the limitations of normal classroom settings and highlighted the need for innovations that respond to the needs of the learners.

Because of its recognition on this urgent need, the Schools Division Office (SDO) of Cavite City initiated the implementation of TaRL, piloting last school year 2024 – 2025, as part of its commitment to ensuring that no Caviteño learner is left behind and that the interventions for improving learning outcomes are data-driven and context-specific. Below are the numeracy results of the pilot implementation of TaRL in SDO Cavite City:

Figure 1
Student Progress at School A

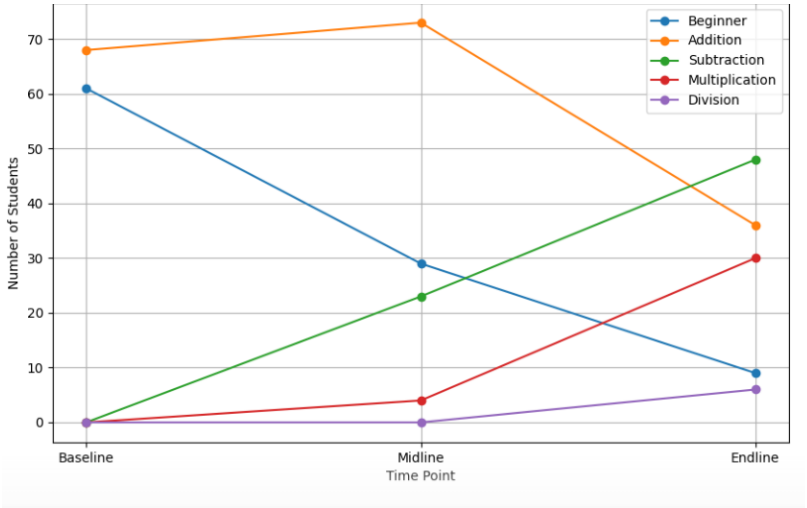
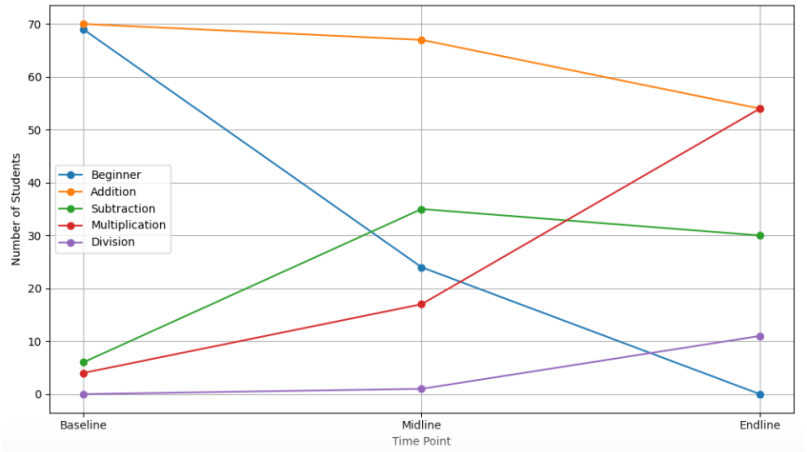


Figure 2
Student Progress at School B



While pilot implementation results reveal that TaRL had a positive impact in Cavite City in terms of numeracy, there will always be room for improvement. Further investigation is needed for a deeper understanding of the implementation from the lens of the teachers since the teachers are the main implementors of TaRL. They adopt the strategies in their teaching, navigate the difficulties, and innovate practices that respond to the challenges they encountered throughout the implementation, all to meet the needs of the learners. This study therefore addresses these important questions:

1. What are the perceptions of teachers regarding the effectiveness of Teaching at the Right Level (TaRL) in improving students' foundational math skills?
2. What challenges do teachers encounter in implementing TaRL strategies within the classroom setting?
3. What instructional practices and adaptations do teachers employ to deliver TaRL effectively in their respective contexts?
4. What TaRL implementation recommendations can be proposed based on the results of the study?

By exploring their experiences to understand their perceptions about the strategy, the difficulties they encounter and their practices to overcome the aforementioned challenges, this research aims to inform future improvements in the implementation of TaRL and contribute to how SDO Cavite City positions itself as a leading TaRL implementor in the Philippines.

Literature Review

Global Foundations and Evidence of Teaching at the Right Level (TaRL)

The COVID-19 pandemic disrupted education systems worldwide. It negatively affected learning outcomes, including basic reading and numeracy, resulting from long-term school closures (Jack & Oster, 2023).

In a more recent study, Jakubowski et al. (2024) present learning losses of 0.11 to 0.33 SD in international reading scores, which is equivalent to more than a year of schooling, based on data from 2016 to 2021, attributing greater consequences to low-performing learners and in schools with extended closures.

Adding to the data on inequity, Tadesse and Muluye (2020) state that developing countries faced greater challenges in education during the COVID-19 pandemic due to a lack of infrastructure and limited access to technology that allows the conduct of alternative learning modalities.

Several international studies evaluated TaRL's impact under randomized controlled trials, further establishing its effectiveness in various contexts.

For instance, Banerjee et al. (2016) investigated the effectiveness and feasibility of scaling TaRL into government school systems. Anchored on the premise that TaRL establishes greater relevance based on the extent to which it can be mainstreamed and embedded within the educational system.

Maruyama and Igei (2022), in partnership with the Japan International Cooperation Agency (JICA) and the Ministry of Education, assessed the effectiveness of community-wide support and TaRL in Madagascar.

Another TaRL adoption, Zambia's Catch-Up Program (Zambia, 2023), was implemented in close collaboration with education-focused organizations, including the Ministry of Education, Pratham, J-PAL (Abdul Latif Jameel Poverty Action Lab), and TaRL Africa.

Botswana-based health and education-focused organization Youth Impact also supports TaRL and its delivery in Botswana, Namibia, South Africa, and the Philippines, among other countries (Angrist et al., 2024). Based on Youth Impact's large-scale randomized controlled trial in Botswana in 2022, involving 17,622 learners from grades 3 to 5, the TaRL numeracy program yielded significant learning gains.

Although TaRL has been adopted in various contexts worldwide, its core principles continue to guide its implementation. TaRL consistently applies level-based grouping, targeted instruction, and continuous assessment and monitoring (Angrist et al., 2024; Teaching at the Right Level Africa, 2025).

Implementation Enablers and Barriers in TaRL Programs

An examination of various large-scale TaRL implementations reveals key factors affecting the success of the program. Comprehensive teacher preparation, active community engagement, strong and committed leadership, and well-functioning monitoring systems all contribute to TaRL scaling successes. These elements, when present, create enabling conditions to implement the program with fidelity and sustained impact.

Lipovsek et al. (2023) highlight the crucial role of strong government ownership in successfully scaling TaRL within Zambia's public education system. Intensive teacher training and mentoring boosted educators' confidence and ownership of the program. Contextualizing and localizing the approach improved its relevance and feasibility.

Similarly, Lebanon's TaRL pilot implementation presents that robust teacher preparation—including an intensive two-day training followed by ongoing support—and active community involvement were key to its success (World Bank, 2024).

While identified key factors have contributed significantly to the success of TaRL, scaling the approach to broader contexts presents its own set of challenges that require attention.

Commonly observed, limited instructional time and rigid school schedules restrict effective delivery of TaRL. Teachers balance the demands of the regular curriculum with the TaRL implementation (Banerjee et al., 2016; World Bank, 2020).

Teacher capacity remains a challenge. In many contexts, the short duration of capacity-building efforts limits the integration and lasting use of these skills (Darling-Hammond, 2017).

Finally, systemic and policy impediments hinder program sustainability. Rigid curricula, bureaucratic processes, and poor policy alignment can limit the flexibility TaRL needs to thrive (World Bank, 2018).

To address the earlier challenges, strengthening teacher capacity emerges as a fundamental step (Poverty Action Lab, 2025).

Equally important is fostering strong collaboration between schools, communities, and education authorities. Coordinated planning, where local leaders and caregivers are actively engaged, helps ensure that interventions align with learners' real needs (What Works Hub for Global Education, 2025).

Instead of depending on brief, one-time training sessions, expansion efforts are strengthened by ongoing, practical professional development that supports level-based instruction through consistent coaching and collaborative peer learning (Darling-Hammond, 2017; Poverty Action Lab, 2025).

Crucially, large-scale adoption is more sustainable when TaRL is embedded within policy frameworks and complemented by grassroots participation (Lipovsek et al., 2023; UNESCO IIEP, n.d.). In this way, scaling becomes less about duplicating a model and more about cultivating adaptable systems that preserve TaRL's core principles while responding to diverse educational landscapes.

TaRL in the Philippine Context: Policy and Programmatic Alignment

TaRL is shown to be a focused, time-sensitive program designed to address gaps in foundational literacy and numeracy skills for learners who lag behind their grade level (Hevia, 2024). This aligns closely with DepEd's priority for catch-up learning by providing targeted intervention to students who need it most, enabling them to "catch up" to their peers and build essential academic skills quickly and effectively.

DepEd has integrated TaRL with its broader education reform and learning continuity efforts in accordance with the Basic Education Learning Continuity Plan (BE-LCP), which emphasizes learning recovery, flexibility in modalities, and quality education. The strong connection between TaRL's catch-up model and DepEd's reform priorities supports sustainable quality learning for targeted students and improves learning motivations as well (Ningrum, 2025).

Early efforts and pilot studies of TaRL in the Philippines involved key partnerships, including with Youth Impact and other stakeholders, Early efforts and pilot studies of TaRL in the Philippines have involved multiple partnerships and collaborative initiatives with organizations such as Youth Impact, Innovations for Poverty Action (IPA), Ateneo de Zamboanga University, and other stakeholders committed as part of the effort to implement this targeted foundational learning approach in public schools (Lim, 2023).

TaRL also introduces increased inclusivity. By grouping learners by skill, not age or grade level, TaRL promotes inclusivity for learners who have fallen behind due to varied circumstances, including socio-economic disparities and interrupted schooling (Hevia, 2024). It also offers opportunities to support diverse learner needs within heterogeneous classrooms. On the other hand, teachers face difficulties in fully understanding and implementing TaRL's level-based, learner-centered approach amid existing curriculum reforms like the MATATAG curriculum.

Methodology

This study made use of the Phenomenological research method as it explores the essence of a phenomenon from the experiential perspective of the respondents (Bonyadi, 2023). This qualitative study aims to describe and understand the individual experiences of the teachers involved in the implementation of TaRL in SDO Cavite City. The researchers deemed it necessary to use phenomenological methodology as it best fits the study.

Phase 1 – Pre-data Gathering

The researchers secured all the permits needed to conduct the study. The documents were forwarded to SDO Cavite City and were signed and approved by the Schools Division Superintendent. Immediately after, the researchers convened and drafted the instrument to be used for the data gathering process. Different experts from different fields were consulted to make sure the validity and reliability of the instrument to be utilized. Upon revision of the instrument, the study proceeded to the data gathering phase.

Phase 2 – Data Gathering

When the data gathering instrument was finalized, the target participants were purposively identified specifically as the teachers who have experienced implementing the TaRL approach. The selected participants signed informed consent forms and were subjected to pre-interviews to assess participants' willingness and openness to deeply reflect on their experiences. The primary data collection method was a Focus Group Discussion (FGD).

Phase 3 – Post-data Gathering

After the data gathering procedure, the research team convened and immersed themselves in the collected data. The researchers identified significant themes, subthemes, and significant insights that reveal meaningful aspects of the implementation of the TaRL approach. Validation of results were done through member checking during a formal meeting where the data interpreted was presented to the respondents in which participants reviewed and confirmed the accuracy of the interpretations. Finally, a summary was synthesized to convey the essential and significant ideas of the research as interpreted in the results.

Ethical Considerations

The researchers complied with the permits necessary for the conduct of this research. An informed consent form was secured from the participants, discussing the objectives of the research, the sampling, confidentiality, voluntary participation, and the absence of risks involved in their participation. Responses were coded to ensure that the participants remain anonymous. Lastly, this research complies with the Elsevier's Al author policy for use of generative Al and Al-assisted technologies, using AI to improve its readability.

Findings and Discussion

This study investigated the experiences of the TaRL teachers in SDO Cavite City to understand their perceptions of the program, the difficulties they faced, and the practices they employed to respond to these aforementioned challenges, with TaRL implementation recommendations as the end in mind. The results revealed a positive perception on TaRL because of its ability to increase engagement and its focus on foundational skills, which will be leveraged in the succeeding grade levels. Challenges include time issues, and practices incorporate contextual adjustments like peer learning. These results support the need for adjustments in time and additional teachers. The following themes are the results of the study:

Teacher Perceptions on TaRL

Teachers shared their experiences in their implementation of TaRL. These insights informed the investigation about their perceptions on TaRL and how it influenced their classroom practices and ultimately, student achievement.

Table 1
Themes on Teacher Perceptions on TaRL

Theme	Subthemes	Significant Insights
Increased engagement and increased confidence	Increased student participation	Learners become more cooperative and participative in the activities because concepts are taught in languages they understand.
	Boosted learner confidence	Their confidence grew as they experienced success in tasks aligned with their competency levels.
Significant progress because of learner-centeredness and a focus on foundational skills	Instruction tailored to actual learning levels	Teachers witnessed significant leaps in the skills of the students because of learning focus and a focus on foundational skills. These form building blocks for future learning.
	Emphasis on core operations	
	Sustainable learning gains	
Rewarding and empowering	Sense of fulfillment from student progress	Witnessing how the students progressed in terms of engagement, confidence, and achievement, teachers felt a sense of fulfillment.
	Increased teacher agency and responsiveness	

Increased Engagement, and Increased Confidence

Results revealed that the teachers' experiences describe the results of TaRL with improved understanding, increased engagement, and increased confidence. Najah et al. (2024) reported the same by discussing that since the students are working on their competency level, increased enthusiasm, engagement, and level of confidence in expressing their ideas were observed. As one of the teachers shared, "I witnessed how TaRL played a major role in my learners' development. Their understanding of fundamental math skills deepened, and I could see their confidence growing with each activity."

Because the approach recommends that students ask questions and collaborate with peers, their confidence is boosted because of the enriched collaboration with classmates with the same competency level.

A more active participation because of this new-found confidence was reported by the teachers. World Bank Group (2025) highlighted this in the pilot implementation of TaRL in Lebanon, where students enjoy the interactive and collaborative activities which contributes to their confidence and ultimately, their engagement. One of the teachers had this to say: "My pupils showed genuine excitement during math lessons. They participated more actively and seemed eager to learn, which made the classroom environment more dynamic and positive."

A TaRL classroom is dynamic and empowering. It provides learning opportunities that respond to the needs of the learners without regard to their ages and grade levels. Since groups are responsive and flexible, students are prompted to participate more and engage better with their classmates, the learning materials, and the competencies being transferred.

Significant Progress Because of Learner-Centeredness and a Focus on Foundational Skills

TaRL organizes instruction and activities considering the current level of competence of the students. This is the learner-centeredness that TaRL offers. This is parallel to the findings of Rahmawati et al. (2025), when they discussed that a significant improvement in learning outcomes was observed because the approach addresses the heterogenous competency levels in the classroom. As one of the teachers said, "I witnessed significant progress in my students' math skills when instruction was tailored to their actual learning levels. This shift allowed me to meet them where they were, rather than where the curriculum expected them to be."

The progress that the students made under the TaRL approach is not a band-aid solution but rather a sustainable means to ensure that the students are successful in the succeeding years of their schooling. Akdi and Belamhitou (2024) supported this in their research on Moroccan education's focus on accelerating the learning of their students using TaRL. It was reported that TaRL targets the deep crisis in foundational knowledge among Moroccan students. A teacher from school A shared her experience about this: "Focusing on foundational skills made a noticeable difference. I saw how learners who previously struggled began to understand and apply basic operations with more confidence."

Similarly, a teacher from school B shared: "Teaching became more meaningful as I observed learners mastering the basics. The emphasis on core mathematical operations helped them build a stronger foundation, which reflected in their overall performance."

If done right, the progress is significant because it is impactful and is done efficiently within a short span of time. Because of the strategies that this approach employ, which are all simple and relatable to the students, the foundational skills, which will serve as the building blocks for future learning are built.

Rewarding and Empowering

Aside from the significant leaps in student achievement and confidence in learning, teachers also reported experiences about TaRL, being rewarding and empowering on their part. Akyeampong (2022) emphasized that TaRL empowers teachers by enabling them to employ more effective, inclusive, and learner-centered teaching practices. Because of improved understanding and confidence as well as significant progress shown by the students, the teachers feel rewarded and empowered. A teacher from school A shared that: "In my experience, students became more engaged during our sessions. I noticed a significant improvement in their ability to perform basic math tasks, which made teaching more rewarding."

Another teacher from school A also shared the same feelings when she stated that: "I felt empowered as a teacher to adjust my instruction based on what my students actually needed. This responsiveness led to real improvements in their understanding and engagement with math."

While the improvement on the students' achievements and confidence as well as the significant leaps they made in acquiring the foundational skills which shall form the building blocks for more complex competencies is a big win, it is also important to know that from the experience of the teachers, TaRL has had significant effects on them as well as they felt rewarded and empowered, witnessing how the students progressed, with the help they gave for these learners.

TaRL Implementation Challenges

The experiences of the teachers also revealed some TaRL implementation challenges that are crucial to how the program was delivered.

Table 2
Themes on TaRL Implementation Challenges

Theme	Subthemes	Significant Insights
Time Constraints	Short contact time	The teachers experienced not being able to finish some activities because of short contact time.
	Gathering students together shortens the contact time even more	Since TaRL is implemented as a remediation approach, the students come from their regular classes and gathering them presents difficulties.
Group Management and Individual Support	Students with different competency levels are grouped together.	Because of a shortage of TaRL trained teachers, there was a time early in its implementation where students of different competency levels are assigned to a single teacher.
	Shortage of TaRL trained teachers.	

Time Constraints

The results consistently report time constraints as the primary challenge that the teachers face in their implementation of TaRL. Lim (2023) stated that the instruction time under TaRL is 30 minutes per day only, which is not enough time to conduct regular classes, even more so, TaRL classes. A teacher from school A lamented that: "Time allocation has consistently been a concern in my experience. It often feels insufficient for the depth of instruction required."

This was also the same case in school B, evident when she shared that: "There were days when I couldn't carry out the planned activities because time simply ran out. It was frustrating to leave tasks unfinished."

This is the main challenge for the teachers. Given the major upside that TaRL has to offer, as well as the strides the students made because of this intervention, it is still important to note how better these students will perform if ample TaRL instruction time is given to them and their teachers.

Another challenge, as reported by the teachers, are the time constraints in terms of gathering the students together. Here is what a teacher in school A had to say: “Managing groups with varying learning levels demanded careful planning and close monitoring. The sessions often started late because students came from different sections, which further shortened our actual teaching time.”

This is the same case in school B. A teacher in School B had this to say: “The delays in assembling students significantly reduced the time available for actual learning. I often felt rushed and unable to maximize the session.”

This could be a challenge that is unique to the context of SDO Cavite City, given how it implemented TaRL. However, this will be significant in future policy recommendations if TaRL is to be implemented on a wider scale.

Group Management and Individual Support

Grouping the students presented a difficulty. This is contradictory to what Angrist et al. (2024) discussed that grouping the students should be according to learning level rather than age or grade. A teacher lamented that: “Early in the implementation, I struggled with grouping because the number of students in each teaching group was overwhelming, and their learning levels varied significantly. It was difficult to manage instruction effectively.”

This should not be the case. From the onset, the students should have been grouped according to competency level and there should not be students with varying competencies in a group. This is what one of the teachers shared: “When there weren’t enough teachers available, I had to combine groups and teach multiple operations at once. This made the sessions more challenging and less focused.” “These conditions made it hard for me to give each learner the attention they needed. With limited time and a large number of pupils, I often felt I couldn’t support everyone as much as I wanted to.”

Some challenges are external and cannot be controlled by the teachers like time, and some are internal and can be addressed like group management. Knowing these challenges, paired with the best instructional practices, can form meaningful TaRL implementation recommendations.

TaRL Instructional Practices

In response to the challenges reported, the teachers also applied certain instructional practices to adapt TaRL implementation to specific contexts.

Table 3
Themes on TaRL Instructional Practices

Theme	Subthemes	Significant Insights
The use of other manipulatives and visual aids	Use of other manipulatives like dice.	In relation to teacher resourcefulness, teachers got creative by using contextualized manipulatives like dice.
Peer learning	Pairing or grouping students so more advanced students can help the others.	In response to the group management and individual support challenge, teachers created smaller groups within their assigned classes.

The Use of Manipulatives and Visual Aids

The use of simple materials help the students be more engaged in the activities (Ahmed et al., 2024). Visuals and manipulatives make learning more interesting, and active participation increases, especially when these materials are accessible. A teacher from school A shared that: "Incorporating materials like sticks and stones into my lessons made the activities more engaging and accessible. These tools allowed me to connect with learners who struggled with traditional methods."

The same practice is being implemented in school B. A teacher in school B shared that: "Interactive and hands-on activities like matching number cards, stone throw, and stick bundling kept my students focused and actively involved in the learning process."

The use of manipulatives and visual aids resulted in more engagement and focus on the part of the learners. This is backed by Bakriev (2023) when he discussed that these manipulatives help learners create mental images of information and helps with understanding. As what the teachers said: "I found that using stick bundling for addition and subtraction helped my learners visualize the process more clearly. It made abstract operations more concrete." "Techniques such as stone throw, stick bundling, and the multiplication ladder proved to be highly effective. I saw how these visual and tactile strategies supported my students' understanding." "To teach place value, I had my students express numbers in expanded form. I also used dice and a target board to randomly select numbers, which made the lessons more dynamic and helped learners grasp the concept more intuitively."

To better help the students become more engaged and learn the concepts, the use of manipulatives and visual aids is an outstanding practice.

Peer Learning

In its early stages, the very foundation of TaRL, which is grouping the students in terms of their competency level was not fully achieved because of large groups of students since there are few teachers to handle the remediation. Peer learning is one of the strategies the teachers employed to respond to this challenge. As what one of the teachers shared, "Peer learning is also effective. I often pair or group students so that those with stronger skills can help guide others."

The teachers formed smaller groups within their classes to still form the competency grouping that TaRL promotes. After which, students with more advanced skills and understanding within the competency group share their learning to the other members of the group. Dehghani et al. (2014) supports the effectiveness of peer learning as they found significant improvements in student achievement after peer learning sessions.

The use of visuals and peer learning are the most outstanding TaRL instructional practices reported. These, paired with the challenges, can provide meaningful insights into how TaRL implementation can be further improved as an intervention strategy to address learning gaps.

TaRL Implementation Recommendations

Considering how challenges and the practices interact, some TaRL implementation measures are recommended.

Table 4
TaRL Implementation Recommendations

Theme	Subthemes	Significant Insights
Provision of lesson plans		Given the nature of TaRL implementation in SDO Cavite City, instructional goals do not differ from one teacher to another. Ready-made lesson plans may ease the burden of preparations, and the teachers can focus more on instruction.
Time and group size adjustments	Provision for more contact time for TaRL sessions	Teachers recommend giving more time for TaRL sessions to better teach foundational skills to the learners.
	Smaller groups of learners	Teachers recommend forming smaller groups of learners to better respond to homogeneity in the classroom in terms of competency levels.
Additional support and staffing	Additional teachers to handle TaRL sessions	Teachers recommend assigning more teachers to handle TaRL sessions. This is a call for management to train more teachers in teaching TaRL classes.

Provision of Lesson Plans

According to Abad and Hattie (2025), instructional materials and lesson plans are crucial not only for providing structure to the teaching process but also provides opportunities for ongoing

professional development and instructional innovation. This is also true for TaRL instruction. As what a teacher in school A requested, "Provision of ready-made lesson plans and instructional materials would be a great help."

A teacher in school B had the same request. Here is her request: "Ready-made lesson plan and examples for all operations and more tips and techniques in teaching division level."

Given the intervention nature of TaRL implementation in SDO Cavite City, instructional goals do not differ from one teacher to another. This shared goal opens doors for collaboration for teachers to refine teaching and ultimately, learning (Guo et al., 2025).

Time and Group Size Adjustments

TaRL sessions only last for 30 minutes (Lim, 2023). These sessions are supposed to be short and meaningful in terms of acquiring student competencies. The students are grouped according to their competency levels (UNICEF, 2023). This is to ensure that the groupings are homogenous and that instruction is targeted. However, in the initial implementation of TaRL in SDO Cavite City, these were not realized. Because of this, a teacher from school A recommended that: "I would suggest giving more time for TaRL sessions and reducing the number of learners per group."

In school B, another recommendation was given by a teacher: "Mabawasan ang bilang ng mga bata bawat group. (Reduce the number of learners per group.)"

Jez and Wassmer (2013) discussed that there is a positive relationship between instructional time and student performance. Additionally, Antoniou et al. (2024) conferred that smaller class sizes promote positive behavior and engagement which results to better acquisition of learning. Both are applicable to the context of TaRL and how it is implemented in SDO Cavite City. If given more contact time and smaller groups, TaRL instruction will be more effective, and the students will gain more benefits.

Additional Support and Staffing

Additional support and staffing are crucial to any program implementation, especially in schools, because it creates a positive atmosphere and productive learning environments which are crucial for student success (Khalilpour, 2024). Teachers reported the need for additional teachers that will handle TaRL classes. As what one of the teachers lamented, "Sana nadagdagan ang mga magtuturo sa TaRL. (We hope there will be additional teachers to handle TaRL.)"

This informs policy about the need to train additional teachers that will handle TaRL classes. If there are more teachers to handle the classes, there will not be any gaps in terms of grouping of students and time constraints. This is one key element for a successful TaRL implementation.

The insights extracted from the experiences of the teachers revealed a deep understanding of the enablers and challenges of TaRL implementation as a remediation strategy. It was very clear that TaRL has led to significant improvements in student engagement and achievement. However, its accomplishments were somehow hindered by realities in time constraints, challenges in group management and individual support, and shortage of teachers. The

practices employed by the teachers demonstrate adaptability, innovation, and creativity, which reinforced TaRL as a responsive remediation strategy. These findings provide meaningful inputs to how program implementation and scaling can be further improved and inform future policy.

Conclusions and Implications

The findings of this study affirm that TaRL is a responsive and effective remediation strategy to address the learning gaps in early-grade Mathematics. The lived experiences of the teacher-participants report that TaRL resulted in increased engagement, confidence, and student achievement. These outcomes were achieved through targeted instruction and a focus on foundational skills which paved the way for meaningful and sustainable progress.

While TaRL proved to be an effective remediation strategy, in its implementation in SDO Cavite City, certain challenges must be addressed to ensure its sustainability and scalability. Teachers responded resourcefully to the challenges such as group management and individual support issues through instructional practices like peer learning. These practices not only supported student achievement but also empowered the teachers in their roles. However, persistent challenges like time constraints and the need for additional teachers remained beyond their control. These challenges highlight the need for policy-related interventions and adjustments to fully realize the potential of TaRL as a remediation strategy.

The findings point to several implications for future policy. Providing ready-made lesson plans and instructional materials will not only ease the burden of planning instruction and activities but also improve quality of instruction. This should advise management for future write-shops on TaRL lesson planning and instructional materials development. Provision for more contact time and adjusting the group size will also be beneficial for the TaRL learners. Most importantly, additional teachers and support staff will ensure that learners are grouped according to their competency levels and be given the instruction they need.

This study therefore calls for strategic policy intervention to make sure that the institutionalization and large-scale implementation of TaRL will be effective and more geared towards the achievement of the learners.

Acknowledgement

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Designing for Engagement: Exploring Task Workload and Interaction in an Online Professional Development Course for Teachers

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Abstract

This paper investigates the task workload experienced by teachers in an online professional development course, analyzed through the lens of Moore's Theory of Interaction. The study examines how different forms of interaction such as learner-content, learner-instructor, learner-learner, and learner-interface shape teachers' perceptions of workload. The online course was introduced through an in-person orientation workshop that familiarized participants with registration, login, and navigation procedures. Teachers completed the NASA-TLX questionnaire at the beginning and end of the course, defining the task as the completion of all modules leading to certification. To complement quantitative data, unstructured interviews with selected participants provided qualitative insights into perceived workload, challenges, and suggestions for improvement. Findings from the study revealed that teachers experienced moderate workload across several dimensions, including mental effort, physical interaction, temporal pressure, and emotional strain. These results highlight the significant influence of course design, task complexity, and interface usability on teacher engagement in digital professional development contexts. The findings emphasize the crucial role of well-designed interactions in managing workload and maintaining learner engagement in online learning environments.

Keywords: digital learning, task workload, interaction theory, teacher experience, user experience, interaction techniques, learner engagement

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Introduction

e-Learning, broadly defined as an interactive mode of instruction delivered through digital platforms (Paulsen, 2002), has emerged as a widely adopted strategy in professional development programs. It provides a flexible and scalable framework for supporting lifelong learning and extending access to formal education (Mason & Rennie, 2006). Key advantages of e-learning include its capacity to accommodate self-paced learning, promote learner autonomy, encourage self-reflection, and facilitate collaboration within dynamic digital environments.

However, alongside these benefits, several challenges have been consistently identified in literature. A frequently cited limitation is the reduced opportunity for social interaction and interpersonal communication due to the lack of face-to-face engagement (Kear, 2010). This can lead to feelings of isolation and disengagement, particularly in courses that do not provide peer collaboration or instructor presence.

In addition, for learners who are less familiar with digital technologies, the process of navigating online learning environments can introduce significant interface-related challenges. Complex or unintuitive user interfaces may increase the physical and mental effort required to complete tasks, contributing to task overload and negatively impacting the learning experience. These usability-related barriers, when combined with the intrinsic complexity of learning tasks, can intensify perceived workload across multiple dimensions such as mental demand, effort, and frustration.

While prior studies have explored learner engagement and cognitive load in e-learning environments, there is limited empirical research examining how different types of interaction, particularly learner–interface interaction specifically influence task workload in teacher professional development contexts. This gap is particularly relevant as online professional development often involves both structured content and platform-mediated interaction, requiring learners to navigate and engage independently. Moreover, as education systems increasingly turn to online modes to deliver technical content, the design of effective learning environments and resources becomes critical for engaging both teachers and learners. This need is especially pronounced in countries like India, where teachers are not yet fully equipped to integrate digital components into the curriculum, even as substantial efforts are underway to build this capacity. Institutions such as UNESCO MGIEP are leading this shift, offering professional development courses through hybrid, fully online, and workshop-based formats. These courses include a variety of training modules designed to engage both educators and students.

The present study draws on Moore's Theory of Interaction (Moore, 1989) to examine how different forms of interaction namely learner–content, learner–instructor, learner–learner, and learner–interface affect the perceived task workload in "The Digital Educator: A Primer", an online professional development course for teachers. This course is hosted on "FramerSpace", UNESCO MGIEP's digital learning platform.

Literature Review

Daniel et al. (1982) suggests that all educational transactions exist along an interaction continuum, with learner-instructor interaction at one end and learner-content interaction at the other. Building on this, Anderson (1987) and Keegan (2013) emphasize that meaningful

interaction is essential for effective learning and knowledge exchange. Moore (1989) further categorizes interaction in distance education into three distinct types. The first is learner-content interaction, defined as intellectual engagement with content that facilitates changes in the learner's understanding, cognition, or perspectives. The second is learner-instructor interaction, which involves the instructor's role in motivating, guiding, and clarifying misunderstandings for the learner. The third type is learner-learner interaction, which refers to communication among learners, either individually or in groups, and may occur with or without the real-time presence of an instructor.

As technology becomes increasingly central to mediating learning interactions, the design and functionality of educational tools take on higher importance. Garrison (1989) observes that while the medium may not fundamentally alter the nature of communication, it significantly shapes how learners perceive and experience that communication. Building on Moore's well-established framework of interaction comprising learner-content, learner-instructor, and learner-learner Hillman et al. (1994) introduced a fourth dimension: learner-interface interaction. This refers to how learners engage with the technological medium itself, which serves as a prerequisite for accessing all other forms of interaction.

This paper critically examines all four forms of interaction namely learner-content, learner-instructor, learner-learner, and learner-interface within the context of the online professional development course "Digital Educator – A Primer", designed specifically for school teachers. While prior research has highlighted platform features such as gamification, scaffolded interactivity, and learner-centered pacing as key contributors to engagement and performance (Silverajah & Govindaraj, 2018; Wang et al., 2021), these studies have not specifically examined how such platforms impact teachers in professional development settings (Feng & Sun, 2021). Our study addresses this gap by measuring perceived workload using the NASA-TLX (Hart & Staveland, 1988) instrument, providing a focused understanding of the cognitive and physical demands experienced by educators during online training.

Findings from our analysis reveal that teachers experience moderate workload across multiple dimensions such as mental demand, physical demand, temporal pressure, effort, performance, and frustration when interacting with the course platform. This suggests that while the platform fosters learning engagement, it may also impose some cognitive and interface-related demands that hinder effective interaction.

To address these challenges, we propose a set of user-centered design enhancements, including simplified navigation, real-time feedback, and modular task structures, aimed at reducing unnecessary effort and improving the overall usability of the platform. These recommendations build upon previous research but move the focus from engagement features alone to include the usability and workload impact of learner-interface interactions thus offering a more comprehensive approach to EdTech design in professional development settings.

Study Design

Course Overview

"The Digital Educator – A Primer" course is structured around five key quests designed to equip teachers with the knowledge and skills to integrate digital pedagogy effectively. Module 0 - Quest 0 (Introduction) sets the stage by familiarizing participants with the course

design and encouraging reflection on their comfort with technology, emphasizing a neuroscience-informed whole-brain approach to learning. Module 1 – Quest 1 (Understand Digital Pedagogy) explores learner variability and introduces digital pedagogy as a means to create inclusive, engaging learning experiences that are responsive to diverse student needs. Module 2 – Quest 2 (Design Learning Experiences) delves into Universal Design for Learning (UDL) principles and demonstrates how digital tools can be used to overcome learning barriers by offering multiple means of engagement, representation, and expression. Module 3 – Quest 3 (Navigate the Digital Space) focuses on digital citizenship, helping educators understand the importance of online identity, safety, and ethical behavior in digital environments. Finally, Module 4 – Quest 4 (Hybrid Learning Environments) explores how to effectively design hybrid (blended) learning by balancing online and in-person teaching strategies. Module 5 – Quest 5 (Reflect and Share Your Learning) provides an opportunity for participants to reflect on their learning journey, complete assessments, and consider how to continue applying digital strategies in their professional practice. Together, these quests promote a thoughtful, inclusive, and purposeful use of technology in education.

Participants

The study involved 30 teachers (both male and female) from a well-established English-medium school, with ages ranging from 25 to 50 years. Prior to participation, informed consent was obtained from each individual. The study received ethical clearance from the institution's review committee.

Procedure

The course was introduced to the participating teachers through a brief in-person orientation workshop. During this session, participants received step-by-step guidance on registering, logging into the FramerSpace platform, and enrolling in the course. The course itself was designed to be fully online and self-paced, allowing learners to progress independently through the modules. In this study, the task is defined as the completion of all course modules and the successful generation of a course certificate. Participants completed the NASA-TLX questionnaire prior to the commencement of the first module. Upon completing all modules, they were again asked to complete the questionnaire to report their perceived task workload. The FramerSpace platform also provided learners with access to a learner's dashboard, enabling them to monitor their progress and view individual scores for each completed module. Technical assistance was available as needed, primarily to resolve access-related issues such as login difficulties. To gain deeper insights into the learner experience, a series of unstructured one-on-one interviews were conducted with a selected subset of participants after they completed the course. These interviews explored several dimensions of the learning experience, including perceived workload, challenges encountered, and suggestions for improving different types of interaction within the course. By integrating quantitative data from the NASA-TLX with qualitative insights from participant interviews, this study enabled a comprehensive understanding of teachers' experiences with the course content and the digital learning environment.

Data Collection

The NASA Task Load Index questionnaire was employed to assess the perceived task workload at both the beginning and the completion of the course. Participants rated six subscales which are the mental demand, physical demand, temporal demand, effort,

performance, and frustration on a 5-point Likert scale ranging from 1 (very low) to 5 (very high). The mental demand subscale referred to the extent of mental and perceptual activity required (e.g., thinking, deciding, calculating, remembering, searching, reading course materials, and reflecting). Physical demand captured the level of physical activity involved in interacting with the course (e.g., navigating menus, clicking, scrolling, and operating interface features). Temporal demand assessed the perceived time pressure experienced due to the pace and flow of tasks and activities within the course. Effort measured the degree of mental and physical exertion required to complete the course tasks while maintaining performance. The performance subscale reflected the participants' perceived success in accomplishing course goals and their satisfaction with their outcomes. Frustration examined the extent of negative emotional responses such as stress, irritation, discouragement, or insecurity experienced during the course.

Table 1 and Figure 1 below show the task workload for each of the subscale. After normalization, the overall task workload after completion of the task was calculated to be 56.94. According to the classification proposed by Ernawati et al. (2019), this value corresponds to a moderate level of task workload.

Table 1
Perceived Task Workload

NASA TLX TASK WORKLOAD				
Subscales	***Beginning of the Course***		***After Completion of the Course***	
	Mean	***SD***	***Mean***	***SD***
Mental Demand	15	18.41	56.66	24.94
Physical Demand	21.66	18.58	55	22.73
Temporal Demand	25	16.36	58.33	19.72
Effort	26.66	14.84	56.66	21.34
Performance	13.33	12.9	58.33	23.57
Frustration	15	12.67	56.66	23.21
Total	19.44	5.376	56.94	19.89

Statistical analysis using the Mann-Whitney U test revealed significant differences across all six subscale and the overall workload:

Mental Demand: U = 23.00, p = .0001, r = .68 (large effect). The course required considerable concentration and decision-making, suggesting a cognitively intensive experience. While such demands are common in professional development, overly high levels may overwhelm some learners, indicating the need for refinement at both the platform and instructional design levels.

Physical Demand: U = 31.00, p = .0005, r = .62 (large effect). Learners reported a notable increase in physical interaction, reflecting tasks such as frequent navigation and engagement with interactive elements.

Temporal Demand: U = 22.50, p = .0001, r = .68 (large effect). Participants reported increased time pressure, potentially due to course pacing, tight deadlines, or competing personal obligations.

Effort: U = 27.50, p = .0002, r = .64 (large effect). The findings indicate that learners exerted substantial mental and physical effort to complete course activities.

Performance: U = 11.50, p < .0001, r = .76 (large effect). A significant change was observed in perceived performance, with some learners feeling they underperformed or struggled to meet expectations.

Frustration: U = 12.00, p < .0001, r = .76 (large effect). The results point to increased frustration levels, possibly linked to unclear instructions, lack of feedback, or technical difficulties.

Total Perceived Task Workload: U = 14.00, p < .0001, r = .75 (large effect). The overall perceived cognitive load significantly increased following the course.

Figure 1
Subscales and Task Workload



In summary, while the course was cognitively engaging and aligned with the goals of professional development, the consistently elevated workload across dimensions highlights areas for improvement. Refining course design and platform usability could help reduce unnecessary task load and better support learner performance and satisfaction. The results show that there is a need to balance course rigor with usability. Platforms must support teachers by minimizing unnecessary effort through thoughtful design such as chunking content, reducing interface complexity, integrating help systems, and allowing flexible pacing. These enhancements not only reduce cognitive overload but also promote sustained participation and successful skill transfer to classroom settings. Hence, for online teacher professional development programs to be effective and sustainable, EdTech platforms must prioritize user-centered design that considers teacher workload. By addressing issues of usability, cognitive demand, and emotional experience, such platforms can better support teacher learning and foster long-term adoption of digital tools in education.

Findings and Discussion

We analyzed the course using Moore's theory of interaction (Moore, 1989), along with Hillman et al., (1994) learner-interface interaction and have found several strengths as well as areas for improvement across different subscales of task workload.

Learner–Content Interaction was a key strength of the course. The use of multimedia elements including videos, quizzes, reflective tasks, readings, and case studies facilitated deep engagement with digital pedagogy and the principles of Universal Design for Learning (UDL). The modular, self-paced structure supported autonomy, while scenario-based questions and curated toolkits enriched the learning experience. However, the inclusion of lengthy videos increased the perceived task load, as noted by several participants. One participant remarked, "It would be better if the videos are cut short as they are too long". Segmenting videos into shorter, digestible units could reduce cognitive overload and enhance learner retention. Many participants also recommended shortening the modules so that each focused on a single topic. They noted that this would reduce *mental demand* and *effort* and help minimize *frustration* associated with processing multiple concepts within a single module.

Learner–Instructor Interaction was present but limited in scope. While instructional intent was conveyed through embedded videos, quiz having predefined questions and answers, and reflective prompts, opportunities for real-time guidance or personalized feedback were minimal. Several learners expressed uncertainty about whether their responses were acknowledged or recorded. As one participant noted, "Though I spent time answering the question, I didn't get any feedback, so I wasn't sure if my answers were recorded or not". This lack of responsive communication likely contributed to increased *frustration* and *mental demand*, as teachers were left uncertain about their progress and the validity of their efforts. To address this, the inclusion of periodic synchronous sessions, moderated discussion threads, or automated feedback systems could help strengthen learner–instructor interaction and ease the associated workload stressors.

Learner–Learner Interaction, although collaborative tools such as Padlet were made available, they were largely underutilized, resulting in limited opportunities for peer dialogue, cooperative learning, and shared knowledge construction. According to Moore, this form of interaction is essential for fostering a sense of community and supporting social learning. One participant remarked, "I did not know the need of the discussion forum, as I did not see any comments or questions or threads in that section". The absence of peer engagement may have contributed to increased *mental demand* and *frustration*, as learners navigated complex content in isolation without the cognitive or emotional support of a learning community. Future iterations of the course could benefit from integrating active peer discussion forums, collaborative assignments, and structured peer feedback mechanisms to promote deeper engagement and reduce perceived workload.

Learner–Interface Interaction, as conceptualized by Hillman et al. (1994), played a significant role in shaping the overall learning experience. The digital learning platform offered supportive features such as dashboards, progress tracking, embedded tutorials, and emotional check-ins, all of which facilitated self-regulation and reduced initial navigation load. These elements helped ease *mental* and *temporal demands* in the early stages of the course. However, participants also encountered several usability challenges that disrupted their interaction with the system. Difficulties included remembering unique login IDs,

inconsistencies in resuming course progress, and technical issues with embedded forms. One participant noted, “I wanted to submit the form, but I got lost as I was taken to the next module”. Additionally, the “Resume” feature failed to return learners to their last active point, requiring them to manually retrace their steps. These usability friction points likely increased *effort*, *physical demand*, and *frustration*, particularly among novice users. These findings underscore the importance of intuitive user flow design and accessible interface features, especially in courses that emphasize inclusive and learner-centered design principles.

The results of the NASA-TLX analysis revealed that teachers experienced moderate workload across multiple dimensions indicating high mental effort, physical interaction, temporal pressure, and emotional strain while navigating the online course. These findings underscore the need to redesign both the platform and the course to better align with the actual needs and constraints of educators participating in professional development.

To address these issues and improve overall usability, we *recommend* (a) Simplify course navigation and structure to help teachers move through content effortlessly and reduce confusion. (b) Streamline user interactions by minimizing repetitive tasks and optimizing platform responsiveness. (c) Allow flexible pacing and personalized learning paths to accommodate teachers’ varied schedules and workloads. (d) Provide in-context guidance and on-demand support to assist teachers during complex or unfamiliar tasks. (e) Deliver immediate and clear feedback on activities to help teachers track progress and build confidence. (f) Maintain transparent communication and responsive support systems to quickly address user concerns. (g) Design content using microlearning principles to avoid overload and ensure each module contributes meaningfully to professional growth.

Conclusion

This study examined how interaction design influenced task workload in an online professional development course for teachers. Utilizing the NASA-TLX instrument, the overall task workload for course completion was assessed, revealing particularly moderate scores in mental demand, performance pressure, and temporal demand. Interpreting these findings through the lens of Moore’s Theory of Interaction, the analysis highlighted that limited learner–learner interaction, delayed and inadequate feedback, and interface usability issues were key contributors to increased mental effort and frustration. These results point to the need for revising both the course structure and the digital platform by enhancing instructor responsiveness, integrating more robust social learning features, and improving platform navigation. We firmly believe that strengthening these elements will improve the quality of the learning experience and also support continuous participation and engagement of teachers in online professional development, ultimately contributing to more effective and scalable capacity-building in the education sector.

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Enhancing Curriculum Planning and Student Academic Performance in Special Schools Through Learning Progression Framework (LPF)

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Abstract

This study examines the effectiveness of the Learning Progression Framework (LPF) in Hong Kong as an assessment tool for evaluating the academic performance of students with intellectual disabilities. The LPF enables teachers to better understand student performance and strategically enhance curriculum planning, teaching, and learning, thereby improving the learning-teaching-assessment cycle. Given that students with intellectual disabilities may struggle with written tests, formative assessments are typically employed to gauge their abilities. However, formative assessments pose challenges, including subjectivity and consistency in evaluation. Developed by the Education Bureau (EDB) in 2007, the LPF aligns with high school curricula for these students and provides a common assessment framework to facilitate learning progress and inform future learning objectives. Despite its long-term implementation, there has been limited research on the impact of LPF on student learning, particularly in optimizing curricula and addressing learning differences. This research involved 170 students with mild to moderate intellectual disabilities at TWGHs Tsui Tsin Tong School from 2021 to 2025. Results indicate significant improvements in students' academic performance following the implementation of LPF. Future studies could expand on these findings to explore how special schools can further enhance curriculum planning and academic outcomes through LPF. The findings contribute to a deeper understanding of how structured frameworks like LPF can facilitate better educational practices in special education, paving the way for improved academic achievements. This paper aims to provide valuable insights for educators, policymakers, and researchers interested in enhancing the educational landscape for students in special schools.

Keywords: special education, exceptional education, assessment, curriculum

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Introduction

In the dynamic education landscape, effective assessment strategies are crucial, particularly for students with special education needs. This study investigates the Learning Progression Framework (LPF), a framework adopted by the Hong Kong Education Bureau to tackle the specific challenges encountered by students with intellectual disabilities.

In mainstream schools in Hong Kong, standardized tests and various forms of assessments like formative and summative evaluations are commonly used to gauge academic performance. However, these traditional assessment tools often fail to encapsulate the abilities of students with special needs, given the diverse nature of their disabilities.

A significant number of students with intellectual disabilities encounter obstacles that traditional assessments cannot adequately address. For instance, some students may be unable to write, while others may be non-verbal or have visual impairments that hinder their ability to engage with standard assessment materials. Additionally, students with conditions such as dyslexia, dyscalculia, and dysgraphia face severe challenges with tasks related to reading, number handling, and spelling. This highlights a critical gap in the educational system, as traditional standardized assessments do not provide a comprehensive understanding of these students' capabilities, learning progress, or academic levels.

In response to these challenges, the Hong Kong Education Bureau initiated the development of an assessment framework focused specifically on students with intellectual disabilities. Introduced in 2007, the Learning Progression Framework (LPF) serves as an innovative assessment system, offering a structured learning ladder that allows educators to systematically track and document the learning trajectories of their students. By implementing the LPF, this study aims to enhance curriculum planning and improve student academic performance in special schools. Through a detailed exploration of the LPF, this research seeks to contribute to more effective educational practices that recognize and nurture the unique learning needs of all students.

Literature Review

Learners with special educational needs are individuals whose educational requirements cannot be sufficiently met through conventional teaching methodologies (Gutuza et al., 2015).

Students with intellectual disabilities (ID) exhibit diverse characteristics that influence their learning and daily functioning, including cognitive limitations, leading to challenges in learning and understanding complex concepts, and academic difficulties in areas like reading, writing, and mathematics, necessitating specialized instruction (Kumar et al., 2024). Additionally, they may face limitations in adaptive behaviors, including conceptual, social, and practical skills, as well as communication challenges. Social and emotional development can also be impacted, affecting peer interactions and emotional regulation (Kumar et al., 2024). Some students may experience delayed motor skills and potential health issues, but they often thrive with concrete, hands-on learning experiences due to their unique learning styles (Kumar et al., 2024). To assess students ability, teachers encounter the greatest challenges in assessing written tests, such as essays, and oral examinations (Mozetič Hussu & Strle, 2010). This calls for the implementation of teaching and learning methods that differ from traditional approaches, highlighting the need for educators to reevaluate their assessment methods.

In 2007, the Hong Kong Education Bureau launched the Learning Progression Framework (LPF) for core subjects (Curriculum Development Council, 2012). The primary objective was to create a unified language and structure for articulating students' learning progress and outcomes, serving as a shared reference point for teachers, parents, students, and educators to evaluate learning levels and progress (Curriculum Development Council, 2012). At its core, the framework aims to foster a common vocabulary that enhances discussions and understanding of the academic performance of students with intellectual disabilities, thereby supporting effective teaching practices and curriculum development, providing a clear learning ladder that enables educators to systematically track and record students' learning progress (Curriculum Development Council, 2012).

Students' learning is a continuous development process. The Learning Progression Framework (LPF) provides a reference for cognitive abilities, subject-specific skills, knowledge, and understanding to describe students' learning progress and levels. Developed through rigorous research, trials, and validation with the involvement of local and international consultants as well as frontline teachers, each subject's LPF consists of two main parts: "Initial Mastery Levels" and "Subject Specific Levels." These frameworks categorize learning levels into different stages, ranging from the earliest forms of learning (I1) to advanced subject-related outcomes (S9), illustrating the progression and overview of various learning levels (Curriculum Development Council, 2012).

The Learning Progression Framework (LPF) is based on the concept of "milestones," where each level signifies important learning achievements that correspond to specific key learning requirements. Each milestone is rooted in students' cognitive development, and within the "Subject Specific Levels," these milestones consider both the breadth and depth of subject content and the distinctive characteristics of each subject area. In summary, the LPF defines critical learning milestones that reflect students' cognitive progress while integrating the comprehensive aspects of each subject's curriculum (Curriculum Development Council, 2012).

Developed by the Education Bureau (EDB) in 2007, the LPF aligns with high school curricula and serves as a common assessment framework designed to facilitate learning progress while informing future learning objectives. Despite its long-term implementation, there has been limited research investigating the LPF's impact on student learning, particularly regarding its role in optimizing curricula and addressing learning differences.

Considering the identified research gap, this study focuses on examining the effectiveness of the Learning Progression Framework (LPF) in Hong Kong as an assessment tool for evaluating the academic performance of students with intellectual disabilities. Therefore, the subsequent methodology will outline the research design and techniques employed to explore the LPF's effectiveness, aiming to provide valuable insights that may enhance curriculum planning and improve academic outcomes for these students.

Methodology

This study employs a mixed-methods research design to comprehensively evaluate the effectiveness of the Learning Progression Framework (LPF) in assessing academic performance among students with intellectual disabilities. The quantitative component focuses on analyzing the number of students reaching various proficiency levels across multiple years and examining the variations in median and highest levels attained. This analysis provides insights into the changes in student abilities over time. In parallel, the qualitative aspect

involves systematic evaluations of data recorded in minutes from reflective and annual subject meetings, along with teachers' comments on student performance during these meetings. Additionally, LPF analyses will be conducted across different subjects to quantify the impact of the framework. By integrating both qualitative and quantitative data, this research design aims to provide a robust understanding of how the LPF influences student learning outcomes and informs curriculum development.

In total, there are 62 special schools in Hong Kong, of which 43 cater specifically to students with intellectual disabilities, offering individualized learning programs that include modified curricula and life skills training. Additionally, the network includes 7 schools for students with physical disabilities, 8 focused on social development, 2 for visual impairments, 1 for hearing impairment, and 1 hospital school. This study was conducted at the Tung Wah Group of Hospitals Tsui Tsin Tong School, a special school in Hong Kong that serves students with mild to moderate intellectual disabilities.

Intellectual disability (ID) is a condition defined by incomplete or stalled mental development, significantly characterized by a decline in concrete functioning across different developmental stages. This impairment impacts overall intelligence, affecting cognitive, language, motor, and socialization skills, which leads to difficulties in adapting to the environment (Katz & Lazcano-Ponce, 2008). The students participating in this study have mild to moderate ID, with IQ ranges of 52–69 for mild ID and 36–51 for moderate ID.

The research population for this study consists of 170 students with mild to moderate intellectual disabilities, ranging from Primary 1 (P.1) to Secondary 6 (S.6), aged between 6 and 20 years. These students are enrolled at TWGHs Tsui Tsin Tong School, which serves as the research site. Data have been collected annually as part of an ongoing process, with this study utilizing data from 2021 to 2025. Throughout this period, the Learning Progression Framework (LPF) has been systematically implemented across the curriculum. This targeted application of the LPF aims to strengthen curriculum planning and enhance academic performance for these students, offering valuable insights into the framework’s effectiveness in meeting their unique educational needs.

The LPF operates by designating specific students as targets for tracking throughout their educational journey until graduation. Evidence of students' learning performance is collected, often through videos or photographs. During meetings, teachers present this evidence alongside the LPF levels assigned to the targeted students. Discussions then focus on evaluating student performance, aligning their achievements with the appropriate LPF levels. Teachers apply their professional judgment to determine grades for all students within the school. The subject panel head analyzes the collected data to provide an overview of student performance across various key stages.

The LPF is intricately linked with curriculum implementation, functioning as a crucial element within the school's assessment framework. This alignment ensures that the LPF informs instructional practices and evaluations, thus enhancing the teaching and learning processes. By observing specific learning behaviors and employing school-based assessment tools, educators can effectively assess students' learning progress and levels, generating valuable insights into each student’s development to tailor support accordingly. Furthermore, the LPF fosters collaboration among teachers, students, and parents to establish or adjust learning goals and plans, serving not just as an assessment tool but as a dynamic system that promotes continuous learning.

The study focuses on the follow research questions:

1. How does the implementation of the Learning Progression Framework (LPF) influence the academic performance of students with intellectual disabilities over time?
2. What variations exist in the proficiency levels achieved by students with intellectual disabilities within the LPF framework across different key stages?
3. How do teachers' insights and professional judgments, informed by the LPF, impact curriculum planning and instructional practices for students with special educational needs?
4. In what ways can the LPF facilitate collaboration among educators, students, and parents to enhance students' learning goals and plans?

The study focuses on the follow research objectives:

1. To evaluate the effectiveness of the LPF in improving the academic performance of students with intellectual disabilities by analyzing proficiency levels and trends over time.
2. To assess the distribution and variations in LPF levels attained by students across multiple years and key stages.
3. To explore how teachers utilize insights gained from the LPF to inform curriculum planning and adapt teaching strategies to meet the diverse needs of their students.
4. To investigate the role of the LPF in promoting collaborative efforts among teachers, students, and parents in establishing or revising learning goals and enhancing continuous learning.

Results

Students' performance has been recorded and analyzed annually. The levels of students range from S1 to S9, each representing a distinct cognitive level achieved in two subjects. These cognitive levels are linked to specific subject areas, allowing for an assessment of how well students can perform in various categories of each subject. The nine Learning Progression Framework (LPF) levels are detailed as follows (Curriculum Development Council, 2012):

Table 1

Levels of Learning Progression Framework (LPF)

S1	Recognize	Students are able to recognize and name basic concepts, items, or terms within the subject. This foundational level indicates initial awareness and identification.
S2	Identify	At this level, students can correctly identify and label more specific concepts, demonstrating an understanding of the differences between items or ideas.
S3	Demonstrate	Students can exhibit practical skills related to the subject, applying their recognition and identification skills in real-world scenarios or tasks.
S4	Describe, Distinguish	Students can describe key characteristics of concepts and distinguish between similar ideas, showcasing their ability to articulate differences and details.
S5	Apply	Students are now able to apply their knowledge and understanding to practical situations, solving problems and carrying out tasks that require the use of learned skills.

S6	Explain	At this level, students can explain concepts and processes in their own words, demonstrating a deeper understanding and the ability to communicate their knowledge effectively.
S7	Outline	Students begin to organize their thoughts systematically, outlining main ideas and supporting details, which reflects their ability to structure information logically.
S8	Analyze	Students are capable of breaking down complex concepts and examining the relationships and components, showing critical thinking and evaluative skills.
S9	Evaluate, Comment	At the highest level, students can make judgments about information and ideas, evaluating the effectiveness or significance of various concepts, and providing reasoned commentary on their findings.

Additionally, students' performance in Chinese Language and Mathematics has been compared. Data for students with mild and moderate intellectual disabilities are collected and analyzed separately to provide targeted insights into their academic progress. Students are evaluated across different categories to assess their capabilities in various areas. For Chinese Language, the four categories include reading, writing, listening, and speaking. In Mathematics, the categories consist of number and algebra, measurement, geometry and spatial sense, and data handling. This categorization allows for a comprehensive understanding of students' strengths and areas for growth.

Table 2

Comparison of Students' Performance on Chinese Language of Students of Mild Intellectual Disability

21/22						24/25				
KS1	Reading	Writing	Listening	Speaking		KS1	Reading	Writing	Listening	Speaking
Median	S3	S4	S4	S4		Median	S3	S3	S3	S4
Highest	S4	S5	S5	S5		Highest	S6	S6	S7	S6
KS2	Reading	Writing	Listening	Speaking		KS2	Reading	Writing	Listening	Speaking
Median	S4	S4	S4	S4		Median	S3/S4	S4/S5	S4	S5
Highest	S5	S5	S5	S5		Highest	S5	S6	S6	S6
KS3	Reading	Writing	Listening	Speaking		KS3	Reading	Writing	Listening	Speaking
Median	S4	S4	S5	S5		Median	S4	S5	S5	S5
Highest	S8	S8	S7	S6		Highest	S6	S8	S7	S8
KS4	Reading	Writing	Listening	Speaking		KS4	Reading	Writing	Listening	Speaking
Median	S5	S5/S6	S6	S5		Median	S5	S6	S6	S6
Highest	S9	S8	S9	S9		Highest	S9	S8	S9	S9

Table 3

Comparison of Students' Performance on Chinese Language of Students of Moderate Intellectual Disability

21/22						24/25				
KS1	Reading	Writing	Listening	Speaking		KS1	Reading	Writing	Listening	Speaking
Median	S3	S2	S2	S2		Median	S2/S3	S2	S2/S3	S2
Highest	S4	S3	S3	S3		Highest	S4	S5	S5	S4
KS2	Reading	Writing	Listening	Speaking		KS2	Reading	Writing	Listening	Speaking
Median	S2	S2	S2	S2		Median	S3	S2	S3	S2
Highest	S4	S4	S4	S4		Highest	S4	S5	S5	S5
KS3	Reading	Writing	Listening	Speaking		KS3	Reading	Writing	Listening	Speaking
Median	S2	S2	S3	S2		Median	S2/S3	S2	S3/S4	S2/S3
Highest	S5	S5	S5	S5		Highest	S5	S4	S5	S5
KS4	Reading	Writing	Listening	Speaking		KS4	Reading	Writing	Listening	Speaking
Median	S2	S2	S3	S2		Median	S3	S3	S3	S3
Highest	S4	S5	S4	S4		Highest	S5	S5	S6	S6

Table 4

Comparison of Students' Performance on Mathematics of Students of Mild Intellectual Disability

21/22						24/25				
KS1	Numer and Algebra	Measure ment	Geometr y and spacial sense	Data handling		KS1	Numer and Algebra	Measureme nt	Geometr y and spacial sense	Data handling
Median	S5	S3	S3	S3		Median	S3	S3	S3	S3
Highest	S5	S4	S3	S3		Highest	S5	S4	S5	S5
KS2	≈	Measure ment	Geometr y and spacial sense	Data handling		KS2	Numer and Algebra	Measureme nt	Geometr y and spacial sense	Data handling
Median	S5	S3	S4	S4		Median	S6	S8	S6	S4/S5
Highest	S5	S5	S5	S6		Highest	S6	S8	S7	S6
KS3	Numer and Algebra	Measure ment	Geometr y and spacial sense	Data handling		KS3	Numer and Algebra	Measureme nt	Geometr y and spacial sense	Data handling
Median	S5	S4	S4	S5		Median	S6	S5	S6	S6
Highest	S7	S7	S6	S8		Highest	S8	S8	S8	S9

KS4	Numer and Algebra	Measurement, Geometry and spacial sense	Data handling		KS4	Numer and Algebra	Measurement, Geometry and spacial sense	Data handling
Median	S5	S5	S6		Median	S6	S5	S6
Highest	S8	S7	S9		Highest	S9	S8	S9

Table 5

Comparison of Students' Performance on Mathematics of Students of Moderate Intellectual Disability

21/22						24/25				
KS1	Numer and Algebra	Measurement	Geometry and spacial sense	Data handling		KS1	Numer and Algebra	Measurement	Geometry and spacial sense	Data handling
Median	S2	S2	S3	S2		Median	S2/S3	S2	S2	S2
Highest	S4	S3	S4	S3		Highest	S4	S4	S4	S5
KS2	Numer and Algebra	Measurement	Geometry and spacial sense	Data handling		KS2	Numer and Algebra	Measurement	Geometry and spacial sense	Data handling
Median	S3	S2	S2	S3		Median	S3	S3	S3	S3
Highest	S4	S5	S4	S5		Highest	S5	S5	S4	S5
KS3	Numer and Algebra	Measurement	Geometry and spacial sense	Data handling		KS3	Numer and Algebra	Measurement	Geometry and spacial sense	Data handling
Median	S3	S2	S3	S3		Median	S3	S3	S3	S3
Highest	S6	S7	S6	S6		Highest	S5	S6	S5	S7
KS4	Numer and Algebra	Measurement, Geometry and spacial sense		Data handling		KS4	Numer and Algebra	Measurement, Geometry and spacial sense		Data handling
Median	S3	S3		S3		Median	S3	S3		S2
Highest	S6	S6		S7		Highest	S7	S7		S6

In the diagram above, "KS" refers to the "key stages" of students, with KS1, KS2, KS3, and KS4 corresponding to Primary 1 to 3, Primary 4 to 6, Secondary 1 to 3, and Secondary 4 to 6, respectively.

The data indicate significant improvement in students' Learning Progression Framework (LPF) levels between the 2021–2022 and 2024–2025 academic years. More than half of the categories in both Chinese Language and Mathematics show notable advancements (highlighted in red).

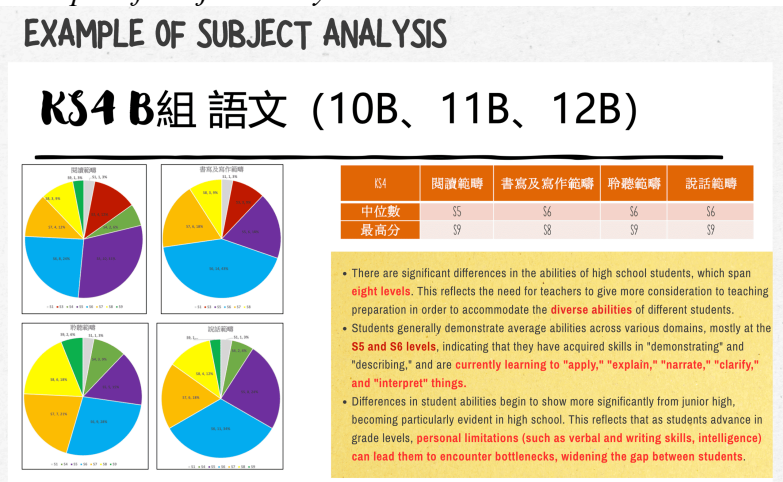
The transition from KS2 to KS3 marks the most substantial progress overall. For instance, students with mild intellectual disabilities in KS2 and KS3 demonstrated improvement in Mathematics across all categories in the 2024–2025 year. Specifically, the median levels for KS2 students increased from S5 to S6 in general performance, while scores in specific categories rose from S2 to S8 and from S4 to S6. Similarly, KS3 students showed improvements from S5 to S6 and from S4 to S5, with growth noted in all four key areas.

However, a decline is evident in some KS1 levels, which is uncommon in other key stages. For example, the median score for KS1 students in the Chinese Language category dropped from S4 to S3 in writing and listening skills. A similar decrease was observed in Mathematics, where mild ID students' performance fell from S3 to S2 in geometry. Additionally, students in KS4 exhibited improvements in several areas, though the increases were less pronounced compared to those seen in KS2 and KS3.

These findings have been further analyzed and discussed during subject and panel meetings to enhance teaching practices and curriculum development.

Figure 1

Example of Subject Analysis



In addition to conducting cross-year analyses of student performance, subject panel heads also perform same-key-stage and cross-key-stage analyses utilizing Learning Progression Framework (LPF) data, as illustrated in the diagram above. This quantitative data provides valuable insights into the distribution of abilities within each class, enabling teachers to develop tailored teaching plans and materials that meet the diverse needs of their students. Furthermore, this analysis aids panel heads and curriculum leaders in reflecting on and refining the curriculum, ensuring it remains relevant and effective in promoting student learning. By using LPF data effectively, educators can make informed decisions that enhance instructional practices, support student growth, and align curriculum development with the varying proficiency levels of students in different key stages.

The qualitative component includes methodical assessments of data documented in the minutes from reflective and annual subject meetings, as well as teachers' feedback on student performance discussed during these sessions. Students' performance and trend of improvement have been discussed and further analyzed in meetings to find out reasons behind for further improvement in teaching and curriculum in the future.

The use of Learning Progression Framework (LPF) data assists teachers in understanding the current challenges and circumstances faced by students across various key stages. Reviewing the minutes from subject meetings reveals that teachers have gained substantial insights from analyzing LPF data. For instance, it has been noted that KS1 students may experience declines in several categories. During discussions, teachers reflected that this could be significantly influenced by the quality and capability of the student intake for that year, which impacts overall performance outcomes.

Furthermore, students with intellectual disabilities (ID) often require more time to show improvement, which is why notable progress is observed during KS2 and KS3. However, the degree of improvement in KS4 tends to be less pronounced. This is largely due to the limitations in ability that many ID students experience, preventing them from reaching the highest LPF levels as they progress to senior secondary education. Additionally, some ID students may be non-verbal or unable to write, making it challenging for them to meet the skill requirements associated with higher LPF levels. As highlighted in the minutes, subject teachers have proposed increasing the use of Augmentative and Alternative Communication (AAC) tools to enhance students' communication skills. These tools can support students in meeting the necessary criteria for higher achievement levels. Moreover, teachers have suggested incorporating a “Voice Input” feature into the curriculum, allowing students with limited motor skills to articulate their ideas verbally and “write” compositions through speech input, thereby facilitating their advancement to higher LPF levels and enhancing their overall capabilities. In addition, teachers affirmed the role of LPF in enabling same-key-stage and cross-key-stage analyses, allowing subject panels to gain a deeper understanding of student groupings, class structures, and individual abilities. This information is crucial for effectively facilitating both teaching and learning, ensuring that instruction is aligned with the unique needs of each student.

Discussion

The implementation of the Learning Progression Framework (LPF) has significantly contributed to improvements in students' academic performance in a variety of ways. First and foremost, the LPF has enhanced teachers' understanding of student performance by providing structured assessment tools that offer clear insights into individual capabilities. This deeper comprehension allows educators to tailor their instruction more effectively. As a result, curriculum planning has become more strategic and targeted, addressing the specific needs of students with intellectual disabilities. The alignment of teaching strategies with these needs fosters an environment conducive to learning. Over the course of the study, students exhibited measurable academic progress, underscoring the effectiveness of the LPF in driving better educational outcomes. By facilitating a continuous improvement cycle in the learning-teaching-assessment process, the LPF not only enhances curriculum planning and teaching practices but also enriches the overall educational experience, ensuring that students are supported in their diverse learning journeys.

Future research in the realm of the Learning Progression Framework (LPF) holds great potential for further enhancing curriculum planning and academic outcomes in special schools. Subsequent studies could build upon the findings of this thesis by investigating how the LPF can be more effectively utilized across various subjects, enabling educators to harness data from the framework to reflect student abilities comprehensively. Additionally, expanding the scope of research to include cross-school comparisons can provide valuable insights into whether students at different institutions, despite attaining similar proficiency levels, exhibit comparable abilities and underlying implications. Collaboration among special schools in

sharing data and findings could further facilitate effective teaching and curriculum planning, ultimately enhancing learning outcomes. Future inquiries may also delve deeper into specific mechanisms behind the LPF's effectiveness, allowing for a nuanced understanding of its impact. Exploring the broader application of the LPF across diverse special education contexts, as well as assessing the long-term effects on student achievement, will be critical in developing a robust evidence base that informs educational practices and policies in the field of special education.

Conclusion

The findings of this thesis demonstrate that significant improvements in students' academic performance are evident following the implementation of the Learning Progression Framework (LPF). One of the primary reasons for this positive outcome is that the LPF enables frontline teachers to gain a deeper understanding of their students' abilities, allowing them to design teaching materials that are more suitable and effective. Additionally, teachers gain insights into the distribution of student capabilities within their classes, facilitating more appropriate lesson design that meets diverse learning needs. Furthermore, the LPF equips subject panels with comprehensive information regarding students' strengths and weaknesses, enhancing their curriculum planning efforts. Looking ahead, future research should explore additional strategies for how special schools can further leverage the LPF to optimize curriculum planning and improve academic outcomes for students with special educational needs. By continuously refining and implementing the LPF, educators can foster a more inclusive and effective learning environment that supports the unique learning journeys of all students.

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From Theory to Practice: Evaluating Short-Term Project-Based Learning for Design Thinking Pedagogy

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Abstract

Design thinking is primarily taught through three pedagogical approaches: project-based, lecture-based, and workshop-based learning. Project-based learning is common in art and design education. It emphasises hands -on practice and supports the development of tactic knowledge, such as brainstorming, experimentation, and problem solving. Lecture-based learning, more common in non-design disciplines, prioritises theoretical understanding but often lacks practice. Workshop-based learning offers a structured, step-by-step format aligned with the stages of the design thinking process. Although project-based learning is highly effective, it typically requires a significant amount of time and sustained engagement. This study addresses the challenges of implementing design thinking pedagogy within a limited time frame by evaluating a short-term, project-based activity aimed at cultivating core design thinking skills. This study adopted a qualitative approach, with nine graduate students from design and non-design backgrounds as participants. The participants were divided into three groups and tasked with solving a tangible, time-bound problem that required creative ideation, prototyping, and testing. Data was collected through observation, video and photographic recording, and thematic analysis of post-activity reflections. The results showed that even in a brief intervention, students demonstrated greater awareness flexibility, openness to experimentation, and reflective learning. This exercise served as a facilitator for mindset shifts and interdisciplinary collaboration. This study validated that short-term, domain-neutral activities are effective teaching tools for design thinking and contribute to instructional design. Simplified experiential formats have potential in reinforcing theory, promoting the acquisition of tacit knowledge, and supporting inclusive, interdisciplinary learning.

Keywords: design thinking, paedology, project-based pedagogy, doctoral education, tacit knowledge, collaboration, case study, experimentation

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Introduction

This study investigates how brief, constrained, and project-based mini-exercises can support the teaching and learning of design thinking for students from diverse professional backgrounds in real institutional settings. Design thinking, as an iterative, human-centred methodology, has been widely adopted to address complex real-world challenges and is frequently incorporated into the curricula of business, engineering and design schools within higher education institutions. Many universities deliver design thinking within compressed, semester-based courses where the time available for iterative projects is constrained by fixed deadlines (McLaughlin et al., 2022). Much of the existing literature in higher education focuses on semester-long project-oriented courses or multi-week studio projects, indicating improvements in students' creativity, collaboration, empathy, and problem-framing abilities. These implementations are described as time-intensive, active methodologies that rely on sustained project work and appropriate learning environments (Alvarado, 2025; McLaughlin et al., 2022). By contrast, there is relatively limited research on integrating brief, sub-day design thinking exercises into regular curricula for students from diverse disciplinary backgrounds under tight time and resource constraints.

This study analysed a single three-hour egg drop challenge integrated into the 12-week of a 13-week graduate level design thinking course. The challenge intentionally set restrictive time, budget, and material constraints, and was observed using a framework of the eight design thinker characteristics. The research focus was not on outcome (such as whether eggs break), But on how three interdisciplinary student teams engaged with the task, and how core design thinking traits manifested in their behaviour. The exercise was positioned to test whether students showed evidence of a mindset shift in design thinking after twelve weeks of coursework. Its simplicity of the exercise design was intentional, requiring no prior specialised knowledge, allowing students from diverse backgrounds could be observed on a comparable basis. The study adopted a qualitative research design, combining structured non-participatory observation with thematic analysis.

This study contributes to three aspects. First, it provides evidence that a strategically scheduled, constrained mini exercise following theoretical instruction can make design thinking traits visible in higher education context. Second, for design thinking courses operating under institutional constraints, it highlights critical instructional design considerations, including when to introduce brief interventions, how to use constraints, structure student groups, and setup physical learning spaces to foster peer learning and cross-group influence. Third, it outlines a course design direction in which multiple brief exercises are distributed across the semester, aligned with stages of the design thinking process and supplemented by reflective methods such as the photovoice, to support the progressive development of design thinking mindsets and to provide richer evidence of students' learning journeys.

The next section reviews literature on design thinking, experiential learning, project-based learning, constraints, and multidisciplinary design teams, and formulates the research questions guiding this study. The following section describes the course context and the egg-drop intervention, followed by the methodology, which outlines participants, data collection, and analysis procedures. The findings and discussion section presents three group case narratives, cross-group patterns, and key pedagogical insights. The study then discusses limitations and future research directions before concluding with implications for designing design thinking pedagogy under institutional constraint.

Background

Design thinking is described as an analytical and creative process that guides individuals to engage in experimentation, creation, and prototyping, solving complex and often unstructured problems through gathering feedback and iterative redesign (Razzouk & Shute, 2012). In professional practice, this approach is frequently described as a human-centred innovation methodology that integrates user requirements, technical feasibility and organisational constraints (Brown, 2008). The five-stage model promoted by Stanford University's Institute of Design, empathy, define, ideate, prototype, and test, has become the standard framework for teaching design thinking in higher education (Plattner, 2013).

The theoretical foundations of design thinking in the field of education are closely linked to experiential learning. Kolb's experiential learning theory conceptualises learning as "the process of creating knowledge through experiential transformation". This process is realised through a cycle of concrete experience, reflective observation, abstract conceptualisation, and active experimentation (Kolb, 2015). In design and studio pedagogy, the Kolb's model is used to describe how learners progress through a cycle of practice, reflection, theorisation, and re-attempt when tackling real-world design tasks (Kolb, 2015, 2007). Schön's concept of "reflection-in-action" further positions design practice as an ongoing dialogue with materials, situations and stakeholders, where practitioners think and learn while acting in uncertain environments (Schön, 2017). These perspectives position design thinking as an experiential, reflective, and iterative inquiry rather than a purely procedural toolkit.

Within the field of higher education, design thinking has increasingly been integrated into project-based learning (PBL), evolving into mixed teaching approaches such as Design Thinking and Project-Based Learning (DT–PBL) (Jia et al., 2023). PBL is typically defined as a learner-centred approach in which participants undertake extended periods of inquiry and response to real-world, complex problems or issues (Thomas, 2000). PBL in higher education has been demonstrated to positively impact students' learning outcomes, motivation, and teamwork abilities. However, research also indicates that actual effectiveness varies significantly depending on project design methodology, level of teaching support, assessment approaches, and the overall environmental conditions within which PBL is implemented (Guo et al., 2020). Recent review of DT–PBL indicated that integrating the stages and mindset of design thinking into project-based teaching frameworks effectively enhances creativity, problem-solving abilities, collaborative skills, and learning transfer outcomes (Jia et al., 2023).

However, design thinking and DT–PBL are often implemented through projects lasting several weeks or an entire term, which require ongoing access to materials, space, and teaching support. Studio-based and project-oriented teaching implementation models typically require substantial time for iterative cycles and formative feedback and may be constrained by the semester-based structural framework within higher education (McLaughlin et al., 2022). In many organisations, these conditions are difficult to maintain. The compressed academic term reduces the time and space for iterative refinement and reflection; class sizes are often large; student cohorts, while diverse, possess uneven levels of design experience. Design thinking is typically practised through coursework or multi-week projects, but the time and trust required for iterative design work are frequently constrained by semester deadlines (McLaughlin et al., 2022). Simultaneously, studies on creativity and education indicates that increasing constraints can reduce the scope for choice within tasks and limits alternative solutions, though restricting the initial number of options can provide a creative advantage, this encourages individuals to focus on exploring innovative outcomes and fosters deep exploration rather than superficial

engagement (Tromp & Baer, 2022). In collaborative design processes, carefully designed creative constraints have been shown to guide student teams in defining design tasks, generating ideas, and deciding which design solutions to develop. When openness and constraint are balanced, such constrained tasks effectively stimulate collaborative creative thinking (Lahti et al., 2022). These findings support the view that purposefully designing challenging time and resource constraints within design thinking scenarios may enhance rather than hinder participation and learning outcomes.

Research in design education indicates that within heterogeneous teams comprising students from different departments, those including members with interdisciplinary design education produce richer creative outcomes. Furthermore, their participation levels during the ideation and proposal evaluation stages significantly exceed those of teams formed purely from design department students (Kwon & Jang, 2014). However, in the multi-institutional study by McLachlan et al. on design thinking courses, the analysis and characterisation of student cohorts were based on their primary academic disciplines (e.g. business, design and engineering, other) and student types, rather than whether courses deliberately adopted interdisciplinary grouping (McLaughlin et al., 2022). There are still relatively few studies and DT-PBL remains in an exploratory stage, while also recognising that the DT-PBL model is dynamic and adaptable across diverse educational contexts and is ready to undergo progressive refinement into a mature pedagogical methodology that transcends disciplinary boundaries (Jia et al., 2023). Research into integrating brief, sub-day design thinking exercises into regular curricula remains relatively limited, particularly within interdisciplinary classes, and even more restricted when conducted as practical studies under real-world time and resource constraints. This study investigates how a single three-hour highly constrained micro-practice session brings design thinking characteristics and potential shifts in thinking patterns within a design thinking course, and what insights it offers for design thinking pedagogy in higher education. This study is guided by the following questions:

1. How can the characteristics of design thinking be demonstrated within the brief and constrained project-based exercises of a design thinking course?
2. How do time, budget, and material constraints shape students' creative problem-solving processes in these small-scale exercises?
3. How does team composition influence strategic orientations and behavioural patterns within interdisciplinary teams?
4. To what extent can small-scale exercises, following a theoretical instruction phase, facilitate shifts in students' design thinking mindset and demonstrate these in practice?

Course Context and Intervention

This research was conducted within a 13-week graduate-level design thinking course at the School of Design of The Hong Kong Polytechnic University, enrolling students from design, education, business, social sciences, and healthcare. The mixed-learning group was intentionally formed to explore how design thinking learning unfolds within an interdisciplinary environment. It simulates the diverse professional backgrounds found in real project teams, enabling students to gain practical experience in cross-disciplinary collaboration.

This course used a mixed teaching model. Weeks 1 to 11 focused on the foundational concepts, process models, case studies, and historical perspectives of design thinking, delivered through lectures and seminars. Students were introduced to the Empathy, Define, Ideate, Prototype, and Test model and explore its application through topics such as human-centred research methodologies, problem framing and reframing, divergent and convergent ideation, prototyping strategies, and the role of iteration, feedback, and reflection. Considering that many participants have no design background, the initial phase focuses on establishing a shared conceptual understanding and cultivating critical and creative thinking skills.

This course incorporated a single intensive project-based intervention, a three-hour egg drop challenge in Week 12. This practical session was designed as an opportunity for students to apply and test the theoretical concepts and mindsets developed earlier in the course under purposefully constrained conditions. In the egg drop challenge, students worked in teams of three to design and build solutions that would protect raw eggs from breaking when dropped from a height on campus. Each team received three raw eggs and a HK$50 budget to purchase materials from on-campus facilities such as digital print shops, workshops, and convenience stores. The entire activity was completed within three hours. To emphasise hands-on learning, contextual problem solving, and in-person collaboration, the use of online resources, including AI tools and general web searches, was prohibited. This challenge reflects constraints commonly encountered in professional design practice: limited budgets, fixed timelines, incomplete background information, and the necessity to work resourcefully with available materials. It requirs teams to understand the problem, articulate success criteria, generate ideas, construct prototypes, and test them by physically dropping eggs from height, with success or failure immediately visible. The task was intentionally simple and did not require specialised technical knowledge, enabling students from diverse disciplinary backgrounds to participate under comparable conditions.

From an educational perspective, this intervention is designed to validate students' ability to apply design thinking concepts and mindsets under real-world constraints, revealing how they navigate ambiguity, time pressure and collaborative challenges. It generates rich observational data on group dynamics and individual behaviour. The research focus was on how design thinking characteristics translated into observable actions, rather than focusing on outcomes, such as whether the egg remains undamaged.

Methodology

This study adopted qualitative research methods to explore how design thinking characteristics can be demonstrated in graduate classroom settings through brief, highly constrained project-based exercises. The egg drop challenge served both as a routine teaching activity and as a defining case study, enabling the investigation of student behaviours and interaction patterns. Analysis was conducted by comparing findings with design thinker characteristics.

Research Design

The objectives were to understand and enhance teaching practices. Three observers each followed one student team throughout the three-hour challenge. Observers were instructed not to intervene in decision-making or problem-solving processes, only to record the real-time development of processes. This design enabled researchers to capture detailed process data from all teams in real time without changing the challenge parameters or adding extra guidance.

Participants and Group Composition

Nine graduate students enrolled in the Design Thinking course participated in the egg drop challenge. They formed three self-selected teams. Allowing students to choose their own teammates aligns with course conventions, aiming to foster trust and collaboration within groups. The final team composition was as follows:

- Group 1: A professional designer with extensive industry experience, an event planning company practitioner, and an academically oriented student.
- Group 2: Students with academic and healthcare service backgrounds, whose professional cultures emphasise evidence-based approaches and pragmatic methodologies.
- Group 3: Students from business and academic backgrounds.

This composition created a diverse distribution of design experience and disciplinary perspectives. Research findings indicate that team composition significantly influences thematic orientation, leadership styles, and problem-solving strategies, a discovery consistent with interdisciplinary design education research.

Data Collection

Before the implementation of the intervention measures, observers attended a briefing session introducing the eight-characteristic framework of design thinkers and outlining the observation criteria. The characteristics adopted include navigating ambiguity, learning from others.

Integrating or synthesising information, rapid experimentation, mastering the concrete and abstract, conscious construction and creation, conscious communication, and designing one's design work. Observers, as non-participants, clearly identify behavioural patterns within each group (e.g., sequence of ideas, decision points, collaborative dynamics, substantive strategies) and provide guidance on capturing contextual details and direct quotations. During the three-hour session, observers gathered data through the following methods:

- Continuous on-site notetaking documented each group's process, including action sequences, shifts in focus, debates, and key events (such as design redirections or failures).
- Transcriptions of student dialogue are recorded with the precision, subsequent Chinese paragraphs are translated into English.
- Photographs documenting material collection processes, prototyping stages, and final outputs, supplemented by video recordings where feasible.
- Physical artefacts such as sketches and idea lists were collected or photographed for record-keeping.

Observers avoided answering questions related to the challenge, offering design suggestions, or influencing strategy in any manner. Their role was specifically communicated to students as strictly observational to minimise the risk of response bias.

Data Analysis

Following the completion of the activity, the research team integrated and analysed field notes, photographic records, and physical artefacts using thematic analysis. An initial comprehensive review of each dataset was conducted to reconstruct the process narrative for each group. The behavioural cases were subsequently coded according to eight design thinking characteristics,

with their frequency, intensity, and contextual circumstances documented. Triangulation of field notes, visual records, and physical artefacts enhanced the reliability of interpretative findings while reducing observer bias. A cross-case comparison was developed to highlight similarities and differences across groups in terms of structural composition, thematic focus, leadership patterns, conceptualisation styles, and materialisation methods. These comparative insights facilitate understanding of how constraints and team composition shape the articulation of design thinking characteristics.

Findings

During the three-hour challenge, observers documented eight characteristic behaviours of design thinking demonstrated by three teams. Despite encountering unfamiliar tasks, incomplete information about falling objects, and multiple viable solutions, they learned by observing peers, exploring the physical environment, and applying individually similar prior experience. They integrated insights from rapid testing, material interactions, and discussions, flexibly shifting between abstract inference of impacts and concrete manipulation of physical components. Rapid experimentation, deliberate construction, clear communication, and process-level reflection were also evident, though each group emphasised different key aspects. These characteristics did not appear in a linear, phased sequence but emerged as overlapping cycles as students repeatedly cycled between conceptualisation, prototyping, and testing. Each group activated all eight characteristics but demonstrated distinct emphases and operational patterns due to differences in team composition and preferred problem-solving styles.

Group 1: Designer-Led Creative Innovation

The first group included a professional designer who adopted an exploratory, creativity-driven strategy from the beginning. The team swiftly departed the studio for outdoor brainstorming sessions to explore novel concepts. Early ideas included a bucket-and-parachute combination, a bold experiment involving blinding participants, and a conical protective structure for objects. The designer's involvement appeared to make adventurous experimentation routine, encouraging the team to boldly explore unconventional possibilities before reaching agreed final idea. A crucial breakthrough occurred during the materials exploration phase. While reviewing resources, the team discovered steel wool, a material not initially considered in conceptual discussions. The moment of encountering steel wool sparked an idea moment, revealing its potential to absorb impact and distribute the force directed at the egg. This insight originated from direct interaction with the material rather than abstract reasoning, highlighting the importance of physical exploration in generating design inspiration. Budget constraints further shaped their process. The unexpected discovery of steel wool prompted the team to adjust their plans, reallocating resources within financial limitations to purchase cement at a cost of HK$40. The first group's process demonstrated multiple design thinking characteristics. They navigated ambiguity by exploring a broad conceptual solution space; learned from their environment, with material discoveries driving design shifts; conducted rapid experimentation by testing different material combinations and compositions; and demonstrated conscious construction through the meticulous layering of protective materials around the egg. Particularly noteworthy was the interplay between concrete fabrication and abstract reasoning concerning structure, cushioning, and force distribution.

Group 2: Pragmatic Systematic Protection

The second group of members, with backgrounds in academia and healthcare services, approached the challenge with a practical and protective mindset. During initial brainstorming sessions, they proposed ideas such as paper aeroplane parachutes, helium balloons, and pre-cooking eggs to transform egg structure properties. However, they swiftly initiated a self-critical assessment, systematically filtering out concepts deemed unreliable or overly complex under the exercise's constraints. The parachute solution faced doubts regarding operational reliability; balloons were considered difficult to control outdoors; and pre-cooking eggs was seen as an unnecessary complication. The team reframed the core problem as “What conditions must an egg satisfy to endure high-impact forces?” shifting focus to fundamental requirements: cushioning, stability, and controlled deceleration. The team subsequently concentrated on utilising recycled materials and workshop waste to create a robust, relatively simple protective container, maximising impact absorption within time and budget constraints. Leadership responsibilities were collectively shared, with all decisions reached through group discussion and consensual agreement. The second group's approach demonstrated how to manage ambiguity by focusing on problem definition, purposefully eliminating impractical ideas after ideation to balance divergent and convergent thinking. They extracted insights from material exploration and iterative testing, integrating information on feasibility, ease of construction, and anticipated performance. This methodology demonstrates that design thinking not only fosters creativity but also serves as an evidence-based problem-solving approach.

Group 3: Adaptive Exploratory Learning

The third group members, with backgrounds in both commerce and academia, demonstrated an adaptive learning model integrating digital and physical resources. One member recalled experience from social media, recalling protective packaging designs for fragile medical supplies, which subsequently influenced the team's initial concept. This connection between everyday examples and challenging problems highlights how real-world physical objects can inspire design thinking within the educational domain. The distinctive feature of Group Three was their implementation of real-time peer learning. As their workspace was near Group Two's, they could observe the progressively formed solutions being developed by the neighbouring team, including the use of elements such as balloons. Rather than avoiding potential perceptions of copying, Group Three openly acknowledged being inspired by this approach, adapting it into their own design. This behaviour tangibly demonstrated the practice of learning from others while highlighting the pedagogical benefits of shared physical space. Group Three gathered materials from the workshop and everyday settings like convenience stores and clinics, transforming items such as beverage cup packaging into protective components. Their division of tasks was flexible: while some collected materials, others simultaneously refined sketches or built prototypes. Their approach was both exploratory and responsive, with design concepts continually developing as new materials became available. The third group fully demonstrated the characteristic of “learning from others”, referencing both digital examples and contemporary peers’ solutions. They simultaneously exhibited an attitude of seeking opportunities, not only exploring diverse material sources but also maintaining openness to unexpected discoveries. Their conscious communication strategy was particularly evident when addressing external influences and reflecting on the creative process.

Cross-Group Patterns

Cross-case analysis revealed several patterns, identifying correlations between team composition and thematic orientation, leadership styles, and problem-solving strategies. The first group, led by senior designers, emphasised creative novelty, non-linear iteration, and opportunistic material exploration, adopting a designer-led leadership model. The second group comprised members with academic and healthcare service backgrounds, prioritising practical protection, systematic exploration, and a balanced generative-critical cycle, employing a shared leadership model. The third group integrated commercial and academic perspectives, focusing on understanding pedagogical intentions while leveraging peer learning and external inspiration, adopting a flexible distributed leadership model. These patterns demonstrate that team composition is a critical pedagogical variable, influencing problem framing, risk tolerance, success criteria, and time budgeting strategies. For educators, such diversity presents both an opportunity and a challenge when designing, facilitating, and evaluating design thinking activities.

Discussion

The discussion will interpret these findings by integrating existing research within higher education concerning design thinking, experiential learning, constraints, and curriculum design.

Brief Exercise, Visible Engagement

Research findings indicate that following thorough theoretical guidance, a single three-hour project-based exercise can enable graduate students to demonstrate observable engagement with the eight core attributes of design thinking. The egg drop challenge, through its moderate complexity and constraints, successfully triggered behaviours associated with the following traits: ambiguity management, learning from others, synthesis and integration, experimental exploration, concrete-to-abstract thinking shifts, construction and implementation, communication and collaboration, and meta-level reflection.

Constraints as Creative Catalysts

The study also emphasised the role of constraints as creative catalysts. Budget, time and material limitations did not merely restrict choice; they shaped and stimulated creativity. Budget constraints forced teams to clarify priorities and explore low-cost or repurposed materials; the three-hour time limit created urgency, motivating early prototype development, while restricted material access driven students to reinterpret everyday objects as design resources. These observations resonate with research on “creativity under constraints”, a field emphasising how limitations focus attention and foster deep engagement.

Learning-by-Making and Tacit Knowledge

The egg drop challenge underscores the importance of hands-on learning, transforming theoretical knowledge into tangible understanding. After eleven weeks of lectures and seminars, students have absorbed design thinking concepts and methodologies. This practical exercise provided an opportunity to apply these principles under pressure, observing the consequences of design decisions. By handling materials directly, constructing prototypes, and experiencing both successes and failures, students gained tangible insights into concepts such

as iteration, feedback, and risk-taking. This created a meaningful connection with experiential learning and reflective practice frameworks.

Peer Observation and Classroom Environment

Peer observation and cross-group learning emerged as another key insight. The third group's refinement of the second group's balloon concept served as a notable example, though more subtle cross-group influences were also observed, such as shifts in work pace or confidence levels. When teams collaborate within visible range, the classroom transforms into a shared experimental ecosystem rather than isolated project islands. This demonstrates that space layout and visual accessibility should be considered, with classroom configurations intentionally planned to foster peer learning and cross-group influence.

Implications for Course Design

Research findings point towards a curriculum design strategy that combines extended concept teaching with strategically scheduled brief, high-constraint exercises. Embedding micro-exercises within each phase of the design thinking process, such as assigning small observation tasks after the “empathy” phase, conducting rapid brainstorming sessions after the “ideation” phase, or setting constrained creation challenges after the “prototyping” phase, helps progressively cultivate design thinking traits and makes experimental exploration a routine practice early in the course. Combining such exercises with reflective methods like photo voicing or learning journals yields richer data on student learning trajectories and cognitive shifts, aligning with recommendations from design thinking-problem-based learning research.

Limitations and Future Directions

This study has several limitations. Firstly, the small sample size, comprising only nine students across three groups from a single institution and course, limits the generalisability of the findings. Secondly, the intervention consisted of a single three-hour practice session; while the study captured immediate behavioural outcomes, it did not investigate long-term development or learning transfer effects. Thirdly, the absence of a control group precludes determining the relative efficacy of this mini practice compared to other teaching methods. Fourth, an observer effect may have been present: students' awareness of being observed for research purposes could have influenced their behavioural performance, particularly during clear communication or argumentation segments. Fifthly, data primarily relied on observational records; the absence of systematic student self-reports means conclusions regarding internal cognitive shifts remain preliminary. Finally, multiple variables, including interdisciplinary composition, course scheduling, and self-organised team structures-intertwined, complicating the isolation of individual factors' influence.

Conclusion

This study investigates how a single, highly constrained three-hour egg drop challenge can enable interdisciplinary student teams to exhibit design thinking characteristics within a graduate-level design thinking course. Through structured non-participatory observation and analysis using an eight-characteristic framework, results indicate that all three teams demonstrated behavioural design thinking traits: navigating ambiguity, learning from others, synthesising information, rapid experimentation, shifting between concrete and abstract modes, conscious construction, conscious communication, and meta-level reflection, though emphasis

varied across teams due to composition differences. This practice demonstrates that strategically incorporating brief, constrained project tasks following theoretical instruction creates a powerful domain for observing and cultivating design thinking traits. Constraints function as catalysts for creativity rather than mere limitations; hands-on learning facilitates translating abstract models into tacit understanding; and peer observation within shared classroom environments enhances cross-group learning. These findings indicate that short-duration, highly constrained interventions play a significant role in higher education design thinking pedagogy, particularly in time- and resource-constrained settings. They offer valuable insights for curriculum design that balances conceptual depth with practical feasibility.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Preserving Local Fishing Heritage With a VR Educational Game: Integrating Sustainability and Cultural Identity Mechanisms

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Abstract

Once a cornerstone of Taiwan's economic development, the fishing industry is now facing challenges such as marine resource depletion and labor shortages. As the SDGs and ESG principles gain prominence, preserving local fishing culture and fostering regional identity have become critical issues. This study designed a VR game centered on Huanggang's century-old Benghuozi (Sulfur fire fishing) practice to promote cultural identity and belonging. Twenty-one university students in northern Taiwan participated in the VR experience and completed a questionnaire and qualitative survey. Results showed enhanced immersion in Benghuozi culture and stronger place identity and dependence on Huanggang fishing port. The VR experience also fostered deeper understanding of traditional fishing methods and active learning motivation. Overall, the culturally embedded VR game serves as a digital tool for cultural preservation with educational and sustainability value.

Keywords: friendly fishing technique, virtual reality, game-based learning, cultural identity, SDGs

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Introduction

The Benghuozi (Sulfur fire fishing) practice in Jinshan's Huanggang is a century-old, environmentally friendly fishing technique. Nevertheless, the practice now faces a transmission crisis due to a shortage of skilled labor. In light of sustainable development goals (SDGs) and environmental, social, and governance (ESG) principles, innovative approaches are needed to preserve intangible cultural heritage and strengthen regional identity. By utilizing virtual environments to assist college students in game design, 3D virtual tools can be employed to visualize discussion content, enabling participants to gain a more concrete understanding of the topics explored. This approach also enhances critical thinking, creativity, communication, and collaboration skills (Damaševičius & Sidekerskienė, 2024), while positively influencing engagement (Pellas et al., 2021) and academic emotions (Lin et al., 2025).

Virtual Reality (VR) allows individuals to transcend the limitations of time and space. Even places that cannot be physically visited can be previewed comprehensively in advance. For example, VR experiences have documented the traditional Benghuozi culture, raising public awareness of cultural heritage and immersing audiences in the lives of fishermen and maritime traditions. This not only enhances tourists' experiences but also contributes to the preservation and innovation of fishing port culture.

Research further indicates that virtual tourism experiences can serve as an information preview and reference for travelers before their trips. Activities that are time-sensitive or location-restricted can still be experienced anytime through VR. This form of virtual tourism has already been proven effective in stimulating users' willingness and motivation to travel (An et al., 2021). The VR educational game designed in this study incorporates features such as operational simulation, character simulation, and scene simulation to cultivate students' sense of local identity.

To investigate the impact of integrating local fishing knowledge into VR educational games on learners, the research questions are as follows:

1. What is the effect of this VR educational game on learners' sense of presence?
2. What is the effect of this VR educational game on learners' place identity and attachment?
3. What are the qualitative opinions of learners after using this VR educational game?

Method

This study recruited 21 Taiwanese participants aged 18 and above, with an average age of 22.30 years, who engaged in learning activities using VR headsets. The research procedure included: a 10-minute activity briefing, followed by a 40-minute VR game-based learning session, and concluded with a 20-minute administration of scales measuring sense of presence, place identity, and place dependence, along with an open-ended questionnaire. The scales were structured as follows: The Sense of Presence scale comprised 5 items based on Hwang et al. (2022). Place Identity and Place Dependence scales were derived from the Place Attachment Inventory used by Williams and Vaske (2003), with 6 items each. All scales employed a 5-point Likert scale design.

This study utilizes portable VR glasses and an integrated application characterized by their stability and efficiency to address the temporal limitations inherent in traditional Sulfur Fire

Fishing. The primary goal is to foster cultural identity among tourists through immersive digital storytelling, thereby facilitating the preservation of cultural heritage. The interface architecture is anchored in on-site field investigations, featuring digital reconstructions of fishing scenes and regional maps complemented by brief annotations. To enhance interactivity, the system employs an interactive quiz-based mechanism, which not only increases participation but also maximizes the educational impact of combining emerging technologies with intangible cultural heritage (Figure 1, Figure 2, and Figure 3).

Figure 1

VR Operation Simulation – Fishing Boat Interactive Facility



Figure 2

VR Character Simulation – Role-Play As Crew Members to Experience Fishing Missions

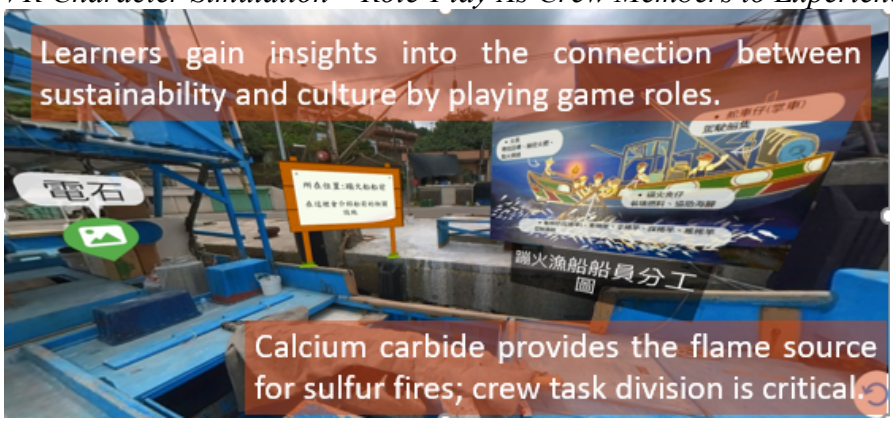


Figure 3

VR Scenario Simulation – On-Site Filming Scene Production



Results

This study employed Wilcoxon signed-rank tests to analyze sense of presence, place identity, and place dependence. Results indicate that the mean scores for all three variables significantly exceeded the median of 3 on the five-point scale ($p < .001$) (Table 1). This indicates that using this VR game for historical and cultural knowledge learning not only provides students with a heightened sense of presence but also fosters greater identity and place dependence toward the local culture.

Qualitative questionnaires further explored learners' perceptions of differences between VR-based local cultural learning and traditional lecture-based learning. Findings are summarized as follows: 48% (10 persons) believed VR's presence enhanced understanding of local industry techniques and cultural context; 29% (6 persons) felt VR fostered emotional resonance and motivated learning; 19% (4 persons) found VR more engaging than conventional lectures. 4% (1 person) had no opinion (Figure 4.)

Table 1

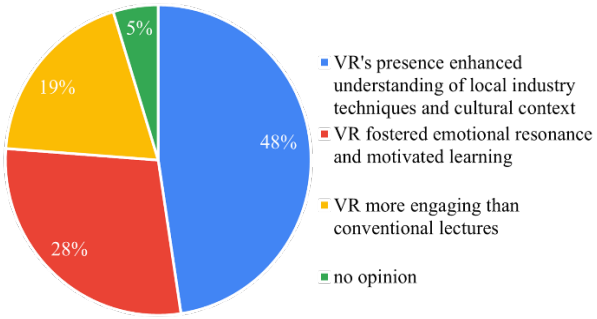
The Result of the One-Sample T-test for Each Aspect

	Mean	*SD*	*p*	*Effect Size*
Sense of Presence	3.98	.66	$< .001^{***}$	.97
Place Identity	4.17	.53	$< .001^{***}$	1.00
Place Dependence	3.91	.43	$< .001^{***}$	1.00

$^{***}p < .001$, test value = 3

Figure 4

The Result of the Qualitative Opinion Analysis



Conclusion

This study designed a VR game themed around Jinshan's Huanggang culture, enabling students to simulate traditional fishing processes and explore local industrial characteristics. The aim was to enhance students' understanding of local fishing techniques and cultural significance, thereby fostering a stronger sense of cultural identity and attachment to their community. Results indicate that the VR experience significantly enhanced participants' sense of presence within Jinshan's Huanggang culture, accompanied by heightened local identity and attachment. Qualitative feedback further revealed that VR exploration

deepened understanding of century-old fishing techniques and cultural significance while boosting learning motivation.

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Reimagining Critical Thinking Development: A Teacher Perspective on Alternative Approaches to Hong Kong's Education System

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Abstract

This study examines critical thinking education (CTE) in Hong Kong's secondary schools, exploring how competing national identities and educational reforms have shaped pedagogical practices. Through mixed-methods research involving 23 questionnaire respondents and 4 in-depth interviews, we investigate teachers' perceptions of critical thinking skills (CTS) development and how the educational system shapes their professional identities. Findings reveal significant gaps between content delivery and practical application of CT, systemic barriers including examination-oriented curricula and socio-political constraints, and teachers' evolving roles as knowledge transformers, strategic guides, and motivational encouragers. The study highlights the tension between developing independent thinking and navigating institutional demands, particularly following the implementation of the National Security Law. We argue that meaningful educational reform requires empowering teachers, reimagining assessment frameworks, and balancing institutional structures with the transformative potential of nurturing critically aware learners.

Keywords: critical thinking education, Hong Kong, teacher identity, educational reform, Liberal Studies, pedagogical barriers

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Introduction

The complex relationship between national identity and educational reform in post-1997 Hong Kong presents a unique case study in critical thinking education (CTE), particularly within rapid social and political change. This study examines how competing identities—characterized by nationalism emphasizing loyalty to China and a local-centric mentality prioritizing Hong Kong's unique identity—have shaped educational policies and practices (Morris & Vickers, 2015; Veg, 2017). The tension between these dual hegemonies has profoundly influenced education, where promoting critical thinking (CT) has emerged as a central concern.

The unclear conceptualization of CT creates fundamental challenges for educators. Without an official definition, CT is sometimes misinterpreted as promoting political activities. The field lacks both a precise definition and universally accepted assessment methods (Petrie et al., 2020). This definitional ambiguity extends throughout education, where various professionals hold different perspectives on CT.

Recent reforms have sparked debates about educational goals and teaching methods. The Hong Kong Diploma of Secondary Education (HKDSE) system emphasizes standardized testing, which often conflicts with developing critical thinking skills (CTS). Although Liberal Studies (LS) became compulsory to promote CTS (Spires, 2017), unclear guidelines created significant implementation challenges. The 2011 introduction of "Moral and National Education" (MNE) marked a crucial shift. Critics claimed it promoted narrow patriotism while omitting politically sensitive topics (Leung & Tang, 2011). The resulting 2012 Anti-national Education movement demonstrated growing concerns about preserving democratic values and independent thinking (Tse, 2023).

This study examines how Hong Kong's education system navigates these challenges while developing students' CTS. By analyzing curriculum development, teacher perspectives, and institutional responses, the research explores complex relationships between national identity, educational reform, and CT development in Hong Kong's distinctive post-colonial environment, including restrictions following the 2019 protests and the 2021 dissolution of the Hong Kong Professional Teachers' Union (HKTPU). This paper evaluates the current state of CT development through educational professionals' perspectives, examining teachers' perceptions, attitudes, and challenges in promoting CT in schools.

Literature Review

Conceptualizing Critical Thinking in Education

CT is generally recognized as encompassing various cognitive processes aimed at evaluating and enhancing one's thinking. It involves meticulous assessment of evidence, eschewing reliance on questionable authority. CT shares affinities with rational thinking and problem-solving, yet it is distinct in its broader scope, integrating logical, reflective, metacognitive, and creative thinking into a cohesive process.

Critical thinkers are self-regulating and habitually inquisitive, seeking to clarify issues, honestly confront personal biases, and make judgments with prudence. Ennis (1962) describes CT as reflective, reasonable thinking focused on decision-making. McPeck (1981) emphasizes reflective skepticism and intelligent use of evidence. Facione (1990) encapsulates CT as

pervasive, self-rectifying, and essential for interpretation, analysis, evaluation, and inference. The ideal critical thinker is well-informed, honest, prudent, clear, orderly, diligent, reasonable, focused, and persistent in pursuing accurate conclusions.

Critical Thinking Movement Versus Critical Pedagogy Movement

The CT Movement and Critical Pedagogy (CP) Movement reflect distinct educational projects with different aims and methods.

Table 1
Comparison of the CT Movement and CP Movement

	Critical Thinking Movement (CT Movement)	Critical Pedagogy Movement (CP Movement)
Objective	To teach critical thinking skills and dispositions to enhance individual thinking, without a specific cultural, moral, ethical or political agenda	Seeks to bring about social change and justice, viewing political issues as integral to critical thinking and reasons for its necessity.
Scope	Focuses on teaching individuals how to think critically, developing skills for reasoned, reflective thinking to guide beliefs and actions and creating better thinkers.	Aims to foster social justice by making students aware of indoctrination and the social conditions perpetuating it, empowering them to challenge and escape these conditions.
Method	Involves using teachers, fellow students, and resources to cultivate cognitive skills and critical dispositions. It values impartiality on issues as a key virtue and critical thinking disposition.	Emphasizes dialogue to develop confidence and literacy, eliminating feelings of powerlessness. It views impartiality as evidence of domination and oppression, reflecting different approaches and philosophies towards education and social change.

The CT Movement and Critical Pedagogy (CP) Movement pursue different projects. CT focuses on cultivating reasoning skills and dispositions through rational reflection and comparatively impartial analysis (Burbules & Berk, 1999; Davies, 2015). CP is explicitly political, aiming to develop consciousness of oppression and support action against inequity (Giroux, 1988), linking reflection to praxis (Fernandez-Balboa, 1993; Rahimi & Sajed, 2014; Zembylas, 2015). In practice, integration is delicate: CT without CP can become technocratic neutrality, while CP without CT risks moralism or dogma. In Hong Kong, this distinction is salient for LS, where policy and assessment shape what forms of criticality are teachable and institutionally permissible (Chong et al., 2022; Kennedy, 2010; Morris & Adamson, 2010).

Historical Evolution and System Characteristics

Hong Kong's education has long balanced civic ideals with nation-building. From the mid-1980s, policy increasingly emphasized national identity and patriotism (Fisher, 2012; Hung, 2014). Post-1997 reforms promoted active learning through the Basic Education Curriculum Guide and, in 2006, introduced LS to strengthen CT for civic participation (Education and Manpower Bureau, 2004). Controversy over the 2012 MNE Guide, criticized as ideological "brain-washing", exposed tensions between policy directives and democratic, independent thinking (Law, 2009). The Concern Group on National Education called for national education

compatible with democracy and CT, reinforcing links between CT, social consciousness, and citizenship (Tse, 2023). Structural features also hinder CTE. Task-based, outcome-driven learning encourages rote memorization and exam strategies (Ng, 2019), while a provider–receiver model positions teachers as transmitters and students as passive recipients, limiting inquiry (Yuen, 2015). Teacher-centered instruction in crowded classrooms further reduces interaction needed for CTS development (Biggs, 1996).

The Role of Teachers in CTE

Teachers act as transformative agents whose influence extends beyond content delivery to students' cognitive development and personal formation (Choy & Cheah, 2009; Mullins, 1990). Professional identity matters because beliefs and philosophies shape instructional decisions and the classroom climate for CT, including whether students feel able to express ideas (Beijaard et al., 2004; Hussain et al., 2019).

Contemporary Hong Kong education confronts emerging challenges that threaten to diminish traditional teacher influence. The rise of "star tutors" and expanding shadow education undermines traditional teacher roles, with these tutors predominantly focusing on test-taking strategies rather than holistic development (Lai & Byram, 2012; Tsoi, 2013). Despite this increasing commercialization, teachers remain essential in creating structured environments where students engage with democratic principles, human rights, and social justice.

In the global educational landscape, teachers occupy a distinctive position at the intersection of CT development and civic engagement cultivation. Strengthening their voice in critical pedagogy involves researching their practices and sharing insights, contributing to evolving understandings of teaching methodologies. Beyond fostering intellectual growth, teachers also play a pivotal role in shaping students' moral development, functioning as both information sources and transformative figures, guiding students in developing personal and civic virtues.

Conceptual Framework

This study integrates three frameworks to examine CTS development, teacher perceptions, and role identity under Hong Kong's institutional and sociopolitical constraints: Davies' Critical Thinking Model (2015), Wong's Teachers' Perceptions Model (2021), and Kaplan and Garner's DSMRI (2017).

The Stages of CT Development in Hong Kong Secondary Education

The Model of Critical Thinking in Higher Education provides a multidimensional framework for evaluating CT within educational contexts by integrating cognitive skills, judgment, dispositions, emotions, attitudes, readiness, actions, and social relationships. Although originally designed for higher education, its application to secondary education is particularly relevant, as this stage serves as a crucial preparatory phase for university, where expectations for CT are heightened (Stupple et al., 2017). Given that fundamental components of CT—such as skills, dispositions, judgment, and affective-social-relational dimensions—develop incrementally across educational stages, the model's theoretical constructs are readily transferable for examining CT development in earlier-stage learners.

Figure 1
The Model of Critical Thinking in Higher Education

	Forms of criticality
CT Movement	Critical Rationality
	Critical Character
Criticality Movement	
	Critical Actions
CP Movement	
	Critical Virtue *(Awareness of oppression)*
	Critical Consciousness
	Participation *(Resistance of oppression)*
	Critical Pedagogy
Critical Openness	Critical Creativity
	Critical Being

Criticality Level
Low
High

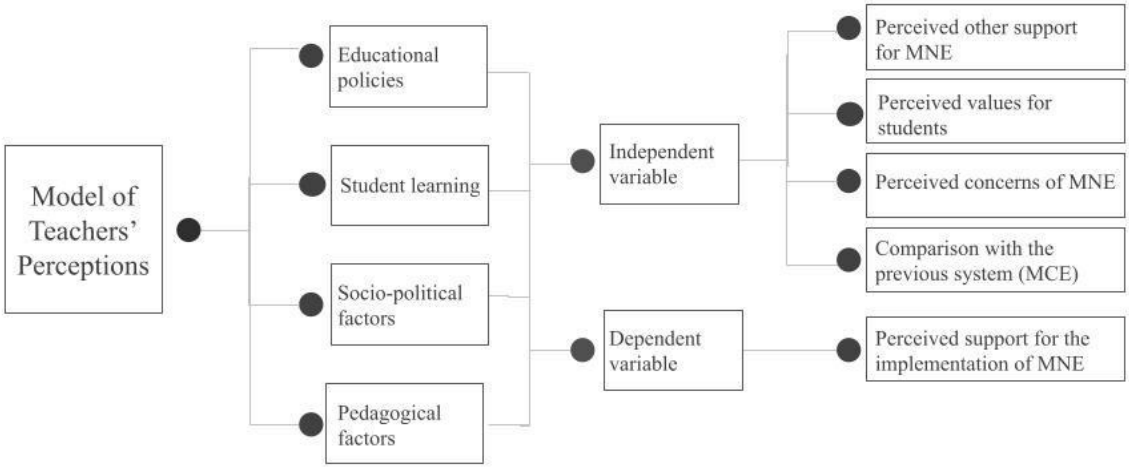
Note. From Davies, 2015

Applied here, the model supports evaluating how far the system enables criticality and where structural conditions constrain it, linking individual skills to sociocultural context (Bailin & Battersby, 2016) and informing targeted, context-responsive reform.

Teachers' Perspectives on CT: Opportunities and Obstacles

The Model of Teachers' Perceptions provides a structured framework for analyzing how educators cultivate CT in Hong Kong's classrooms while addressing the complexities of national identification through a critical education lens. Tailored to the Hong Kong educational context, it identifies four fundamental factors shaping teachers' perceptions: educational policies, student learning, socio-political influences, and pedagogical considerations (Hoffman-Kipp, 2008). The model further incorporates independent variables—such as perceived external support for MNE, perceived educational value for students, concerns regarding MNE, and comparisons with the previous system—as well as a dependent variable measuring perceived support for MNE implementation.

Figure 2
The Model of Teachers' Perception



Note. From Wong et al., 2021

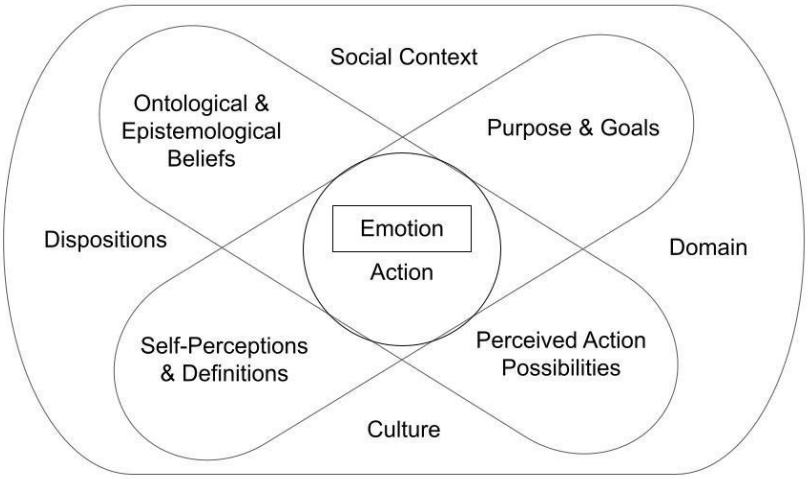
Additionally, this model draws on Freire's concept of praxis, which emphasizes the integration of critical reflection with action. Within this approach, problem-posing techniques in critical pedagogy are employed to empower students as active knowledge creators rather than passive recipients. This theoretical foundation enables exploration of how external factors—including educational policies, student learning approaches, socio-political contexts, and pedagogical considerations—influence teachers' perceptions and strategies for promoting CT in secondary schools.

The Intersection of Teacher Identity and Role in CTE

The DSMRI provides a valuable lens for understanding the complexities of teacher identity and its influence on CTE. This model conceptualizes teacher identity as a dynamic construct shaped by the interplay of four interrelated components: beliefs and values, goals, self-perceptions, and perceived action possibilities. These components evolve in response to personal experiences, professional environments, and sociocultural factors, collectively shaping an educator's unique and continuously developing professional identity.

The DSMRI underscores the notion that identity is not static but is constantly redefined through interactions between individuals and their environments. By examining the intersection of personal motivations and institutional constraints, this framework sheds light on why some educators embrace or resist certain pedagogical approaches. This model offers a systematic approach to analyzing teacher identity by investigating how personal beliefs and external influences shape their roles in CTE, providing an analytical foundation for examining how teachers navigate challenges associated with promoting CTS across diverse educational settings.

Figure 3
The DSMRI



Note. From Kaplan & Garner, 2017

Together, the three frameworks enable analysis of system-level criticality, teachers' perceptions, and identity-driven instructional dynamics in Hong Kong's CTE.

Methodology

This study explores teachers' perceptions of CTS development among secondary school students in Hong Kong and examines how the educational system influences teachers' professional identities. The research is guided by two primary questions:

1. *How do teachers perceive the progression of critical thinking skills among secondary school students in Hong Kong?*
2. *How does the educational system shape teachers' identities in facilitating critical thinking development in Hong Kong?*

Research Design

A mixed-methods approach was adopted to investigate CT development in Hong Kong's secondary education system. The quantitative component employs structured questionnaires using a five-point Likert scale. The qualitative component consists of semi-structured interviews exploring four thematic areas: teachers' perceptions, identity formation (considering both internal and external influences), and outcomes through 11 questions. To enhance participant engagement and ensure data reliability, a dual-language methodology was implemented, with surveys and interviews conducted in both English and Cantonese.

Participants and Sampling

Participants were selected based on their active engagement in CT instruction, particularly within the LS curriculum, overseen by the Education Bureau (EDB). Eligibility criteria included holding a valid teaching license, being within Hong Kong's standard working age range being aged 18–65, and possessing at least a tertiary-level academic qualification. Recruitment began through personal professional networks within secondary schools and expanded via snowball sampling.

The primary data collection phase focused on questionnaire distribution, resulting in 23 valid responses. Participants' ages ranged from their 20s to early 60s, with teaching experience varying from 1 to over 40 years. All interviews conducted in Cantonese were carefully transcribed and translated into English by the researcher. From the survey respondents, four interview participants were selected through purposive sampling based on their willingness to provide deeper insights.

The interviewees represented diverse backgrounds, spanning different age groups, teaching experiences (2-20 years), and subject areas, including STEM disciplines (Chemistry, Mathematics) and humanities (Religious Studies, Visual Arts, English, and Citizenship and Social Development).

Table 2
Demographic and Professional Profiles of Interview Participants

Participant	Age group	Educational level	Years of Teaching	Teaching subjects
A	30-39 years old	Master	11–15 years	Chemistry
B	20-29 years old	Bachelor	2 years	Mathematics
C	40-49 years old	Bachelor	About 20 years	Religious Studies, Visual Arts, Citizenship and Social Development (CSD) (Previously Liberal Studies)
D	20-29 years old	Master	2 years	English, Visual Arts

Ethical Considerations

Given Hong Kong's complex political climate, the study implemented stringent ethical safeguards, including voluntary participation protocols, strict anonymization of participants, data confidentiality measures, secure communication channels, and flexible participation options.

Analytical Framework

The research analysis employed a framework examining CT in education through four key analytical elements derived from systematically coded interview and survey data.

Table 3
Conceptual Mapping: CT Research Frameworks

Author	Model	Measurements	Element
Davies (2015)	The Model of Critical Thinking	CT Movement, Criticality Movement, CP Movement, Critical Openness	1. Criticality level of the current Hong Kong Education System 2. Teachers' perspectives on the current state of critical thinking education 3. Pedagogical barriers in critical thinking instruction 4. Opportunities and challenges shaping the future of critical thinking education
Wong et al. (2021)	The Model of Teachers' Perceptions	Educational policies, student learning, socio-political factors, pedagogical factors	
Kaplan and Garner (2017)	The DSMRI	Ontological and epistemological beliefs, sense of purpose, goals, self-perceptions, and perceived action possibilities	

This framework synthesized three critical theoretical models, systematically mapping their core dimensions to provide a structured approach to understanding CT through interconnected lenses of criticality, teacher perceptions, and instructional dynamics.

Findings

The investigation into CTE in Hong Kong's secondary schools revealed four key themes: (1) the criticality level of the current education system, (2) teachers' perspectives on CTE, (3) pedagogical barriers to CT instruction, and (4) opportunities and challenges shaping the future of CTE.

Criticality Level of the Current Hong Kong Education System

Hong Kong's education system demonstrates considerable strength in content delivery, with over 65% of respondents affirming its effectiveness in broad subject knowledge transmission. However, significant limitations emerge in developing practical application and CTS. More than 70% of educators express uncertainty about students' capacity to translate theoretical knowledge into real-world contexts, highlighting a substantial gap between academic learning and practical implementation.

The development of CTS presents a particularly complex picture. Educators' responses indicate marked ambivalence, with 45% maintaining a neutral stance on students' abilities to compare, contrast, synthesize, and critically evaluate information from multiple sources. This neutrality suggests not just an absence of CT development, but potentially a systemic challenge in designing and implementing pedagogical approaches that genuinely cultivate analytical reasoning.

The integration of critical pedagogy shows limited success, with two-thirds of respondents either disagreeing or remaining neutral about the system's effectiveness in fostering advanced cognitive skills. While the system exhibits moderate achievement in promoting student identity and self-awareness, its ability to transform learning into substantive, actionable critical engagement remains constrained. These findings underscore a critical need for comprehensive reform, emphasizing the imperative of bridging the significant theory-practice divide and developing more sophisticated methodologies for instructing CT capabilities within Hong Kong's educational framework.

Teachers' Perspectives on Critical Thinking Education

The complex nature of CTE in Hong Kong is characterized by characterized by educators' varied perceptions and systemic challenges. Teachers universally recognize the importance of fostering CTS in students but their perspectives diverge when exploring key aspects of implementation across four critical categories:

Purpose of Education

A critical underlying theme emerges regarding the multifaceted purposes of education. Educators conceptualized educational objectives through three interconnected lenses: workplace skill development, fostering holistic and independent thinking, and facilitating societal adaptation. This comprehensive perspective challenges reductive views of education, positioning learning as a transformative process that extends beyond immediate academic or professional instrumentality. By conceptualizing schools as microcosmic social environments where students can encounter and navigate complex interpersonal and intellectual landscapes, teachers articulate a vision of education that is fundamentally about empowerment, critical engagement, and societal preparation.

Definition of Critical Thinking

Educators' conceptualization of CT moves beyond simplified definitions toward a practical account of intellectual engagement. Interviewees described CT as a multifaceted capacity involving independent judgment, comprehensive analysis, and the ability to evaluate issues from multiple stakeholder perspectives. This understanding is reflected in varied pedagogical approaches: science teachers emphasize data-informed objectivity, mathematics teachers encourage exploration of multiple solution pathways, and humanities teachers rely on open-ended questioning and real-world scenario integration. Across these strategies, the shared pedagogical orientation is to cultivate students' capacity to question assumptions, consider complex possibilities, and resist uncritical acceptance of dominant views. At the same time, educators must work within systemic constraints, most notably Hong Kong's examination-oriented framework, which they identify as limiting genuine CT development by privileging standardized assessment metrics over substantive intellectual exploration.

Importance of Teacher's Role

Fundamentally, teachers unanimously recognize the pivotal role of CT development, with 60% categorizing it as "very important" and 40% as "important". However, a notable discrepancy emerges between this recognition and actual implementation, as educators' self-assessment of their CT instructional effectiveness demonstrates ambivalence: approximately half perceive their efforts as "effective" or "very effective", while 40% maintain a neutral stance, and 5% candidly acknowledge limitations in their approach.

Teacher Identity Formation

The investigation further highlights the complex dynamics of teacher identity formation within CTE. Personal background, socioeconomic experience, and professional trajectory strongly shape instructional approaches. More experienced educators reported greater confidence in developing refined questioning techniques, while also emphasizing the careful balance required to manage classroom dynamics. The findings also show teachers' strong awareness of their own strengths and limitations. For example, some noted that rapid cognitive processing can unintentionally disadvantage students who learn at different speeds. At the same time, they expressed a clear commitment to building inclusive, participatory learning environments that move beyond traditional didactic models.

This study underscores the complexities of integrating CT in Hong Kong's education system, highlighting key challenges in translating recognition into practice. While the system has potential, significant structural and pedagogical reforms are needed.

Pedagogical Barriers in Critical Thinking Instruction

Building on how teachers' perceptions shape critical thinking education, this section examines the practical challenges educators face in applying CT instruction.

Syllabus

At the core of these challenges is a deeply entrenched examination-oriented curriculum that restricts educators' capacity to foster substantive critical engagement. A rigid syllabus and its emphasis on standardized assessment create a pedagogical environment that privileges content

memorization and model-answer reproduction over nuanced analytical thinking. Teachers consistently report being constrained by packed schedules, large class sizes, and institutional pressures that make individualized attention and sustained exploratory discussion difficult to achieve.

Teacher Qualification System

The teacher qualification system represents a critical institutional constraint, as the Postgraduate Diploma in Education (PGDE) and wider certification processes show substantial weaknesses in preparing educators for CT pedagogy. Although certification has become increasingly competitive, it often fails to provide meaningful training in CT instructional strategies. As a result, new teachers tend to concentrate on classroom management and textbook-driven content delivery, with limited institutional support for developing critical inquiry approaches. This systemic gap produces a clear disparity between experienced teachers who have built sophisticated strategies for integrating CT and early-career educators who enter the profession without comprehensive preparatory frameworks.

Socio-Political Dynamics

Political and sociopolitical dynamics introduce another profound layer of complexity to CT instruction. The implementation of the National Security Law (NSL) has created a chilling effect on educational discourse, compelling teachers to exercise extraordinary caution in material selection and classroom discussions. Liberal arts educators, in particular, report significant self-censorship, avoiding potentially sensitive topics related to political rights and social policies. This environment of restricted expression fundamentally undermines the core principles of CT, transforming educational spaces from platforms of intellectual exploration into zones of constrained dialogue. The potential professional and legal repercussions—including job loss or legal prosecution—create a pervasive atmosphere of intellectual restraint that directly conflicts with the open-minded inquiry essential to CT development.

Pedagogical barriers to critical thinking instruction stem from sociocultural and institutional factors. Teachers must navigate information complexities while balancing institutional demands, political sensitivities, and pedagogical goals. Addressing these challenges requires comprehensive reforms in teacher preparation, institutional culture, and alignment between education and sociopolitical contexts.

Opportunities and Challenges Shaping the Future of CTE

The landscape of CTE in Hong Kong is characterized by a dynamic interplay of promising opportunities and considerable challenges. At the heart of potential transformation lies curriculum design, which offers remarkable potential for cultivating multi-contextual CT by integrating real-life examples across disciplines. This approach seeks to reframe CT as a versatile skill that extends far beyond traditional academic boundaries.

The technological infrastructure of Hong Kong provides a compelling backdrop for this educational evolution, with its advanced digital ecosystem offering unprecedented platforms for information gathering and analysis. Nevertheless, this technological advantage is simultaneously a challenge, as students must develop refined skills to navigate and critically assess the overwhelming volume of available information. The multilingual educational environment, particularly the use of English as a primary instructional medium, presents

additional opportunities for fostering rich intellectual discourse, though these potential advantages remain largely unexplored within current pedagogical practices.

Classroom dynamics further complicate the implementation of CTE, with educators constantly negotiating between comprehensive curriculum demands and the imperative to promote deeper analytical thinking. The examination-oriented system creates significant time constraints, compelling teachers to develop innovative strategies that balance standardized assessment requirements with meaningful intellectual exploration. The diverse student backgrounds add another layer of complexity, requiring educators to develop adaptive teaching approaches that can engage students with varying levels of intellectual curiosity and participation.

The sociocultural context of CTE in Hong Kong introduces additional layers of complexity. While academic spaces nominally permit open-minded questioning and intellectual exploration, the broader political and institutional environment creates subtle yet significant constraints on discourse. Teachers must navigate these delicate boundaries, seeking to create meaningful CT opportunities within systematically defined parameters.

Ultimately, the future of CTE in Hong Kong hinges on a fundamental reimagining of educational priorities. Success will demand a holistic approach that conceptualizes CT not merely as a skill set, but as a fundamental mode of engaging with knowledge. This transformation necessitates comprehensive reforms spanning teacher training, curriculum design, and institutional culture—shifting from a model of passive information transmission to a dynamic ecosystem of intellectual inquiry and independent thought.

Discussion

Transforming Education: The Role of Teachers in Fostering Critical Beings

Fostering CTS has become a central priority, and teachers play a key role in supporting students' analytical development. In Hong Kong, educators function as essential intermediaries in CTE, continually balancing institutional requirements with educational aims. This study identified three distinct yet interconnected roles that teachers have developed.

As *knowledge transformers*, teachers maintain a delicate balance between preserving objectivity, particularly in subjective subject areas, while continuously examining and adjusting their teaching methods through self-reflection. In their role as *strategic guides*, educators leverage their classroom experience to develop multiple questioning techniques and create structured frameworks for intellectual exploration, implementing careful interventions that challenge student assumptions while providing scaffolded support for analytical development. As *motivational encouragers*, teachers focus on creating dynamic learning environments that transform CT from a mere requirement into an engaging practice, fostering student independence and genuine interest in complex intellectual concepts.

These roles, however, are increasingly shaped by external constraints, including rigid curriculum demands, examination standards, and socio-political sensitivities. Ambiguity around "freedom of expression" encourages teachers to operate within what one respondent described as a "legal and compliant framework," carefully distinguishing analytical skill development from political activism. This caution reflects the balance educators must maintain to promote CT while avoiding contentious or potentially risky territory.

With limited institutional support and no clear guidelines or assessment frameworks, many teachers rely heavily on personal creativity and resilience to manage these pressures. This growing burden highlights shifting educational dynamics in which teachers' work becomes simultaneously more demanding and more constrained. The intensifying challenges, alongside declining teacher autonomy, underscore the need for stronger systemic support so educators can sustain their evolving responsibilities and continue to nurture students' intellectual growth in a changing world.

Reforming Education: The Role and Controversy of Critical Thinking

The development of CT in Hong Kong's education system has been a focal point of discussion and reform. Reflecting on the former educational reform, the transition from the Advanced Level (AL) examination system to the HKDSE, while representing a significant structural shift, has had minimal impact on the delivery of CT instruction.

Within the DSE system, the LS curriculum stands out as a paradoxical case, showcasing both the successes and unintended consequences of efforts to foster CTE. Despite its controversial removal, the curriculum's original intent to develop students' ability to "apply CTS, creativity and different perspectives in making decisions and judgments on issues and problems at both personal and social levels" (CDC & HKEAA, 2007) was notably manifested through student-led social movements (Fung & Lui, 2017). These movements, most prominently the Anti-National Education campaign, reflected students' capacity to translate academic learning into real-world application, effectively proving the curriculum's underlying pedagogical objectives.

The elimination of LS, however, sparked intense societal debate about the role of CT in education. Former Chief Executive Tung Chee-hwa criticized the subject as a "complete failure", suggesting it encouraged excessive social activism. This perspective necessitates a crucial clarification: CTE is fundamentally about developing independent thinking skills, not promoting political opposition. The ultimate goal of CTE extends beyond mere academic achievement or political engagement—it aims to cultivate individuals capable of sophisticated analytical reasoning, informed decision-making, and thoughtful engagement with complex societal issues, equipping students with essential competencies for lifelong learning and meaningful participation in an increasingly complex world.

The ongoing discourse and reforms in Hong Kong highlight the need for a more diverse and sustained approach to CTE, ensuring that future generations are equipped to navigate the complexities of an interconnected world.

Systemic Barriers to Critical Thinking Education in Hong Kong

While the issue is widely acknowledged, the barriers to CT instruction remain persistent in practice. Teachers operate within an institutional landscape structured by interlocking pressures, including curriculum mandates, examination requirements, and socio-political sensitivities. As a result, CT instruction is less a discrete pedagogical task than a form of strategic negotiation, in which educators must continuously balance institutional constraints against educational ideals.

For instance, the absence of CT as a standalone subject creates significant implementation barriers, particularly within an examination-oriented environment that prioritizes content coverage over analytical skill development. Teachers repeatedly face an impossible choice

between facilitating meaningful discussions that develop higher-order thinking and meeting rigid curriculum coverage requirements. Without clear guidelines and established assessment mechanisms, teachers struggle to develop and verify instructional strategies, perpetuating a cycle of pedagogical improvisation where individual creativity and resilience become the primary mechanisms for CTE, rather than structured, institutionally supported development.
The lack of a comprehensive assessment framework further exacerbates these challenges, rendering the systematic evaluation of students' CT development exceptionally problematic. Traditional assessment methods, predominantly focused on content recall and standardized testing, prove inadequate for capturing the cognitive processes associated with CT.

These institutional challenges intersect with teachers' personal and professional experiences in complex ways. Our research illustrated how teachers' own socioeconomic backgrounds significantly influence their pedagogical approaches and understanding of student needs. One educator from the middle class demonstrated heightened sensitivity to the thinking patterns of students from similar socio-economic circumstances, while acknowledging difficulties in understanding the constraints faced by students from lower socio-economic status families. Similarly, educators who experienced traditional, examination-focused education during their own schooling acknowledged how these early experiences initially created barriers to adopting innovative teaching approaches.

These challenges are further compounded by historical practices within the education system in Hong Kong. The implications of this uncertain landscape extend beyond immediate classroom dynamics, potentially reproducing existing social and intellectual inequalities through inconsistent implementation of CTE. However, the declining role of teachers and their decreasing autonomy in shaping curricula and pedagogical approaches present significant barriers, further complicating efforts to achieve educational objectives.

The Shift From Teaching Critical Thinking Skills to Cultivating Critical Thinkers

The development of CT in Hong Kong fundamentally reframes its purpose as the cultivation of critical beings—individuals able to navigate complex intellectual and social landscapes. The aim moves beyond knowledge transmission toward fostering adaptive cognitive capacities that support nuanced analysis, independent judgment, and transformative engagement with multifaceted global challenges.

At the heart of this approach is identity development through critical openness, a dynamic process of self-discovery that interrogates the foundations of personal understanding. Critical openness functions as a demanding form of self-engagement in which individuals learn to deconstruct inherited narratives, trace the genealogy of their beliefs, and shape a more authentic sense of self that is grounded in lived experience yet open to deep change. Identity is treated not as a fixed construct but as an ongoing, negotiated space of becoming, where personal agency intersects with wider social, cultural, and intellectual forces.

In an era of intensified informational complexity and rapid technological change, CT becomes an essential adaptive mechanism. Individuals must cultivate the ability to analyze, evaluate, and synthesize information across diverse sources, resisting uncritical acceptance and forming well-reasoned perspectives. This orientation privileges knowing how to think over accumulating static knowledge, emphasizing cognitive resilience and the capacity to interpret and engage meaningfully with complex societal challenges.

The educational imperative, then, is to prepare individuals who can grasp intricate information, consider varied perspectives, and translate understanding into meaningful action. Critical openness becomes a transformative practice of identity formation, teaching learners to hold their views with both seriousness and humility, capable of commitment while remaining open to reimagining. In doing so, education extends beyond traditional academic boundaries, positioning learning as a comprehensive process of identity formation and intellectual development that prepares individuals not as passive recipients of information, but as active agents able to engage with and shape social, technological, and cultural change.

Opportunities for Reform: The Role the Government Can Play

Educational reform requires recognizing teachers as the primary implementers of change, particularly as professional autonomy and support have weakened after the HKTPU's dissolution. The government should provide safe, politically neutral channels for educators to share challenges without fear, while allowing flexibility for diverse teaching approaches within a coherent strategy.

Reform should combine clearer curriculum guidance with assessment frameworks that reward critical engagement, alongside practical training, sustained professional development, and international exchange. Such infrastructure can protect academic space, support teacher growth, and better balance institutional requirements with the cultivation of independent, critically aware learners.

Conclusion

This study shows that critical thinking education (CTE) in Hong Kong is shaped by systemic barriers and sociopolitical constraints: despite reforms such as Liberal Studies (LS), an examination-oriented culture still weakens real CT practice, compounded by the lack of a standardized definition of CT, political sensitivities that narrow open discourse, and assessment systems that privilege standardized testing over independent thought. Teachers sit at the center of this tension, expected to satisfy institutional mandates while nurturing students' analytical and critical reasoning, and this research affirms their efforts and that they are not alone. At its core, CTE aims to cultivate "critical beings" who can think reflectively, act purposefully, and engage deeply with the world; as Dewey (1897) argues, education is lived and becomes meaningful when knowledge connects to practice, and in Hong Kong this is also inseparable from identity formation as students reflect on values, experiences, and roles in society. Davies further stresses that skills and dispositions are insufficient without action— "criticality without action is blind" (as cited in Davies, 2015, p. 65)—so CTE must move beyond passive reflection to purposeful, ethically grounded action. Importantly, fostering CT is not a political agenda but an educational commitment to equip students to navigate diverse perspectives and societal challenges with judgment and integrity. Achieving this requires reforms beyond curriculum tweaks: empowering teachers through stronger training and support, reimagining assessment to reward critical engagement rather than rote learning and creating pedagogical spaces that protect intellectual autonomy and meaningful exploration of identity, so Hong Kong can balance institutional demands with the transformative potential of nurturing independent, critically aware learners in a complex, interconnected world.

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From Adaptation to Engagement: Evaluating the Effectiveness of an AI-Based Personalised Learning Platform in Physics Education

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Abstract

This study explores how a personalised learning platform powered by AI can support secondary school students in physics by tailoring instruction to their individual needs. A total of 120 students participated in the study, with one group using the adaptive platform and the other following traditional classroom instruction. The study used a mixed-methods approach, combining pre-test and post-test performance data with insights from student interviews and focus groups. The findings showed that students using the adaptive platform achieved higher levels of conceptual understanding, with an independent sample t-test score 7.55 points higher than that of the control group. These gains were closely linked to features such as adaptive quizzes, individualised lesson pathways, and progress-tracking tools, which allowed learners to monitor and adjust their learning more effectively. Students frequently described the platform as providing "timely feedback" and "guidance at my own pace," suggesting that personalisation helped reduce frustration and sustain motivation. Interview feedback also revealed that learners in the experimental group were more engaged, often citing the platform's gamified elements and interactive content as motivating factors. While students recognised these advantages, they also identified challenges, particularly technical issues and a desire for a broader range of content. Overall, the study highlights the potential of AI-driven adaptive learning to improve both immediate academic outcomes and the development of self-regulated learning habits. At the same time, it emphasises the importance of balancing technological innovation with thoughtful instructional design to ensure accessibility and sustained effectiveness in classroom practice.

Keywords: personalised learning, AI, physics education, learning platform

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Introduction

Personalised learning (PL), tailored to individual students' needs, has recently resurged, driven by Artificial Intelligence (AI) and big data analytics (FitzGerald et al., 2018). Modern classrooms face challenges in ensuring equitable, meaningful learning due to students' varied interests, knowledge, and backgrounds. The one-size-fits-all model has shifted to PL, which adapts to each learner's strengths, potential, and pace. When combined with AI-powered data solutions, PL can create more engaging, effective, and inclusive education (Castro et al., 2024).

PL extends beyond simple differentiation by emphasising learner agency, adaptability, and data-driven decision-making. Based on constructivist and self-regulated learning (SLR) theories, PL encourages learners to set goals, monitor progress, and reflect on their learning. Constructivist theory highlights prior knowledge, engagement, and social context in the construction of knowledge, not just passive instruction (Anderson, 2008). Piaget's and Vygotsky's theories focus on active participation, meaning-making, and contextual learning (Piaget, 1964; Vygotsky, 1978). Effective learning environments let learners experiment, explore, and reflect through real-world tasks (Wang et al., 2019). SLR involves learners actively controlling their learning via goal-setting, self-monitoring, strategic planning, and reflection. Cycles of planning, tracking, and interpreting guide future actions, fostering independent, lifelong skills (Chen, 2022; Khiat & Vogel, 2022; Zimmerman, 1989).

PL aligns with constructivist principles, placing learners as active participants whose experiences are tailored to interests, readiness, and knowledge (Richter et al., 2024). It features flexible pathways, inquiry-based tasks, and choice activities that foster engagement and understanding. Teachers act as guides within learners' zones of proximal development (Chand, 2023). PL environments support the development of SLR skills by encouraging goal-setting, pacing, and feedback, strengthening ownership of learning. Digital and AI-supported systems enhance SLR through adaptive feedback, analytics, and progress visualisation, aiding self-monitoring and reflection.

Constructivist theory, along with SLR theory, provides a strong theoretical foundation for PL. Constructivism focuses on building active knowledge through meaningful engagement, while SLR describes how the engagement is managed and maintained over time. PL integrates these two perspectives by creating learning environments that are both intellectually stimulating and encourage learner independence. This approach emphasises the alignment of PL with solid pedagogical foundations rather than viewing PL as tech-based innovations.

The rapid evolution of AI is transforming science education, creating more adaptable and student-centred learning environments. In physics, concepts such as Force and Motion are difficult for students to grasp due to their abstract nature and common misconceptions (Adha et al., 2023). Traditional methods with fixed visuals and steady pacing may not suit diverse learners' styles, knowledge, and readiness. There is a growing demand for customised, pedagogically sound educational platforms (Contrino et al., 2024).

An AI-driven webpage was created to teach Force and Motion, offering a tailored approach through adaptive content, real-time feedback, and data-guided paths. It customises simulations, explanations, and activities to meet each learner's needs. For example, students with misconceptions about Newton's laws benefit from visualisations and guided examples. Extension activities and inquiry-driven tasks are for advanced learners. This flexibility promotes understanding by allowing exploration at individual paces (Piyatissa & Waduge,

2023). AI supports instructional choices and provides insights into student progress, fostering participation, deeper understanding, and fair outcomes in Force and Motion.

This study aims to evaluate the effectiveness and learners' perceptions of an AI-supported PL pathway for teaching Force and Motion subtopics. It compares the learning outcomes of students using this customised approach with those receiving the current 21st-century teaching approach. Furthermore, the focus is on examining their perceptions, experiences, and attitudes towards the PL method. This research explores the pedagogical value and practical implications of AI-driven PL in physics education by examining both cognitive and affective outcomes, contributing to a more holistic understanding.

Literature Review

Personalised Learning and Pedagogical Foundations

PL has become a key instructional method aimed at addressing diverse learner needs by customising learning experiences for each student. Unlike traditional differentiated instruction, which groups students by ability, PL emphasises learner agency, adaptability, and ongoing data-driven adjustments (Tetzlaff et al., 2020). Its goal is to develop flexible pathways that allow students to progress at their own pace, with content tailored to their prior knowledge and interests (Peng & Li, 2025). Rooted in constructivist and self-regulated learning theories (Piaget, 1964; Vygotsky, 1978), PL fosters exploration, experimentation, and reflection through inquiry-based tasks and adaptive challenges (Ibrahem et al., 2022).

SLR, described by Zimmerman (1989), involves goal setting, strategy use, self-monitoring, and reflection. Evidence shows students with strong SRL skills perform better, stay motivated, and persevere (Efklides & Metallidou, 2020). Digital PL environments support SRL by enabling control over pace, prompt feedback, and progress monitoring, enhancing metacognitive skills (Faza & Lestari, 2025).

AI-Supported Personalised Learning Systems

Recent AI advancements significantly enhance PL systems, enabling adaptive, responsive, and scalable experiences. These systems analyse data such as performance, response times, and learning patterns to adjust content difficulty, sequencing, and feedback (Khine, 2024). Unlike static resources, AI-driven platforms continually adapt to learners' evolving needs, providing targeted support (Hariyanto et al., 2025).

Research suggests AI personalisation improves efficiency by reducing redundancy and focusing attention on weak areas (Gupta, 2024). This aligns with Vygotsky's Zone of Proximal Development, where tasks slightly beyond learners' abilities are effectively guided (Murray & Arroyo, 2002). Empirical studies show that adaptive environments enhance understanding in demanding areas such as science and maths (Tetzlaff et al., 2020).

AI systems also boost self-regulated learning (SRL) through analytics, progress visuals, and personalised feedback, promoting self-monitoring and reflection (Afzaal et al., 2023). These tools foster deeper metacognitive engagement when integrated effectively (Lodge et al., 2018). However, success depends on high-quality pedagogical design; superficial feedback, lack of transparency, or usability issues can hinder the benefits unless addressed (Tetzlaff et al., 2020).

Challenges in Physics Education and Technology Integration

Physics education faces ongoing challenges due to the abstract nature of core concepts and widespread misconceptions, especially regarding force and motion. Students often rely on everyday intuition, which often clashes with scientific understanding, hindering conceptual shifts (Shrestha et al., 2023). Conventional teaching methods, with their uniform pace and static visuals, might not address the diverse levels of students' prior knowledge and cognitive readiness (Michelene & Roscoe, 2006). Technology-enhanced learning environments have been extensively studied as solutions to these challenges. Interactive simulations, visualisations, and inquiry-based digital tools enable students to test hypotheses, observe results, and connect different representations of physical phenomena, aiding conceptual understanding (Kaldaras et al., 2024). When equipped with adaptive features, such technologies can further tailor instruction by targeting individual misconceptions and learning gaps (Tetzlaff et al., 2020). Recent research shows that adaptive learning tools in science education can greatly enhance learning outcomes and student satisfaction (Contrino et al., 2024). Platforms supported by AI provide tailored explanations, scaffolded practice, and extension activities, allowing both struggling and advanced students to learn together effectively. This adaptability is especially important in physics classes, where students' abilities vary widely (Marshman et al., 2018).

Learner Engagement and Motivation in AI-Driven Personalisation

Learner engagement is a key factor in academic success and is often conceptualised as a multidimensional construct encompassing behavioural, emotional, and cognitive aspects (Xue et al., 2025). Studies consistently indicate that personalised and interactive learning settings boost engagement by enhancing relevance, fostering autonomy, and improving perceived competence (Yaseen et al., 2025).

AI-powered PL systems can boost engagement by offering adaptive pacing, instant feedback, and interactive assessments. According to Self-Determination Theory, these features fulfil learners' needs for autonomy and competence, which are key for intrinsic motivation (Bucher et al., 2024). Research on adaptive testing and gamified learning shows that personalised challenges and real-time feedback help maintain focus and encourage perseverance (Zhang & Huang, 2024). However, the literature also indicates that the benefits of engagement heavily rely on system usability and clarity. Poor interface design or technical issues can undermine motivation, even when adaptive algorithms are well-crafted (Neugnot-Cerioli & Laurenty, 2024).

Research Gap and Study Rationale

While existing research shows the potential of AI-supported personalised learning, several gaps still exist. There are limited empirical studies that explore both conceptual understanding and student engagement in secondary physics education. Additionally, many studies mainly concentrate on quantitative results, paying less attention to learners' experiences and perceptions of adaptive systems. Further research is needed that explicitly aligns with constructivist and self-regulated learning frameworks.

This study addresses existing gaps by evaluating an AI-driven personalised learning platform for teaching force and motion concepts, focusing on both cognitive improvements and learners' perceptions. By combining quantitative and qualitative data, it offers a thorough understanding

of how AI-supported personalised learning can improve physics education and highlights important pedagogical factors for future use.

Methodology

Research Design

This study used a mixed-methods quasi-experimental design to assess the effectiveness of an AI-driven personalised learning platform for teaching Force and Motion concepts in physics. The quantitative part compared students' conceptual understanding between an experimental group that used the AI-supported personalised learning path and a control group that followed traditional 21st-century teaching methods. The qualitative part investigated students' perceptions, experiences, and challenges with the AI-based personalised learning environment. Combining both types of data enabled a thorough analysis of cognitive and emotional outcomes.

Participants and Context

The study involved 120 secondary school students enrolled in a physics course on Force and Motion. Students were selected from a uniform educational background to reduce differences in curriculum, instruction, and assessment. Of these, 58 students were assigned to the control group and 62 to the experimental group, with assignments based on existing classroom arrangements and following quasi-experimental research methods. All participants had prior experience with basic physics concepts and similar access to digital devices and the internet.

Instructional Intervention

The experimental group used an AI-powered personalised learning webpage focused on Force and Motion topics. The platform featured adaptive learning paths, interactive simulations, varied practice exercises, and instant feedback. Data on learner performance, such as accuracy and progress trends, were analysed to tailor the level of content difficulty and the instructional order. Students with misconceptions received targeted visual aids and step-by-step explanations, while more advanced learners were given extension tasks and inquiry-based activities.

The control group was instructed using standard 21st-century teaching methods, including teacher-led explanations, textbook-based activities, and traditional formative assessments. Both groups learned the same material during the same amount of instructional time, taught by teachers with similar levels of experience.

Instruments

Conceptual understanding was assessed with the Force Concept Test (FCT), administered as a pre- and post-test to each group. The FCT is a validated tool frequently used in physics education research to assess understanding of core force concepts and identify common misconceptions.

For qualitative data, semi-structured interview protocols were created to explore students' perceptions of the AI-based personalised learning platform. The questions focused on perceived value, the effectiveness of AI-driven adaptation, challenges faced, usability, and the

impact on engagement. Ten students from the experimental group were intentionally chosen to reflect a range of learning experiences.

Data Collection Procedure

Data collection happened in three phases. First, both groups took the FCT pre-test to establish baseline equivalence. Next, the instructional intervention was carried out during the teaching period. Both groups then completed the FCT post-test. Finally, semi-structured interviews were conducted with selected students from the experimental group; these interviews were audio-recorded and transcribed verbatim.

Data Analysis

Quantitative data were examined using descriptive statistics and independent-samples t-tests to compare learning improvements between groups. Effect sizes were computed to assess the intervention's impact magnitude. Qualitative interview data were analysed using an inductive coding approach to uncover recurring themes in learner experience and engagement.

Results and Discussions

Effectiveness of an AI-Based Personalised Learning Platform in Teaching Force and Motion Concepts

A total of 58 students in the controlled group and 62 students from the experimental group completed the pre-test and post-test using the Force Concept Test (FCT). An Independent-Samples t-test was conducted using the pre-test and post-test scores. Table 1 presents the descriptive statistics.

Table 1
Descriptive Statistics

Group	Test	N	Mean	Std. Deviation
Control Group	Pretest	58	28.41	6.12
Control Group	Posttest	58	36.62	6.34
Experimental Group	Pretest	62	27.95	5.87
Experimental Group	Posttest	62	43.71	6.01

The descriptive statistics presented in Table 1 provide an overview of students' performance on the FCT before and after the intervention. Both the control group (N = 58) and the experimental group (N = 62) began with comparable pretest scores (M = 28.41, SD = 6.12 for the control group; M = 27.95, SD = 5.87 for the experimental group), indicating a similar baseline understanding of force concepts. This equivalence in pre-test scores is important, as it establishes that the two groups had no significant prior differences in conceptual knowledge, thereby ensuring any observed post-test differences are more likely attributable to the intervention rather than pre-existing disparities.

In the post-test, however, clear differences emerged. The control group, which received traditional instruction, improved to a mean score of 36.63 (SD = 6.34). In contrast, the experimental group received web-based instruction. Achieved a notably higher mean of 43.71 (SD = 6.01). This gap suggests that integrating web-based teaching strategies enhanced students' conceptual understanding of physics to a greater extent than conventional methods.

The magnitude of improvement in the experimental group (mean increase = 15.76 points) compared to the control group (mean increase = 8.21 points) reflects the potential of technology-enhanced learning to accelerate knowledge acquisition and deepen comprehension.

These findings are consistent with prior research highlighting the advantages of technology-supported instruction in science education. For instance, studies have shown that digital platforms incorporating visualisation, interactivity, and adaptive feedback can significantly enhance learners' grasp of abstract concepts in physics (Zacharia & Olympiou, 2011). The higher post-test mean of the experimental group thus not only supports the effectiveness of web-based teaching in fostering conceptual change but also reinforces the value of integrating multimedia and interactive tools into traditional curricula.

Table 2 displays the Independent Sample t-test results comparing pre-test and post-test FCT scores between the two groups.

Table 2
Independent Sample t-Test Results

Group	N	Mean Difference	Std. Deviation	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)	Effect Size
Control Group	58	8.21	5.15	6.85	9.57	12.07	57	.000***	0.75
Experimental Group	62	15.76	5.90	14.25	17.27	21.01	61	.000***	1.41

Table 2 provides the inferential statistics that confirm the descriptive trends observed in Table 1. For the control group, the independent sample t-test revealed a statistically significant improvement from pre-test to post-test ($t(57) = 12.07$, $p < .001$), with an effect size of 0.75. Based on Cohen's (1988) benchmarks, this indicates a medium-to-large effect, implying that standard instruction alone led to significant improvements in students' grasp of force concepts. This result supports previous research demonstrating that structured physics instruction, even without technological enhancements, can improve conceptual understanding when applied regularly (Hake, 1998).

The experimental group, however, demonstrated a substantially greater improvement. The independent sample t-test yielded a t-value of 21.01 ($p < .001$) and an effect size of 1.41, indicating a very large effect. This indicates not only that the web-based intervention was highly effective but also that the degree of improvement was almost double that of the control group. Such a strong effect suggests that web-based instruction offers distinct pedagogical benefits that surpass those of conventional teaching. These options might include self-paced learning, instant feedback, and interactive simulations, all of which are recognised for boosting student engagement and fostering a deeper understanding of concepts (Clark & Mayer, 2016).

The larger effect size observed in the experimental group supports constructivist learning theories, which argue that learners build knowledge more effectively through active engagement with content through exploration, problem-solving, and feedback (Jonassen, 1999). Web-based environments facilitate these processes by including multimedia simulations, dynamic models, and formative assessments, all of which likely help students develop more robust conceptual understandings of force. Additionally, the significant difference in learning gains between the groups underscores the scalability and efficiency of

technology-supported instruction, especially in complex subjects like physics, where misconceptions are common (McDermott & Redish, 1999).

Overall, the findings in Table 2 show that although both teaching methods enhanced learning, web-based instruction led to substantially greater conceptual gains. This indicates that digital methods should not just supplement traditional teaching but can act as a transformative tool for attaining a deeper understanding of physics.

Learners' Perceptions and Experiences

Following the intervention, semi-structured interviews were held with 10 students from the personalised learning path group to explore their experiences, challenges, and views on the AI-driven adaptation and customised content.

Subtheme 1: Perceived Value of Platform

The interviews showed that students highly value the adaptive learning platform. Throughout the discussions, students consistently emphasised the platform's adaptability, its motivational effects, and their overall positive experience. For example, one student said, "It was very positive. I liked how the system adjusted to my pace" (S1). This indicates satisfaction with the personalised learning path, which aligns with theories of self-paced and mastery learning that emphasise tailoring instruction to individual progress (Bloom, 1984; Corno & Snow, 1986). By enabling students to learn at their own pace, the system fostered a sense of ownership and minimised cognitive overload, both of which are known to enhance learning outcomes (Shute & Towle, 2003).

Another important theme from the interviews was motivation, as one student stated, "Very motivating because the AI adjusted the difficulty for me" (S2). This supports Ryan and Deci's (2000) Self-Determination Theory, which emphasises that autonomy and competence are vital for intrinsic motivation. By gradually increasing difficulty, the platform offered students an ideal mix of challenge and support, boosting their engagement. This adaptive scaffolding aligns with Vygotsky's (1978) Zone of Proximal Development, where learners excel when tasks are just beyond their independent abilities but attainable with help.

Several students initially expressed doubt but eventually grew to value the adaptive system. For instance, S4 mentioned, "At first I was unsure, but then I appreciated the adaptation." This indicates that initial hesitation towards AI-driven adaptation can turn into acceptance as users become more familiar with it and see its benefits. Such a pattern aligns with broader research on educational technology, where students' scepticism often shifts to acceptance after experiencing the tangible advantages (Ertmer & Ottenbreit-Leftwich, 2010).

The qualitative evidence clearly shows that students found the adaptive platform highly valuable. Key themes such as personalisation, motivation, focus, and satisfaction align with existing research on adaptive learning systems, which emphasise the transformative role of technology in boosting engagement and conceptual understanding (Freeman et al., 2014; Mayer, 2009). The examples illustrate that the platform benefits not only cognitive learning outcomes but also improves affective and motivational aspects, making it a promising solution for tackling challenges in physics education.

Subtheme 2: Effectiveness of AI-Driven Adaptation

The second subtheme emphasises students' views on how effectively AI-driven adaptation supports their learning. Throughout the interviews, students saw the adaptive system as both helpful and transformative, often highlighting how it personalised the learning experience to meet their individual needs. For instance, one student said, "The AI helped me to focus on what I didn't understand, instead of repeating things I already knew" (S2). This example shows a key feature of adaptive learning: its ability to minimise unnecessary repetition and focus the learner's attention on areas needing improvement. This personalisation aligns with the goal of efficient instruction, where adaptive systems save time and effort by customising learning paths (Shute & Towle, 2003).

Students also noted the motivational benefits of this adaptation. For example, S3 mentioned, "It was encouraging to see the system change questions based on my answers. It made me want to try harder." Here, adaptation not only met cognitive needs but also enhanced emotional engagement, supporting research on Self-Determination Theory (SDT), which emphasises that competence and autonomy foster intrinsic motivation (Ryan & Deci, 2000). When students felt the AI "responded" to their input, they perceived themselves as being recognised and supported, which strengthened their motivation to tackle difficult tasks.

Not all responses were entirely positive. Some students mentioned initial difficulties with adjustment, with one remarking, "At first it was confusing when the questions kept changing, but later I realised it was helping me learn" (S4). This highlights the need for effective orientation and support for learners when implementing adaptive platforms. Similarly, educational technology research indicates that unfamiliarity can cause early discomfort, but as learners get used to adaptive features, they tend to recognise their benefits more (Ertmer & Ottenbreit-Leftwich, 2010).

Overall, the excerpts from Subtheme 2 suggest that students view AI-driven adaptation as a strong tool for personalisation, focus, motivation, and building confidence. These findings support existing research on adaptive learning systems, which regularly highlight their ability to improve efficiency, increase engagement, and deepen understanding (de Jong et al., 2013; Freeman et al., 2014). Additionally, the comments about initial confusion emphasise the importance of providing scaffolding not only for the learning content but also to help learners understand how to use adaptive technologies.

Subtheme 3 for Interview: Challenges in AI-Driven Learning

Although students were mostly satisfied with the adaptive learning platform, interviews under Subtheme 3 identified challenges related to AI-driven learning systems. These issues, while not frequent or severe, offer important insights into areas needing improvement to support the platform's long-term use and growth.

More often, students highlighted pedagogical issues, especially regarding the depth of feedback. For example, S2 mentioned, "Sometimes I wanted more explanation for wrong answers," while S5 commented, "Feedback was sometimes too short." These remarks indicate that although the platform offered corrective feedback, it was frequently seen as lacking in detail. In adaptive learning, feedback serves not just to indicate correctness but also to promote metacognitive reflection and enhance conceptual understanding (Shute, 2008). The brevity of responses might have restricted learners' chances to address misconceptions, which is

particularly important in physics education, where conceptual misunderstandings are common (McDermott & Redish, 1999).

Interestingly, many students minimised or completely dismissed significant challenges. Several respondents (S6, S7, S8, S10) explicitly mentioned, *"No major challenges,"* indicating that, for most learners, the benefits of the adaptive system outweighed any limitations. This aligns with broader research showing that, once users are familiar with adaptive systems, issues such as brief feedback or initial adjustment tend to become less important compared to the advantages of personalisation, engagement, and motivation (de Jong et al., 2013).

In summary, the challenges identified in Subtheme 3 were not overwhelming but highlighted key areas for improvement in feedback detail, content richness, and learner-centeredness. While technical issues were minor, they emphasise the importance of digital equity and access. Pedagogically, learners preferred feedback that not only corrected errors but also clarified the reasoning behind them, and they wanted more examples to enhance understanding. These findings indicate that although AI-driven platforms can effectively adjust pacing and difficulty, they must also focus on enhancing the quality of instructional support in their design.

Subtheme 4: User Experience With Platform

The analysis of Subtheme 4 shows that students mainly viewed the platform as highly usable and easy to use, with smooth navigation being the most frequently mentioned feature. For instance, Student 1 (S1) called the platform *"very user-friendly,"* while Student 2 (S2) said it was *"easy to navigate."* Likewise, S10 highlighted the system's overall smooth interaction, noting it was *"very smooth to navigate."* These common comments indicate that the platform's interface effectively supports user-focused design, minimising obstacles to engagement and enabling a more seamless learning experience.

Student 4 (S4) noted that it became *"easy after a while,"* suggesting a brief initial adjustment before feeling comfortable with the system. This highlights the crucial role of adaptability in educational technologies, as learners often need a brief orientation to become fluent users. Studies on e-learning platforms indicate that after overcoming the initial learning curve, perceptions of usability tend to improve considerably, thereby boosting satisfaction and motivation (Al-Fraihat et al., 2020).

The emphasis on ease of use and smooth navigation is crucial for engaging learners and improving their outcomes. When students perceive the system as accessible and intuitive, they are less likely to experience technology-related frustration, a common obstacle in digital learning (Selim, 2007). Offering a seamless user experience can boost intrinsic motivation and persistence, both of which are essential for successful online learning (Ryan & Deci, 2000).

Subtheme 5: Impact on Student Engagement

Findings in Subtheme 5 show a strong agreement among students that the AI-driven platform greatly improved their engagement with learning activities. Participants consistently described the system as *"engaging,"* with many highlighting that it was *"much more engaging than traditional methods"* (S3, S6) or *"more engaging than in class"* (S2). This pattern indicates that the platform's adaptive features effectively boosted motivation and maintained interest in learning.

Several students specifically compared their experiences with standard classroom lessons, noting that the platform felt *"more engaging than school lessons"* (S9) and *"engaging compared to usual methods"* (S4). This implies that the system's novelty, personalisation, and interactivity contributed to higher engagement levels than static teaching methods. Previous research supports that digital learning environments with adaptive elements can produce more dynamic learning experiences, increasing student involvement (Yaseen et al., 2025).

Overall, the excerpts highlight the platform's effectiveness in turning engagement into an active, enjoyable, and meaningful experience. The results indicate that adaptive learning systems may surpass traditional approaches in maintaining attention, motivating learners, and fostering a positive emotional environment for learning. This aligns with existing research on engagement, which emphasises the role of technology in sparking curiosity and fostering deep learning (Fredricks et al., 2004).

Conclusion

This study aimed to assess the effectiveness, strengths, and challenges of deploying an AI-powered adaptive learning platform within student learning and engagement contexts. Results showed that the platform effectively bridged traditional teaching and technology-enhanced education by offering a more personalised, interactive, and adaptable learning environment. Data from interviews and focus groups consistently revealed that students using the AI-supported platform exhibited higher motivation, satisfaction, and engagement levels than those in the control group. These outcomes align with existing research indicating that adaptive learning tools can significantly enhance learner outcomes by customising instruction to individual needs, reducing cognitive overload, and fostering deeper understanding (Holmes et al., 2019).

A key strength of the platform was its capacity to provide personalised learning paths through adaptive quizzes, customised dashboards, and progress tracking. Students gained greater control over their learning and developed self-regulation skills, including goal-setting, progress monitoring, and strategy adjustments. This supports Roll and Winne's (2015) claim that AI-driven analytics help learners reflect deeply on their metacognitive skills, improving self-directed learning. Likewise, Luckin (2018) highlights that adaptive tools encourage higher-order thinking by enabling students to take ownership of their learning, a result confirmed by the current study.

Nevertheless, the study also identified key challenges and limitations that need to be addressed. Technical issues, such as occasional navigation problems and reliance on internet access, created barriers for certain learners. Additionally, disparities in digital access and device availability underscored ongoing concerns about equity in technology-driven education. These issues align with broader critiques in existing research, which emphasise the importance of supportive infrastructure and teacher training for successful AI implementation in education (Holmes et al., 2019; Zawacki-Richter et al., 2019). Furthermore, in some instances, the lack of direct teacher feedback led students to seek clarification, highlighting the crucial role of human teachers in providing emotional support and scaffolding. This indicates that while AI platforms can boost student independence and efficiency, they should complement, rather than replace, traditional teacher-led methods (Garrison et al., 2000).

This research highlights the significance of combining traditional and AI-based education rather than choosing one over the other. A blended model would leverage teachers' personal

and emotional strengths alongside AI's adaptive, data-driven features. According to Luckin (2018) and Holmes et al. (2019), the best learning environments are those in which technology enhances rather than replaces human instruction. For policymakers and educators, this emphasises the need to invest not only in AI infrastructure but also in ongoing teacher training to fully realise the benefits of these technologies.

In conclusion, this research adds to the growing evidence that AI-driven adaptive learning can boost engagement, self-regulation, and personalised education. It shows both the potential and the limitations of these platforms, emphasising the need for careful integration into current teaching strategies. Future studies should examine the long-term effects of adaptive systems on learning outcomes, particularly in knowledge retention, critical thinking, and skill transfer across subjects. Additionally, understanding the role of teachers as facilitators in hybrid AI-human environments will be vital to ensure equitable access and sound pedagogy. By focusing on these aspects, education can fully leverage AI to develop learning spaces that are not only effective and adaptable but also human-centred, inclusive, and sustainable.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing tool, was used to proofread and refine the manuscript's language. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are written initially and derived from the appropriate and systematic conduct of the research.

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From Lingua Franca to Multilingual Place-Making: Autonomy and Positioning in Online International Collaboration

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Abstract

This paper examines students' multilingual experiences in Collaborative Online International Learning (COIL) programs. In 2022–2023, the author, as a teacher-researcher, designed and facilitated two COIL programs involving 52 university students from Japan and Malaysia who engaged virtually in group discussions. Participants brought diverse linguistic backgrounds to the interaction, with English serving as the lingua franca. Drawing on three key notions—translingualism, the social construction of learning places, and multilingual identities—the study scrutinizes how learners negotiated their identities and evaluated their language practices, participation, and engagement. Data were collected through seven post-program interviews, complemented by activity logs, online whiteboards, and reflection papers. The interviews, audio-recorded and transcribed with participants' consent, were analyzed using positioning theory (van Langenhove & Harré, 1999) as the analytic framework. The findings highlight the complexity involved in constructing multilingual learning places. Students reported varied evaluations of first-language use, differing levels of appreciation for each language, and a tendency to view competence in a single language as more advantageous for identity negotiation. These insights reveal persistent challenges posed by the monolingual habitus while underscoring the importance of recognizing multilingualism and translingualism as essential conditions for fostering collective autonomy in COIL contexts.

Keywords: COIL, translingualism, positioning theory, multilingual identity

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Introduction

The below reflection from a participant in a Collaborative Online International Learning (COIL) program seems to capture the spirit of intercultural engagement.

> Difficulty is always language, but I think it's okay because that's how this program is. Even though we have language barriers, we cannot give up to communicate, and at the end, the ideas we have, we can share even we have, like, language barriers. (An excerpt from interview with M University Student, October 4, 2022)

Despite linguistic challenges, students strive to communicate, collaborate, and co-construct meaning beyond differences by drawing flexibly on multiple language resources for communication and learning. However, even though put in a positive sense as a challenge and joy to overcome, the notion of language as "barriers" held by the participants raised an alert for the author, a teacher-researcher, to revisit and critically look at the participants' experience around language used during the International Collaborative Learning (ICL) projects.

In this increasingly interconnected world, higher education institutions are expanding international exchange programs. The COVID-19 pandemic pushed international educational practitioners to go online, which diversified both practitioners and participants. As the number of practitioners grows, the aims of ICL programs have diversified. These programs no longer target solely on second/foreign language acquisition but increasingly emphasize learning how to interact productively across cultural and linguistic differences while deepening topical knowledge. The scope has expanded significantly, now addressing a wide range of topics and social issues including immigration, religion, gender roles, and national responses to global crises such as the COVID-19 (O'Dowd, 2021, p. 217).

As the number of participants grows, the linguistic resources they bring to ICL contexts also become increasingly diverse. English often serves as the lingua franca, but students possess differing levels of language proficiency, and there is greater diversity in their first, second, and additional languages. English becomes both a bridge and a barrier, enabling communication while simultaneously creating an uneven degree in students' participation, causing mixture of feelings. The instructor, therefore, must carefully design activities that are inclusive and scaffolded, ensuring that students with lower proficiency are not marginalized or silenced, while at the same time students with more proficiency also feel satisfied with their engagements.

Although language learning may not be the central focus in such programs, language remains deeply intertwined with learning processes. In multilingual environments, linguistic dynamics become complex, and participants must "be resourceful to enable their interactions" (Naicker et al., 2021, p. 505). Recognizing these multilingual realities urges practitioners to shift how language is conceptualized, not as a barrier to overcome but as a resource that shapes interaction, identity, and learning.

Literature Review

To examine and understand the essence of multilingual ICL context, three concepts are briefly reviewed: 1) Translingualism, 2) Social Construction of Learning Places, and 3) Multilingual Identities.

Translingualism

Translingualism is a notion which challenges the monolingual view of languages. While monolingualism see languages as fixed and separated from one another, Translingualism promotes the fluid use of multiple linguistic resources for meaning making.

> The term translingual conceives of language relationships in more dynamic terms. The semiotic resources in one's repertoire or in society interact more closely, become part of an integrated resource, and enhance each other. The languages mesh in transformative ways, generating new meanings and grammars. (Canagarajah, 2013, p. 8)

While Monolingualism grants legitimacy and authority to "native" speakers, translingualism encourages people to reclaim the agency of language.

As participants in ICL bring diverse linguistic backgrounds to their collaborations, they often rely on multiple linguistic resources to co-construct meaning. In such environments, it is important to challenge deficit-oriented perspectives that position non-dominant languages, or less proficient English use, as barriers. By adapting the notion of Translingualism, teachers can encourage learners to strategically draw on their full linguistic repertoires.

Social Construction of Learning Places

Second perspective is understanding of place as social constrictions. In this notion, classroom is a space where actions occur and as actions are performed, space is transformed into a learning place. Kocatepe (2018) argues that autonomous language learners are learners who can "exercise the capacity to transform a classroom into a place for learning by evaluating and shaping social practices and classroom identities in ways that create effective participation in meaning making processes" (p. 146). Furthermore, Lamb and Vodicka (2018) discuss the collective autonomy of language learning as "language communities autonomously finding spaces where they can challenge the monolingual habitus, collectively creating the conditions in which multilingualism can be normalized and interlingual encounters nurtured" (p. 15).

This perspective is particularly relevant in ICL settings, where students must navigate both linguistic and cultural diversity to co-construct productive learning environments. Autonomous learners in ICL contexts are not only responsible for their own learning but must also negotiate shared meanings, practices, and norms with peers from different linguistic and cultural backgrounds.

Multilingual Identity

Thirdly, research on language and identity increasingly recognizes that language is not merely a communicative tool but a social practice through which meanings, relationships, and identities are constructed. Norton (2013) defines identity as "how a person understands his or her relationship to the world" (p. 45) and understanding learners' histories and lived experiences is therefore essential for creating learning environments where learners can claim the right to speak (p. 179).

While Norton's framework emerged from second language research, Forbes et al. (2021) extend it to multilingual contexts by introducing the notion of multilingual identity. They argue

that multilingual identity is shaped by learners' experiences with language, their evaluations of different languages, and the emotions associated with multilingual learning (pp. 434–435).

If we understand all ICL participants, though to varying degrees, as language learners engaged in creating a multilingual learning place, this conceptualization of language learning as identity construction aligns closely with the aims of ICL/COIL programs.

The Study

Research Question

In ICL, where English functions as the lingua franca but is not the first language of participants, students regularly move among English, their own languages, and sometimes their partners' languages. How learners evaluate these practices, and how they feel about using their linguistic resources, impacts their identity positions, participation, and engagement, therefore need to be examined to understand multilingual place-making in ICL contexts. Hence, this study investigates students' multilingual experiences in Collaborative Online International Learning (COIL) programs focusing on questions below.

- How did learners negotiate language & identity in COIL?
- How did they transform a space into a place for multilingual learning?

Local Context

In 2022–2023, the author, working as a teacher-researcher, designed and facilitated two COIL programs involving 52 university students from Japan and Malaysia who participated in virtual group discussions. Students were placed into mixed groups consisting of participants from both J University and M University. Each group engaged in a series of collaborative tasks, with topics designed to facilitate interaction, encourage reflective dialogue, and promote the co-construction of knowledge. The themes and the number of participants for each program were as shown in Table 1.

Table 1
Themes and Number of Participants in COIL Programs

Program	Theme	# of participants	
		J University (# interviewed)	M University (# interviewed)
Summer, 2022	Designing a SDGs lifestyle	12 (3)	18 (2)
Spring, 2023	Designing an intercultural learning space	5 (2)	18 (0)

The two programs differed in their group management structures. In the 2022 program, students remained in the same group for the entire duration of the program and were responsible for coordinating their own online meeting times. In the 2023 program, on the other hand, students were assigned to a new group for each topic, and meeting times were pre-determined by the instructor.

Data Collection and Analysis

Data for this study were collected through semi-structured individual interviews and supplementary program artifacts. Semi-structured interviews with seven participants were conducted to elicit the participants' views of the process of learning place transformation with their own words. All interviews were audio-recorded with the participants' consent and later transcribed for analysis. To complement the interview data, additional artifacts, such as activity logs, online whiteboards, reflection papers, were also collected throughout the programs and these materials were often revisited during and after interviews to deepen contextual understanding and to support interpretive analysis. Interviews with J university students were conducted in Japanese and translated into English by the author. The list of interview participants is shown in Table 2.

Table 2

List of Interview Participants (all names are pseudonyms)

Name	Affiliation	Program	Self-Evaluation of the groupwork
Aisha*	M University	2022	Positive
Lee*	M University	2022	Positive
Rin*	J University	2022	Positive
Haruto	J University	2022	Negative
Takako	J University	2022	Positive
Ami	J University	2023	Positive
Itsuki	J University	2023	Negative

Note. Aisha, Lee and Rin were groupmates in the 2022 program.

Positioning Theory and Identity Negotiation

For analytic framework, the positioning theory was used. Positioning refers to "the assignment of fluid 'part' or 'roles' to speakers in the discursive construction of personal stories that make a person's actions intelligible and relatively determinate as social act" (van Langenhove & Harré, 1999, p. 17). It is a notion based on social constructionism which understand person's action and identities are constructed/gave meaning in interaction with others. Same utterance or speech act can mean or function differently in each context, and there exist social powers. "Positioning, shaped by power and many factors, is the dynamic construction of personal identities and an essential feature of social interaction. Therefore, analyzing positioning in written and oral discourse is a way of uncovering participants identities" (Kayı-Aydar, 2019, p. 22).

Findings and Discussion

Students draw on language resources, at least, in English, Japanese, and Malay during groupworks. However, the frequency or attitude of using those three languages had certain connotation. In this section, experiences of participants were illustrated under four themes: 1) "Not good at English" or "resourceful" person, 2) Multilingual identity, 3) Transforming a space into a place of multilingual learning, and 4) Complexity of Stereotypes. The interview excerpts demonstrate how they described their feelings and experiences around languages, and how that became places of struggles to claim the right to speak and negotiate their identities in their group works.

"Not Good at English" or "Resourceful" Person

When participants were asked to evaluate their collaboration, the first challenge they consistently mentioned was language. Students from both J University and M University referred to English as a barrier, although they conceptualized "language difficulty" in different ways. For some, it was about linguistic proficiency; for others, it was more about meaning-making, pragmatics, and identity negotiation.

For Itsuki, a J University student, this was his first time participating in an international program. He first vaguely claimed that he was "not good at English" yet then described how he managed his participation and his uncertainty.

> I often used chat. In the worst case, I asked for help via chat. I also used screen sharing, showing websites, and translation sites to manage somehow. It's too bad that I couldn't rely much on Google, the great teacher. (Itsuki)

Even though he first vaguely claimed that he was "not good at English", he was still communicating using English, but in written form using the chat functions, or the translation site. As the interview continued, he also mentioned:

> I wasn't sure if what I am thinking was the same as what they were thinking. Even though we use the word 'internship,' I didn't know whether it referred to the same thing, same 'internships' commonly understood in Japan or in Japanese. (Itsuki)

This clearly shows that he was aware of cultural differences, he still demonstrated his engagement in using at least two language knowledge despite his lack of the confidence in his understanding. Even though his own evaluation about his language proficiency is "not good at English," he was still communicating using both Japanese and English resources.

On the other hand, Rin, who had difficult time previously when she participated in another international exchange program, employed similar make-up strategies as Itsuki, felt positive about her contribution to the groupwork as she was able to convey her message.

> English skill may have some influence, but I think it's more about my mentality, that I was able to maintain calm, like it's ok if they don't understand my English, I mean using my facial expression and other thing, if I can convey what I want to say, that is good enough. Before, I felt like I must speak English, but in the end, I was not able to say anything, so this time, I tried to focus on expressing my thinking, so I think that is why it was better this time. (Rin)

Her claim is confirmed by her groupmate Lee, who have friends in Japan and had previous experience talking with Japanese students.

> At first, we were shocked and then we kept on asking questions and then after she (Rin) realized that there was a misunderstanding, she looked like a bit panicked at the beginning and then she would speak out some of Japanese words and then, after that she would start to try long ways like typing in English or speaking English or showing another proof to strengthen conversation. Mostly they (Japanese students) can write very good in English. (Lee)

Lee did not position Rin as "lacking English ability," even when a misunderstanding occurs. Instead, she emphasizes Rin's resourcefulness and ability to clarify using multilingual strategies.

Although, both Itsuki and Rin described not being able to express themselves fully and reliance on non-linguistic tools, their evaluation of their own contribution was different. Translingual practices enabled their participation, yet Itsuki's understanding of spoken "English" as the legitimate lingua franca continues to shape his negative self-evaluation, while Rin, who consciously accepted translingual practice, was positioned as resourceful person and had positive evaluation about herself.

Multilingual Identity

The way participants described their or their counterpart's first language had different connotation. Aisha from M university, who had participated in a same program a year before, stated:

> Sometimes it's very hard to talk with them because I'm not good at Japanese, but I know basic Japanese things. But if I want to make a conversation, it's very hard for me to… (Aisha)

Even though Aisha put it in a negative way, she claimed that she possesses Japanese language resource and positioned herself as a multilingual speaker. However, she also mentioned not using Malay, because that creates a need for double translations.

> We were not using Malay language, because for me, if you use Malay language and we need to translate it into English, then we need to translate it into Japanese, so you just use the English language… (Aisha)

Lee, who was also a multilingual speaker of Japanese, English, and Maly, shared very similar experience.

> We seldom use Malay language because for Malay only Malaysian students understand, so we are more trying to use English. But when they (Japanese students) start in English, we also prompted that 'you can use Japanese. Maybe we can understand,' but they are not willing to use Japanese. They really stick to English because they want to learn English. (Lee)

This shows that even she encouraged the use of Japanese, Japanese students tried to use English only and Lee, herself also did not use Malay.

From these descriptions, we can understand, even though participants made effort to normalize translingual practice, both Japanese and Malaysian students limited the use of their first languages, for consideration to their groupmates, or preconceived notion of "English as linga franca."

Transforming a Space Into a Multilingual Learning Place

Lee noted the change in her Japanese groupmates attitude as groupwork unfolded, however:

> First and second time, the Japanese students, although they are Japanese, but they are from different campus, so they also don't know each other. When they have problems with language, they will not seek help from the Japanese student. They will tend to want to search by themselves. But at the end of the meeting. They will start to ask the Japanese student, the other Japanese students, to help them. And then when they are stuck in language, the other students and also help them to translate into English. (Lee)

Lee recognized the increased use of Japanese language by her Japanese groupmates. Her observation is confirmed by Rin's description; Rin also shared about her experience of using Japanese with her Japanese groupmate for time to time.

While Rin perceived her utilizing her Japanese language resource in positive way, she also noticed not only her own behavioral change but also Malaysian groupmates' behavior.

> Well, Malaysian students started to speak slowly, so it became easy to listen, maybe I was also getting used to, and also we were looking at the Streetview while talking so it was easy to understand what we were talking about. (Rin)

These may indicate that, in the process of transforming a space to a place of learning, translingual practice could be reinforced.

Complexity of Stereotypes

There were several moments in the interview that students acting or positioned as acting cultural stereotypes, such as the belief that Muslim participants would not even allow others to talk about pork products or that Japanese participants are inherently shy. These assumptions created hesitation and nervousness. However, the influence of such culturally stereotyped images proved significant only in the initial stages of interaction. In contrast, the fixed image of what constitutes "a proper discussion" was more persistent and often led students to negatively evaluate their own language abilities.

Itsuki, Haruto and Takako shared similar view that a good discussion should involve deep synthesis of ideas, yet they felt unable to achieve such discussions. Itsuki and Haruto, who evaluated their own English proficiency negatively, attributed the failure as language problem. The following excerpt from Haruto's interview illustrates this point; he felt that while his group succeeded in generating diverse ideas, they were unable to "consolidate them into one," due to language difficulties.

Haruto: (looking at the group Padlet) This, we wrote this, oh I remember, we didn't write this beforehand, but we wrote down opinions while talking, the members who could not attend the meeting added up later, but I think we wrote this while in the zoom meeting
Kato: while talking
Haruto: shared our opinions and wrote them down, and then we tried consolidate to one, but that was very hard
Kato: is that so, what was difficult about?
Haruto: for example, I think I could do this if it was in Japanese, extract and summarize elements, but it was in English.

On the other hand, Takako, who had lived in the US during her childhood, shared a similar evaluation of her group's discussion outcome, but offered a different explanation for it.

> Then I asked each person in their own field of expertise what aspects of the SDGs they were involved with. Since I was sort of the facilitator for Group 2, I made that call, gathered opinions, and then offered my own perspective based on my knowledge, like pointing out other aspects to consider. But honestly, critical opinions didn't really surface, so it ended up feeling more like exchanging ideas not like a proper discussion. […] Japan seems to be pretty big on this (SDGs), though. I mean, here in Japan, you see SDGs Week or stuff like that covered a lot on TV... But I hear that overseas, it's not really like that**.** I guess it probably depends on the country. (Takako)

Takako, felt that she managed "to speak and navigate it well" and acted as the facilitator of the group, recognized her group's difficulty not to language ability but to differences in knowledge or awareness of the theme across their respective societies.

Discussion

Across groups, participants drew on multiple semiotic resources: English, Japanese, Malay, gestures, chat writing, visuals, translation tools, and shared screens. These were not as separate from languages, but as an integrated repertoire of their translingual practices. This aligns with translanguaging theory, which conceptualizes communication as the orchestration of available linguistic and semiotic resources rather than switching among discrete languages.

For students with less English proficiency, however, participation required negotiating a balance between their desire to contribute and their perception of limited English proficiency. Their acceptance of a "not-perfect self" functioned as an emotional and identity strategy that enabled translanguaging, at the same time, allowing them to claim their right to speak in the place without striving for monolingual, native-like competence. Rin's case exemplifies how identity is also socially co-constructed: Despite misunderstandings, her Malaysian peer described her as resourceful rather than limited.

Although participants engaged in fluid translanguaging practices, many continued to evaluate themselves through an "English as Lingua Franca" lens. This revealed a persistent ideological tension. Students frequently attributed communicative difficulties, groupwork challenges, and unsatisfactory outcomes to their lack of English proficiency. Even when Japanese or Malay resources could have supported communication, participants avoided using them out of a belief that English was the "proper" language for international work.

Thirdly, essentialized images of the other, creating hesitation and nervousness, was only constraints for early stages, but internalized fixed image of what constitutes an "academic" discussion, namely deep synthesis of ideas, impacted more persistently. When collaborative outcomes did not meet their expectation, less fluent participants blamed their individual language ability rather than task design or the constraints of online groupwork. Their perceived "failure" reflects the misalignment between their translingual practices and institutionalized norms of academic discussion.

ICL space was a space of struggle for identity and ideology. Translanguaging was normalized, yet it did not just happen by bringing people with diverse linguistic resource in one space. Translingual norms such as slowed pacing, rephrasing, use of visuals, mutual assistance across languages, gradually emerged, as participants together transformed a space to a place of learning. In doing so, there were always tensions, between translingualism and monolingualism,

between ideal self and imperfect self, and between ideal image and reality of international collaboration.

Conclusion

The program functioned as an emergent place of translingual practices; a site where variety of linguistic resources were mobilized, identities were negotiated, and cultural assumptions were reshaped. Yet learners internalized monolingual norms shaped how they interpreted their own success and participation. These findings point to the need for more intentional pedagogical design that recognizes and supports translingual practices.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT 5.1 was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from ChatGPT 5.1, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Analysis on the Effect of Digital Literacy, Innovative Behavior, Culture, and Interpersonal Communication on Teachers Performance at DLSU-D Through SEM

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Abstract

Assessing a teacher's performance may involve examining how much they have achieved the necessary competencies. Professional competence, personality competence, pedagogical competence, and social competence comprise the four competencies a teacher should have. Teacher performance has an important role in improving the quality of education through their knowledge and efforts. Teachers' performance is affected by numerous variables. This study aims to analyze the effect of digital literacy, innovative behavior, culture, and interpersonal communication on teachers' performance at De La Salle University Dasmariñas. The statistical survey methodology was employed in this study to substantiate its findings. This study was conducted at De La Salle University-Dasmariñas (DLSU-D) in Cavite, for the undergraduate college teachers only. The university comprises of almost 534 undergraduate college teachers from nine departments, 248 participated in the study. The study used the Partial Least Squares - Structural Equation Model (PLS-SEM) to derive the latent variable values to analyze the effect of digital literacy, innovative behavior, culture, and interpersonal communication on teachers' performance, and to determine the relationship of these variables. Furthermore, to construct a structural model to help management to improve teachers' performance. The study introduced nine hypotheses which has generated several significant discoveries. These findings are consistent with prior research, demonstrating beneficial impact of digital literacy and innovative behavior to teachers' performance. Based on the results, digital literacy, innovative behavior, interpersonal communication, and teachers' performance have a positive relationship with each other.

Keywords: digital literacy, innovative behavior, culture, interpersonal communication, teachers performance, structural equation modeling

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Introduction

Teacher's performance assessment may involve examining how much they have achieved the necessary competencies. Professional competence, personality competence, pedagogical competence, and social competence comprise the four competencies a teacher should have (Ishak & Suyatno, 2020). Examining teacher performance is captivating despite its longstanding presence in educational research (Dewanto et al., 2024). Several educational academics have previously investigated the issue of teacher performance (Mailool et al., 2020). Teacher performance has an important role in improving the quality of education through their knowledge and efforts. Therefore, the topic of teacher performance has been a significant focus of research for educational academics up to the present time (Dewanto et al., 2024).

In recent decades, with the rapid increase in technological development and advancements, the digitalization of society has abruptly change (Travkina, 2022). As the effect of this technological advancement in every aspect of the society is observed, the result of digitalization in life and education is inevitable. Education is one of the major contributors in a nation's progress. It has a crucial role in the advancement of a country (Jahantab, 2021). The process of digitalization in education has been on its way for a long time (Arisoy, 2022). The onset of novel coronavirus disease 2019 or Covid-19 pandemic during a period of temporary communication restrictions has arisen a strong surge of interest to a completely remote format of interaction between all participants in educational process (Chertoff et al., 2020).

Digitalization has affected all levels of education, and directly the activities of students, teachers, administrators, and stake holders. The current advancements in information technologies have facilitated transparency in implementing educational methods in schools. The availability of this information enhances the ease of monitoring teacher performance (Howard et al., 2019). To address teacher performance issues, all school leaders must exert significant effort. Teacher performance encompasses teachers' measurable actions and behaviors that contribute to attaining school or organizational objectives (Wahab et al., 2020).

Furthermore, to enhance the caliber of education, teachers need to possess a dependable and enduring comprehension of digital literacy (Dewanto et al., 2024). The teacher's lack of comprehension of digital literacy may adversely affect the learning process and academic achievement as stipulated by the school curriculum (Afriliandhi et al., 2022).

De La Salle University-Dasmariñas, like other universities elsewhere in the Philippines and the world, have been experiencing a set of important changes induced by technological innovations and social trends towards digitalization. Nevertheless, in spite of these perceived barriers, institution like De La Salle University-Dasmariñas have adapted the e-learning strategy through the e-class embedded in its school book design (Rocina, 2017). Similarly, the digitalization revolution involves an intense readjustment in all sectors of education. Currently, the adoption of technologies by universities is related to a paradigm shift, where technology and advancement is conceived as a complex and interconnected environment that enables digital learning (Rodney, 2020).

De La Salle University-Dasmariñas, also referred to by its acronym DLSU-D or La Salle-Dasma, is a private Roman Catholic, Lasallian co-educational secondary and higher education institution run by the De La Salle Brothers of the Philippine District of the Christian Brothers in Dasmariñas City, Cavite, Philippines. It is a member of De La Salle Philippines, a network of 16 Lasallian educational institutions. Studies and research pertaining to the effect of digital

literacy, innovative work behavior, culture, and interpersonal communication on teachers' performance is not yet undertaken in the university.

Research Goals and Objectives

This study aims to analyze the effect of digital literacy, innovative behavior, culture, and interpersonal communication on teachers' performance at De La Salle University Dasmariñas using Structural Equation Modeling (SEM). It also intends to address the gaps of the teachers in relation to the constructs mention. This research aims to answer the following questions:

1. What are the significant factors that affects teachers' performance at De La Salle University Dasmariñas that covers digital literacy, innovative behavior, culture, and interpersonal communication;
2. What is the impact of these significant factors that affects teachers' performance at De La Salle University Dasmariñas in terms of digital literacy, innovative behavior, culture, and interpersonal communication; and
3. In what ways can this research study help faculty management at De La Salle University Dasmariñas improve teachers' performance.

Hypotheses of the Study

This research will combine digital literacy, innovative behavior or attitudes, culture, interpersonal communication, and teacher performance into single research. The researcher aims to examine the impact of digital literacy, innovative behavior, culture, and interpersonal communication on teacher's performance at De La Salle University Dasmariñas.

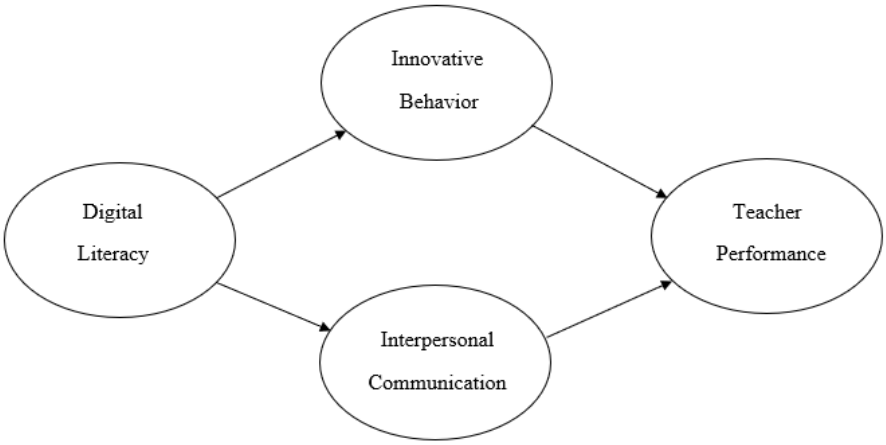
The researcher formulated the following hypotheses based on the statement of the problem and objectives of the study.

H1: Digital literacy and innovative behavior have a positive correlation
H2: Digital literacy and interpersonal communication have a positive correlation
H3: Digital literacy and teachers' performance have a positive correlation
H4: Culture and innovative behavior have a positive correlation
H5: Culture and interpersonal communication have a positive correlation
H6: Culture and teachers' performance have a positive correlation
H7: Culture and digital literacy have a positive correlation
H8: Innovative behavior and teachers' performance have a positive correlation
H9: Interpersonal communication and teachers' performance have a positive correlation

Literature Review

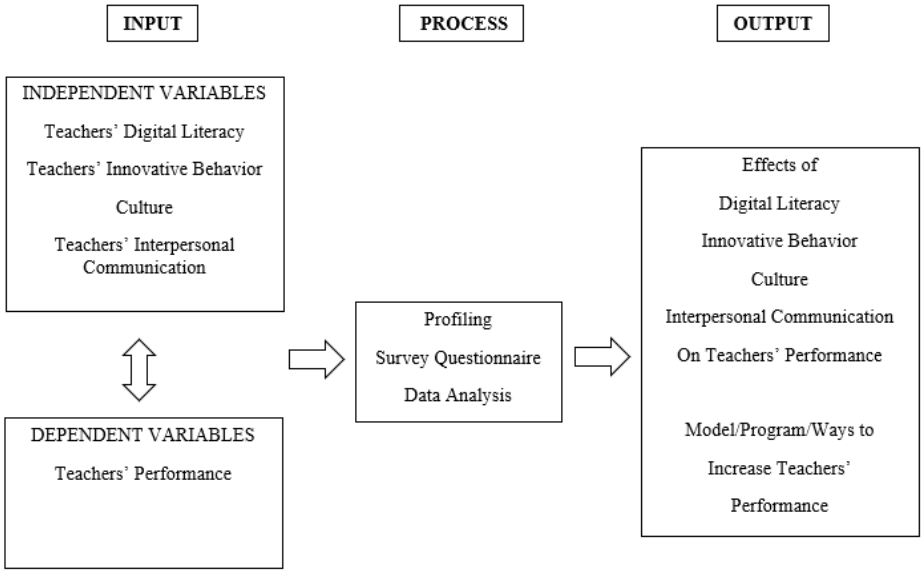
The theoretical framework of the study is based on the previous study regarding the effect of digital literacy, innovative attitudes, and interpersonal communication on teacher performance (Dewanto et al., 2024). According to the prior findings and discussion, the research uncovered four noteworthy and statistically significant discoveries. One is that a direct relationship exists between digital literacy and innovative mindsets. A direct relationship exists between innovative mindsets and teacher performance. A direct relationship exists between digital literacy and interpersonal communication. Interpersonal communication and teacher performance exhibit a positive association (Dewanto et al., 2024).

Figure 1
Theoretical Framework



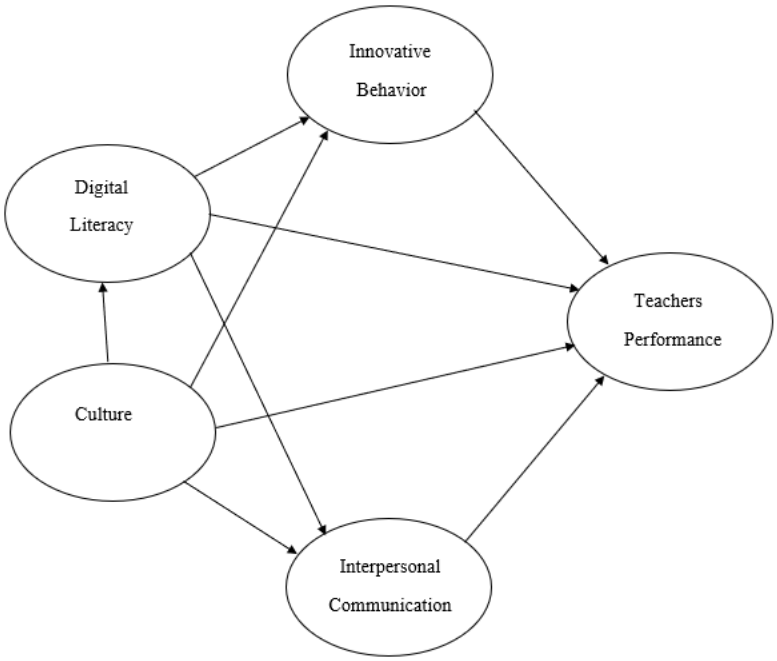
The conceptual framework of the study is represented as an IPO (Input – Process - Output) method. The inputs are the dependent and the independent variables. The independent variables are the teachers' digital literacy, innovative behavior, culture, and interpersonal communication while the dependent variable is the teachers' performance. Culture was added in the current study.

Figure 2
Conceptual Framework



Intervening variables which are not represented are the faculty age, gender, educational attainment, and years in teaching, and the type of faculty. Processes include profiling, survey questionnaire, and data analysis. The desired output is the analysis of the effects of digital literacy, innovative behavior, culture, and interpersonal communication on teachers' performance. Furthermore, the study will help faculty management to develop program, or ways to improve teachers' performance. The study will revolve around this framework that serves as the researcher's guide.

Figure 3
Conceptual Paradigm



Methodology

This study will employ a cross-sectional study descriptive research design using statistical survey approach to ensure the accuracy of its results. The researcher will use the Partial Least Squares-Structural Equation Model (PLS-SEM) to generate predictions and to determine the values of the hidden variables. Descriptive research is a quantitative research method that attempts to collect quantifiable information to be used for statistical analysis of the population sample. The collected and analyzed data from the descriptive research can then be further studied using different research techniques and computer software.

Data Gathering Procedure

The researcher will use university records, online data, and publications as a basis for the preliminary data required in the research study. Respondents will be composed of the faculties of the selected university. Sample size will be determined from the total population of all faculties of the university using the Slovin's formula. Based on the information provided by the university, the total population of the intended respondents is 534, using the Slovin's formula with a 5% error tolerance level, the number of adequate samples are 228.

Survey method using Google Forms will be used in data gathering. In survey research, respondents will answer through survey or questionnaires, or polls. Permission in conducting the survey will be obtained from the selected university in-charged personnel. Consent of the respondents will be asked before any survey should be done and assurance of confidentiality will also be explained to them. A letter requesting consent or approval for employee participation will also be presented before starting the survey. Participation in the survey is voluntary and based on the faculty or administrator ability to give informed consent. All the questionnaires and interview or survey forms that will be used in data collection will be treated as confidential and will be placed in a secured or locked file storage.

Data Analysis and Results

Table 1 shows the demographics of the respondents. Two hundred forty-eight (248) faculty took part in the study and are currently employed at De La Salle University Dasmariñas. Participants are composed of undergraduate faculty both full time and part time.

Table 1
Respondent Profile

Indicator	Frequency	Percent	Valid Percent	Cumulative Percent
		Age		
23 to 30 years old	24	9.7%	9.7%	9.7%
31 to 40 years old	77	31.1%	31.1%	40.8%
41 to 50 years old	104	41.9%	41.9%	82.7%
above 50 years old	43	17.3%	17.3%	100.0%
Total	248	100.0%	100.0%	
		Gender		
Male	134	54.0%	54.0%	54.0%
Female	114	46.0%	46.0%	100.0%
Total	248	100.0%	100.0%	
		Civil Status		
Single	83	33.5%	33.5%	33.5%
Married	165	66.5%	66.5%	100.0%
Total	248	100.0%	100.0%	
		Degree		
Bachelor	43	17.3%	17.3%	17.3%
Masteral	157	63.3%	63.3%	80.6%
Doctoral	48	19.4%	19.4%	100.0%
Total	248	100.0%	100.0%	
		Years in Teaching		
less than 10 years	46	18.5%	18.5%	18.5%
10 - 20 years	77	31.1%	31.1%	49.6%
21 - 30 years	125	50.4%	50.4%	100.0%
Total	248	100.0%	100.0%	
		Faculty Appointment		
Full time	120	48.4%	48.4%	48.4%
Part time	128	51.6%	51.6%	100.0%
Total	248	100.0%	100.0%	
		Have other duties outside university		
Yes	133	53.6%	53.6%	53.6%
No	115	46.4%	46.4%	100.0%
Total	248	100.0%	100.0%	

Statistical Description and Assessment of Normality

The survey question exclusively provides information in numerical format. Table 2 displays various normality measures and descriptive data for each item-level construct, including skewness, kurtosis, standard deviation, and mean.

The values for asymmetry and kurtosis between -2 and +2 are considered acceptable to prove normal univariate distribution (George & Mallery, 2024). Hair et al. (2019) argued that data is normal if skewness is between -2 to +2 and kurtosis is between -7 to +7. If the skewness statistic

is less than 2 and the kurtosis statistic is less than 7, then the data is considered to have a normal distribution (Curran et al., 1996).

Table 2

Statistical Description and Assessment of Normality

Construct	Item	Sub-Item	Mean	Median	Min	Max	Standard deviation	Excess kurtosis	Skewness
DL	DL1	DL11	3.363	4	2	5	0.841	-1.099	-0.688
		DL12	3.625	4	2	5	1.028	-0.958	-0.474
		DL13	2.992	3	1	5	1.181	-0.831	-0.797
	DL2	DL21	3.105	4	1	5	1.217	-0.757	-0.931
		DL22	3.569	4	2	5	0.519	-1.314	-0.191
		DL23	2.988	4	1	5	1.243	-1.202	-0.662
	DL3	DL31	3.032	4	1	5	1.208	-1.105	-0.698
		DL32	3.028	4	1	5	1.259	-1.187	-0.737
		DL33	3.923	4	2	5	0.86	0.037	-0.693
	DL4	DL41	4.032	4	2	5	0.665	-0.464	-0.119
		DL42	3.141	4	1	5	1.238	-0.72	-0.951
		DL43	3.109	4	1	5	1.208	-0.717	-0.942
	DL5	DL51	2.968	4	1	5	1.341	-1.376	-0.668
		DL52	2.935	4	1	4	1.351	-1.462	-0.651
		DL53	3.194	4	1	5	1.071	-0.895	-0.769
IB	IB1	IB11	3.254	3	2	4	0.606	-0.552	-0.19
		IB12	3.573	4	2	4	0.656	0.356	-1.263
		IB13	3.524	3	2	5	0.889	-0.765	0.325
	IB2	IB21	3.363	3	2	5	0.646	-0.513	-0.337
		IB22	3.339	3	2	5	0.627	-0.563	-0.308
		IB23	3.117	3	2	5	0.865	-1.5	-0.154
	IB3	IB31	3.351	4	2	5	0.93	-1.368	-0.663
		IB32	3.351	4	2	5	0.926	-1.336	-0.631
		IB33	3.343	4	2	5	0.937	-1.427	-0.675
	IB4	IB41	3.262	3	2	5	1.074	-1.122	0.366
		IB42	3.565	4	2	5	1.098	-1.226	-0.432
		IB43	3.512	3	2	5	1.248	-1.637	0.06
	IB5	IB51	3.153	3	2	5	0.88	-1.48	-0.198
		IB52	3.359	4	2	5	0.927	-1.378	-0.743
		IB53	3.621	4	2	5	1.182	-1.392	-0.38
C	C1	C11	4.363	5	3	5	0.831	-1.126	-0.766
		C12	4.492	5	3	5	0.516	-1.565	-0.145
		C13	3.968	4	2	5	0.718	-0.881	-0.018
	C2	C21	4.185	4	3	5	0.787	-1.313	-0.342
		C22	4.508	5	3	5	0.516	-1.543	-0.21
		C23	4.504	5	3	5	0.516	-1.549	-0.194
	C3	C31	4.617	5	3	5	0.494	-1.409	-0.585
		C32	4.339	4	3	5	0.49	-1.254	0.478
		C33	4.593	5	3	5	0.499	-1.534	-0.477
	C4	C41	4.165	4	2	5	0.809	1.814	-1.277
		C42	4.504	5	3	5	0.516	-1.549	-0.194
		C43	3.968	4	3	5	0.659	-0.69	0.034
	C5	C51	4.331	4	3	5	0.495	-1.099	0.421
		C52	4.25	4	3	5	0.442	-0.552	1.02
		C53	4.153	4	3	5	0.554	0.009	0.05

IC	IC1	IC11	3.899	4	2	5	1.126	-0.829	-0.755
		IC12	4.581	5	3	5	0.51	-1.305	-0.512
		IC13	4.573	5	3	5	0.503	-1.616	-0.391
	IC2	IC21	4.81	5	2	5	0.484	10.632	-3.016
		IC22	4.806	5	2	5	0.47	7.986	-2.679
		IC23	4.798	5	2	5	0.483	9.773	-2.837
	IC3	IC31	4.536	5	2	5	0.56	0.493	-0.838
		IC32	4.794	5	2	5	0.477	7.13	-2.535
		IC33	4.141	5	2	5	1.1	-1.139	-0.703
	IC4	IC41	4.552	5	3	5	0.652	0.167	-1.163
		IC42	4.569	5	3	5	0.503	-1.63	-0.374
		IC43	4.488	5	3	5	0.66	-0.275	-0.93
	IC5	IC51	4.718	5	3	5	0.468	0.066	-1.209
		IC52	4.282	5	3	5	0.814	-1.271	-0.562
		IC53	4.75	5	3	5	0.442	0.093	-1.302
TP	TP1	TP11	4.403	4	2	5	0.522	-0.049	-0.117
		TP12	4.448	4	2	5	0.521	-0.145	-0.219
		TP13	4.444	4	3	5	0.505	-1.754	0.134
	TP2	TP21	4.448	4	3	5	0.505	-1.759	0.118
		TP22	3.988	4	2	5	0.687	-0.657	-0.06
		TP23	4.46	4	3	5	0.514	-1.58	-0.016
	TP3	TP31	4.548	5	3	5	0.506	-1.691	-0.29
		TP32	4.399	4	3	5	0.506	-1.498	0.226
		TP33	4.641	5	3	5	0.488	-1.251	-0.696
	TP4	TP41	4.472	4	2	5	0.531	-0.045	-0.376
		TP42	4.403	4	2	5	0.522	-0.049	-0.117
		TP43	4.347	4	2	5	0.654	-0.244	-0.591
	TP5	TP51	4.415	4	2	5	0.524	-0.068	-0.162
		TP52	4.254	4	2	5	0.864	1.607	-1.386
		TP53	4.415	4	2	5	0.517	-0.121	-0.096
	TP6	TP61	4.444	4	3	5	0.505	-1.754	0.134
		TP62	4.593	5	3	5	0.499	-1.534	-0.477
		TP63	4.488	5	3	5	0.654	-0.279	-0.914
	TP7	TP71	4.657	5	3	5	0.483	-1.125	-0.774
		TP72	4.649	5	3	5	0.494	-0.822	-0.83
		TP73	4.621	5	3	5	0.501	-1.058	-0.694
	TP8	TP81	4.722	5	3	5	0.457	-0.391	-1.123
		TP82	4.722	5	3	5	0.457	-0.391	-1.123
		TP83	4.726	5	3	5	0.464	0.211	-1.26
	TP9	TP91	4.375	4	3	5	0.501	-1.422	0.325
		TP92	4.593	5	3	5	0.507	-1.241	-0.566
		TP93	4.577	5	3	5	0.502	-1.601	-0.408
	TP10	TP101	4.774	5	3	5	0.428	0.631	-1.474
		TP102	4.585	5	3	5	0.501	-1.569	-0.442
		TP103	4.419	4	3	5	0.502	-1.711	0.232

Note. DL: Digital Literacy; IB: Innovative Behavior; C: Culture; IC: Interpersonal Communication; TP: Teachers Performance

The descriptive statistics show that out of all the variables that make up the DL (Digital Literacy), the one with the lowest mean value is DL52, with a standard deviation of 1.351. On the other hand, DL41 has the highest mean value. DL22 has the most significant standard

deviation at 0.519. This means that faculty at De La Salle University Dasmariñas possess information and communication digital skills but lacking in problem solving digital skills.

For IB (Innovative Behavior), IB53 have the highest mean value of 3.621, and 1.182 values of standard deviation. IB23 have the lowest mean value at 3.117. Faculty can promote and sustain innovative ideas, while suggesting improvements on expressed ideas are rarely overlooked.

Regarding C (Culture), C13 and C43 has the lowest mean value at 3.968, while C31 has the highest at 4.617. Provision of adequate resources and training for addressing cultural diversity, and experiences in teaching methods and curriculum has the lowest mean. C52 has the most significant standard deviation at 0.442. Teachers feel respected and valued by the administration and other staff members at De La Salle University Dasmariñas.

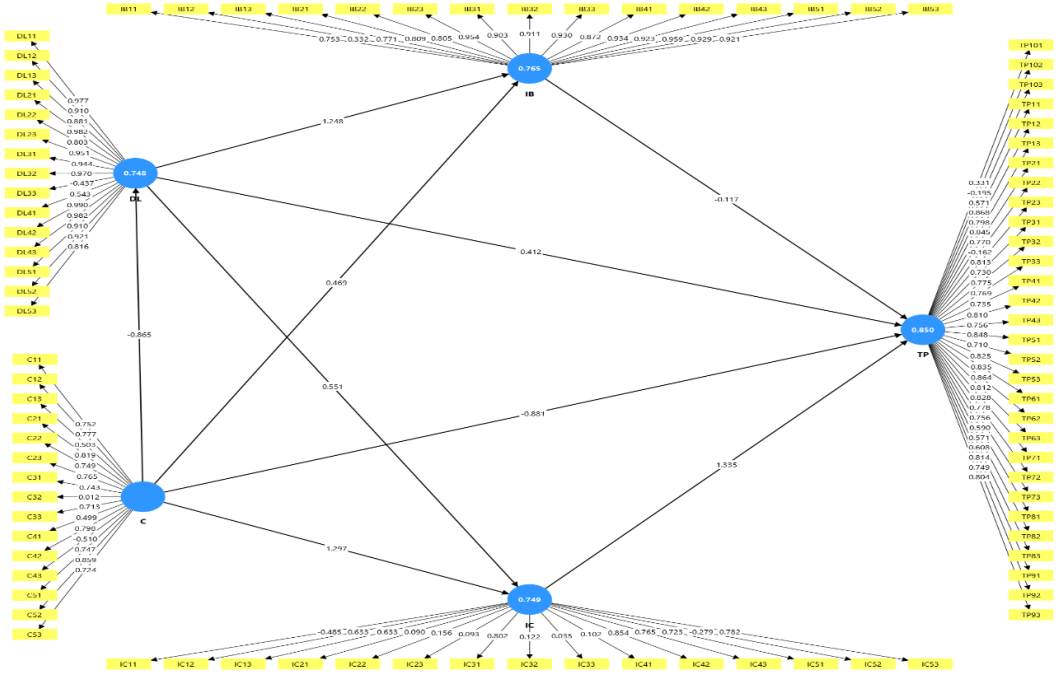
With the highest mean value and lowest value of standard deviation at 4.806 and 0.47 respectively, IC22 displays the most uniform distribution out of the variables that make up the IC (Interpersonal Communication). Respect with everyone is the most important factor in communication amongst the faculty. IC11 which focuses on dimension of expression and collaboration has the lowest mean value.

For TP (Teachers Performance), TP22 has the lowest mean value of 3.988, with a significant value of standard deviation at 0.687. Incorporating digital innovations in lesson plan of the faculty can improve both the quantity and quality of student learning. TP101 has the highest mean value at 4.774. Ensuring proper attire and good grooming before and after classes is one of the important factors in teachers self-reflection.

Measurement Model (Outer Model): Validity and Reliability

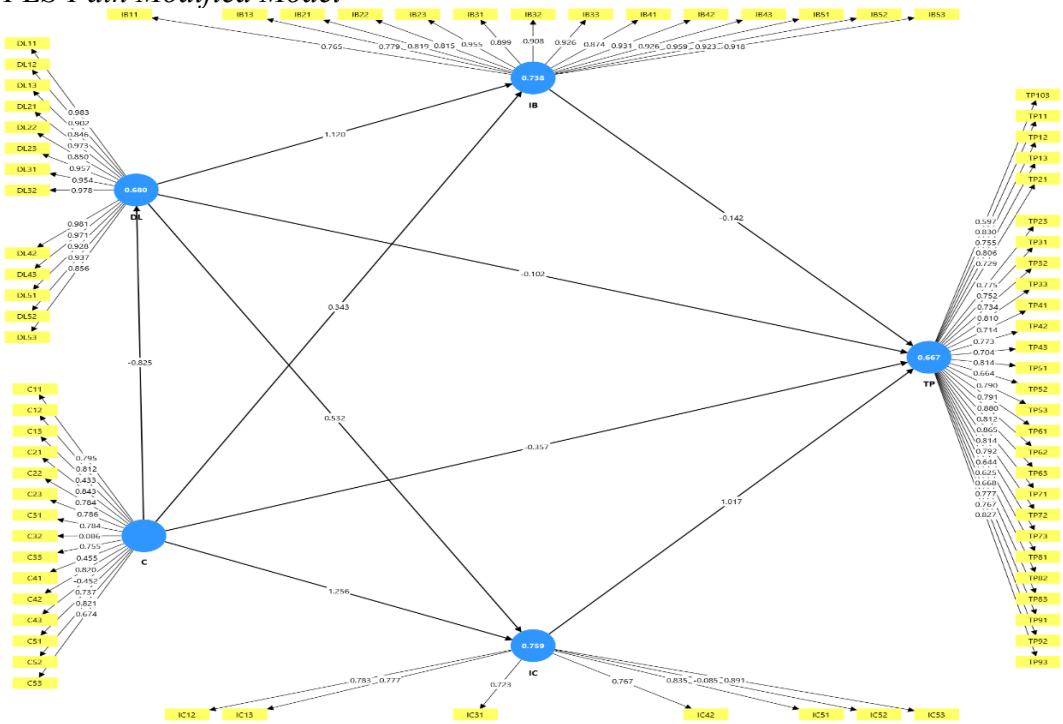
Concurrent and convergent forms of validity will be identified thru the measurement model. Convergent validity describes the degree to which indicators of the latent construct correlate with each other and perfectly embody the construct they are meant for. Convergent validity is assessed using three indices: outer (peripheral) loadings, average variance extracted (AVE), and composite reliability (CR) (Hair et al., 2019). They suggest that the value of AVE and outer loadings should be greater than 0.500 and 0.708 respectively for each of the constructs, and likewise CR should be above 0.7.

Figure 4
PLS-Path Initial Model



On Figure 4, path initial model, outer loadings for indicators DL33, DL41, IB12, IC11, IC21, IC22, IC23, IC32, IC33, IC41, IC52, C32, C41, C43, TP22, TP101, and TP102 falls below the significant threshold of 0.500 at 0.05 significance level, and they are excluded in the study.

Figure 5
PLS-Path Modified Model



On Figure 5, path first modified model, outer loadings for indicators C13, C32, C41, C43 and IC52 falls below the significant threshold of 0.500 at 0.05 significance level, and they are excluded in the study.

Figure 6
PLS-Path Structural Model

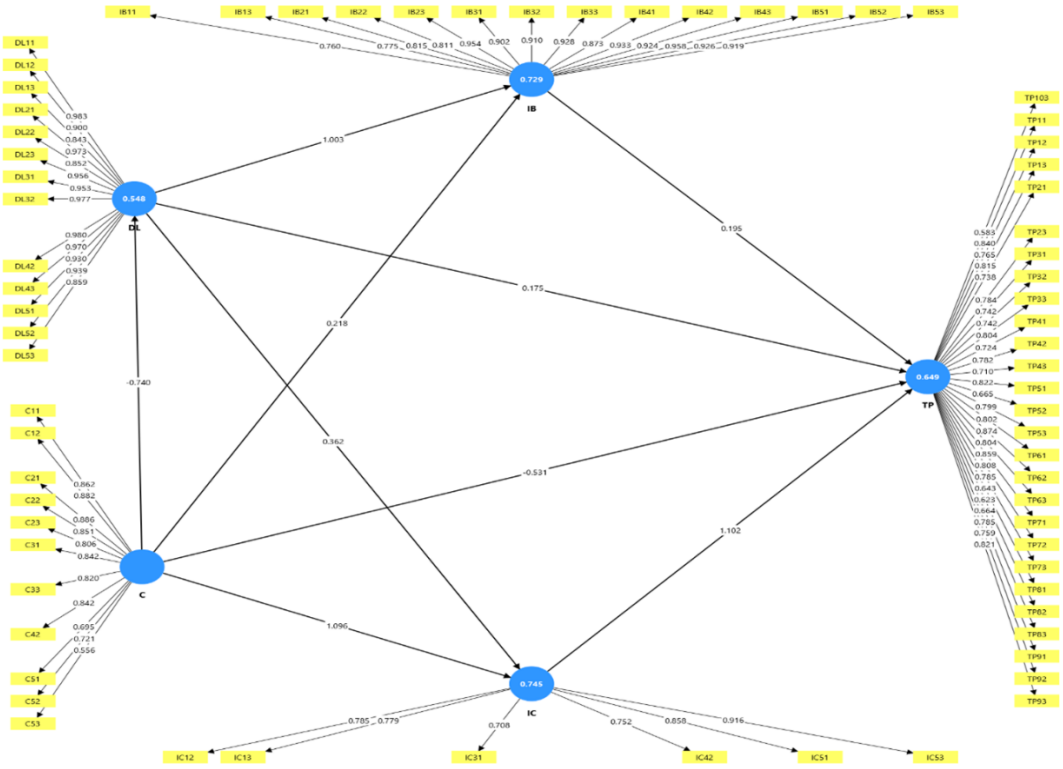


Table 3
Convergent Validity

Construct	Item	Sub-Item	Outer Loading	Cronbach Alpha	CR	AVE
DL	DL1	DL11	0.983	0.987	0.989	0.871
		DL12	0.9			
		DL13	0.843			
	DL2	DL21	0.973			
		DL22	0.852			
		DL23	0.956			
	DL3	DL31	0.953			
		DL32	0.977			
	DL4	DL42	0.98			
		DL43	0.97			
	DL5	DL51	0.93			
		DL52	0.939			
		DL53	0.859			
IB	IB1	IB11	0.76	0.979	0.981	0.787
		IB13	0.775			
	IB2	IB21	0.815			
		IB22	0.811			
		IB23	0.954			
	IB3	IB31	0.902			
		IB32	0.91			

		IB33	0.928			
	IB4	**IB41**	0.873			
		IB42	0.933			
		IB43	0.924			
	IB5	**IB51**	0.958			
		IB52	0.926			
		IB53	0.919			
C	**C1**	**C11**	0.862	0.943	0.951	0.644
		C12	0.882			
	C2	**C21**	0.886			
		C22	0.851			
		C23	0.806			
	C3	**C31**	0.842			
		C33	0.82			
	C4	**C42**	0.842			
	C5	**C51**	0.695			
		C52	0.721			
		C53	0.556			
IC	**IC1**	**IC12**	0.785	0.887	0.915	0.644
		IC13	0.779			
	IC3	**IC31**	0.708			
	IC4	**IC42**	0.752			
	IC5	**IC51**	0.858			
		IC53	0.916			
TP	**TP1**	**TP11**	0.583	0.973	0.974	0.584
		TP12	0.84			
		TP13	0.765			
	TP2	**TP21**	0.815			
		TP23	0.738			
	TP3	**TP31**	0.784			
		TP32	0.742			
		TP33	0.742			
	TP4	**TP41**	0.804			
		TP42	0.724			
		TP43	0.782			
	TP5	**TP51**	0.71			
		TP52	0.822			
		TP53	0.665			
	TP6	**TP61**	0.799			
		TP62	0.802			
		TP63	0.874			
	TP7	**TP71**	0.804			
		TP72	0.859			
		TP73	0.808			

	TP8	TP81	0.785			
		TP82	0.643			
		TP83	0.623			
	TP9	TP91	0.664			
		TP92	0.785			
		TP93	0.759			
	TP10	TP103	0.821			

Figure 6 and Table 3 shows that measurements are dependable. All the remaining outer loadings exceeded the significant threshold of 0.500 at 0.05 significance level shows that all individual items' measurement adds considerable significance to their studied constructs and sufficiently met the acceptable criterion set for individual item reliability (Adeleke et al., 2015). On the other hand, the results indicated that the average variance extracted (AVE) values, which varied between 0.584 and 0.871, surpassed the minimum requirement of 0.500 (Henseler et al., 2014). Cronbach's alpha and composite reliability (CR) are recommended to be higher than 0.7. Table 3 shows that all structures have Cronbach's alpha and CR values higher than the critical value of 0.70.

Cronbach's alpha and CR coefficient are frequently used index in organizational research in assessing the internal consistency of reliability of a scale, particularly those containing multiple items (McCrae et al., 2010). This study utilized a composite reliability coefficient for the assessment of internal consistency reliability. In this study, composite reliability (CR) as provided in Table 3 ranged from 0.915 to 0.989 for all the constructs which exceeded the minimum requirement of 0.7 (Hair et al., 2019), thereby validating the constructs' internal consistency and reliability.

Discriminant validity is the degree by which a latent construct differs from others in a model (Vinzi et al., 2009). The test's discriminatory power was initially assessed using the Fornell-Larcker Criterion. In the assessment of Fornell-Larcker criterion, it compares the square root of Average Variance Extracted (AVE) with the latent variable correlations. Specifically, the square root of each construct's AVE should be greater than its highest correlation with any other construct and only with this assessment the discriminant validity can be achieved (Afthanorhan et al., 2021). Table 4 shows the results for discriminant validity of the study. However, negative values are noticeable in some comparison.

Table 4

Discriminant Validity: Fornell-Larcker Criterion

Construct	DL	IB	C	IC	TP
DL					
IB	0.815				
C	0.752	0.533			
IC	0.487	0.408	0.850		
TP	0.450	0.352	0.600	0.778	

Recent research suggest that Fornell & Larcker criterion is not effective under certain circumstances in PLS method and therefore Roemer et al. (2021) offered Hetetrotrait-Monotrait (HTMT) approach to replace Fornell & Larcker criterion.

To examine this, the Heterotrait-Monotrait Ratio (HTMT) which was recommended by Roemer et al. (2021) as an alternative to Fornell and Larcker's method has been applied. The HTMT is advocated to be a superior boundary measure for assessing discriminant validity. As an evaluation for factor correlation, the HTMT should be considerably smaller than 1 (ideally < 0.850) to distinguish between two factors (Hair et al., 2019).

Table 5

Discriminant Validity: Heterotrait-Monotrait Ratio (HTMT)

Construct	DL	IB	C	IC	TP
DL					
IB	0.815				
C	0.752	0.533			
IC	0.487	0.408	0.850		
TP	0.450	0.352	0.600	0.778	

From Table 5, the results show a range between 0.352 and 0.850 which drop beneath the threshold level of 0.90, thus implying all constructs are independent of each other and that the benchmark for discriminant validity have been met.

In conclusion, convergent and discriminant validity evaluations show that the constructs are adequately valid and reliable in the study model.

Structural Model: Examination of the Impact of Interaction

The objective of structural model evaluations is to verify hypotheses concerning the statistical significance (t-values), the range of confidence intervals, and the relative significance (R2) of exogenous and endogenous variables. SmartPLS Bootstrapping method was utilized in the computation of T-values and standard errors. Two tailed tests at significance level of 0.05 was employed to ascertain results. In SmartPLS, a T-value greater than 1.96 (for a two-tailed test at a significance level of 0.05) is generally considered significant. Random subsamples of 5,000 was set and calculating the mean of the results.

Table 6

Hypotheses Result

Hypothesis	Path	Strd. Beta	Strd. Error	T-Value	P-Value	Bias	Confidence Interval		Decision
							Bias	Corrected	
H1	DL->IB	1.003	0.033	30.629	0.000	0.000	0.939	1.068	ACCEPTED
H2	DL->IC	0.362	0.045	8.017	0.000	0.003	0.274	0.450	ACCEPTED
H3	DL->TP	0.175	0.091	2.135	0.000	0.009	0.050	0.330	ACCEPTED
H4	C->IB	0.218	0.15	6.827	0.000	0.000	0.153	0.279	ACCEPTED
H5	C->IC	1.096	0.035	31.299	0.000	0.003	1.027	1.165	ACCEPTED
H6	C->TP	0.531	0.141	3.764	0.000	-0.029	0.774	0.924	ACCEPTED
H7	C->DL	-0.740	0.031	1.166	0.244	-0.008	-0.508	0.083	REJECTED
H8	IB->TP	0.195	0.127	2.535	0.000	0.000	0.230	0.501	ACCEPTED
H9	IC-TP	1.102	0.100	11.075	0.000	0.019	0.871	1.272	ACCEPTED

Table 6 showed confidence intervals for the correlation between DL and IB, ranging from 0.939 to 1.068. The statistical significance of this link was the second highest with a Beta coefficient

of 1.003 and a T-value of 30.629. This result indicates that a standard deviation rise in DL was connected to an increase in IB. Therefore, we will accept H1.

For the correlation between DL and IC, confidence intervals ranged from 0.274 to 0.450. We can say that the link was also statistically significant with a Beta coefficient of 0.362 and a T-value of 8.017. This implies that there is also a positive relationship between the two, thereby H2 was accepted.

With a confidence interval ranging from 0.050 to 0.083, and a Beta coefficient of 0.175 and a T-value of 2.135 we can assume that there is significant relationship between DL and TP. Hence, we can accept H3.

For the correlation between C and IB, confidence intervals ranged from 0.153 to 0.279. We can say that the link was also statistically significant with a Beta coefficient of 0.218 and a T-value of 6.827. This implies that there is also a positive relationship between the two, thereby H4 was accepted.

For C and IC correlation, with a confidence interval ranging from 1.027 to 1.165 and a T-value of 31.299, we can say that, the statistical significance of this link is he highest, with a Beta coefficient of 1.096, therefore H5 was accepted.

For the correlation between C and TP, confidence intervals ranged from 0.774 to 0.924 indicates that correlation between these two was statistically significant, with a Beta coefficient of 0.531 and a T-value of 3.764. H6 will be accepted also.

With a confidence interval ranging from -0.508 to 0.281, and a Beta coefficient of -0.740 and a T-value of 1.166 we can assume that there is no significant relationship between C and DL. Hence, we can reject H7.

For the relationship between IB and TP, confidence intervals ranged from 0.230 to 0.501, Beta coefficient of 1.195 and a T-value of 2.535, the link is also statistically significant so we can accept H8. This means that increase in IB is connected to increase of TP.

Lastly, with a confidence interval ranging from 0.871 to 1.272, and a Beta coefficient of 1.102 and a T-value of 11.075 we can assume that there a significant relationship between IC and TP. Therefore, we will accept H9.

Discussion

The descriptive statistical analysis of the data reveals significant factors that affects teachers' performance in relation to digital literacy namely: technical digital skills, creativity digital skills, critical-thinking digital skills, information and communication digital skills, and problem-solving digital skills. For innovative behavior, the factors are opportunity exploration, idea generation, idea promotion, idea realization, and idea sustainability. The significant factors for culture are cultural values and beliefs, communication styles, student-teacher relationship, and school culture. For interpersonal communication, the factors are dimension of respect, dimension of discipline, and teaching and learning dimension. The significant factors for teachers' performance are knowledge of subject matter, teacher-student relationship, tools and resources, collaboration with others, feedbacks, standards and expectations, fairness and justice, risk taking and self-reflection.

The statistical analysis of structural model reveals significant relationships between the variables. These correlations demonstrates that each variables have impact to other variables. From the results of the study, we can conclude that digital literacy has positive impact to innovative behavior and interpersonal communication and eventually positive results to teachers' performance. Culture has also direct relationship to interpersonal communication and teachers' performance, however it has no significant impact to innovative behavior as per the data analyzed. Innovative behavior and interpersonal communication positively affect teachers' performance at De La Salle University Dasmariñas.

This study introduced nine hypotheses which has generated several significant discoveries. These findings are consistent with prior research conducted by Dewanto et al. (2024), demonstrating beneficial impact of digital literacy and innovative behavior to teachers' performance. Based on the results, digital literacy, innovative behavior, interpersonal communication, and teachers' performance have a positive relationship with each other. However, as per the result of this research culture has no significant relationship with digital literacy.

Conclusion

The current study analyzes the effect of digital literacy, innovative behavior, culture, and interpersonal communication on teachers' performance at De La Salle University Dasmariñas. According to the findings and discussion, the research generated significant discoveries. One is that direct relationship exists between digital literacy and innovative behavior. Digital literacy has positive relationship with interpersonal communication. Digital literacy has a direct relationship in teachers' performance at De La Salle University Dasmariñas. Culture has direct relationship with innovative behavior, interpersonal communication, and teachers' performance, whereas it has no direct relationship with digital literacy. Innovative behavior and interpersonal communication also have a direct relationship with teachers' performance.

This research study also aims to find ways to help faculty management improve teachers' performance at De La Salle University Dasmariñas. Based on the structural equations modeling, we can conclude the significant factors that positively affects the performance of teachers, and thru this study management must focus and align the university's policy, rules, and regulations to these significant factors. They must enhance teachers' performance by improving their digital literacy, innovative behavior, culture, and interpersonal communication capabilities.

This study has multiple challenges. A notable constraint may be the limited sample size, restricted by duration of the study and concentrate solely on undergraduate college faculty. Applicability to all or general faculty of the university may be also be limited.

Future research on the effects of digital literacy, innovative behavior, culture, interpersonal communication, and interpersonal communication on teacher performance is anticipated to be conducted at all levels of the university, not only specific level. This study has major implications for institutions to consider the various independent variables that exist as significant factors that must be considered to support teacher performance. Future research should be able to further explore other psychological variables that are not widely identified at this time. The addition and heterogeneity of more samples can also increase the quality of the expected results.

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Pedagogical Innovation in Interior Architecture Education: Integrating a User-Experience Learning Model for Spatial Service Design

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Abstract

This study presents the results of comparative classroom research exploring pedagogical innovation in interior architecture education through two approaches: the conventional design studio model and a user-experience-based learning model. The research examined how different instructional modes shape students' design processes, learning outcomes, and capacity for innovation in experiential architecture and new service design. In the conventional approach, students typically follow a linear process, beginning with site or user research, gathering requirements, and programming before developing design proposals. While effective for cultivating technical and creative skills, this process often privileges form and representation over the lived experiences of users. By contrast, the user-experience–based model required students to begin with experiential inquiry into user needs, unmet expectations, behaviors, and emotions. Reframing the design process around user insights encouraged students to move beyond conventional problem-solving toward empathetic and reflective design thinking. Both approaches produced aesthetically strong outcomes; however, the latter generated designs enriched with experiential architectural qualities, innovative spatial programming, and service-oriented solutions that integrated offline and online experiences. The research sample consisted of 18 third-year interior architecture students who engaged in both models through a flagship store design project. Their outcomes were compared in terms of technical skills, reflective insights, and the originality of their proposals. Findings suggest that while conventional pedagogy reinforces established competencies, user-experience–based learning represents a significant pedagogical innovation that cultivates empathy, adaptability, and leadership. These insights highlight the value of user-focused teaching models in advancing interior architecture curricula.

Keywords: user-experience-based learning, interior architecture education, experiential architecture, spatial service design

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Introduction

Interior architecture education has historically relied on studio-based pedagogy as its primary instructional model. This approach emphasizes spatial composition, functional organization, material articulation, and aesthetic resolution through iterative design exercises. Within conventional design studios, students typically engage in a linear design sequence beginning with site and contextual analysis, followed by user analysis, program development, conceptual exploration, schematic design, and final representation. This pedagogical structure has played a critical role in cultivating foundational design competencies and professional discipline among interior architecture students.

Despite its long-standing effectiveness, the conventional studio model has been increasingly critiqued for its limited engagement with the experiential dimensions of spatial use. Although users are introduced early in the design process, as a user analysis process, they are often represented through personas, functional requirements, or demographic profiles. Such representations tend to remain static throughout the design development, resulting in spatial proposals that prioritize formal coherence and aesthetic expression while underrepresenting how users actually experience, navigate, and inhabit interior environments over time. Consequently, students may complete design projects that are technically resolved yet insufficiently grounded in lived human experience. This pedagogical limitation has become more evident as the scope of interior architecture expands beyond the design of static physical environments toward the orchestration of complex experiential systems. Contemporary interior spaces—particularly within retail, hospitality, and public environments—are increasingly shaped by service design, digital interfaces, and hybrid online–offline interactions. These shifts require designers to consider not only spatial form and function, but also user journeys, emotional responses, and temporal patterns of use. As such, interior architecture education faces growing pressure to equip students with methodologies that support empathetic, adaptive, and experience-driven design thinking.

User-experience–based learning models have emerged as a promising pedagogical response to these challenges. Influenced by service design and human-centered design frameworks, these models reposition users as central agents within the design process. Through experiential research methods such as observation, user shadowing, journey mapping, and behavioral analysis, students are encouraged to investigate users' needs, emotions, and unmet expectations prior to formal design development. This shift reframes the design process from a primarily solution-driven activity toward an exploratory and iterative mode of inquiry grounded in lived experience. While the theoretical value of user-centered and experiential approaches has been widely discussed across design disciplines, empirical studies examining their pedagogical impact within interior architecture education remain limited. In particular, there is a lack of comparative classroom research that systematically evaluates how user-experience–based learning models influence students' design processes, learning outcomes, and capacity for experiential and service-oriented innovation when compared with conventional studio pedagogy.

This study addresses this gap by conducting a comparative classroom investigation involving the same cohort of interior architecture students engaged in identical design contexts under two distinct pedagogical frameworks. By analyzing quantitative and qualitative data derived from questionnaires, interviews, and student design work, the research examines how a user-experience–based learning model reshapes students' approaches to spatial design, enhances experiential architectural quality, and supports reflective learning. The findings aim to

contribute empirical evidence to ongoing discussions on pedagogical innovation and to inform the future development of interior architecture curricula aligned with contemporary design practice.

Research Objectives

The objectives of this study are as follows:

1. To compare the conventional design studio model with the user-experience–based learning model in interior architecture education.
2. To examine how the user-experience–based learning model influences students' design processes and their understanding of user needs.
3. To evaluate the impact of the user-experience–based learning model on students' learning outcomes, particularly in relation to reflective thinking and empathy.
4. To assess whether the user-experience–based learning model enhances students' ability to develop innovative and experiential spatial design solutions.

The expected outcome of this research is to contribute to the reframing of interior architecture teaching practices toward a more user-centered pedagogical approach. Through the application of a user-experience–based learning model, students are expected to demonstrate an enhanced ability to integrate users as active agents within the design process. This includes articulating users' spatial experiences, behaviors, and emotional responses, as well as constructing coherent user scenarios that inform spatial and service-oriented design decisions.

Literature Review

Conventional Design Studio

The conventional design studio model is a foundational learning approach in design education, in which students are assigned real-life problems and are expected to develop creative design solutions (Hettithanthri et al., 2023). Learning in this model occurs primarily through reflection-in-action, supported by critiques and feedback from design jurors and tutors (Schön, 1983). The design process in the conventional studio typically consists of four main phases: the programming phase, schematic design phase, design development phase, and construction documents phase (Soliman, 2017). In alignment with this framework, the course adopted a conventional studio structure beginning with the programming phase, during which students collected and analyzed data such as project background, site analysis, and user analysis. These data informed subsequent ideation, programming, space planning, and conceptual development, corresponding to the schematic design phase. During the design development phase, students frequently moved back and forth between stages as part of an iterative refinement process. However, once the design process was completed, the final design solutions were primarily critiqued by tutors based on research and documented data rather than direct engagement with real users or stakeholders. This approach may distance designers from human-centered concerns and lived social contexts (Hettithanthri et al., 2023). Similarly, Nicol and Pilling (2000) argue that traditional design studios often prioritize final outcomes and visual aesthetics over process-based learning and social engagement.

User Experience-Based Learning

User Experience (UX) design is a human-centered design process that begins with understanding users' needs, behaviors, emotions, and expectations through empathy-driven inquiry, and progresses through ideation, iterative prototyping, and usability testing (Töre Yargın et al., 2018). Rather than focusing solely on formal or aesthetic outcomes, UX design emphasizes how people interact with spaces, systems, and services over time. Norman (2013) argues that meaningful design emerges not from aesthetic refinement alone, but from a deep understanding of user interaction, perception, and experience. Within architectural and design education, human-centered approaches have been increasingly associated with innovation and critical thinking. Dorst (2011) connects empathy and reframing to the ability to address complex or "wicked" design problems, suggesting that designers must first reinterpret the problem space through the lens of user experience before proposing solutions. Together, these perspectives support a pedagogical shift away from linear, solution-driven design processes toward more reflective, iterative, and empathetic modes of design thinking, which are particularly relevant in contemporary interior architecture education.

User-Experience-Based Learning and Experiential Architecture Quality

User-experience-based learning refers to a design process that places humans at the center of inquiry, emphasizing users' needs, behaviors, emotions, and expectations as the foundation of design development. In contrast, experiential architecture quality refers to the creation of environments that engage users through multisensory and emotional interactions, enabling meaningful spatial journeys rather than focusing solely on aesthetic expression (Hartong, 2025). The relationship between user-experience-based design and experiential architecture quality is reflected in Bitner's (1992) *servicescape* framework, which considers both physical and non-physical environmental elements. Bitner identifies ambient conditions—such as temperature, sound, music, and odor—as factors that significantly influence user behavior and spatial experience. Extending this perspective, Stickdorn et al. (2018) incorporate digital touchpoints into user journeys, demonstrating how contemporary spaces increasingly integrate physical and virtual experiences. When interior architecture students adopt these frameworks, they are better equipped to design environments that support holistic user experiences, characterized by sensory richness, coherent behavioral flows, and emotional resonance.

Research Methodology

Research Design

This study employed a comparative classroom research design to examine the pedagogical impact of a conventional design studio model and a user-experience–based learning model in interior architecture education. The research was conducted across two consecutive semesters using the same cohort of students and project in order to control variations in student background, project complexity, and learning objectives. By applying two distinct pedagogical frameworks to an identical design brief, the study aimed to systematically compare differences in students' design processes, experiential architectural quality, and learning outcomes. The research adopted a mixed-methods approach, integrating quantitative data from structured questionnaires with qualitative data obtained through semi-structured interviews and analysis of student design work. This approach enabled both measurable comparison and in-depth interpretation of students' learning experiences.

Participants and Educational Context

The participants consisted of 18 third-year undergraduate students enrolled in the Interior Architecture program. All participants were required to complete a retail design project as part of their studio coursework. The same group of students participated in both phases of the study, allowing for direct comparison of learning outcomes under different instructional approaches. The research was conducted within two courses offered in the 2024 academic year. In the first semester, students undertook the retail design project under a conventional studio-based teaching model. In the second semester, the same project was revisited and redesigned using a user-experience-based learning model within the course INA 454: Cross-Disciplinary Study Experiential Architecture through Spatial Service Design. This structure ensured continuity in project scope while allowing pedagogical variation to be the primary variable under investigation.

Pedagogical Phases

The research was implemented in three main phases.

Phase 1: Conventional Studio Design Process

During the first semester, students followed a conventional studio-based design process. Instruction focused on site and contextual analysis, user analysis, programming, conceptual development, zoning, space planning, schematic design, design development and final design representation. The design outcomes emphasized spatial organization, functional resolution, and aesthetic coherence, reflecting established interior architecture studio pedagogy.

Phase 2: User-Experience–Based Learning Process

In the second semester, the same cohort of students revisited their retail design projects using a user-experience-based learning model. Students were introduced to a set of experiential and service-design tools. These tools were applied intensively during the initial two weeks of the course to support experiential inquiry and user-centered analysis. Following this preparatory phase, students revised their original design projects by incorporating user-experience data, developing new spatial programs, and exploring the integration of online and offline retail experiences. This phase emphasized iterative design thinking, reflective analysis, and the translation of experiential insights into spatial and service-oriented design strategies.

Phase 3-4: Data Collection and Analysis

Data collection was conducted during and after the completion of the second-semester design projects. Both quantitative and qualitative data were gathered to assess the pedagogical impact of the user-experience–based learning model.

Phase 5: Conclusion

Findings from both data sets were evaluated to determine the pedagogical impact of the user-experience–based learning model in comparison with the conventional studio approach.

Figure 1
Research Methodology

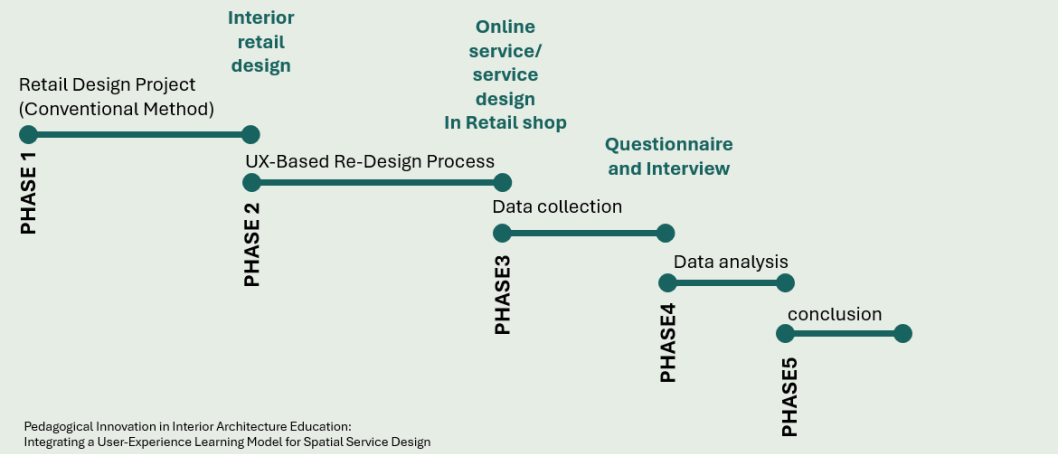
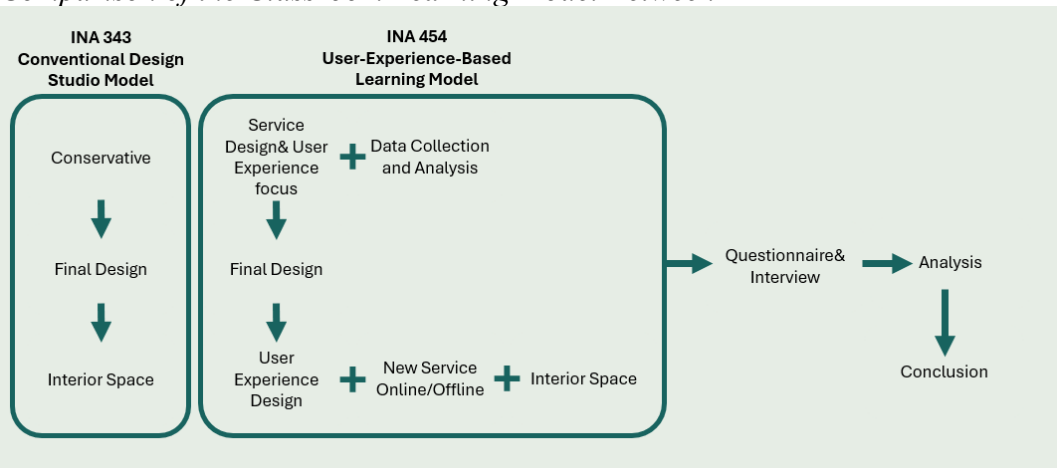


Figure 2
UX-Based Learning Model

Target Image	Insight
Shopping Mall Decision	User Image Definition
User Chasing -Role Casting	Tagger/User & Chaser/Observer
Mall Observation	Class, Size, Location and etc
User Chasing	2 Hours
Ethnography Review	
Photo Diary & Persona Creation	
CustomerJourney Map	
Service Planning	B to C Model Planning & UI Design
Service Prototyping	Paper Prototyping
Service Prototyping	Paper Prototyping
Shop Display Design	
Prototyping	Paper Mock-up
Prototyping	Paper Mock-up

Figure 3
Comparison of the Classroom Learning Model Between



Data Collection Methods

Data collection was conducted during the second phase of the study, following the implementation of the user-experience-based learning model. A mixed-methods approach

was adopted to capture both measurable learning outcomes and students' reflective insights into the design process. Quantitative data were gathered through a structured questionnaire, while qualitative data were obtained through semi-structured interviews and analysis of student design work. The use of multiple data sources enabled triangulation and enhanced the credibility of the findings.

Questionnaire Survey

A structured questionnaire was developed using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) to evaluate students' perceptions of the user-experience-based learning model. The questionnaire was designed in alignment with the research objectives and focused on three key dimensions: (1) design process, (2) experiential architectural quality, and (3) learning outcomes. These dimensions reflect core aspects of user-centered and experiential design education, including the integration of user insights, the quality of experiential spatial outcomes, and the development of reflective and empathetic thinking. The questionnaire examined students' ability to understand users prior to initiating design decisions, integrate experiential data systematically into the design process, engage in iterative thinking, and articulate user journeys across both online and offline contexts. Additional items assessed perceived improvements in experiential innovation, reflective learning, and the ability to create meaningful spatial experiences beyond aesthetic considerations. The questionnaire was administered after students completed the revised design projects under the user-experience-based learning model to ensure that responses reflected the full learning experience. A total of fifteen students from the cohort of eighteen completed the questionnaire. Descriptive statistical analysis was used to identify overall trends and mean scores across the three evaluation dimensions, providing an overview of students perceived learning outcomes.

Semi-Structured Interviews

To complement the quantitative findings and gain deeper insight into students' learning experiences, semi-structured interviews were conducted with a purposive sample of five students. The interview participants were selected to represent a range of design approaches and levels of engagement observed during the studio process. This qualitative method allowed for a more nuanced understanding of how students interpreted and applied the user-experience-based learning model within their design work. The interview questions focused on identifying the most significant skills developed through the UX-based learning process, specific examples of design improvement resulting from user-experience methods, and changes in students' perceptions of users and spatial experience. Students were encouraged to reflect on their design decision-making processes, the role of experiential data, and the challenges encountered when integrating user insights into spatial and service-oriented design solutions. Interview responses were transcribed and analyzed thematically to identify recurring patterns related to user-centered thinking, experiential quality, and reflective learning.

Analysis of Student Design Work

In addition to questionnaires and interviews, students' design outputs were reviewed as part of the data collection process. The analysis focused on comparing design outcomes produced under the conventional studio model and those revised through the user-experience-based learning model. Particular attention was given to the articulation of user journeys, the

integration of online and offline experiences, spatial programming strategies, and the translation of experiential insights into architectural form and service elements. This qualitative examination provided contextual support for the questionnaire and interview findings and strengthened the overall interpretation of the pedagogical impact.

Research Result

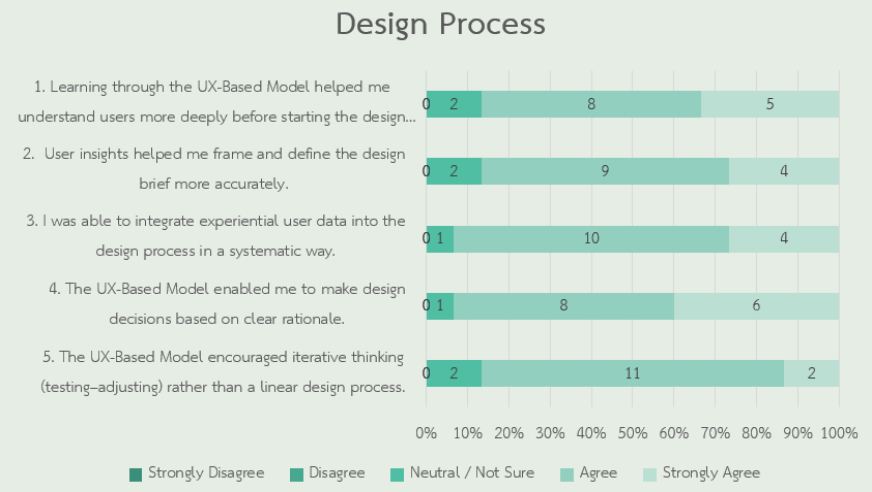
Questionnaire Survey

The research results demonstrate a consistently positive perception of the user-experience-based learning model across all evaluated dimensions. Analysis of the questionnaire responses indicates high levels of agreement regarding its impact on students' design processes, experiential architectural quality, learning outcomes, and overall perception of design improvement.

Design Process

The results reveal strong agreement that the user-experience-based learning model enhanced students' ability to engage with users before initiating design decisions. Most respondents indicated that experiential inquiry helped them develop a deeper understanding of user needs before beginning the design process. High levels of agreement were also observed in items related to framing and defining design briefs more accurately through user insights, as well as integrating experiential user data into the design process in a systematic manner. In addition, students reported that the User-experience–based learning models supported clearer design decision-making by providing explicit rationales derived from user research. The majority of respondents also agreed that the model encouraged iterative thinking, characterized by cycles of testing and adjustment, rather than a strictly linear design process. These findings suggest that the User-experience–based learning models effectively reshaped students' design workflows toward more reflective and user-centered approaches.

Figure 4
Questionnaire Results in Terms of the Design Process



Experiential Architectural Quality

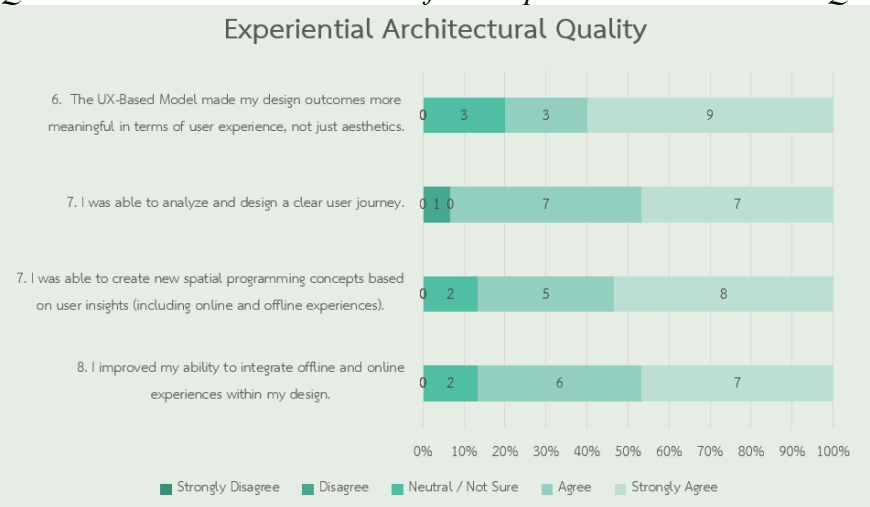
Responses related to experiential architectural quality showed strong positive outcomes. Students indicated that the user-experience–based learning model enabled them to design

spaces grounded in user experience across multiple temporal stages, resulting in more meaningful design outcomes beyond aesthetic concerns.

The findings also suggest that students developed a clearer understanding of user journeys and were able to translate these insights into spatial, programmatic, and online–offline integrated strategies, demonstrating the model's effectiveness in supporting experiential depth and service-oriented spatial thinking.

Figure 5

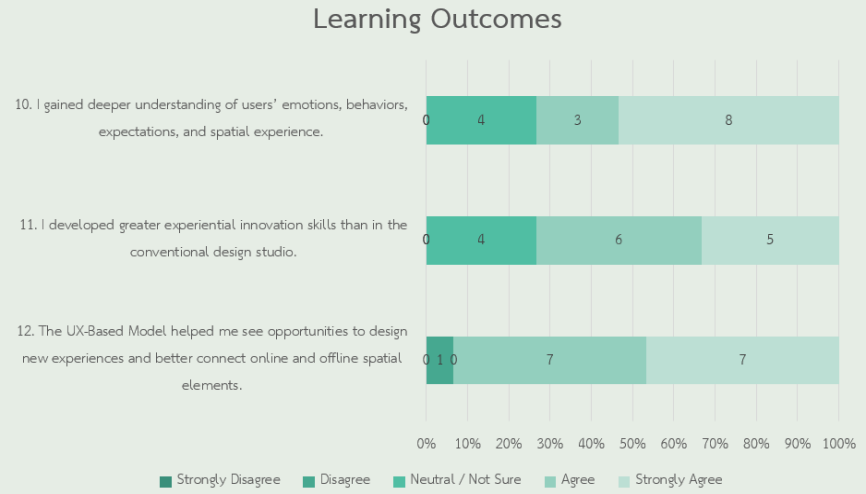
Questionnaire Results in Terms of the Experiential Architecture Quality



Learning Outcomes

The findings related to learning outcomes demonstrate that the user-experience-based learning model contributed positively to students' cognitive and affective development. Students reported enhanced reflective and critical thinking abilities, as well as a deeper understanding of users' emotions, behaviors, and expectations. The majority of respondents also perceived that their capacity for experiential innovation was greater than that achieved through the conventional design studio model. Moreover, students indicated that the User Experience-based approach helped them identify new opportunities for design intervention, particularly in connecting digital and physical experiences within interior environments. These results suggest that the model supports the development of competencies aligned with contemporary interior architecture practice, including empathy, adaptability, and experiential innovation.

Figure 6
Questionnaire Results in Terms of Learning Outcomes



Overall perception items reveal strong agreement that the User-experience–based learning modelsimproved students' ability to design user-centered interior spaces and enhanced the overall quality of their design work. The radar chart summary further reinforces these findings, with all evaluated categories demonstrating high mean scores, ranging approximately between 4.13 and 4.31 out of 5. Among the three primary dimensions, experiential architectural quality recorded the highest mean score, indicating the strongest perceived impact of the User Experience-based model.

Collectively, the results suggest that the user-experience-based learning model is highly effective in supporting user-centered design thinking, experiential architectural quality, and reflective learning outcomes. These findings provide empirical evidence that integrating user-experience methodologies into interior architecture education can significantly enhance students' readiness to address the experiential and service-oriented demands of contemporary design practice.

Figure 7
Questionnaire Results in Terms of Overall Perception

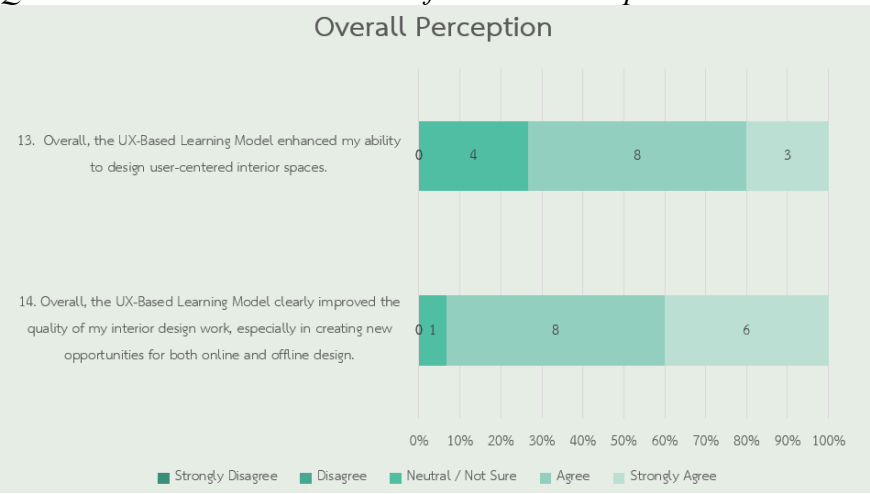
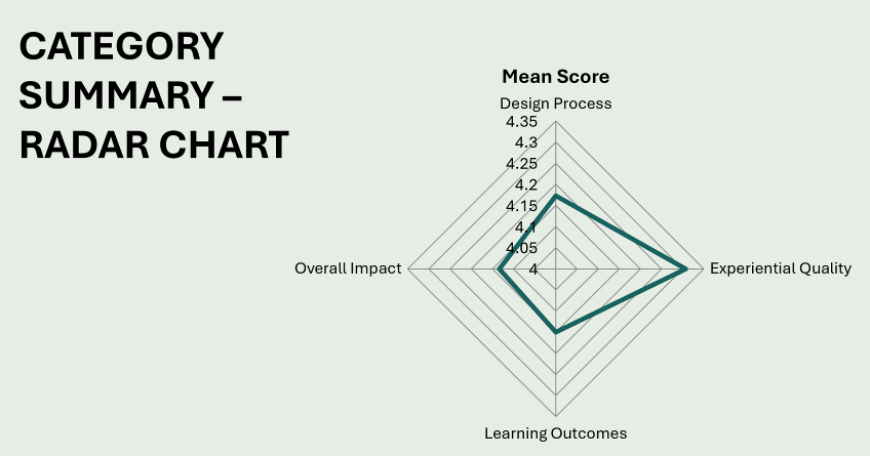


Figure 8
Category Summary Radar Chart



Interview Result

Qualitative analysis of the semi-structured interviews reveals consistent themes highlighting the pedagogical impact of the user-experience-based learning model on students' design thinking and practice. Three key themes emerged from the interview data: (1) a shift toward user-centered design perspectives, (2) the practical application of experiential methods to improve design outcomes, and (3) a transformed understanding of users as active participants in spatial experience.

Shift Toward User-Centered Design Thinking

Interview responses indicate that students developed a stronger user-centered perspective through the UX-based learning model. Participants reported moving away from an exclusive focus on aesthetics or personal design assumptions toward a more evidence-based approach grounded in users' needs, pain points, and behaviors. Several students emphasized that the most important skill they gained was the ability to evaluate user experiences systematically and translate those insights into informed design decisions. This shift reflects a deeper engagement with empathy and reflective thinking, aligning with the intended learning outcomes of the User Experience-based pedagogy.

Application of UX Methods in Design Improvement

The interviews further reveal that the use of experiential research methods contributed directly to improvements in students' design outcomes. Participants described applying techniques such as user shadowing and persona development to identify spatial issues that were not initially apparent in their original designs. These methods enabled students to recognize challenges related to circulation clarity, functional zoning, and spatial usability. By incorporating user feedback and experiential insights, students reported being able to revise spatial layouts in ways that improved navigability and comfort for occupants, demonstrating the practical value of the UX-based approach in interior architectural design.

Reframing the Concept of "Users" in Spatial Design

A prominent theme across the interviews was a fundamental change in how students conceptualized "users" within the design process. Participants reflected that, prior to

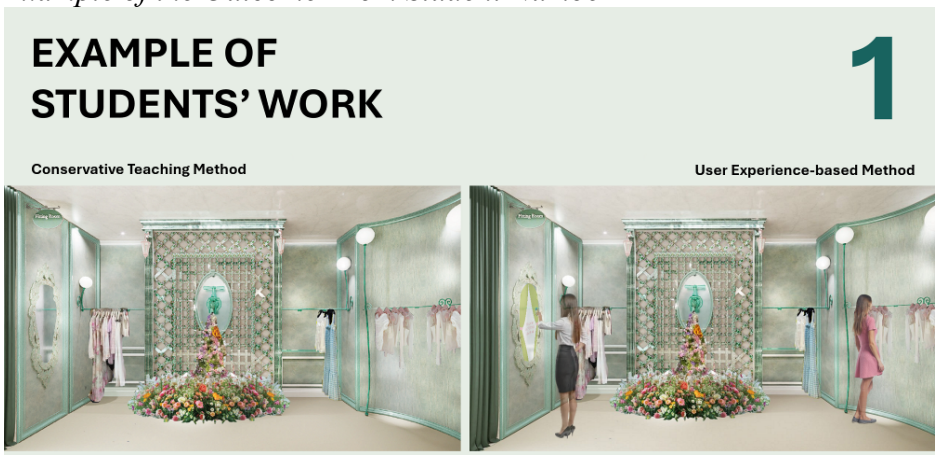
engaging with the UX-based learning model, users were often perceived as abstract target groups or design requirements. Through experiential inquiry, students began to understand users as real individuals with daily routines, emotions, frustrations, and lived experiences. This reframing prompted greater attention to subtle behavioral patterns and experiential details that influence how spaces are used over time. Such insights suggest that the User-experience–based learning modelssupports the development of empathy and experiential awareness, which are critical competencies in contemporary interior architecture practice.

Analysis of Student Design Work

Student Number 1

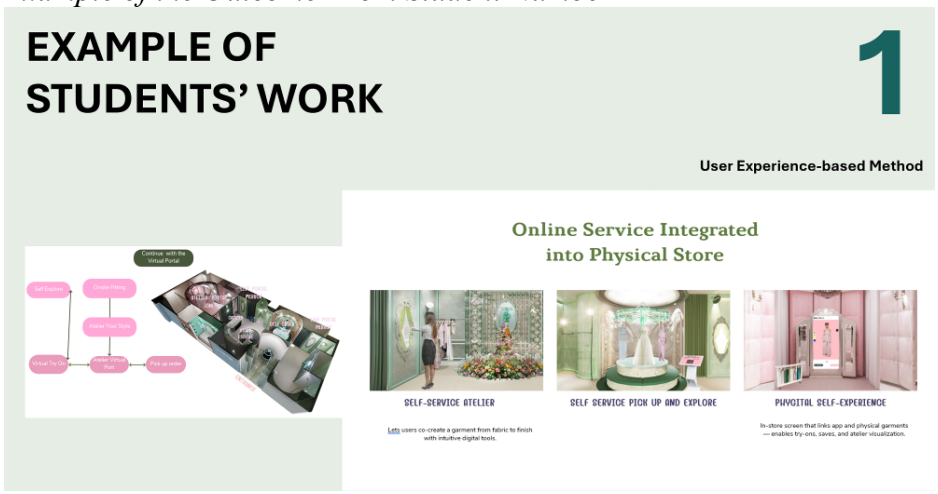
Pong designed a Landmeé retail shop, a Thai local clothing brand. In the conventional model, she proposed a "gift box" concept derived from brand research and user analysis to develop the interior space. In the user-experience–based model, she proposed a "Phygital Atelier Porta Retail" concept, which allows customers to customize products and connect services through online platforms.

Figure 9
Example of the Outcome From Student Number 1



Note. Landmeé retail shop designed and produced by Pong, 2024.

Figure 10
Example of the Outcome From Student Number 1



Note. Landmeé retail shop designed and produced by Pong, 2024.

Student Number 2

Parkes designed a Chaksarn retail shop, a Thai handbag brand made from handwoven water sedge and genuine leather. In the conventional model, Parkes proposed showcasing the richness of handcraft integrated into the retail space through the brand's narrative. In the user-experience–based model, Parkes added an online style companion that allows customers to match outfit pairings with the products, an on-site interactive wall where customers can record messages explaining their reasons for purchasing the product, and a post-purchase appreciation experience in which an online platform is used to share behind-the-scenes stories and care tips, thereby enhancing customers' emotional engagement and brand loyalty.

Figure 11

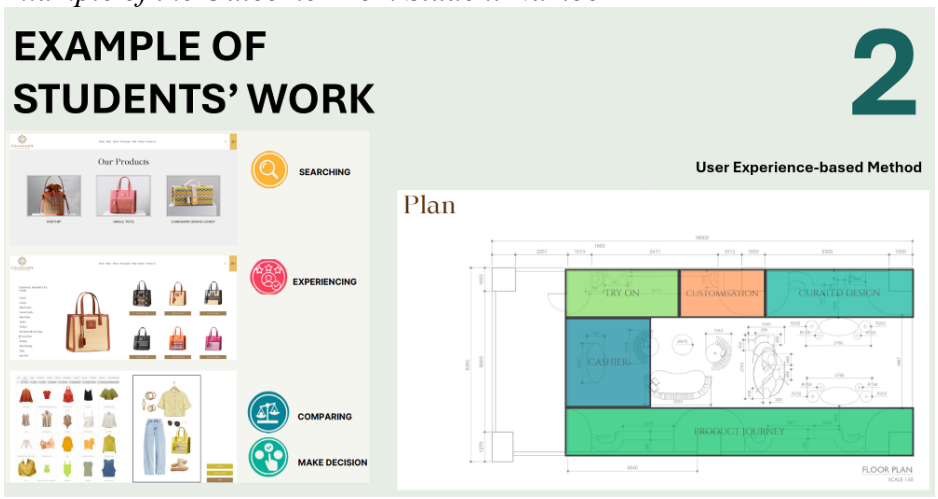
Example of the Outcome From Student Number 2



Note. Chaksarn retail shop designed and produced by Parkes, 2024.

Figure 12

Example of the Outcome From Student Number 2



Note. Chaksarn retail shop designed and produced by Parkes, 2024.

Student Number 3

Kiatthawornchai designed a Blackdog BKK retail shop, a Thai local clothing brand known for incorporating food illustrations into its clothing designs. In the conventional model, Kiatthawornchai analyzed the brand identity to inform the shop design. In the user-

experience–based model, the same brand identity was also applied to a virtual online try-on platform, allowing customers to save styling options online and scan them in-store to try the physical versions.

Figure 13

Example of the Outcome From Student Number 3



Note. Blackdog BKK retail designed and produced by Kiatthawornchai, 2024.

Figure 14

Example of the Outcome From Student Number 3



Note. Blackdog BKK retail designed and produced by Kiatthawornchai, 2024.

Research Finding

The findings of this study indicate a consistently high level of agreement across all evaluated categories, with mean scores ranging between 4.13 and 4.31 out of 5. These results suggest that the user-experience–based learning model had a strong positive impact on interior architecture students' design processes, experiential architectural quality, and learning outcomes. Among the three primary dimensions, experiential architectural quality achieved the highest mean score (approximately 4.31). This result indicates that the User-experience–based learning models was particularly effective in enhancing students' ability to design spaces grounded in user journeys and lived experiences. Students demonstrated an increased capacity to consider spatial experience across multiple temporal stages, including before, during, and after use, as well as to integrate online and offline experiences within a cohesive

design framework. The prominence of experiential quality underscores the pedagogical value of prioritizing user experience as a central driver of spatial and service-oriented design.

Design process and learning outcomes also recorded strong positive effects, reflecting the model's influence on students' design workflows and cognitive development. The findings suggest that the UX-based approach supported clearer design decision-making grounded in user insights and encouraged iterative, reflective processes rather than linear problem-solving. In addition, students reported enhanced reflective thinking, greater empathy toward users, and improved capacity for experiential innovation. These outcomes indicate that the model contributed not only to design output quality but also to deeper learning and skill development. Furthermore, overall impact scores confirm that students perceived the user-experience–based learning model as highly beneficial for developing user-centered interior design solutions. The convergence of high scores across all categories suggests that the model effectively aligns pedagogical objectives with contemporary professional demands, particularly in addressing experiential, service-oriented, and hybrid spatial environments. Collectively, these findings provide empirical support for the integration of user-experience–based learning models within interior architecture education as a means of enhancing both design quality and learning outcomes.

Discussion

The findings of this study provide empirical support for the pedagogical value of integrating a user experience–based learning model into interior architecture education. High levels of agreement across all evaluation dimensions indicate that positioning users at the center of the design process reshapes students' approaches to spatial design and learning.

First, the results related to the design process suggest that the user experience–based learning model effectively challenges the linear and form-driven tendencies of conventional studio pedagogy. While traditional studios remain effective in developing technical and aesthetic skills, they often rely on abstract representations of users. In contrast, the integration of experiential inquiry tools—such as user observation, journey mapping, and behavioral analysis—encouraged students to adopt more iterative and reflective design workflows, enabling them to justify design decisions through user-derived insights rather than intuition or aesthetic preference.

Second, experiential architectural quality emerged as the strongest outcome of the user experience–based learning model. Students demonstrated an enhanced ability to design for user journeys, temporal experience, and the integration of online and offline interactions. This reflects a shift from static spatial composition toward experiential orchestration, aligning interior architecture education with contemporary professional practice. The positive learning outcomes further indicate that user experience–based learning supports deeper reflective thinking, empathy, and experiential innovation. Students' responses suggest a transformed understanding of users—not as abstract design targets, but as individuals whose lived experiences shape spatial use. The convergence of quantitative and qualitative findings strengthens the validity of these results, as questionnaire data indicating high perceived effectiveness are reinforced by interview insights explaining how these outcomes emerged. This triangulation suggests that the observed impacts are embedded within students' design processes and outcomes.

Despite these positive outcomes, the findings also point to important pedagogical considerations. The user experience–based learning model was implemented as an intensive intervention within a limited time frame, suggesting that sustained integration across multiple studio levels may further enhance its effectiveness. Rather than replacing conventional studio pedagogy, the findings support the development of hybrid instructional models that combine traditional spatial training with user experience–based inquiry. Overall, the results underscore the relevance of user experience–based learning in preparing interior architecture students for experiential and service-oriented design challenges.

Conclusion

This study demonstrates that while conventional studio-based pedagogy in interior architecture education remains effective in developing students' technical skills, spatial organization, and aesthetic competence, it exhibits limitations in addressing user-centered and experiential dimensions of design. Traditional studio methods tend to emphasize formal resolution and functional clarity, often resulting in design outcomes that are technically proficient but insufficiently grounded in users' lived experiences.

The findings indicate that the integration of a user experience–based learning model significantly shifts students' design thinking toward a deeper consideration of experiential, emotional, and behavioral aspects of spatial use. By repositioning users as active agents within the design process, the model encourages students to move beyond linear, solution-driven workflows and engage in iterative and reflective design cycles informed by experiential inquiry. This shift enables students to justify design decisions based on user insights rather than relying primarily on aesthetic intuition or preconceived design assumptions. Moreover, the study reveals that the user experience–based learning model supports the development of competencies aligned with contemporary interior architecture practice. Students demonstrated enhanced capacity to design experiential architectural quality, articulate user journeys, and integrate online and offline spatial experiences within cohesive design frameworks. These outcomes reflect the increasing relevance of service-oriented and experience-driven approaches in modern interior environments, particularly within retail and public contexts.

Overall, the findings suggest that user experience–based pedagogy offers a valuable and effective framework for advancing pedagogical innovation in interior architecture education. Rather than replacing conventional studio pedagogy, the model complements and extends traditional approaches by enriching students' understanding of users, fostering empathy and reflective thinking, and preparing graduates to address the complex experiential demands of contemporary professional practice.

Further Suggestion

As interior architecture educators, future pedagogical development should focus on bridging conventional studio pedagogy with user-experience–based learning within a single semester. Integrating user experience design tools into early-stage data collection would enable students to translate user insights directly into design decisions from the outset.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author(s) declare that ChatGPT (OpenAI), an AI-assisted language model, was used solely for proofreading and refining the academic language and structure of this manuscript. The use of this tool was limited to improving clarity, coherence, and readability. All research design, data collection, analysis, interpretation of findings, and conclusions are the original work of the author(s). No AI technologies were used to generate research content, data, or results.

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Enhancing Secondary Mathematics Learning Through STEAM2C: Creative Assessment With Graphing Technology

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Abstract

This study examines the integration of STEAM2C (Science, Technology, Engineering, Arts, and Mathematics with Creative and Critical Thinking) into the teaching and assessment of the topic "Graphs of Functions" among secondary school students in Southeast Asia. The project aimed to move beyond traditional instruction and rote-based evaluation by incorporating alternative assessments approaches that emphasise creativity, reasoning, and application, supported by digital graphing technologies such as Desmos, GeoGebra, and graphing calculators. The intervention began with a two-day professional development workshop for mathematics teachers, followed by classroom implementation of inquiry-based learning activities. A student-led creative graph design project served as the core assessment task and was evaluated using a structured rubric emphasizing mathematical reasoning, design aesthetics, and reflective thinking. Data collected through teacher interviews, student reflections, and rubric-based evaluations revealed that the STEAM2C approach significantly enhanced engagement, deepened conceptual understanding, and encouraged students' creative self-expression. Teachers perceived STEAM2C as a promising alternative assessment approach aligned with 21st-century learning goals, while highlighting the need for curriculum alignment and stakeholder support for sustainable implementation.

Keywords: STEAM2C, mathematics education, alternative assessment, graphing technology, creative and critical thinking

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Introduction

The integration of STEAM2C into mathematics focuses on the application of STEAM (Science, Technology, Engineering, Art and Mathematics) in the learning of Secondary Mathematics and the process involved in showcasing the 2C (Creative and Critical Thinking) in Mathematics lessons (Bertrand & Namukasa, 2020; Wannapiroon & Pimdee, 2022). The Mathematical technological tools such as Desmos, graphing calculator and GeoGebra was proposed in this study.

The new mathematics curriculum for secondary schools requires students to demonstrate their mathematical skills associated with creativity, showcasing originality in thinking and ability to connect with their surroundings in a new perspective. Emphasis should be given on promoting knowledge and skills such as creative thinking, innovation, problem-solving and leadership (Yean et al., 2024).

Tasks that require creative and critical thinking with technology can be introduced to the current generation of technology natives. In fact, they ought to be given tasks that will challenge them to do better in the presence of more thought-provoking higher order thinking questions from the knowledgeable teacher. Therefore, the role of a teacher as a compulsive facilitator is very pertinent and relevant.

Statement of the Problem

While STEM initiatives have gained momentum, many mathematics teachers still lack the confidence, resources, or pedagogical frameworks to integrate technology, creativity, and critical thinking into their lessons. Assessment practices remain focused on procedural fluency and do not capture students' ability to reason, design, or model mathematically.

Furthermore, although software like Desmos and GeoGebra are available, their classroom usage is often limited to teacher demonstrations rather than student exploration. There is a need to explore how such tools, when used creatively through a STEAM2C lens, can enhance student agency and conceptual understanding. This research is designed to address the following key problem: How can STEAM2C be applied effectively in the teaching and learning of Graphs of Functions to promote creative expression, mathematical reasoning, and alternative assessment.

Literature Review

Research over the last decade the concept of STEAM education has gained significant momentum over the past decade as a response to the growing demand for interdisciplinary learning. Originally rooted in STEM (Science, Technology, Engineering, and Mathematics), the integration of the Arts ("A") broadens the educational scope by emphasising creativity, innovation, and aesthetic understanding (Sousa & Pilecki, 2013). The shift toward STEAM has been validated by studies that show improved student engagement and critical thinking when lessons incorporate visual and performance arts (Colucci-Gray et al., 2019).

Incorporating technology tools such as GeoGebra and Desmos into mathematics education has also demonstrated strong potential in improving conceptual understanding. Research by Pierce and Stacey (2010) highlighted how digital tools can transform static mathematics problems into dynamic, interactive experiences that foster deeper comprehension. Similarly, Saha et al. (2010) found that the use of GeoGebra in teaching coordinate geometry significantly improved

students' performance and engagement. Integrated STEM (Science, Technology, Engineering and Mathematics), a well-known acronym in the education fraternity is implemented widely to increase students' academic achievement in both mathematics and science. However, studies show that new ideas are still in demand to increase the students' interest especially in learning of mathematics.

One of the suggested methods is to introduce cross curriculum and move away from the traditional mathematics curriculum. Therefore, by incorporating the "A" in arts through mathematical activities, students should be able to appreciate the beauty and aesthetics values of mathematics through engaging activities that are more explorative and connected with real-world tasks (Bush et al., 2016). Thus, STEAM integrated instructional practice are expected to inculcate positives attitudes related to motivation, anxiety, confidence towards learning Mathematics with the inclusion of 21st Century Skills such as creativity, collaboration, communication and critical thinking. Studies conducted by Sousa and Pilecki (2013), shows that the arts component added into STEM is able to create more critical thinking, problem solving and communication opportunities.

There is growing recognition that the mainstream education needs to be more innovative and creative in developing knowledge and pertinent skills to face the challenges in the 21st century. Therefore, teaching of mathematics should focus on activities that could lead students to their own learning with the introduction of more explorative, connected and the real-world tasks. Meanwhile, learning outcomes will be measured in students' abilities to build new knowledge that could lead to effective self-learning that would sustain life-long learners.

Researchers (Bahrum et al., 2017; Conradty & Bogner, 2018) suggests that students should be exposed to more challenging activities that needs thinking at a higher level of cognition. Taking this into consideration, higher order thinking is not only about making the questions more complicated, but rather should be the one that can transform any child into a person that appreciate mathematics and its application in real life. This scenario can be changed with the intervention of more visualisation tool that can benefit students especially the heterogenous group of high, average and low ability students.

Methodology

This research employed a mixed-methods design integrating both quantitative and qualitative data collection to provide a comprehensive evaluation of the STEAM2C implementation. The three-phase structure allowed for iterative professional learning, practical application, and reflective analysis. It focuses on the application of STEAM (Science, Technology, Engineering, Art and Mathematics) in the learning of Secondary Mathematics and the process involved in showcasing the 2C (Creative and Critical Thinking) in Mathematics lessons in the presence of graphing technological tool such as Desmos and GeoGebra.

Tasks that require creative and critical thinking with technology was introduced to the current generation of technology natives. In fact, they were given tasks that will challenge them to do better in the presence of more thought-provoking higher order thinking questions from the knowledgeable teacher. Therefore, the role of a teacher as a compulsive facilitator is very pertinent and relevant.

Instruments used included pre- and post-workshop questionnaires to gauge teacher perceptions, reflection journals, observation checklists, and interview protocols. Google Forms and

structured templates were used for uniform data collection. Technology tools used in lessons included Desmos, Graphing Calculator and GeoGebra.

Quantitative data were analysed using descriptive statistics to assess teacher learning outcomes and perceptions. Qualitative data, including classroom observations, open-ended responses, and interview transcripts to identify recurring patterns and challenges. Evidence from each phase was analysed to ensure reliability.

Results and Discussion

Here are the general findings from this research project according to Phase 1, Phase 2 and Phase 3.

Phase 1 (Hands-On Workshop)

32 mathematics teachers participated in an immersive, two-day professional development workshop designed to build capacity in using Desmos, GeoGebra, and graphing calculators within the STEAM2C framework. Quantitative findings showed a significant increase in teacher confidence and willingness to apply graphing technologies in their teaching practices, with mean perception scores improving markedly. Qualitative feedback revealed that teachers appreciated the ability of these tools to facilitate conceptual understanding, student creativity, and interdisciplinary integration. Their participation not only enhanced pedagogical skills but also cultivated enthusiasm for alternative assessment strategies grounded in mathematical reasoning and visual design.

They also responded positively in post-workshop surveys. Many indicated that the graphing technologies enabled students to visualise mathematics conceptually. One participant noted, “Desmos allowed my students to create and manipulate functions with meaning.” Another shared, “GeoGebra helped even my lower-performing students see how changes in variables affected the graph.” These reflections are consistent with findings by Pierce and Stacey (2010), who assert that the instructional value lies not just in the tool, but in how it is used to facilitate deeper mathematical understanding. Refer to table 1 and 2 for the Pre-test/ Post-test items and its related mean score.

Table 1
Pre-test / Post-test Mean Score of Phase 1

Item No	Pre-test / Post-test Statement	Pre-test		Post-test	
		Mean	SD	Mean	SD
1.	Are you planning to use any graphing technology in your teaching and learning sessions in the classroom?	3.06	0.66	4.44	0.52
2.	Have you attended any sharing session with graphing technology?	2.76	0.75	4.50	0.51
3.	Do you think graphing technology can enhance the learning of mathematics?	3.41	0.71	4.50	0.53
4.	Will you share the knowledge you gained in this workshop with other teachers at your school or other educational institutions?	3.18	0.53	4.50	0.57
5.	Do you think you can create a creative design with graphing technology just by using mathematical functions?	3.00	0.61	4.31	0.52
6.	Do you think the task to create a creative design with Graphing technology can be used as part of classroom-based assessment (CBA)?	2.94	0.75	4.25	0.60
7.	Will you recommend the use of graphing technology to other mathematics teachers?	3.00	0.61	4.50	0.63

Table 2
Overall Mean Score for Pre-test, Post-test Survey, and Mean Gained Score for Overall Score of Phase 1

	Pre-test		Post-test		Mean Gained Score
	Mean	SD	Mean	SD	δ
Overall	3.05	0.66	4.42	0.55	1.37

The comprehensive analysis of the post-test results reveals remarkable improvements in participants' acceptance and application of the workshop content. The overall post-test mean score of 4.42, paired with a standard deviation (SD) of 0.55, indicates a substantial positive impact on learning outcomes. Compared to the pre-test mean score of 3.05 (SD = 0.66), the mean gain score of 1.37 highlights a significant increase in knowledge among the 32 participants. This growth is further underscored by the reduced dispersion of post-test scores, suggesting more consistent performance across participants. Additionally, all post-survey

means scores exceeded 4.0, ranging from 4.00 to 4.50, reflecting a high level of comprehension and engagement (Nunnally & Bernstein, 1994).

Phase 2: Multiplier Effects in School Mathematics Departments

In Phase 2, the Phase 1 teachers were encouraged to conduct sharing sessions with colleagues at their respective schools. These multiplier sessions served as a bridge to scale professional learning and disseminate the STEAM2C approach. Teachers successfully conducted sharing sessions using lesson exemplars, rubrics, and student artifacts developed during Phase 1. Pre- and post-session data from their peers indicated a significant rise in awareness, interest, and readiness to implement STEAM2C in their own classrooms. These multiplier effects demonstrate the model's scalability and the efficacy of peer-led professional learning in fostering instructional change. Refer to Table 3 for the overall score.

Table 3
Overall Mean Score for Pre-test, Post-test Survey, and Mean Gained Score for Overall Score- Phase 2

	Pre-test		Post-test		Mean Gained Score
	Mean	SD	Mean	SD	δ
Overall	2.48	0.72	4.13	0.60	1.65

These findings suggest that the STEAM2C sharing successfully enhanced the mathematics teachers foundational knowledge on graphing technology and eventually on the ability to design a creative design with just mathematical functions. Even tough, there is a drop in the post-test mean score to 4.13 compared to 4.42 recorded from the teachers involved in Phase 1, it still records a higher mean gained score of 1.65. The statistically significant improvements found in this study reaffirms the relevance of graphing technology knowledge to be incorporated in the teaching and learning of mathematics especially with topics related to graphs of functions.

Qualitative feedback corroborated the quantitative gains: teachers recognised the benefit of instant visualisation, perceived graph-art tasks as catalysts for higher-order questioning, and requested extended hands-on time for deeper exploration. Collectively, the data indicate that brief, well-structured multiplier sessions can effect a substantial shift in teachers' awareness and practical readiness to operationalise STEAM2C, thereby amplifying the workshop's impact beyond the original cohort.

Phase 3: Classroom Implementation and Observations

The third phase involved actual implementation of STEAM2C lessons in three selected schools. These lessons featured graphing tasks where students used technology to explore, model, and design functions.

The actual classroom observation was divided into three parts; the first one was the first session on the sharing of knowledge on graphing technology by the mathematics subject teachers followed by some techniques on answering more effectively the exam-based questions. The following observation focused on the students' presentation of the design they created through

their creative thinking with mathematical functions. Each students was also given a good opportunity to evaluate critically their friends work and will make use of a verified evaluation rubric. The presenting student has to explain and justify his/her creative design with mathematical graphs of functions. Eventually, teacher would choose three different best designs based on both teacher and peer evaluation and the critical justifications presented.

On the whole, the graphing technological tools were able to inculcate students Higher Order Thinking (HOTS) through the Question – Answer sessions such as:

1. What is the name of the shape of quadratic equation? (Remember)
2. Is there any general pattern that you observe? Please explain (Understand and Analyse)
3. Could you explain the effect of a, b and c value? (Analyse the shape in terms of wideness and position of the graph)
4. What happens to the graph when $b = 0$, $b > 0$, $b < 0$? Please explain. (Analyse)
5. How is the graph when $a = 0$? (Understand)
6. What is the effect of the c value? (Analyse)
7. In your opinion which one is more different? Why? (Analyse)
8. What are the strategies you employed to make sure it works? (Apply, Analyse & Evaluate)
9. What did you learn after completing this design activity? (Creative)
10. What are the other types of functions and its associated graphs that you know? (Creative and Critical)
11. How are these graphs and functions that we learn is useful for us? (Analyse & Creative)

There are also more critical thinking questions that can be posed either by the students to their presenting peers or by the teachers themselves. Some example questions are:

- What are the possible values?
- Write down your understanding…
- Can you explain the connection that you observe?
- How do you arrive at the answer? Explain your findings.
- What do you understand about the x-intercept?
- What do you understand about the y-intercept? Explain your answer
- Compare your answers. Are they the same?
- Please elaborate on your answer.

Thus, students could be given opportunity to explore, investigate, explain and give reasons to support their answers.

Meanwhile, the role of the teacher is to:

- Observes and listens to students as they present and explain their work.
- Plays the role of a facilitator.
- Corrects any misconceptions that appears during their explanation.
- Pose more thinking questions.
- encourages and create opportunity for other students to ask questions

Graphing tools such as Desmos, Graphing Calculator and GeoGebra were used as the cognitive tool, whereby the participants will do the thinking as Graphing Technology will be able to show the relationship between the Graphical (visual), Algebraic (equation) and Numerical (tabular). (Talib et al., 2019).

Conclusion

The outcome of this study can support the need for a change in today's education. Taking into consideration the fast-paced, ever changing 21st century workplace demands for critical thinkers, confident problem-solvers and technology savvy innovators with a thirst for lifelong learning. Students are also required to be equipped with skills that will ensure their prosperity in tomorrow's world (Budhai & Taddei, 2015).

Importance should be given to the expansion of students' creativity and critical thinking in solving mathematical tasks as well (Abdullah et al., 2016). This means, the solution to a task should not be a fixed answer or at least should give the student an opportunity to try to solve the task in multiple methods. This will automatically create a room for students to reflect on their cognitive strategies that requires planning, monitoring and evaluating their own strategies. Eventually, the lesson can inculcate them to be risk takers and more logical in exploring the mathematical concepts especially in the presence of technology.

Students ought to be given an exposure to "Think out of the box" before throwing all the difficult questions at them. Therefore, there is a need to improve the instructional method in the classroom so that it is not always the end results (students score) that matters. Opportunity should be given to explore the knowledge that students have gained in the classroom and then apply it in more creative manner according to their critical thinking ability (Bellanca, 2014; Kivunja, 2015).

The positive findings from this study can also be used to justify that the focus on teacher training should move away from isolated technology training and gear towards integration of technology into the curriculum to help teachers use technology to support student-centered pedagogy which allows more interaction and expression of students creative and critical thinking and learning as evidence of active learning (Rohid & Rusmawati, 2019; Saldo & Walag, 2020).

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The Power of Environments in Social and Emotional Learning

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Abstract

Compelling research and literature demonstrate the significant impact of social and emotional learning (SEL) on young children. There is a strong correlation between well-developed social and emotional skills and positive academic outcomes, healthy relationships, and the competencies children need to navigate the unfolding future. Adults play a central role in fostering social and emotional skills. Equally important are the environments created for and with children. Emotional, psychological, and physical environments shape children's well-being; their sense of safety and belonging; as well as their engagement and motivation to learn. Environments have the power to facilitate SEL. Why leave it to chance? Using an action research approach, this presentation details trends emerging from a workshop series titled "The Power of Environments in Social and Emotional Learning". Through a thematic examination of data, key findings from this research contribute to a deeper understanding of: 1) the application of frameworks to plan for SEL with intentionality and consistency; 2) a focus on building psychological safety in an early years context; and 3) the messages spaces convey about children's social and emotional learning and development. These findings provide a foundation for further exploration of approaches, strategies, and tools to enhance SEL in early years settings.

Keywords: social and emotional learning, environments, psychological safety

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Introduction

Today's children are experiencing unprecedented social and emotional challenges (Frey et al., 2022; Haidt, 2024; Hannigan & Hannigan, 2021). With overstructure and management in the real world and under protection in the digital landscape, children are becoming an increasingly fragile generation. Thus, social and emotional learning (SEL) is at a crossroads.

While SEL is not a new discussion, the current context in which children are growing up necessitates a shift. Students have always learned social and emotional skills. However, SEL remains part of a hidden curriculum, not explicitly taught with intention and fully integrated into the classroom fabric (Frey et al., 2022). This type of learning is not effective and unsustainable. SEL requires a deliberate, explicit presence in schools. The most important question is not about the merits of different programs that support social and emotional development or which one to use. The question should be about how teachers authentically integrate SEL into everyday practice and interactions with children.

In the 2022 Transforming Education Summit (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2022), a global call to action was issued, urging a prioritization of children's social and emotional development and well-being. SEL is not an add-on. It is learning that matters. Early childhood teachers play a crucial role in driving this commitment. Like any other skill, social and emotional competencies must be taught and it begins early in life.

Why SEL? What Does the Research Say?

There is broad support and growing evidence that consistently show social and emotional learning makes a powerful difference (Collaborative for Academic, Social and Emotional Learning [CASEL], n.d.-a). It helps children build mental wellness and healthy well-being by equipping them with strategies and tools to understand and manage their emotions; face challenges with perseverance and resilience; and develop skills for learning and life (United Nations Children's Fund, [UNICEF], 2020). Developing these skills at an early age sets children up for future success. SEL also shape healthy behaviors as it encourages empathy, positive relationships, and responsible choices that extend well beyond the classroom (UNESCO, 2022). These play an important role in children's overall well-being and their capacity to learn. At the same time, SEL strengthens learning and academic achievement (CASEL, n.d.-b). When students feel safe, supported, and connected, they are motivated and able to engage more deeply and perform at their best. SEL therefore equips children to be successful today and prepares them for the future. It supports them with the adaptability, collaboration, and problem-solving skills needed to navigate an increasingly complex world.

A structure to support the development of social and emotional skills is essential. A framework like CASEL guides the development of knowledge, skills, and attitudes across five competencies. It supports the creation of equitable learning environments and offers evidence-based SEL strategies to implement.

The CASEL framework was chosen for this study as it is widely recognized, research-backed, and adaptable across diverse educational contexts. It provides a comprehensive structure for integrating SEL skills into schoolwide practice including self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. The table below details each of the competencies, however is not exclusive.

Table 1
CASEL Framework (2020)

CASEL Competencies	Description
Self-awareness	• Understanding own values, thoughts, and emotions • Knowing one's personal and social identities • Having a sense of purpose • Identifying own prejudices and biases • Being aware of own strengths and challenges
Self-management	• Being able to effectively manage own thoughts, behaviors, and emotions across situations • Having self-discipline and self-motivation • Setting personal and collective goals • Using stress-management strategies • Practicing planning and organizational skills
Social awareness	• Taking on different perspectives • Empathizing with others and showing compassion • Being sensitive to diverse backgrounds, cultures, and contexts • Knowing own impact on others
Relationship skills	• Forming and maintaining positive relationships • Collaborating in a team • Understanding social demands • Resolving conflict in constructive ways • Knowing when to offer support or challenge to others
Responsible decision-making	• Making constructive and caring choices on a personal level and across diverse social interactions • Reflecting and knowing one's impact to promote personal and social well-being • Analyzing information, data, and facts to make reasoned decisions

Note. Adapted from Wong-Powell, 2023

The CASEL framework is beyond a set of skills. It is an essential foundation for children's well-being and preparing young people for the world ahead. It is about a recalibration for the next generation, necessitating a shift in how learning experiences and environments are planned and designed to support children in developing the social, emotional, and academic skills they need to flourish. When thinking about SEL in this manner, it raises an important question: *Can we really leave the development of these competencies to chance?*

An Action Research Approach to Social and Emotional Learning

The purpose of educational action research is to engage in systematic inquiry to evaluate pedagogy and practice, and improve areas that impact student learning (Clark et al., 2020). The participative and collaborative nature empowers teachers to take ownership of learning and school improvement as they plan, design, implement, evaluate, revise, and refine their practice in real-time.

Given the increasing social and emotional challenges children are facing today, teachers identified there is a pressing need to focus on social and emotional learning in early childhood education. This study was initiated to respond to this urgency, exploring the impact of a structured approach to embed SEL into practice and enhance its effectiveness. Thus, the question framing this study is: *What impact does participation in an SEL workshop series have on teachers' approaches in nurturing young children's social and emotional skills?*

The workshop series titled "The Power of Environments in Social and Emotional Learning" involved 22 early childhood teachers working in international schools in Asia and Europe. The series consisted of three 90-minute sessions delivered virtually. The intent behind this model was to provide a structure that enabled participants to learn, apply, and reflect on their SEL approaches and on-the-job practice through synchronous and asynchronous engagements. Also, collaboration with peers working in different schools across the globe provided diverse educational, cultural, and social contexts to give a wider perspective on experiences, knowledge, and ideas. Consequently, the workshop series provided a structured, iterative, and collaborative framework for this study.

Methods

Three data sources were used to triangulate for validity and reliability as well as for depth and nuance in data.

First, data were gathered at an individual level. Self-assessments were used to capture teacher perceptions of their knowledge, confidence, and current practice in supporting student development of social and emotional skills. Participant reflections offered both verbal and written insights, providing qualitative data on teachers' on-the-job experiences. The use of exit tickets at the closure of each session served as formative check-ins to record immediate learning or shifts in thinking based on the content presented. Participants also completed a webinar evaluation form at the end of each session to gather further data on perceived learning, immediate applicability, and learning needs. At the end of the workshop series, an impact survey was administered to collect data on participants' overall learning; changes in and impact on knowledge, practice, and behavior; perceived effects on student development; and sustainability in practice.

Second, data were collected at a collaborative level. The teachers engaged in non-judgemental peer feedback using protocols which provided data on the application of concepts and professional development throughout the course. The feedback enabled teachers to identify areas for improvement and plan for next steps. Participation in small-group dialogue and engaging in collaborative inquiries captured how the teachers built shared understanding and generated practical strategies around SEL.

Third, data gathered occurred at a collective level. The whole group engaged in processing and reflection throughout the workshop series. This provided a collective voice, allowing teachers to identify patterns; areas of agreement and tensions; and shifts in thinking. It also helped synthesize insights from individual and collaborative work.

Analysis

The analysis of data was approached in three complementary ways to provide a richer and more robust understanding of the impact of participating in an SEL workshop series.

From all data sources, recurring words, phrases, and statements were identified through frequency analysis. NotebookLM was employed to cross-reference findings. Beyond simple counts, the analysis considered the context and sentiment of repeated units, providing an interpretation of those counts to capture meaning and the significance behind participant responses.

Using thematic analysis, patterns in thought were also examined. Themes were identified from the most significant and consistent units that were supported across data sources. Attention was given to shifts in thinking and perspectives including changes in how participants understood SEL; application of workshop content and resources in practice; and how the teacher's role in supporting children's social and emotional development was reimagined.

Finally, connections and nuances across data sources were detected. By identifying connections, it revealed the relationships between themes, leading to a more integrated understanding of findings. By exploring nuances, diverse perspectives and contexts were acknowledged in this international group of participants. Changes over time were also explored. By comparing early reflections and webinar evaluations with later ones, development and impact strengthened findings.

The analysis was shared with teachers to ensure their participation in the process. It also served to strengthen the accuracy and credibility of findings, and promote transparency about the impact of the workshop content on practice and student social and emotional development.

Findings

The analysis revealed key themes of impact from the workshop series including:

1. integrating social and emotional learning with intentionality and consistency;
2. building psychological safety as the condition for SEL to flourish; and
3. having the power to shape learning environments to convey messages about SEL.

With Intentionality and Consistency

The findings show that when professional learning for SEL is structured, teaching and supporting social and emotional development becomes more intentional, consistent, and purposeful. As one teacher noted:

> The most significant takeaway for me was understanding how intentional use of the physical environment can support and enhance children's social and emotional development. I learned that even subtle changes in classroom setup, materials offered,

or the atmosphere we create can influence children's sense of belonging, emotional regulation, and peer relationships.

The webinar series equipped teachers with resources and empowered them with recommended practices, enabling them to integrate SEL more intentionally. The PERMA framework (Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment) developed by Martin Seligman (2011) was introduced as its elements support the development of well-being, self-growth, and relationships. The framework was therefore used to strengthen SEL integration in a meaningful way. Table 2 details how PERMA supports SEL.

Table 2
PERMA Supporting SEL

Elements of PERMA Framework	Connection to SEL Competencies
Positive Emotion	When children experience positive emotions like belonging, connection, and purpose, they are more attuned to their internal states (self-awareness) and they can better manage their emotions (self-management).
Engagement	Engagement enables children to experience flow as they remain focused and self-motivated. It allows them to demonstrate agency as they set goals, and plan and organize initiatives (self-management). Engagement also helps children make constructive choices, and express their curiosity and open-mindedness (responsible decision-making).
Relationships	This element supports the ability to establish and maintain healthy and supportive relationships (relationship skills) and to effectively navigate settings with diverse individuals and groups with empathy and compassion (social awareness).
Meaning	When children have a sense of purpose, they connect to personal values (self-awareness) and they set goals for themselves based on these (self-management). When they find meaning, they see themselves as contributors to something larger, reflecting and evaluating their personal, interpersonal, and community impact (responsible decision-making).
Accomplishment	Experiencing success and achieving goals give children a sense of accomplishment. This process requires self-efficacy and a growth mindset (self-awareness), and self-motivation and resilience in challenging times (self-management).

While the teachers experienced the benefits of using the PERMA framework to be more intentional about SEL, it was also necessary to have a structure to maintain consistency. The SAFE model (Sequenced, Active, Focused, Explicit), popularized by Durlak et al. (2011), provided this foundation. The teachers realized that SEL needed to be *sequenced* with thoughtfully planned and designed learning experiences that were connected and provided in a way where the competencies complemented each other and were mutually reinforcing. This

involved an *active* approach to learning where students were given opportunities to problem-solve and make real-life applications. Therefore, SEL required *focus* where time and attention to supporting children's social and emotional development were deliberate. Additionally, learning was made *explicit* as specific competencies were targeted and children were aware of the skills they were practicing and using.

In the end, the PERMA framework and SAFE model ensured a balanced approach, giving attention to each social and emotional competency where none were overlooked or underrepresented. The teachers felt that the resources held them accountable for integrating SEL into daily practice in purposeful and meaningful ways. As one teacher concluded:

> The webinar helped me see how intentionally designed environments can support social and emotional learning in powerful, everyday ways. I plan to apply what I've learned by intentionally creating a more responsive classroom setup that encourages independence, collaboration, and emotional regulation.

Building Psychological Safety

While intentional and consistent approaches using the PERMA framework and SAFE model supported children in building their social and emotional skills in purposeful ways, the teachers emphasized that deliberateness is only effective when paired with psychological safety. Children need to feel accepted, safe, and respected in order to take risks, express emotions, and fully engage in learning without fear of judgment. Without this, even the most well-planned and designed engagements will not achieve their intended impact.

This led to an exploration of "yes" and "no" environments and language. "Yes" fostered trust and encouraged children's curiosity, experimentation, and participation. It signalled that their ideas, questions, and efforts were being invited, honored, and valued. "No", even when unintentional, limited exploration, reduced engagement, and sent subtle messages that some behaviors and contributions were not welcomed. Changing or reframing to "yes" had a significant impact. "Yes" environments and language contributed to children's sense of safety because they were being heard and valued. As the teachers shared their shifts in practice:

> Participant 1: I'm using what I learned about creating a 'yes environment' by giving children more choices, using positive words instead of saying 'no,' and setting up the classroom so they can do things by themselves more easily.

> Participant 2: During the course, I learned how powerful it is to shift from saying 'no' to offering positive alternatives that guide children's behavior while still respecting their curiosity. This approach helps children feel understood and encourages them to explore in a safe and appropriate way.

Being thoughtful and purposeful about how they planned and designed their environments, the language they used, and their responses to children, the teachers gave more attention to practicing "yes". As Elkins (2019) writes in her article on creating "yes" environments, "Saying yes as often as possible empowers children to make positive choices and have more control in their daily lives. It builds high-quality teacher–child relationships, limits teacher intrusion, increases authentic learning experiences, and promotes independence and self-esteem" (para. 2). Understanding the powerful effects of "yes" environments and language, one teacher concludes: "I will very much try to think of how to turn a 'no' into a 'yes'!"

Shaping Learning Environments

With intentionality and consistency, and recognizing psychological safety as the foundation, the teachers also came to understand the impact learning environments have on children's experiences. Spaces have the power to send specific messages and expectations about SEL. Every choice the teachers made about their environments held significance. Thoughtfully planned and designed learning environments were just as important as intentional and purposeful learning experiences. As some teachers reflected:

> Participant 1: The biggest thing I learned is that the way we set up our classroom really affects how children feel and behave. A calm and friendly space helps them feel safe, manage their emotions, and get along better with others.
>
> Participant 2: The most significant takeaway has been understanding how a supportive and empowering environment enhances children's ability to express emotions and build relationships.
>
> Participant 3: The webinar provided valuable insights into how the physical and emotional environment can be intentionally designed for learning. For example, I will incorporate more natural elements, and quiet corners to help children regulate their emotions. I also intend to set up visual prompts and SEL-focused areas where children can reflect, express their feelings, and engage in cooperative activities.

Consideration and forethought in creating spaces that inspire, nurture, and support children's social and emotional development are essential. It goes beyond basic planning and design. The workshop series enabled teachers to engage in ongoing reflection on their environments and its impact based on the messages being signalled. The teachers then used their assessment to rethink their spaces to optimize SEL opportunities.

Implications

The findings of this study hold important implications for practice. Table 3 presents the outcomes for students, teachers, schools, and research.

Table 3
Implications of Structured Professional Learning

Impact On	Practical Implications
Students	• Participate in more planned and purposeful SEL engagements • Experience SEL in more authentic and integrated contexts • Support in becoming more independent, self-directed learners • Develop future readiness and foundations for lifelong skills
Teachers	• Increase confidence and intentionality in practice • Gain practical approaches, strategies, and tools for SEL integration • Foster a deeper awareness of the values and expectations communicated through student-teacher interactions and environments • Reflect on the impact of environments on social and emotional development • Implement changes to create more supportive classroom environments
Schools	• Develop a shared language and vision for SEL to strengthen coherence • Contribute to a safe and healthy culture focused on well-being • Make data-informed decisions to improve SEL practices • Build professional capital (Hargreaves & Fullan, 2012)
Research	• Add to literature base with focus on SEL in early childhood education • Provide a model for action research by demonstrating how cycles of reflection, practice, and adjustment can empower teachers as researchers of their own classrooms • Offer a promising approach that can be adapted to support children's social and emotional development

Given the implications for practice, structured professional learning is essential to effectively support student social and emotional development.

A workshop series presented in this study is even more critical given that few opportunities exist for teachers to develop their knowledge and skills around teaching SEL (UNESCO, 2024). According to the authors of "Implementation of Social and Emotional Learning" (Dobia et al., 2020), one of the key challenges to implementing SEL is the provision of adequate time given to teacher professional learning and few teachers receive training in SEL during their pre-service learning. A mixed-methods study substantiates this claim with teachers reporting a lack of training for delivering SEL (Schiepe-Tiska et al., 2021). Priorities therefore need to be given to professional learning, embedding SEL into ongoing teacher development and training. A workshop series can close the gap and provide teachers with the professional learning needed to effectively integrate SEL into pedagogy and practice.

Limitations and Recommendations

Although the implications for practice are promising, this study has several limitations including being context-specific as the findings reflect those teaching in an international school setting. Additionally, the small sample size limits the range of experiences and perspectives captured. Also, being that the workshop series was held within a short time span of three 90-minute sessions, the longer-term impact on teacher practice and children's social and emotional development was not fully observed. Finally, the data sources presented participant subjectivity on how they perceived and interpreted the impact of the workshop series on their practice.

While the limitations present constraints to the study, there are recommendations for practice and research. Supported by UNESCO's 2024 executive summary on mainstreaming social and emotional learning, teacher education and professional learning are essential to successfully integrate SEL. However, there remains a need to provide educators with adequate training and ongoing professional development (Hamilton & Doss, 2020; Huck et al., 2023; Oliveira et al., 2025). A workshop series on SEL can address this, providing schools with a model to offer professional learning opportunities.

In addition to offering a model, the workshop series gives a structured way to support teacher reflections that are necessary for the sustainability of SEL practices and an SEL-based culture (CASEL, 2021; Hausburg, 2024; UNESCO, 2024). Not only does it develop teachers' self-awareness to become more intentional about modelling social and emotional competencies, reflection also enables teachers to identify progress and areas for improvement to align with school priorities and ensure systematic and systemic SEL implementation. Providing a workshop series empowers teachers to engage in an iterative cycle of reflection, offering approaches, strategies, and tools to measure and evaluate impact, success, and school development.

For future research, there are also promising directions. Studies could replicate this work in different schools and across contexts to expand on scope and to test its generalizability. Extending the time span would also allow observations of longer-term effects on teacher practice and children's social and emotional development. Besides gathering the perspectives and voices of adults, incorporating children into the data gathering process and reflections would provide greater depth of understanding. Finally, a mixed methods approach with both qualitative and quantitative sources would strengthen the evidence to provide more comprehensive findings.

Conclusion

The teachers who participated in the workshop series understood the need to be intentional and consistent in their approach to SEL, that psychological safety is essential to children's social and emotional well-being, and that the choices they make about their learning spaces affect the messages and expectations communicated about SEL. While the study was context-specific, used a small sample size, held in a short time span, and presented participant experiences and perceptions, the implications of professional learning surpass the limitations.

With a growing "Anxious Generation" (Haidt, 2024), the urgency to pay attention to and support children's social and emotional development is imperative. To effectively integrate SEL into practice, teachers require training and ongoing professional development. In turn, SEL is provided in a more effective way through a structured, deliberate, and meaningful approach. This study makes a case for a workshop series to provide teachers with opportunities to develop their skills, reflect on their practice, and adjust their approach to optimize impact.

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Thank you to the teachers who participated in this workshop series. Prioritizing SEL and dedicating your time on supporting children's social and emotional development will drive meaningful change with the well-being of our children at the heart.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

Generative AI, specifically ChatGPT was used to assist with language refinement including improving clarity and academic expression.

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Competencies in Transdisciplinary Thinking: Development of a Measurement Instrument for Tertiary Students

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Abstract

With the world and its challenges growing in complexity, singular disciplines are no longer sufficient to solve these multifaceted issues. Transdisciplinary Thinking, a skill to connect the dots among disciplines in order to transcend their boundaries, is increasingly recognized as a means for addressing many of today's complex social challenges through innovative problem-solving. Despite the increasing recognition of the importance of Transdisciplinary Thinking, there is no consensus on its conceptual definition, nor is there a validated instrument to measure this construct as a competency. This is a critical gap in transdisciplinary education, in the context of teaching, evaluating and assessing educational initiatives aimed at developing this important ability in students. In this paper, we tested out self-report survey items with a local and international expert panel (n = 8), refined the items based on expert feedback, and validated the survey with a tertiary student population (n = 100) through an exploratory factor analysis. The results suggest a unidimensional construct of Transdisciplinary Thinking with 19 items. The survey instrument is shared in this paper. At the presentation, we also shared classroom activities and real-world student projects to help nurture students in Transdisciplinary Thinking. Our work on measuring Transdisciplinary Thinking and teaching it in a classroom setting will be beneficial to other educators seeking ways to evaluate and foster holistic development in their students.

Keywords: transdisciplinary thinking, measurement instrument, tertiary education

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Introduction

The term "transdisciplinary" was first conceived in 1972 by Swiss psychologist Jean Piaget, who saw it is a "higher stage succeeding interdisciplinary relationships … which would not only cover interactions or reciprocities between specialized research projects but would place these relationships within a total system without any firm boundaries between disciplines" (Piaget, 1972, as cited in Bernstein, 2015, p. 2).

Transdisciplinary Thinking is now increasingly recognized as a means for addressing complex problems beyond the reach of a single discipline, by being able to "add new dimensions and perspectives", and thus "give rise to more innovative, holistic solutions" for the progressively complex problems the world faces (OECD, 2020: 15, 24).

In Singapore, the value of fostering Transdisciplinary Thinking for creative problem-solving and innovation to address multifaceted problems is also at the forefront. A government initiative called SkillsFuture Singapore (SSG) identified Transdisciplinary Thinking as a "Critical Core Skill" essential for employees across all industries to do well in an increasingly complex economy. Also, the Design Education Advisory Committee (DEAC), launched by the Singapore Ministry of Trade and Industry, has a key pillar to "champion transdisciplinary learning", in order for students to "engage different disciplines to synthesize knowledge and make meaning". By applying Transdisciplinary Thinking to real world complex challenges, it can "spur innovation that defy traditional silos of knowledge" (DEAC, 2024).

In line with DEAC's forward strategy, the Singapore Polytechnic created a new Diploma in Media, Arts and Design in 2020, bringing together three different schools (School of Communication, Arts and Social Sciences, School of Design and School of Digital Media, and Infocomm. Technology) and eight disciplines (e.g. animation, applied psychology, creative writing, games development and music). A signature pedagogy of the diploma program focuses on Transdisciplinary Thinking, where students from mixed disciplines work together on real-world projects to create innovative solutions for complex problems like sustainability and active aging.

Despite the acknowledgement of the importance of Transdisciplinary Thinking at the global, local and institutional level, there is still a lack of consensus on a conceptual and operational definition of what Transdisciplinary Thinking is. This paper captures the ongoing research that the authors are doing towards developing and validating a survey instrument for measurement and evaluation of Transdisciplinary Thinking among students. We developed a preliminary set of survey items from a literature review, obtained feedback from an expert panel to test for content validity. Then, we administered the revised survey with a tertiary student population to check for structural validity. The results of the validated survey instrument point to a unidimensional Transdisciplinary Thinking construct consisting of 19 items (in Appendix B).

Literature Review

Sharpening the Understanding of Transdisciplinary Thinking

While recognizing the increasing importance of Transdisciplinary Thinking in society, a challenge faced by educators is that there is still a lack of agreement on definitions of even the terms "multidisciplinary", "interdisciplinary", and "transdisciplinary" (Design Council UK, 2010). Further, related concepts like transdisciplinary learning (e.g., Payne & Jesiek, 2018),

transdisciplinary research (Hadorn et al., 2008), and transdisciplinarity (e.g., Augsburg, 2014) overlap in their conceptual definitions. Finally, Transdisciplinary Thinking has been conceived as a *skill* (e.g., Henriksen, 2018), an *ability* (e.g., SSG, n.d.) or a *disposition* (e.g., Drake, 2021), making things even murkier. An unclear definition of what Transdisciplinary Thinking makes it difficult for educators to purposefully design their curriculum to teach and assess Transdisciplinary Thinking.

Given our Singapore context, we start out our conceptual definition using the definition from SSG, which defines Transdisciplinary Thinking as having two main dimensions: knowledge and ability. Despite the word "thinking" in the construct, we conceptualize Transdisciplinary Thinking as a *competency* consisting of knowledge and ability, as per SSG.

Our overall conceptual definition of Transdisciplinary Thinking is the ability to connect the dots by integrating knowledge, skills and abilities across disciplines, to create innovative solutions beyond the reach of any single discipline, for real-world complex problems.

A further literature review points to the following three possible sub-dimensions:

- *Perceiving:* This involves viewing and understanding an issue from the perspective of different disciplines (Henriksen, 2018; OECD, 2020; Sim et al., 2022), mutual learning (Payne & Jesiek, 2018), exploring/exchanging perspectives from different sources of information (Chew et al., 2020; SSG, n.d.), and consciously breaking away from "disciplinary boundaries" (Finch et al., 2021).
- *Synthesizing:* Transdisciplinary Thinking requires "integration efforts" (Payne & Jesiek, 2018) to synthesize knowledge from other disciplines "in a multi-faceted and cohesive way" (Henriksen, 2018), and to be able to recognise synergies and patterns across different disciplines (Chew et al., 2020; SSG, n.d.) so that new knowledge is gained (Henriksen, 2018; Sim et al., 2022).
- *Solutioning:* This involves combining different disciplinary skills to address a complex issue (Sim et al., 2022; SSG, n.d.), "[creating] models of things or processes that explain the real world" (Henriksen, 2018), and arriving at innovative solutions beyond the reach of any single discipline (OECD, 2020).

From our conceptual understanding of Transdisciplinary Thinking and the possible three sub-dimensions, we formulated an initial 18 items which were carefully refined based on feedback from an expert panel and further validated with a student population. We seek to answer the following research questions:

- RQ1. Do the survey items have high content validity for the Transdisciplinary Thinking construct?
- RQ2. What is the factor structure of the Transdisciplinary Thinking construct?

Method

Research Design

A systematic process following established methods for instrument development and content validation was used (Lawshe, 1975; Zamanzadeh et al., 2015), to ensure both the reliability and validity of the measurement instrument for Transdisciplinary Thinking.

Pursuant to the literature review, an initial draft 18 items were developed, which were then thoughtfully refined based on feedback from an expert panel as well as a student population.

First, we consulted an expert panel, consisting of local and international industry experts, academics, and educators, and obtained their insights on the draft survey items. We calculated the content validity index and carefully revised the draft survey items based on the expert panel feedback. After revision, we further validated the survey with a tertiary student population and conducted an exploratory factor analysis.

Appendix A includes the draft survey items before and after revisions from the expert panel feedback. Appendix B shows the latest 19 survey items after both the expert panel and the student validation exercise.

Expert Panel Participants and Analysis Procedure

We purposefully selected members of the expert panel based on their prior experience with transdisciplinary or interdisciplinary work, and intentionally included both local and international experts, for more comprehensive feedback. The criteria for inclusion were 3 years or more experience with developing curriculum for cross-disciplinary student projects, prior research in interdisciplinary or transdisciplinary research, and/or working on interdisciplinary or transdisciplinary work in the industry. For example, one expert was an educator who had years of experience developing and leading cross-disciplinary projects for students in a higher education institution using design thinking. Another had close to a decade of experience in an agency which helped leaders and organisations innovate through a transdisciplinary strategy, design and practice. Emails were sent to the identified expert panel members and we received returns from eight of them.

To check for content validity of the survey items, which is the degree to which an instrument adequately covers the content domain (Polit & Beck, 2006), the expert panel was asked to rate how relevant each item was to the overall concept of Transdisciplinary Thinking and the sub-dimensions using a 4-point scale (1 = not relevant at all, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant). The expert panel was also asked to provide qualitative feedback, so as to determine the alignment of the items with the sub-dimensions of the survey instrument. Item-level content validity index (I-CVI) scores, scale-level content validity index based on average method (S-CIV/Ave) were calculated (Polit & Beck, 2006).

The scales were judged to have excellent content validity if they composed of items that had I-CVI of .78 or higher and S-CVI/Ave of .90 or higher. For items and scales that did not meet this requirement, we looked closely at the expert panel's qualitative feedback, drawing on their collective experience and insights, and carefully revised the items.

Student Participants and Analysis Procedure

After revising the instrument based on the expert panel feedback, we further tested the instrument with a tertiary student population. Students aged 17 to 19 years old, who were studying in a higher education institution, were sent emails to complete the survey. We targeted students from varied disciplines and years of study for a more diverse sample to test the instrument.

Students rated their level of agreement to the questions, answering the survey as they normally would, when the survey is used for evaluation in a module. 100 students completed the survey. Table 1 shows the demographic profile of the students.

Table 1
Student Demographic Profile

	Student demographic profile (n = 100)
Year of Study	Year 1 (41%) Year 2 (33%) Year 3 (26%)
Discipline	Architecture & Built Environment (8%) Computing (1%) Chemical & Life Sciences (29%) Engineering (16%) Media, Arts, & Design (34%) Business (7%) Maritime Studies (5%)

To check for structural validity, exploratory factor analysis (EFA) was run. As guided by Costello and Osborne (2005), principal axis factoring (PAF) was employed to explore the underlying factor structure of the survey items. PAF will look at the common variance which is more suitable for our needs as we seek to arrive at a more concise conceptual understanding of the latent constructs that underlie the measured variables of Transdisciplinary Thinking (Fabrigar et al.,1999).

Results

Expert Panel Validation

The item-level content validity indexes (I-CVI) and scale-level content validity indexes using average method (S-CVI/Ave) are presented in Table 2.

Items with I-CVI lower than .78 were carefully reviewed and qualitative feedback from the expert panel were thoroughly considered in the revisions (Lawshe, 1975; Zamanzadeh et al., 2015). Two items were retained as these items were very close to .78 and the qualitative feedback revealed no significant issues, five were revised and one was dropped. An additional item was added to the Perceiving sub-dimension after considering the qualitative feedback. This content validity analysis and careful review, with the expert panel's inputs based on their years of experience, enhanced the validity of the revised instrument for the next stage of reliability analysis with the student population.

Table 2
I-CVIs and S-CVI/Age of the Survey Items

Sub-dimension and items	I-CVI	S-CVI/Ave	What revisions we did
Perceiving (excluding PER3 and PER7)		.90	
PER1	1.00		
PER2	1.00		
PER3	.63		Revised to: "Recognise another discipline's strengths and limitations in understanding an issue"
PER4	.88		
PER5	.75		Retained as item was close to .78
PER6	.88		
PER7	.63		Revised to: "See an issue in a new way after considering information from different disciplines"
Synthesizing (excluding SYN5)		.94	
SYN1	1.00		
SYN2	1.00		
SYN3	.88		
SYN4	.88		
SYN5	.50		Revised to: "Move beyond my discipline to integrate information and perspectives from different disciplines"
Solutioning (excluding SOL1)		.88	
SOL1	.63		Revised to: "Try out new skills from different disciplines to explore solutions"
SOL2	.88		
SOL3	1.00		
SOL4	1.00		
SOL5	.75		Retained as item was close to .78
SOL6	.75		Revised to: "Move beyond my discipline to propose solutions that integrate skills from different disciplines"

Note. The expert panel was instructed to rate how relevant each item was to the sub-dimension (1 = not relevant at all; 4 = highly relevant). The CVIs were calculated using the formulas from Polit and Beck (2006). See Appendix A for the wording of the items.

Student Validation

After the expert validation, we further continued with the next phase of validation by testing with the student population. 100 students completed the revised survey with 19 items. Prior to conducting the Exploratory Factor Analysis (EFA), the suitability of the data was assessed. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .94, establishing that there was sampling adequacy for the EFA to proceed. In addition, Bartlett's test of sphericity was significant, $\chi^2(171) = 1670$, $p < .001$, further supporting the factorability of the correlation matrix.

With both KMO and Bartlett's test of sphericity establishing suitability for factoring of the data, we proceeded with Exploratory Factor Analysis (EFA). The scree plot of the EFA using Principal Axis Factoring (PAF) is in Figure 1. Number of factors were determined by examining the scree plot to look for the point at which the slope of the curve levels off, forming an "elbow" (Cattell, 1966), which is at Factor 1 in Figure 1.

Figure 1
Scree Plot

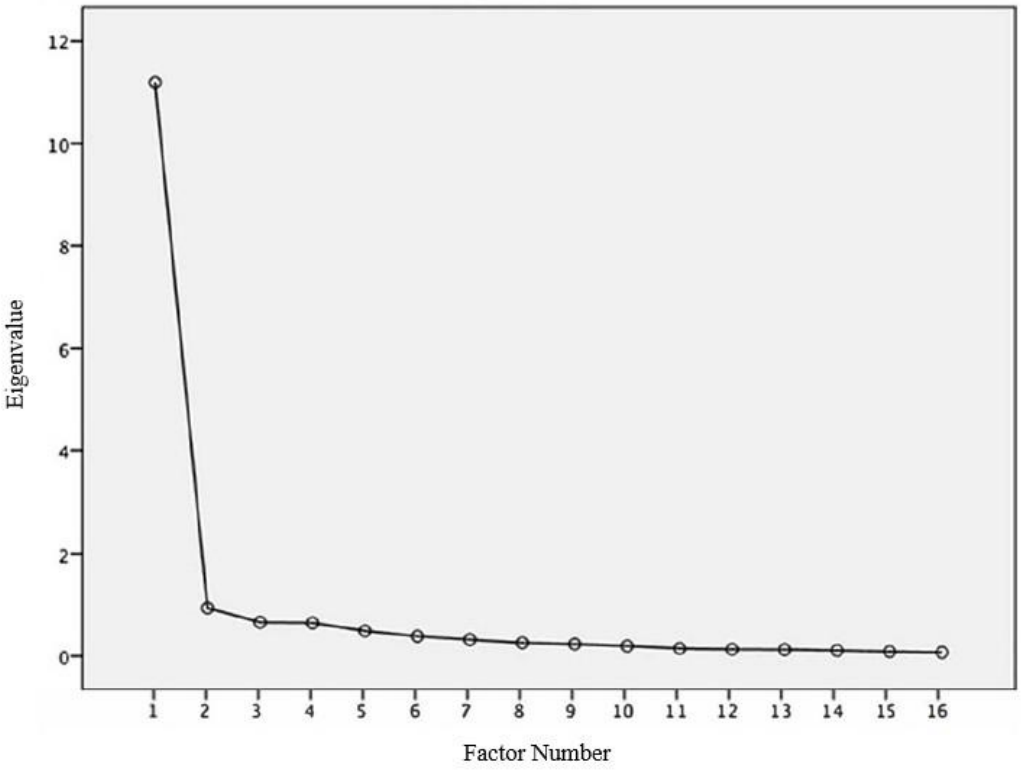


Table 3
Eigenvalues and Variance Explained

Factor	Eigenvalues	% of Variance
1	11.20	70.00
2	.94	5.86
3	.66	4.12

The EFA results point to a unidimensional construct for Transdisciplinary Thinking, with Factor 1 explaining 70.0% of the total variance. Subsequent factors explained less than 6% of the variance, providing strong evidence for a unidimensional construct for Transdisciplinary Thinking (Table 3).

Table 4 shows the factor loadings of the 19-items. The factor loadings are all sufficiently high (all above .7), also indicating a unidimensional construct for Transdisciplinary Thinking.

Table 4
Factor Loadings of the Items

Items	Factor 1 Loading
PER1	.73
PER2	.78
PER3	.80
PER4	.78
PER5	.81
PER6	.85
PER7	.82
PER8	.81
SYN1	.90
SYN2	.85
SYN3	.82
SYN4	.86
SYN5	.87
SOL1	.78
SOL2	.91
SOL3	.83
SOL4	.85
SOL5	.89
SOL6	.82

In addition, analysis of the student test data showed that the 19-items of the survey instrument has a high internal reliability, as Cronbach's alpha was a strong .92. This established the robust consistency of the instrument in measuring Transdisciplinary Thinking among tertiary students.

Discussion and Conclusion

Our analysis in this paper and our ongoing work towards a validated survey instrument to measure Transdisciplinary Thinking fills an important missing piece in our collective understanding of this important construct.

We started out with three possible sub-dimensions of the Transdisciplinary Thinking construct (perceiving, synthesizing, and solutioning). After the expert panel and student validation phases of our research, our current analysis points instead to a unidimensional construct with 19 items, where Transdisciplinary Thinking is a singular and coherent concept.

Our overall conceptual definition of Transdisciplinary Thinking is the ability to connect the dots by integrating knowledge, skills and abilities across disciplines, to create innovative solutions beyond the reach of any single discipline, for real-world complex problems. Potentially, the overarching attribute of Transdisciplinary Thinking is the underlying ability to connect the dots across disciplines in order to transcend the disciplinary boundaries, which would include "perceiving" issues from different disciplines and "synthesizing" knowledge from different disciplines as well as combining different disciplinary skills to come up with innovative "solutions".

After concluding our above expert panel and student validation exercise on Transdisciplinary Thinking and its possible sub-dimensions (perceiving, synthesizing, and solutioning), a paper to be published in August 2025 noted that a different transdisciplinary thinking scale (TTS) was recently piloted with high school students in the Philippines (Honra & Monterola, 2025), seeming to validate a multi-dimensional structure of Transdisciplinary Thinking consisting of: integrative thinking, inquiry skills and collaborative problem-solving. These dimensions differ from our analysis which points toward a unidimensional construct, and warrants further investigation. One reason for the difference could be because Honra and Monterola (2025) conceptualized their Transdisciplinary Thinking concept as a *cognitive process* among high school students in the Philippines, whereas we conceptualized it as a *competency,* per SkillsFuture Singapore's perspective in the Singapore context, and tested it with a tertiary student population.

With a well-established methodology followed for the development and validation of the 19-items Transdisciplinary Thinking survey instrument (based on literature review, expert panel validation and student validation with reliability and content validity analysis), the survey instrument can be used as a tool for educators to assess measure Transdisciplinary Thinking in tertiary students. This is an important step in our common goal of furthering Transdisciplinary Thinking as a competency in students, so as to address increasingly complex real-world challenges that cannot be solved by any single discipline alone.

In future phases of this research, the 19-items may be further tested with industry partners to check for the different instruments' external validity with practitioners and to validate the structural validity with a confirmatory factor analysis.

Appendix C shows a sample of three design-based activities that we use in the classroom to nurture students in Transdisciplinary Thinking. A presentation of our findings at the conference included the 19-item survey instrument as well as a sharing of classroom activities and real world complex project challenges that we run to develop Transdisciplinary Thinking in students. Our work on measuring Transdisciplinary Thinking and teaching it in a classroom setting will be beneficial to other educators seeking ways to foster holistic development in their students.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Appendices

Appendix A

Revisions to the survey instrument before and after expert panel feedback

Items are preceded with the sentence: When working as a team on a project, I am able to…

Item	Initial survey wording	Revisions made after expert panel feedback
PER1	Seek out new information and perspectives from different disciplines.	No change
PER2	Learn new information and perspectives from different disciplines.	No change
PER3	Exchange my discipline's perspective with people from different disciplines.	Recognise another discipline's strengths and limitations in understanding an issue.
PER4	Understand an issue from a different disciplinary perspective.	No change
PER5	Assess how important information from different disciplines is to the issue.	No change.
PER6	Evaluate the relevance of different disciplines to the issue.	No change.
PER7	Identify new opportunities relating to the issue after considering information from different disciplines.	See an issue in a new way after considering information from different disciplines.
PER8	Nil	Recognise my discipline's strengths and limitations in understanding an issue.
SYN1	Find patterns or connections between information and perspectives from different disciplines.	No change.
SYN2	Find new insights by combining information and perspectives from different disciplines	No change.

SYN3	Evaluate the usefulness of patterns and insights found from combining information from different disciplines.	No change.
SYN4	Integrate information and perspectives from different disciplines to understand an issue holistically	No change.
SYN5	Integrate knowledge and skills from another discipline back into my own discipline.	Move beyond my discipline to integrate information and perspectives from different disciplines.
SOL1	Learn new skills from another discipline to enhance a solution.	Try out new skills from different disciplines to explore solutions.
SOL2	Understand that another discipline's skills can help us arrive at a more innovative solution.	Understand that *different* disciplines' skills can help us arrive at solutions.
SOL3	Use the strengths of other disciplines to enhance a solution.	Use the strengths of *different* disciplines to enhance a solution.
SOL4	Find new opportunities for synergy between different disciplines to arrive at an innovative solution.	Find new opportunities for synergy between different disciplines to arrive at *new* solutions.
SOL5	Evaluate the pros and cons of proposed solutions based on the perspective of different disciplines.	No change.
SOL6	Propose a solution that incorporates input from different disciplines.	Move beyond my discipline to propose solutions that integrate skills from different disciplines.

Appendix B

19-item survey instrument (after expert panel and student validation)

When working as a team in a project, I am able to…	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
1. Seek out new information and perspectives from different disciplines.	o	o	o	o	o	o	o
2. Learn new information and perspectives from different disciplines.	o	o	o	o	o	o	o
3. Recognise my discipline's strengths and limitations in understanding an issue.	o	o	o	o	o	o	o
4. Recognise another discipline's strengths and limitations in understanding an issue.	o	o	o	o	o	o	o
5. Understand an issue from a different disciplinary perspective.	o	o	o	o	o	o	o
6. Assess how important information from different disciplines is to an issue.	o	o	o	o	o	o	o
7. Evaluate the relevance of different disciplines to an issue.	o	o	o	o	o	o	o
8. See an issue in a new way after considering information from different disciplines.	o	o	o	o	o	o	o
9. Find patterns or connections between information and perspectives from different disciplines.	o	o	o	o	o	o	o
10. Find new insights by combining information and perspectives from different disciplines.	o	o	o	o	o	o	o
11. Evaluate the usefulness of patterns and insights found from combining information from different disciplines.	o	o	o	o	o	o	o
12. Integrate information and perspectives from different disciplines to understand an issue holistically.	o	o	o	o	o	o	o
13. Move beyond my discipline to integrate information and perspectives from different disciplines.	o	o	o	o	o	o	o
14. Try out new skills from different disciplines to explore solutions.	o	o	o	o	o	o	o
15. Understand that different disciplines' skills can help us arrive at solutions.	o	o	o	o	o	o	o
16. Use the strengths of different disciplines to enhance a solution.	o	o	o	o	o	o	o
17. Find new opportunities for synergy between different disciplines to arrive at new solutions.	o	o	o	o	o	o	o

18. Evaluate the pros and cons of proposed solutions based on the perspective of different disciplines.	o	o	o	o	o	o	o
19. Move beyond my discipline to propose solutions that integrate skills from different disciplines.	o	o	o	o	o	o	o

Dear Students, thank you for taking the time to participate in this survey.

Purpose
This survey aims to gather your views about working in project teams.

Instructions
Participation in this survey is voluntary. The survey should not take you more than 5 minutes to complete. As you respond to the survey statements, please focus on your current experience in project teams rather than your ideal situation. There are no right or wrong answers.

Confidentiality
The data collected will be treated in a highly confidential manner whereby all identities and responses are protected and kept confidential. Your answers will not affect your module grades or class standing in any way. Thank you for contributing to the enhancement of teaching and learning at our school!

As you respond to the survey statements, please focus on your current experience working in teams rather than your ideal situation. There are no right or wrong answers.

Your school:
Your year of study:

Thank you for your time!

Appendix C

Sample lesson activities and how they are used to nurture students in Transdisciplinary Thinking

	Sample lesson activity
Perceiving (i.e., Understanding and evaluating an issue from the perspective of different disciplines and exchanging perspectives beyond discipline boundaries)	**Lightning Demos** (to exchange ideas from different disciplines) Find two examples of product/service/thing **in your Specialisation's industry** that is interesting and inspires you. Take turns to share with your team members your demos. 1. The demo I would like to show you today is… ( ) 2. This company is solving the problem… 3. They did this by… 4. The important aspects of this example are… 5. This applies to our project because…
Synthesizing (i.e., the ability to integrate efforts to synthesize knowledge from other disciplines, evaluate and recognize synergies and patterns across different disciplines)	**Affinity mapping and Insights** (to synthesize and recognize synergies and patterns across different disciplines) 1. Read and highlight key points or quotes 2. Cluster and sort common points, then label each cluster 3. Summarise the key points in each cluster 4. **An insight is something that is new, interesting, and/or presents a new opportunity, perspective, or angle.** Synthesize insights by considering and connecting multiple clusters.
Solutioning (i.e., the ability to propose innovative solutions that go beyond the scope of any single discipline).	**Random Matching** (to spark new ideas by going beyond the scope of a single discipline) Individually, look at the selected ideas and add on your own take on it, from the lens of your **subject area, specialization or industry**. Add 3 pink post-its around the original idea to capture your new ideas.

Bridging the Competence Gap in Ugandan Undergraduate Legal Education

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Abstract

Curriculum design and development are critical for ensuring the quality and relevance of higher education. In Uganda, undergraduate legal education continues to rely on non-competence-based curricula, with each law school or faculty independently designing its own programme, which is then approved by the National Council for Higher Education and the Law Council. The problem is that, despite Uganda's shift to competence-based curricula at the ordinary secondary level, law schools or faculties continue to offer fragmented, theory-oriented programs. As a result, undergraduates possess strong theoretical knowledge but lack essential professional competencies such as advocacy, legal-drafting, ethical-reasoning, problem-solving, client-management, and critical-thinking. Consequently, law-undergraduates are inadequately prepared for contemporary legal practice, limiting the effectiveness of undergraduate-legal-education and Uganda's compliance with the United-Nations-Sustainable-Development Goal 4 (SDG 4) on quality education. The study aims to examine the structure of undergraduate-bachelor of law curricula in Uganda, identify gaps arising from non-competence-based-bachelor of law-curricula, and propose reforms necessary to establish a competence-based-bachelor of law-curriculum aligned with SDG 4. The research questions are: What is the current structure of undergraduate bachelor of law curricula in Ugandan-universities? What gaps arise from non-competence-based bachelor of law-curricula? And what reforms are necessary to establish a competence-based-bachelor of law-curricular aligned with SDG 4? Guided by an interdisciplinary-perspective drawing on educational-theory, sociological-theory, and human-capital-theory, the research is qualitative and doctrinal in nature, employing desktop-review of scholarly articles and reports. Findings indicate that non-competence-based-curricula constrain professional-readiness and underscore the urgent need for a harmonized competence-based-law-curriculum to produce practice-ready-undergraduates.

Keywords: competence-based curriculum, Ugandan undergraduate legal education, professional readiness, curriculum reform, SDG 4

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Introduction

Coşkun Yaşar and Aslan (2021) note that scholars define curriculum in multiple, but closely related, ways, reflecting its complex and multidimensional role in education. They argue that curriculum goes beyond a written syllabus and should be understood as both the planned and unplanned learning experiences provided by an institution, as well as the organised structure of learning opportunities and content. Their review further shows that curriculum has been conceptualised as a comprehensive system that includes objectives, subject areas, learning experiences, and evaluation strategies, emphasising that it encompasses not only what is taught but also how learning is assessed. Drawing on Bintz and Dillard (2007), Yaşar and Aslan also highlight that curriculum is a lived experience and a tool for preparing students for life, while simultaneously functioning as a plan, a content framework, and a belief system that shapes educational practice. Taken together, these perspectives illustrate that curriculum involves the organisation of knowledge, values, and experiences. Therefore, the structure of an undergraduate Bachelor of Laws (LLB) curriculum should be understood not merely as a list of course units, but as a broader framework that integrates learning outcomes, teaching approaches, and assessment practices necessary for meaningful legal education.

Building on the above understanding, the quality of undergraduate-legal-education directly determines the calibre of legal practitioners, who subsequently influence justice delivery, policy development, and social governance. In Uganda, however, the LLB programme remains predominantly theoretical and largely non-competence-based, despite the national shift toward competence-based learning at the secondary level. This has created a clear disconnect between academic training and the practical demands of legal practice, underscoring the need to re-examine the structure and orientation of LLB curricula.

The research problem is that LLB undergraduates possess strong theoretical knowledge but many of them lack essential professional competencies such as advocacy, legal drafting, ethical reasoning, problem-solving, client management, and critical analytical skills. Consequently, LLB undergraduates are inadequately prepared for contemporary legal practice, limiting the effectiveness of undergraduate legal education and hindering Uganda's compliance with the United Nations Sustainable Development Goal 4 (Quality Education).

Currently, law schools or faculties independently design their LLB curricula, leading to substantial variation in course content, teaching-methods, and depth of coverage across universities. This fragmentation undermines consistent undergraduate competence, complicates the enforcement of minimum standards in legal research, ethics, clinical-training, and practical skills, restricts student mobility and credit transfer, and limits professional bodies' ability to assess LLB undergraduates' readiness for legal practice.

The study aims to examine the structure of undergraduate-bachelor of law curricula in Uganda, identify gaps arising from non-competence-based-bachelor of law-curricula, and propose reforms necessary to establish a competence-based-bachelor of law-curriculum aligned with Sustainable-Development-Goal 4. Guided by these objectives, the study seeks to provide evidence-based recommendations to improve curriculum design, enhance practical competence, and ensure that LLB undergraduates are adequately prepared to meet the demands of contemporary legal practice. The research also seeks to answer the following research questions; What is the current structure of undergraduate bachelor of law curricula in Ugandan-universities? What gaps arise from non-competence-based bachelor of law-

curricula? And what reforms are necessary to establish a competence-based-bachelor of law-curricular aligned with the SDG 4?

Importantly, this study is justified by the growing concern that many LLB undergraduates possess strong theoretical knowledge but insufficient practical competence for contemporary legal practice. Legal education plays a central role in strengthening justice systems, rule of law, governance, and national development. Therefore, examining curriculum structure and identifying competence gaps is essential to inform reform efforts that can improve graduate quality and professional readiness in Uganda.

The study is significant because it contributes to the ongoing national and global discourse on competence-based higher education. This research benefits curriculum developers, universities, regulatory bodies, and policymakers by providing guidance for reforming undergraduate bachelor of law curricula. The study also supports Uganda's efforts toward achieving Sustainable Development Goal 4 on Quality Education by proposing strategies for strengthening practical skill development, professional ethics, and employability among LLB undergraduates.

Methodology

This study employed a qualitative-research-approach which was doctrinal in nature using a desktop research strategy in order to examine the structure of undergraduate Bachelor of Laws (LLB) curricula in Uganda, identify gaps arising from the LLB non-competence-based curriculum, and generate evidence to support reforms toward a competence-based curriculum aligned with Sustainable Development Goal 4 (Quality Education). A case-study-research design focusing on three selected Ugandan universities was adopted to enable an in-depth and contextual-analysis of how LLB curricula are structured, how competencies are (or are not) integrated, and where major weaknesses exist. This research design was therefore appropriate for investigating the central research problem that the current LLB curricula remain largely theory-oriented and fragmented, producing undergraduates with limited professional-competence.

To achieve the research objectives, both primary and secondary data were examined. Primary data consisted of the laws regulating the structure of LLB curriculum at the university. Secondary data comprises of the curriculum documents from the three selected universities which have law faculties in the central region, institutional reports, and scholarly articles. These directly supported the first objective by enabling a systematic examination of the existing structure of undergraduate LLB curricula. These sources reinforced the second objective by helping to identify gaps associated with the LLB non-competence-based curricula, particularly relating to practical skills, professional ethics, and readiness for legal practice. Together, these datasets informed the third objective by providing a basis for proposing reforms toward a harmonized competence-based LLB curriculum in line with SDG 4.

Data analysis involved thematic content analysis, doctrinal legal analysis, and documentary review. Thematic content analysis was used to identify recurring themes and gaps in competence integration across curricula. Doctrinal legal analysis facilitated examination of regulatory and policy frameworks governing legal education and how they support—or fail to support—competence-based training. Documentary-review enabled systematic comparison of course content, teaching methods, and assessment strategies across universities. Through

these complementary analytical techniques, the study directly addressed each of its objectives: examining existing curriculum structures, identifying competence-related deficiencies, and informing reform proposals aimed at strengthening alignment with the SDG 4.

Ethical considerations were observed through accurate citation and acknowledgment of all documents and scholarly articles consulted, as well as careful representation of institutional information without distortion. Confidentiality, intellectual-integrity, and respect for academic and institutional-data were maintained throughout the research process. The names of the universities were not mentioned for ethical reasons.

This study employs an interdisciplinary framework combining Educational-Theory, Sociological-Theory, and Human-Capital-Theory to examine the structure, gaps, and proposed reforms in the undergraduate Bachelor of Laws (LLB) curriculum. Educational Theory emphasizes curriculum design aligned with competencies and demonstrates how fragmented, content-heavy, lecture-based programmes limit the development of essential skills such as advocacy, legal drafting, ethical reasoning, and client-centred practice. Sociological Theory explains how institutional norms, policies, and curriculum sequencing embed competence gaps within the higher education system. Human Capital Theory links skills development to employability and national development. Collectively, these theories justify reforms toward coherent, competence-based, and experiential LLB curricula aligned with SDG 4 and capable of producing practice-ready, ethically grounded undergraduates.

Literature Review

Structure of Undergraduate Bachelor of Laws (LLB) Curricula in Uganda

The study examines the structure of LLB curricula in Uganda across three universities, referred to as University A, University B, and University C. Notably, each law school or faculty designs its own four-year LLB curriculum independently, and there are no specific national laws or policies that regulate or standardize the development of these programmes. As a result, there is no uniformity in curricula across universities, leading to significant variations in course content, structure, teaching methods, and assessment strategies. These variations directly impact the consistency and quality of legal education in the country.

The Bachelor of Laws curricula reveal both similarities and distinctions. In Year One at University C, students are introduced to foundational legal principles and essential skills. In the first semester, compulsory courses include Foundations of Law, Criminal Law, Law of Contract, Constitutional History, Computer Applications, and Language and Communication Skills. In the second semester, students study Criminal Law II, Law of Contract II, Constitutional Law, Legal Methods, and Computer Applications II. Collectively, these courses provide a comprehensive grounding in legal doctrine, communication skills, basic computing, criminal justice, contract formation, and constitutional frameworks.

Year Two builds on this foundation, with all courses remaining compulsory. In the first semester, students take Law of Torts I, Administrative Law, Land Law I, Family Law I, and, covering civil wrongs, government powers, land tenure, and family relations. In the second semester, core courses include Law of Torts II, Land Law II, Family Law II, Law of Sale of Goods and Supply of Services, and Equity and Trusts. These subjects further develop student

competence in commercial transactions, equitable remedies, succession, and advanced tort and land law concepts.

In Year Three, students continue with compulsory courses that deepen practical and doctrinal understanding. The first semester includes Law of Evidence I, Criminal Procedure, Law of Business Associations I, and Law of Banking and Negotiable Instruments, covering evidentiary rules, criminal justice procedures, company law, and financial regulation. The second semester consists of Law of Evidence II, Law of Business Associations II, International Trade and Business, and Legal Research Methods and Methodology, emphasizing evidentiary reasoning, corporate practice, international commercial relations, legal research and writing skills.

In Year Four at University C, only Jurisprudence and Civil Procedure remain compulsory, offered across the two semesters. Jurisprudence I and II explore legal philosophy, theories of law, and methods of legal reasoning, while Civil Procedure and Practice I and II focus on court processes, litigation, and procedural rules. All other Year Four courses are electives, allowing students to specialize in fields such as public international law, human rights, intellectual property, labour law, environmental law, clinical legal education, alternative dispute resolution, oil and gas law, refugee law, and revenue and taxation law. This structure ensures a strong compulsory foundation in the first three years, preserves core theoretical and procedural training in the fourth year, and provides flexibility for specialization through elective courses.

When compared with University A and University B, similarities emerge in the early years, where all three universities emphasize core courses designed to introduce students to essential legal doctrines. In Year One, both University A and University B focus on subjects such as Constitutional Law, Contracts, Criminal Law, Legal Methods, and Torts, without incorporating electives. In Year Two, both universities maintain core courses in Family Law, Land Law, Evidence, Administrative Law, Equity, and Trusts, reflecting a shared understanding that competence in substantive law is central to undergraduate legal education.

Differences become more evident in the later years, particularly regarding electives and practical engagement. In Years Three and Four, University A offers a broad range of electives, including clinical legal training, consumer law, gender and the law, environmental law, computers and the law, and criminology and penology, allowing students to tailor their studies to professional interests. University B provides a more focused set of electives in international trade, investment law, international humanitarian law, natural resources law, labour law, taxation, insurance law, and human rights, emphasizing commercial, policy, and public law areas. University C differs by maintaining only two compulsory courses in Year Four—Jurisprudence and Civil Procedure—and offering a wide array of electives for specialization.

A further distinction lies in research and practical requirements. University B mandates a research paper as a core component of the final year, ensuring all students undertake independent legal research. At University A, the research paper is typically elective, with practical and clinical training offered through elective units in clinical legal education. University C integrates practical skills through elective courses in clinical legal education, alternative dispute resolution, and other applied fields in the fourth year. These differences reflect variations in pedagogical emphasis: University B prioritizes research as a universal

requirement, University A emphasizes flexible practical skills development, and University C balances foundational knowledge with elective specialization in senior years.

Understanding the structure of undergraduate Bachelor of Laws (LLB) curricula is central to evaluating how legal education prepares students for professional practice. Contemporary scholarship consistently emphasises that curriculum structures must move beyond fragmented, content-heavy models toward frameworks that foster progressive professional competence. There is broad consensus that traditional curricula, which prioritise theoretical knowledge transmission, are increasingly inadequate for preparing graduates for real-world practice. This observation mirrors the current structure of many LLB programmes in Uganda, where curricula remain largely content-driven and lecture-centred, offering limited opportunities for developing practical legal skills (Açıkgöz & Babadoğan, 2021; Bhatia & Kumar, 2025; Harianto, 2024).

A significant theme in the scholarship is the paradigm shift from teacher-centred, content-heavy instruction to competency-based education (CBE). Bhatia and Kumar (2025) argue that 21st-century education increasingly prioritises demonstrable skills and practical application over rote memorisation. Açıkgöz and Babadoğan (2021) emphasise that effective curricula should be structured around clearly defined learning outcomes, mastery-based progression, and integrated assessment to ensure systematic competence development. Harianto (2024) further highlights that CBE must prioritise problem-solving, adaptability, creativity, and critical thinking, rather than solely accumulating theoretical knowledge. Collectively, these studies underscore that curriculum structure is not merely a sequence of subjects but a framework that shapes the gradual development of professional skills.

Another key theme is coherence and integration within curricula. The Curriculum and Assessment Review Final Report (2025), Cambridge International (2025), and the National Council for Curriculum and Assessment (2012) all argue that effective curriculum design requires integrated, logically sequenced learning pathways rather than isolated subject lists. The First International Conference on Curriculum Development (NCDC-Uganda) observes that post-colonial African curricula, including legal education, often retain content-transmission models that emphasise knowledge recall over applied competencies. This literature collectively highlights the importance of progression, linking foundational, intermediate, and advanced content to ensure that students systematically acquire both theoretical knowledge and practical skills.

Critically, while these studies provide substantial guidance on curriculum structure, they largely focus on school-level or general higher education curricula and do not specifically address professional programmes such as LLB in Uganda. This gap is significant because Ugandan law schools or faculties continue to offer fragmented, theory-heavy programmes, leaving undergraduates with strong theoretical knowledge but insufficient professional competencies, such as advocacy, legal drafting, ethical reasoning, problem-solving, client management, and critical analysis. Therefore, there is a clear need to investigate how LLB curricula are structured, whether they support cumulative skill development, and how they can be reformed to align with UN Sustainable-Development-Goal 4 (Quality Education).

In brief the reviewed scholarship demonstrates that curriculum structure fundamentally shapes learner outcomes. For Ugandan LLB programmes, adopting integrated, coherent, and competency-oriented frameworks is essential to ensure that undergraduates are both

knowledgeable and professionally prepared, bridging the persistent gap between theory and practice in legal education.

Gaps Arising From Non-Competence-Based LLB Curricula

Despite these structural strengths, the predominance of theoretical, non-competence-based curricula across the three universities limits the development of essential practical and professional skills. Consequently, LLB undergraduates often possess strong conceptual knowledge but lack adequate readiness for real-world legal practice, negatively affecting the overall quality and effectiveness of legal education in Uganda.

The variances in course units present both advantages and disadvantages. While differences in elective options allow students to specialize in areas of interest, practical, hands-on training is largely absent across all three universities. Moot court exercises and community engagement are treated as co-curricular activities rather than integrated, credit-bearing components, and the Socratic method is minimally applied, limiting critical thinking, analytical reasoning, and active participation. Clinical legal education is offered only as an elective at University A and University C and is not a core requirement, leaving many students without structured exposure to real-world legal practice.

The significant variation in core and elective course units, combined with the predominance of theoretical, non-competence-based instruction and lecture-heavy teaching methods, creates major disadvantages. Undergraduates complete their LLB programs with uneven knowledge and skill sets, resulting in disparities in professional readiness and employability. Essential competencies—such as advocacy, legal drafting, client management, and practical problem-solving—are inconsistently developed, while active learning, experiential engagement, and critical thinking are limited. Although some students benefit from elective diversity, the overall non-competence-based approach reduces the ability of Ugandan legal education to consistently produce practice-ready undergraduates and undermines the uniformity and quality of the legal profession nationally.

Furthermore, the absence of centralized regulation or a national policy governing LLB curricula exacerbates these challenges. Without uniform standards, universities independently determine course content, teaching methods, and assessment strategies, resulting in considerable disparities between institutions. This lack of uniform-standards hinders the enforcement of minimum professional competencies, complicates credit transfer and student mobility, and limits the capacity of professional bodies to evaluate whether undergraduates meet baseline requirements for legal practice. In turn, these gaps weaken public confidence in the quality and consistency of legal education and contribute to an uneven supply of competent legal practitioners across the country.

Assessment methods across University A, University B, and University C follow a similar structure, combining summative and formative components. Examinations carry a weight of 70 marks and primarily test theoretical knowledge, while the remaining 30 marks are allocated to formative assessment, often delivered through lecture-based group assignments, presentations, or tests. This reliance on written exams and lecture-oriented formative exercises limits opportunities for students to develop practical legal skills, including advocacy, negotiation, drafting, client counseling, and courtroom procedures. Consequently, assessment reinforces rote learning over critical thinking, problem-solving, and applied competence. The absence of structured, hands-on evaluation methods—such as practical

simulations, moot courts, clinical placements, or supervised legal practice—means that undergraduates may pass exams without acquiring essential professional skills. Ultimately, this approach to assessment perpetuates the gap between theoretical knowledge and real-world readiness, further undermining the quality and professional relevance of undergraduate legal education in Uganda.

Notably, despite the growing global emphasis on competency-based education, many Ugandan Bachelor of Laws (LLB) programmes continue to rely on traditional, theory-heavy curricula that prioritise content delivery over the development of practical skills. This misalignment is highlighted across multiple studies. Bhatia and Kumar (2025) argue that conventional curricula, structured around time-bound instruction and fixed content lists, often fail to cultivate critical thinking, problem-solving, and applied competencies. Similarly, Açıkgöz and Babadoğan (2021) note that curricula that lack explicit learning outcomes and mastery-based progression leave graduates unable to translate theoretical knowledge into professional practice. Harianto (2024) reinforces that the absence of structured standards or policies for adaptability, creativity, and applied problem-solving undermines the preparation of students for complex, real-world challenges.

Ugandan studies further illustrate these gaps. Kitasse and Ssembatya (2024) show that competency-oriented reforms in secondary schools falter without clear structural frameworks, explicit competencies, and coherent sequencing of learning tasks. Muwanguzi, Kibaya, and Serunjogi (2023) add that even when competency-based principles are adopted, limited teacher preparedness, inadequate resources, and weak assessment strategies compromise their implementation. Translating these insights to the LLB context, it becomes apparent that law programmes remain fragmented: foundational, intermediate, and specialised courses are often disconnected, and opportunities to practice legal drafting, advocacy, client management, and ethical reasoning are minimal.

The persistence of lecture-based teaching methods exacerbates the problem. Herlinawati, Marwa, Ismail, and Situmorang (2024) emphasise that curricula focused on isolated theoretical content tend to produce graduates who can memorise information but cannot apply it in authentic contexts. Ayasrah (2023) and Owolabi and Ajayi (2023) similarly note that a lack of coherence, standards, and progression within curriculum structures undermines the development of higher-order thinking and professional competence. This gap is particularly critical in the Ugandan LLB context, where undergraduates often enter the legal profession theoretically knowledgeable but underprepared for practical challenges.

Collectively, this body of scholarship reveals a persistent gap between curriculum design and professional readiness. While global and Ugandan studies highlight the benefits of integrated, competence-oriented curricula, the specific structure of LLB programmes in Uganda remains largely unexamined. This underscores the importance of the present study, which seeks to evaluate LLB curricula structures, identify gaps in the LLB non-competence-based-curricular, and propose reforms that align undergraduate-legal-education with the practical demands of the profession and the objectives of UN-Sustainable-Development-Goal 4 (Quality Education).

Proposed Reforms to Establish a Competence-Based LLB Curriculum

The combination of a non-competence-based LLB curriculum, lecture-dominated pedagogy, minimal experiential learning, and the absence of detailed standards on curriculum design

and development constrains the quality of Ugandan undergraduate-legal-education. To align with UN-Sustainable-Development-Goal 4 (Quality Education), reforms should include standardizing the curricula across universities to ensure consistency in foundational and advanced legal training. Integrating experiential learning—such as mandatory moot courts, clinical placements, field placements, simulations, writing assignments, supervised probono activities, community engagement, and research projects—would enhance practical competencies. Teaching methods should emphasize the Socratic method, active learning, and problem-based approaches to cultivate critical thinking and applied legal skills. Additionally, assessment frameworks should balance theoretical knowledge with practical, hands-on evaluation to ensure undergraduates are practice-ready. Enacting and implementing a national policy or regulatory framework to guide curriculum design, assessment, and teaching methodologies would strengthen quality assurance, enhance uniformity, and ensure that all LLB graduates meet minimum professional competencies.

Results and Discussion

Using a qualitative, doctrinal approach with desktop research, this study systematically examined the structure of undergraduate LLB curricula across three Ugandan universities (A, B, and C). The analysis of curriculum documents, institutional reports, and regulatory frameworks revealed that each university independently designs its four-year LLB program, with the absence of detailed standards on curriculum design and development constraining the quality of Ugandan legal education. Early-year courses across universities consistently cover foundational subjects such as Constitutional Law, Criminal Law, Contracts, Torts, and Legal Methods, establishing a strong doctrinal base. Differences emerge in later years: University A provides diverse electives including clinical legal education and criminology, University B emphasizes commercial, public, and policy law, and University C offers only two compulsory courses in Year Four with broad elective options. Practical and research components are inconsistently integrated; for example, University B mandates a research paper, while clinical legal education remains elective at Universities A and C.

From a theoretical perspective, Educational Theory frames these findings as illustrating how content-heavy, lecture-oriented curricula limit the systematic development of competencies such as advocacy, legal drafting, ethical reasoning, and client-centered practice. Sociological Theory contextualizes the variation and fragmentation as products of institutional structures, norms, and the absence of detailed standards on curriculum design, reflecting systemic limitations in ensuring education quality. Human Capital Theory highlights the implications for professional readiness and societal outcomes, indicating that inconsistent curricula constrain undergraduates' employability and contribution to national development.

The thematic and documentary analysis revealed persistent gaps in practical and professional competence. Experiential learning opportunities—moot courts, clinical placements, simulations, and pro bono engagements—are often elective or co-curricular, and assessment methods focus predominantly on theoretical examinations and lecture-based assignments. This reinforces memorization over applied skills, leaving undergraduates theoretically knowledgeable but underprepared for real-world legal practice. The analysis also showed uneven development of core competencies, with some students accessing advanced electives while others complete the LLB with minimal exposure to client management, legal drafting, and courtroom procedures.

The findings align with global and local scholarship demonstrating that conventional, non-competence-based curricula fail to foster problem-solving, critical thinking, and applied legal skills (Bhatia & Kumar, 2025; Harianto, 2024; Herlinawati et al., 2024). Desktop research revealed that gaps are compounded by inconsistent sequencing of foundational, intermediate, and advanced courses, reflecting structural limitations within the higher education system, as emphasized by Sociological Theory.

Analysis of the curricular gaps using thematic content and doctrinal review supports targeted reforms. The study recommends standardizing core LLB courses units across universities to ensure uniformity in foundational and advanced training. Experiential learning should be integrated as mandatory credit-bearing components, including moot courts, clinical-placements, simulations, supervised pro bono work, community-engagement, and research projects. Pedagogical approaches must shift from lecture-dominated teaching to Socratic, problem-based, and active learning methods to cultivate analytical, critical, and applied skills. Assessment frameworks should balance theoretical knowledge with practical evaluation to ensure competence. Establishing a national-policy or regulatory-framework for curriculum design, teaching, and assessment would enhance quality assurance, ensure minimum professional standards, and improve the uniformity and relevance of LLB programs.

Applying Human Capital Theory, these reforms would strengthen undergraduates' employability, professional readiness, and societal contribution. Educational Theory supports designing curricula around explicit learning outcomes and cumulative skill development, while Sociological Theory underscores the need for institutional and policy alignment to embed competence-based education within the higher education system. Collectively, the findings demonstrate that transitioning from fragmented, theory-heavy curricula to coherent, competency-oriented programs is essential for producing practice-ready, ethically grounded law-undergraduates aligned with the SDG 4.

Conclusion

This study examined the structure, gaps, and potential reforms of undergraduate Bachelor of Laws (LLB) curricula in Uganda through a qualitative, doctrinal analysis of curriculum documents from three universities. The findings reveal that LLB programmes are largely content-heavy, lecture-driven, and fragmented, with significant variation in course offerings, electives, and practical components. The absence of detailed standards on curriculum design and development constrains the quality and consistency of undergraduate-legal-education, resulting in undergraduates who possess strong theoretical knowledge but limited practical competence in advocacy, legal drafting, ethical reasoning, and client management.

The implications of these findings are significant. Fragmented, non-competence-based curricula reduce professional readiness, limit employability, and weaken public confidence in Uganda's undergraduate-legal-education-system. From a theoretical perspective, Educational Theory highlights misalignment between curricula and desired competencies, Sociological Theory situates the gaps within institutional structures and practices, and Human Capital Theory underscores the lost societal and economic potential of underprepared undergraduates.

The study is limited by its reliance on desktop research; data were drawn solely from curriculum documents and scholarly sources, without input from students, faculty, or legal

practitioners. Future research should complement these findings with empirical fieldwork to verify how proposed reforms impact professional competence.

Based on the findings, the study recommends standardizing curricula across universities, integrating compulsory experiential learning such as moot courts and clinical placements, adopting competency-focused teaching methods, reforming assessments to include practical evaluation, establishing a national policy framework for curriculum design, investing in faculty development, and implementing continuous monitoring and review. These measures will promote coherent, competence-based LLB curricula, producing ethically grounded, practice-ready undergraduates aligned with United-Nations-Sustainable-Development-Goal 4 (Quality Education).

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Cross-Cultural Adoption of Generative Artificial Intelligence in Higher Education: A Longitudinal Socio-Technical Analysis Using the AI-CLASSIC Framework

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Abstract

Global interest in Artificial Intelligence (AI), and particularly Generative AI (GenAI), has increased sharply over the past decade. While adoption in higher education is accelerating, it remains uneven across countries, institutions, and cultural contexts. Most existing research emphasises automation efficiency, AI literacy, or short-term classroom use, offering limited insight into how GenAI becomes embedded within educational systems over time. This paper introduces AI-CLASSIC (AI Adoption in Classroom Instruction and Cross-Cultural Comparison), a longitudinal, multi-level socio-technical framework integrating classroom practices, institutional readiness, and societal discourse. Drawing on pilot data from Germany, Nigeria, and India, we demonstrate that similar levels of GenAI usage may arise primarily because of different adoption mechanisms. Regression-based analyses identify perceived usefulness as a universal driver, while risk perception, institutional constraints, and cultural expectations shape adoption pathways differently across contexts. By operationalising adoption, the AI-CLASSIC framework proposes the AI Competency Index (ACI), which will be systematically validated in subsequent longitudinal work. This study advances cross-cultural comparability and provides a scalable foundation for predictive modelling and policy-relevant foresight in AI-enhanced higher education.

Keywords: generative AI, artificial intelligence in education, cross-cultural research, socio-technical systems, AI-CLASSIC, higher education

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Introduction

Global interest in generative artificial intelligence (GenAI) has increased sharply over the past decade. There is a substantial growth in both patent activity and reported use among students in higher education (Digital Education Council, 2024; Higher Education Policy Institute, 2025; World Intellectual Property Organization, 2024).Despite this unusual spread, most applications continue to focus on automation and the externalisation of human cognition rather than complementing human intellectual capacity (International Labour Organization, 2023). This situation creates a challenge between efficiency-driven AI and human-centred educational values.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) through ethical guidelines promote responsible GenAI integration. But their impact is undermined by digital divides and uneven national readiness. Also, socio-technical disparities are reinforced through policy fragmentation and media discourse (International Telecommunication Union, 2024; Korneeva et al., 2023). These dynamics present the need to investigate how AI adoption unfolds in different national and cultural settings. While adoption patterns vary widely across countries (Mansoor et al., 2024), existing research remains geographically limited, methodologically fragmented, and largely based on short-term snapshots. The goal of this paper is to advance a longitudinal, cross-cultural, and computationally grounded framework for examining how generative AI is adopted and embedded within higher education.

Why Cross-Cultural AI Research in Higher Education

AI adoption does not happen in a vacuum; it takes shape within the everyday realities of educational systems, institutional practices, and national contexts. Germany, Nigeria, and India offer particularly important contrasts. In Germany, higher education places strong emphasis on critical thinking, academic integrity, and ethical reflection, supported by well-developed infrastructure and relatively stable policy frameworks (Zawacki-Richter et al., 2019). India has rapid uptake of generative AI tools, but this expansion is uneven, limited by gaps in connectivity and insufficient faculty training that affect scalability (Kamble et al., 2024). In Nigeria, growing student demand for AI tools coexists with infrastructural limitations, fragmented policy approaches, and uneven national strategies for AI integration (Adesiji, 2024).

Cultural and educational traditions further influence how generative AI is used in practice. In exam-oriented systems of Nigeria and India, students tend to rely on GenAI for summarisation, rote learning, and exam preparation. But in Western countries, originality and independent thinking are emphasized. Also, GenAI is more often used for brainstorming, drafting support, and idea development (Zawacki-Richter et al., 2019).Recent empirical work confirms that these different educational expectations play a decisive role in influencing patterns of AI use (Ibeh et al., 2025). These contrasts support the need for cross-cultural perspective for understanding AI adoption as a broader, system-level process rather than a uniform or purely technical phenomenon.

Theoretical Foundations

AI-CLASSIC is grounded in a multi-level socio-technical framework integrating organisational theory, educational psychology, and technology adoption research. At the macro level, Cultural–Cognitive Institutional Theory (CCIT) (Scott, 2008) explains how national

norms, regulatory regimes, and institutional logics shape AI legitimacy, policy discourse, and adoption attitudes.

At the meso and micro levels, Socio-Technical Systems Theory (Pasmore et al., 2019) and the Technology Acceptance and Use Continuum (Venkatesh et al., 2012) link technological affordances with institutional practices and user perceptions.

At the micro level, constructivist learning theory, self-efficacy theory, and self-regulated learning (SRL) frameworks (Bandura, 1997; Panadero, 2017; Zimmerman, 2002) conceptualise AI use as an active, metacognitive process shaped by learner agency. Evidence on AI-related self-efficacy further underscores the role of cognitive and motivational factors (Liang et al., 2023). These perspectives enable AI adoption to be modelled as a complex adaptive system (Holland, 2006), bridging behavioural logs, attitudinal surveys, and societal discourse.

Limitations of Existing Research

Most studies on AI in education focus on AI literacy, perceptions, or short-term classroom use (Crompton & Burke, 2023; Stöhr et al., 2024). However, findings are inconsistent across disciplines and contexts and often entangled with ethical debates (Korneeva et al., 2023). Existing frameworks such as DigComp 2.2 (Vuorikari et al., 2022) and UNESCO's AI Competency Framework mainly rely heavily on self-report measures and remain context specific.

Snapshot models such as the Technology Acceptance Model (TAM), Innovation Diffusion Theory (IDT), Normalization Process Theory (NPT), and the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) are used to explain immediate drivers of AI adoption, but they are limited in terms of how adoption evolves over time. In particular, these approaches struggle to account for changing motivations, longer-term learning processes, and the feedback loops that develop as users interact repeatedly with AI systems (Cukurova, 2025). Although computational methods could help address these gaps, they remain under-used in educational research.

Methodology

Design and Data

Pilot data collection demonstrates feasibility across contexts (refer to Table 1). In Germany, a longitudinal classroom-based cohort (n = 210) is being followed over time. In Nigeria, a national multi-institutional survey (n = 445) demonstrates scalability. In India, a zonal survey (n = 62+) is ongoing with planned expansion.

Table 1
Overview of Preliminary Pilot Studies Across Germany, India, and Nigeria (2025)

Country	Sample Size	Design
Germany	210	Longitudinal (classroom)
India	62+	National (zonal, ongoing)
Nigeria	445	National (multi-institution)

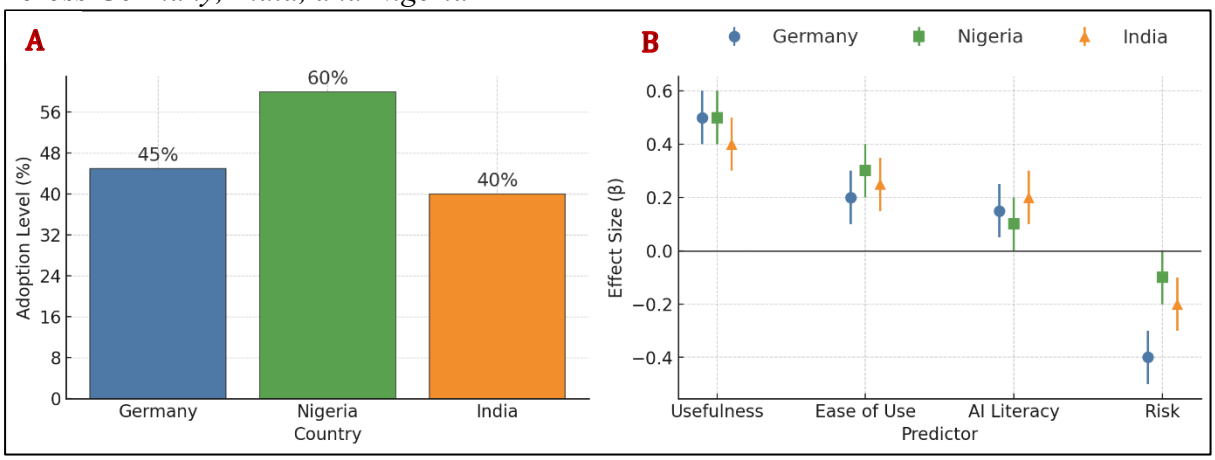
Measures and Analysis

Measures include GenAI usage frequency, perceived usefulness, ease of use, AI literacy, and risk perception. Analyses integrates descriptive comparison and regression modelling, informed by TAM/UTAUT constructs adapted for cross-cultural contexts.

Results and Discussion

Preliminary results show comparable adoption levels across countries, with Nigeria (~60%) slightly higher than Germany (~45%) and India (~40%). However, regression-based analyses (Figure 1) reveal divergent mechanisms. Perceived usefulness resulted as the strongest predictor across all contexts. Risk perception exerts a pronounced negative effect in Germany.

Figure 1
Preliminary Pilot Results on Weekly GenAI Usage (Left) and Adoption Drivers (Right) Across Germany, India, and Nigeria



Results reflect that Germany has more ethical, privacy, and institutional influence on how generative AI is perceived and used. Nigeria and India on the hand, AI adoption is driven primarily by pragmatic considerations. These include exam preparation, and immediate academic utility. Across all the target countries ease of use and AI literacy contribute positively to adoption, but they remain secondary to these broader structural and cultural drivers.

These findings show that similar levels of AI use can result for very different reasons. Apparent convergence in adoption rates therefore masks substantial differences in underlying factors e.g. motivations, constraints, and institutional conditions. This divergence highlights the limits of single-factor or context-neutral explanations of AI adoption and points to the need for a framework that can capture interactions across classroom practices, institutional governance,

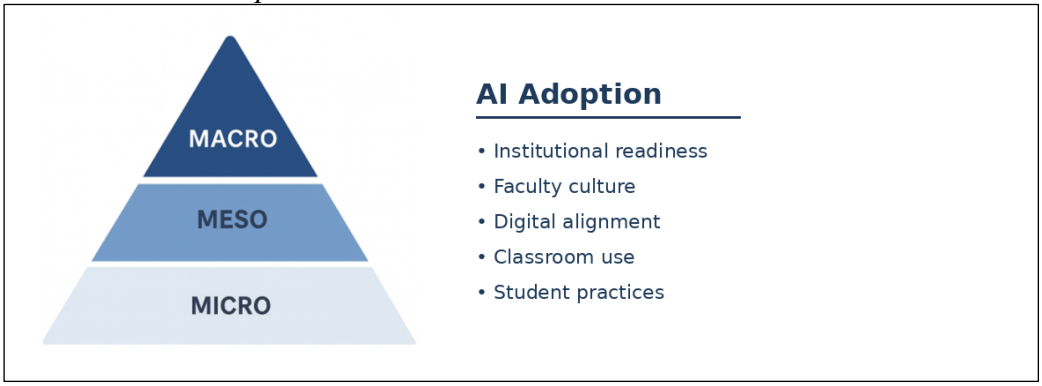
and wider cultural and policy environments. A multi-level socio-technical perspective is therefore essential for understanding not only whether generative AI is adopted, but how and why adoption pathways differ across educational systems.

The AI-CLASSIC Framework and the Proposed AI Competency Index (ACI)

The AI-CLASSIC (AI Adoption in Classroom Instruction and Cross-Cultural Comparison) addresses persistent gaps in literature by conceptualising generative AI adoption in higher education as a multi-level socio-technical process rather than a single behavioural or attitudinal outcome. The framework integrates behavioural traces, attitudinal measures, institutional indicators, and societal discourse across Germany, Nigeria, and India, enabling systematic comparison across educational and cultural contexts.

As illustrated in Figure 2, AI adoption needs to be modelled as a hierarchically structured but interconnected system comprising three analytical levels.

Figure 2
AI-CLASSIC Conceptual Framework



At the micro level, AI adoption is mainly through classroom practices and learner cognition, including patterns of GenAI use, perceived usefulness, AI literacy, and self-regulated learning. These practices are shaped and constrained at the meso level by institutional capacity and governance, such as curriculum design, assessment regimes, faculty culture, and infrastructural readiness. On the other hand, the AI adoption at macro level involves broader factors such as cultural norms, ethical expectations, regulatory frameworks, and national AI policies provide the structural conditions that legitimise, enable, or restrict institutional and classroom-level adoption.

This multi-level integration forms the proposal of a conceptual foundation of the AI Competency Index (ACI). Rather than relying on self-reported AI literacy alone, the ACI operationalises adoption as a validated composite construct that combines behavioural logs, survey-based perceptions, institutional indicators, and policy discourse.

The AI-CLASSIC framework models generative AI adoption in higher education as a unified, multi-level socio-technical system. This encompasses micro-level classroom practices and learner cognition, meso-level institutional capacity and governance, and macro-level cultural and regulatory environments. The AI-CLASSIC proposes a new framework for understanding the AI adoption through the AI Competency Index (ACI), enabling longitudinal and cross-cultural comparison of AI adoption.

Implications

The findings emerging from AI-CLASSIC underline why uniform or one-size-fits-all approaches to AI governance in higher education are unlikely to be effective. Although overall levels of generative AI use may appear comparable across countries, the underlying drivers of adoption differ substantially. In essence, Institutional responses need to therefore move beyond general statements on AI use and address the specific socio-technical conditions within which students and educators operate. In addition, there should be a careful balancing of perceived usefulness, risk communication, governance structures, and educational culture. In contexts where AI adoption is driven primarily by pragmatic needs—such as exam preparation or workload reduction—policy interventions should focus on supporting responsible use through clear guidelines, assessment redesign, and targeted capacity building. In settings where ethical concerns, data protection, and academic integrity are more prominent, institutions must prioritise transparency, trust-building, and participatory governance mechanisms that involve both staff and students.

For policymakers, the results suggest that global ethical frameworks for artificial intelligence cannot be applied mechanically across national systems. While international guidelines provide important normative direction, their effectiveness depends on how well they are adapted to local regulatory environments, infrastructural realities, and cultural expectations. AI-CLASSIC highlights the importance of aligning ethical principles with institutional practices and classroom realities. There is need to ensure that governance strategies remain both context-sensitive and educationally meaningful.

Limitations and Future Research

This study is subject to several limitations that should be acknowledged. First, the pilot samples are uneven across countries, with behavioural log data currently concentrated in the German longitudinal cohort. While this design reflects differences in data access and institutional partnerships, it limits the extent to which behavioural comparisons can be made across all contexts at this stage. Second, the present analyses focus primarily on associative relationships, and do not yet allow for strong causal inference. These limitations point directly to directions for future research.

Subsequent waves of data collection will extend behavioural logging to additional contexts and strengthen the longitudinal component of the study. This will enable more robust modelling of temporal dynamics. This will require examining dynamics in the motivation, learning strategies as well as institutional responses over time. Future work should develop and validate the AI Competency Index (ACI) by refining its components, testing measurement invariance across cultures, and integrating predictive modelling techniques. These extensions will therefore allow AI-CLASSIC to move beyond descriptive analysis toward forecasting adoption trajectories and identifying leverage points for policy intervention.

Conclusion

AI adoption in higher education should not only be understood as a technological choice or short-term response. Researchers should investigate AI adoption as a longitudinal and socio-technical transformation. There should be focus on how interactions between learners, institutions, and broader cultural and regulatory environments are shaped. The AI-CLASSIC

framework provides a structured way to capture these interactions. It also shows how similar levels of AI use can emerge from very different underlying mechanisms.

By combining cross-cultural comparison with longitudinal analysis and computational modelling, AI-CLASSIC offers a rigorous and scalable approach to studying how generative AI moves from novelty to normalised educational infrastructure. This will support evidence-based institutional decision-making. It will aso support more nuanced AI governance, and the development of inclusive policies that recognise the diversity of educational systems worldwide.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that generative AI tools were used only for limited language refinement and stylistic clarity. All substantive content, analysis, interpretation, and conclusions are the original work of the authors, who take full responsibility for the manuscript.

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Increased Efficacy of Teacher Curated Lesson Materials in Learning Management System

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Abstract

Reportedly, in the times of AI and disruptive technologies the sustained usage of faculty-made lesson materials by students were adversely being affected. Thereby, impairing the digital learning with Learning Management System (LMS), meant to enrich educational activities, especially in traditional spaces. To address a similar scenario in author's institution, a design for six sigma using DMADV methodology was initiated along with academic leadership team across various verticals of media, design, pharmacy, allied health, business & management, hospitality & tourism, and computing & analytics with a target to increase the effective usage of lesson materials from sub-optimal (below 25%) to above-optimal level (above 55%) within the period of 3 months of project implementation across the institution. The financial motivation of institution has been the maximization of return on investment on digital infrastructure, minimization of student backlogs and year lags that majorly would lead to dropouts. On the other, improvement in intake quality over the competition based on higher quality of learning outcomes. This paper elucidates the structured view of the project in form of a charter, voice of stakeholders, SIPOC, prioritization, CTQ specification table, sampling of students, faculty and alumni, root cause analysis, Kano modelling, statistical tests and validation of the new design by way of repurposing Bloom's Taxonomy with 10 human-human potential tracks of engagement, each mapped with higher-order thinking triplet verbs for best-fit lesson materials of value, negating rework and waste.

Keywords: lesson-material, real-time, value, design, DMADV

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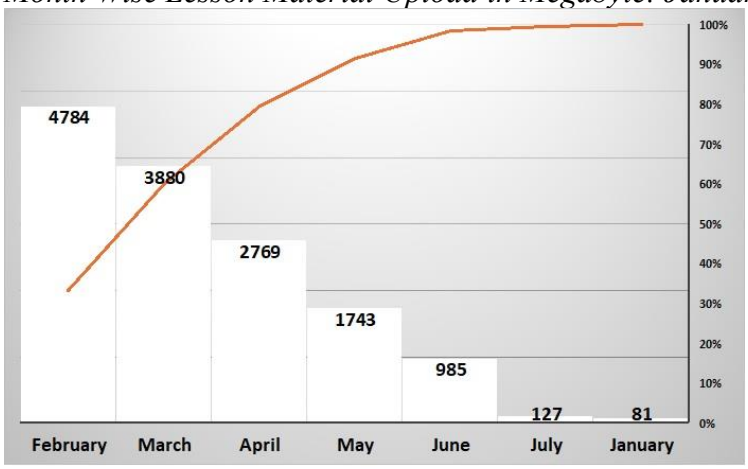
Background

From the data analysis of lesson materials uploaded on our institution's Learning Management System (LMS)[1] covering the even semester of 2025 (January – June) it was found that 6123 files, totaling nearly 15 Gigabyte,[2] additionally with 1045 links to internet resources were made available by 96 teachers, targeting 2548 undergraduate and 790 post graduate students. A Pareto analysis (Figure 1) in the above-mentioned period indicated that most of those materials were uploaded between February and mid-March (source: author, based on LMS data). Aside from that students were required to upload files as part of their continuous evaluation and other assigned tasks amounting not only to huge LMS information load but also raising concerns about its efficacy.

Yet, the information loading has been a routine compliance exercise without factoring students' receptibility of those materials. As a result, the teacher curated lesson materials in the era of Artificial Intelligence (AI) and disruptive digital technologies consistently showed a decline in sustaining the pull and engagement of students with LMS materials. It was a major roadblock for the LMS to transform from passive storage to active learning platform that would be dynamic, essential and optimal. In our consideration, sub-optimal use of lesson materials was anything less than 25% and above optimal, to begin with, was anything more than 55% for gradual elimination of rework and waste in form of unused or underused LMS materials by students.

Figure 1

Month-Wise Lesson Material Upload in Megabyte: January–June 2025



Source: Author

Literature

The Bloom's original *Taxonomy of Educational Objectives* work was revised (Anderson & Krathwohl, 2001) with emphasis on using action verbs for cognitive processes and categorizing types of knowledge, making it more practical for curriculum design, instruction, and assessment. Besides, to help educators more precisely with effective learning outcomes through effective teaching and assessment. Furthermore, how students could excel with real problem-injected learning compared to traditional instruction (Chiu, 2021), particularly when learning

[1] Digicampus (LMS) of NSHM Knowledge Campus Kolkata. India (author's institution).
[2] A Gigabyte is either 1 billion bytes in the decimal system or 1,073,741,824 bytes in the binary system, which equals 1024 Megabytes. In context, a Megabyte equals 1024 Kilobyte, and a Kilobyte equals 1024 bytes.

was meant to be inherently interesting and meaningful in satisfying the psychological needs of competence, autonomy and relatedness for academic success (Froiland, 2011).

The need, therefore, was clear. Teacher-curated lesson materials hosted on LMS must be attractive to students. In practice that was not, even when those materials were found to be instructionally robust and aligned with course outcomes (Bond, et al., 2020; Henderson, et.al, 2017). Because, students increasingly depended on external digital resources, peer-generated content, and AI-mediated summaries, frequently bypassing institutional learning materials (Selwyn, 2019; Zawacki-Richter, et al., 2019). A pattern that portrayed the necessity of instructional quality and accessibility with its sufficiency to establish the real-world usefulness of teacher-curated lesson materials as a value gain. Nevertheless, pedagogical frameworks[3] typically assumed that student's engagement would emerge once barriers were removed, instructional design was optimized, or learner activity got increased. However, what remained comparatively under-theorized was a more foundational question: why should students feel compelled to return to faculty lesson materials when alternative knowledge sources were readily available?

In response, the research instances involving dynamic synergies of teachers, students, and AI showed more adaptive, engaging, and personalised learning with honing of skills such as critical thinking, communication, collaboration, and creativity (Kwan, 2025). But there remained an issue with the verbs and repeat verbs for distinguishing the Bloom's cognitive levels in deployment of those verbs for teaching, learning and assessment (Stanny, 2016).

Introduction

In pursuit of project goal towards significantly improving the efficacy of LMS materials, the investigation using six sigma DMADV (Design, Measure, Analyse, Design, Verify) approach, proceeded with the understanding of the Voice of Customer (VOC) with a Google form survey using a discipline-wise randomized sample of our recent alumni batch. Thereafter, we conducted a focussed group discussion with sample participants over a Goggle meet. Because, as alumni, they had spent the entire student-life with the same LMS's lesson materials and, more so, were without any inhibition or bias after their graduation. The alumni respondents (n = 23) reported no daily use of materials on LMS to the question "*How often during your student days you referred to lesson materials*" and also did not strongly agree with the rest – "*Materials encouraged me to explore and discover more on the taught topics*", "*Materials were relevant and up-to-date*", "*Materials enhanced my knowledge and skills beyond classroom*" and "*Lesson materials on LMS complimented classroom teaching*".

Further, surveys involving a sample of our faculty, stratified based on their last annual appraisal reports, and students' sample, stratified based on their academic grades and disciplines, were conducted using blind, hand-filled questionnaires that ensured respondent diversity, unbiasedness, and anonymity. The survey had Likert-scale, Binary (Yes/No) questions, Categorical and Open-text items. Data were processed from faculty (n = 30) and students (n = 87) responses, enabling both quantitative and qualitative analyses based on questions under sections, namely, *Usage patterns*, *Perceived value*, *Access & usability*, *Communication & engagement* meant for Students and on the other, *Practices*, *Communication with students*, *Quality & resources*, *Challenges* meant for Faculty. Put together, the VOC of alumni, faculty

[3] Provides guidance on evidenced-based strategies and practices supporting an integrated approach for quality teaching aligning curriculum, assessment and pedagogy.

and students indicated low motivation and low expectation about LMS's lesson materials and fuelled the felt need to increase the efficacy of teacher-curated materials.

Given the above, our DMADV project charter focussed on creating a design for plausible solution using Design for Six Sigma (DFSS) methodology (Brue & Launsby, 2003) that can assure increased engagement and satisfaction of students by organically engaging teachers, students, and responsible AI for reclaiming pedagogical prowess in physical spaces without resisting technologies. Moreover, correct the uncontrolled content abundance in LMS and create immediate relevance thereby motivating students to primarily use the faculty-curated resources injected with Real Time Value (RTV) as a design response to the project goal.

Following that, a SIPOC (Suppliers, Inputs, Process, Outputs, Customers) was tabled (Table 1a) with Critical to Quality (CTQ) Specification (Table 1b) based on XY (cause and effect) prioritization matrix, which prioritized process inputs (Xs) based on their impact on customer-critical outputs (Ys), paving the way for positioning the RTV.

Table 1a
SIPOC

SIPOC	
Supplier	Course instructors, LMS administrators, Academic administration, Generative AI, In-house IT support team and Library
Input	Templates for lesson plan and lesson materials, LMS user manual/guides, LMS system, user-interface, Student enrolment data, Faculty data, Faculty-tagged courses, curriculum, attendance, cohorts, routines, system access credentials
Process	▪ Faculty Development Program ▪ Preparation of lesson materials ▪ Upload of materials on LMS ▪ Student access and download ▪ Communication booths for department-wise teachers' group, students' group ▪ AI-assisted real-world applications connect with materials and tasks/assignments, class interactions, group-presentations and multi-mode assessments ▪ Continuous Quality Improvement (Task-design, Teaching, Assessment, Lesson materials, Learning outcomes)
Output	Lesson Material Uploads, Questions/Tasks, Students' task submissions, LMS Usage logs, Survey feedback, Material diversity, RTV Class interaction/presentation, Grades
Customer	Students (primary target). Others (secondary) –Faculty, Internal Quality Assurance Cell, Accreditation bodies, Regulatory, Rating/Ranking agencies, Employers, Parents

Table 1b
CTQ Specification

CTQ Specification Table			
Student Need	CTQs (Students' Batch)	Measurement	Defect Definition
Relevant and Interesting Lesson Material with real-world application triggers	Curated Lesson Material available on LMS	Release status	> 3 days of start of course teaching
	Course articulation available on LMS	Course Outcome (CO)-Program Outcome (PO) mapping, CO-Bloom level mapping, Evaluation rubric	Unavailability
	Faculty expertise	Qualification, Experience, Fulfilment level	Unavailability
	Faculty teaching load	Average teaching hours/ week	> 20
	Faculty Industry awareness and trends	Average faculty hours spent in Industry or Industry relations (visits/collaborations)/ Semester	< 10
Joyful learning and practical engagement with tasks and materials	Problem/Project-based learning support	Average number of Batch-wise RTV assignments/ Semester	< 3
	Beyond classroom	Average student hours used in outdoor study, survey, project, internships etc./ Semester	< 30

Positioning of RTV

Even though, Universal Design for Learning (UDL) had substantial contributions by foregrounding equity and inclusion through multiple means of representation, engagement, and expression (CAST, 2018; Meyer, et.al, 2014), still reviews of UDL research indicated something concerning. That while such frameworks effectively reduced participation barriers, it offered limited guidance on how learners perceive the immediate value or necessity of learning materials once access is ensured (Al-Azawei, et.al., 2016; Rao, et.al, 2014). In that sense, UDL reportedly fell short of ensuring situationally meaningful engagement.

In the study of instructional design models such as Analysis, Design, Development, Implementation, Evaluation (ADDIE) and Technological Pedagogical Content Knowledge (TPACK) the emphasis was found on systematic alignment among content, pedagogy, and technology (Branch, 2009; Mishra & Koehler, 2006). Thereby, strengthening instructional coherence and teacher competence. Whereas learners, at the best, were meant to be recipients of optimized instruction. Arguably, therefore, even well-designed LMS materials were often underused in practice without definitive answers to reverse the trend. Additionally, from the study of another set of literature on design thinking approaches in education, which promoted creativity and problem solving through iterative innovation (Henriksen, et.al, 2017; Razzouk & Shute, 2012), it was apparent that the applications were through episodic or project-based interventions where the injection of real-time value inside taught lessons and materials were not mandated by design. Nevertheless, active learning and student-centred pedagogies were supported by strong empirical evidence in improving learning outcomes (Freeman, et.al., 2014; Prince, 2004).

However, it did not guarantee meaningful engagement or conceptual anchoring, particularly when activities were weakly integrated with coherent instructional narratives (Kirschner, et.al, 2006). So, lesson materials often remained optional supplements for teaching rather than indispensable learning resources.

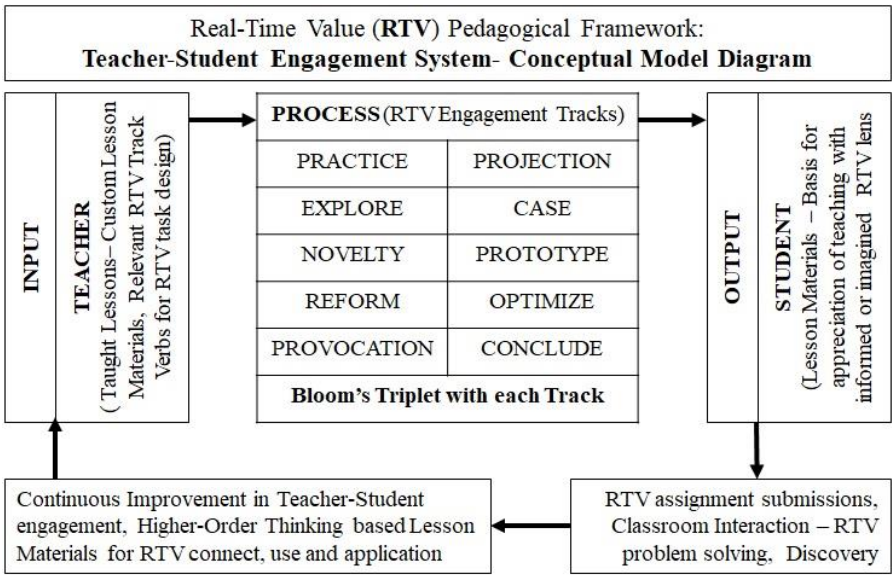
Gap Bridging

Conclusively, the research gap that emerged was the absence of a design logic that explicitly targets perceived real value of taught lessons and materials. Because, existing frameworks or models only prioritized access, alignment, participation, or creativity, but rarely addressed how learning materials can be designed to create immediate relevance and dependency during real problem encounters. Thus, RTV attempted to bridge that gap, by introducing, a value-first, design-led pedagogical construct. Here adding activities or enhancing access with superior user interfaces for user experience's sake was not the issue. Rather, RTV was a design to embed real-time relevant triggers within lesson materials for intentionally creating conditions under which students would be required to consult teacher-curated materials on LMS.

In doing so, RTV aimed to reposition lesson materials from passive to resources of "Must-be" necessity targeting the "Attractive–Performance" domain of the Kano model of quality and satisfaction[4] (Kano et al., 1984; Matzler & Hinterhuber, 1998). That way providing a strong basis to interestingly alter the traditional teacher-student engagement behaviour. Hence, RTV was not to be positioned as a conceptual proposition alone, but as a novel pedagogical framework (Figure 2) for rigorous and continuous application and evaluation by way of a self-organized human-human engagement system involving student tasks and teacher materials.

Figure 2

Real-Time Value (RTV) Pedagogical Framework



Source: Author

Subsequently, the RTV idea-acceptance was ascertained through survey polls conducted on LMS, which was open to all faculty and students' having private access credentials. The

[4] Quality and satisfaction (Kano model) characterized by a predictable evolution from a "delighter/attractive" (unexpected, high satisfaction) to a "performance" feature (desired) and finally to a "must-be" feature (expected, baseline) as customer expectations change over time.

analyses showed positive acceptability, though with some manageable concerns, as indicated in the summary report (Table 2). Going forward, RTV was to be tried and tested as a value injection inside lesson materials curated for RTV tasks, piloted with first semester students.

Table 2
Initial RTV Idea-Acceptance by Teachers and Students: *Survey Summary*

Faculty (n = 58)	**Students (n = 461)**
Overall faculty mean score (per respondent): 1.65 (on 0–3 scale where ~2+ is positive) RTV as a design ~71% positive. RTV with AI ~73% positive. Early Response Positive: majority leaning. **Interpretation**: Strong initial interest. Most faculty were found to be positively inclined toward RTV as a design and supportive of integrating AI where applicable, though there were neutral and concerned voices asking for RTV training workshop and more clarification.	Overall mean score (per respondent): 1.46 (more neutral to leaning positive). Early RTV ~71% positive. Early RTV experience ~ 67% positive. RTV initial use ~51% positive (many reported Low or Not at All). **Interpretation**: Students found the idea interesting, but current use of RTV-like tasks was limited. About half reported high present use while measurable portions reported low or no use. They were curious but expected scaffolding.

Methodology

To operationalize the perceived real-time value using RTV, a Design Science Research (DSR) paradigm was used to create a novel solution that was to be made defect-free and robust with DFSS (Hevner, et.al., 2004; Peffers, et.al., 2007). In this regard, both DSR and DFSS were considered integral to the design for delivering practical and optimized solution to address real-problem tasks with lesson materials. The DFSS (DMADV) methodological structure was finalized based on the previous analyses of student and faculty perceptions and research gap bridging that resulted in the identification of vital few CTQs (Table 3a & 3b) for proceeding with the RTV, as a mechanism for increased effectiveness of lesson material and its verification. Consequently, the RTV tracks with a triplet of engagement verbs against each track was laid out (Figure 3) for task allocation and material curation.

Table 3a
Vital CTQs in DFSS (DMADV) Design: Efficacy

Lesson Material Quality – Root CTQs	**Lesson Material Design**	**Effectiveness**
CTQ-1: Must support a RTV track with relevant taught material concepts	**Static**: Concept mapping diagram of entire course lessons (*common for one taught subject in a Semester*) **Dynamic**: RTV updated materials on LMS from time to time, Practice triggers, Linkages to internet resources and relatable examples.	Lesson material is effective if assignments truly show moderate-to-high use of RTV instances with expected outputs, well-attended RTV class interactions, Grand-RTV high-quality outputs, Attendance is by pull and not push, Value over volume is high (feedback)
CTQ-2: Must allow multi-track assignment creation and multi-mode tests		
CTQ-3: Must allow students to discover new materials both related (disciplinary) and related (inter-disciplinary)		
CTQ-4: Must allow evidence of outputs in sync with Course and Program outcomes		

Table 3b
Vital CTQs in DFSS (DMADV) Design: Verification

	Verification (Batch-wise, Semester-wise)
CTQ-1	Number of Training Programs/ Sessions on RTV attended by faculty > 2, Induction program on RTV for new faculty > 1, Slippages < 10% of faculty lesson materials were without any assigned engagement with RTV track
CTQ-2	RTV multi-mode assignments/tests conducted > 2, Slippages from teachers < 5%, Slippages from students < 10%
CTQ-3	Number of additional materials, reportedly used and verified, outside LMS Lesson Materials (RTV and Grand-RTV submissions) > 5, Slippage < 25 % of students
CTQ-4	Teacher materials with RTV > 75%, Valid RTV task submission by students > 70 %, Valid Grand-RTV submitted by groups > 90%, Course Outcomes covered > 80 %, Average increase in Cumulative Grade Point Average (CGPA) > 7 % (for students with previous CGPA > 6.5)

Figure 3
RTV Track based Teacher-Student Engagement Design

TEACHER		**STUDENT**
# **RTV Track**	**Engagement-Demand Verbs**	**Lesson Materials Efficacy (Measure)** (*single subject or combination of taught subjects*)
1. PRACTICE	Modify, Change, Improve	Active participation in class/Lab/field/home work and assessments based on assigned real value problems
2. EXPLORE	Assess, Appraise, Agree	Motivation for discovery of several resources in and around the given materials on topics of interest
3. NOVELTY	Originate, Create, Build	Learnt foundational knowledge and skills used for innovative pursuits and demonstrations
4. REFORM	Compare, Construct, Elaborate	Study of multiple lesson points and reconstruction of perspectives, especially with interest groups
5. PROVOCATION	Suppose, Propose, Predict	Ideas based on factual basis of materials serving as stepping stone for envisioning possibilities.
6. PROJECTION	Examine, Evaluate, Explain	Use in anticipated problem opportunity and solution
7. CASE	Take part, Survey, Test	Mapping of relevant situation for analyses and inference
8. PROTOTYPE	Design, Develop, Discuss	Model conceptualisation, preparation, presentation
9. OPTIMIZE	Estimate, Measure, Determine	Ability to quantify, compare, best-compromise, decide
10. CONCLUDE	Judge, Justify, Recommend	Relevant citations outside lesson materials supporting the RTV submissions (subject-RTV and Grand – RTV).

Source: Author and Bloom's Taxonomy

DSR-DFSS (DMADV) Integration

To reiterate, RTV design involved DSR and DFSS integration.[5] Specifically, the "Artifact Design and Development" stage of DSR was executed within the "Define" and "Measure" phases of DFSS(DMADV). The "Evaluation" component of DSR was synthesized with the "Analyse" and "Design" phases of DFSS(DMADV) to refine the solution. Finally, DSR-driven validation, conducted through testing and confirmation, was mapped to the "Verify" phase of DFSS to ensuring vital CTQs of the RTV were met by working with the shared objectives of DSR-DFSS integration under the project goal. Those were – a) Reposition lesson materials from passive references to resources of necessity, b) Embed engagement demands in lessons/tasks that necessitated consultation of faculty materials, c) Support higher order thinking without increasing cognitive overload, and d) Ensure applicability within and across disciplines and teaching contexts.

Table 4
RTV As Design Artifact (DSR) With DFSS Integration

Artifact Type	DSR Phase Actions	Problem identification	DFSS (VOC/VOF: LMS[2] materials underutilized)
CONSTRUCT	RTV as a design concept	Objectives	Lesson materials necessary for RTV task
MODEL	Teacher–Student engagement system	Design & development	RTV framework with distinct tracks for lesson material curation and use
METHOD	RTV task-design logic using Bloom triplets	Demonstration	Classroom RTV interactions and Grand-RTV group-presentations using lesson materials
FRAMEWORK	RTV tracks aligned to Kano (Basic, Delighter, Satisfier)	Evaluation	Surveys, Kano analysis, Beneficiary VOC/VOF
INSTANTIATION	RTV and Grand-RTV	Communication	*Student outputs:* Poster, Report, Article, Presentation, Posts, etc.

A Three-Tier Engagement

Tier 1- Cognitive Activation (Verbs). The verbs selected became the cognitive demand.
Tier 2- RTV Relatable Instance (Real-time local-global problem, Human-AI curated). The real-time problem became the context.
Tier 3- Lesson Material on LMS. It became the knowledge resource for accomplishing the assigned RTV task

The triangulation of the above tiers assured that RTV and Grand-RTV, a flip-learning[6] activity, were value-first (Figure 4), backed by Kano-informed educational value classification and engagement logic.

[5] In integration context, DSR delved on the "how" of RTV designing while DFSS focused on the "what "of measurement and control.
[6] Through group work, debates, labs, fieldwork, and real problem-solving with teacher support.

Figure 4

RTV and Grand-RTV Tasking of Students for Curation of Lesson Materials

RTV	**Grand RTV**
Mid-term	End-of-Teaching
Subject-wise	All subjects combined
Do-it-Yourself	Group-based (flip-learning activity)
On/Off-campus activity	On-campus activity
Common Objectives	
Use of AI for generating relatable RTV instances (in and around taught topics)	
RTV Track(s) based task design with the engagement-demand verbs (Fig.3)	
Lesson Materials made available and discussed for the assigned RTV tasks	
Task submission (*with or without use of AI declaration*) and evaluation -- presentation, viva voce, class interaction, peer learning, outputs, feedback	
Continuous quality improvement in -- pen-on-paper examinations, participative and interactive teaching & learning, other course and program outcomes	

Source: Author

Findings

Our early findings were based on RTV subject-wise assignment, evaluation, material submissions on LMS, teacher moderated class interactions around those submissions, and feedback. From that it was fair to conclude that RTV aligned well with the constructivist and situated learning perspectives, which corroborated that learning value emerged most strongly when knowledge was activated within authentic or anticipatory contexts (Brown, et.al., 1989; Jonassen, 1999). Particularly, when challenged to reinterpret, reformulate, or apply concepts (Vosniadou, 2008). Subsequently, a reference template (Table 5) for Grand-RTV task design was made available using an ideal distribution of subject-wise representation in Grand-RTV's group-wise task-design for conducive material preparation and use by each of the groups. Finally, RTV design, as a response to the project goal, were mapped in alignment with Kano zones (Table 6), which captured the fitment of RTV tracks thereto.

Table 5

Distribution of Subject Topics in Grand RTV Group-Tasking: Reference Template

Batch *xyz* **Semester #**	% age distribution of taught topics of subjects for Grand RTV task generation using AI (*an example using 6 core-subjects and 6 groups/ Batch, Group size 3–10 students*)						**Total**
	Group (a)	Group (b)	Group (c)	Group (d)	Group (e)	Group (f)	
Subject 1	25	15	15	15	15	15	100
Subject 2	15	25	15	15	15	15	100
Subject 3	15	15	25	15	15	15	100
Subject 4	15	15	15	25	15	15	100
Subject 5	15	15	15	15	25	15	100
Subject 6	15	15	15	15	15	25	100
Total	100	100	100	100	100	100	

Table 6
RTV-Kano Modelling

RTV Track	Kano Zone	Research Basis	Justification	Insight
PRACTICE	**Emerging Attractive**	Deliberate practice theory (Ericsson, 2008). Formative feedback loops (Hattie & Timperley, 2007).	Students perceived immediate usefulness when lesson materials became necessary for task refinement	Converted static content from Indifferent to Performance (Kano zones).
EXPLORE	**Attractive**	Peer calibration and judgment (Nicol & Macfarlane-Dick, 2006). Metacognition and self-regulated learning (Zimmerman, 2002).	Students considered lesson materials as stepping stones for real world understanding and exploration	Students not only read but also experienced the faculty materials
NOVELTY	**Attractive**	Constructivist knowledge creation (Jonassen, 1999). Creativity in learning (Kaufman & Beghetto, 2014).	Students exhibited learning delight (Kano delighter)	Students accepted RTV as differently engaging with self-urge for next
REFORM	**Emerging Performance**	Dialogic teaching (Alexander, 2017). Conceptual change theory (Vosniadou, 2008).	Intentionally, students reconstructed their prior understanding from lesson materials	Created "must-consult" necessity for lesson materials
PROVOCATION	**Attractive (High)**	Inquiry-based learning (Hmelo-Silver, et al., 2007). Epistemic curiosity (Loewenstein, 1994).	Activated curiosity gaps that was only to be resolved with the help of teacher(s) and materials	Students felt intellectual "pull" not "push" (Kano delighter- High)
PROJECTION	**Attractive**	Situated cognition (Brown, et.al, 1989). Transfer of learning (Perkins, Salomon, 1992).	Moved knowledge into the related and anticipated uses	Students began perceiving lesson materials as tools, not mere notes
CASE	**Emerging Attractive**	Case-based reasoning (Kolodner, 1997). Experiential learning cycle (Kolb, 1984).	Anchored theory to realism, increasing performance needs - linear satisfiers[7]	Strong stabilizer track-- prevented RTV becoming overly abstract
PROTOTYPE	**Emerging Performance**	Learning by making (Papert, 1980). Design-based learning (DBL literature).	Materialized learning and demanded deep reference to faculty materials	Delivered majorly through Grand RTV submissions
OPTIMIZE	**Performance**	Quantitative reasoning in learning (Shavelson, 2008). Decision-based learning (Plummer, et.al., 2017).	Reinforced analytical rigor and decision-making capacity	Evident in STEM[8] and applied fields based RTV submissions
CONCLUDE	**Emerging Must-Be**	Argumentation theory (Toulmin, 1958). Critical thinking frameworks (Facione, 2011).	Demanded synthesis, evidence, and defensible judgment	Transitioned to "Must-Be" (Kano), especially, with Grand RTV

[7] linear satisfiers are service or product characteristics that generate satisfaction when fulfilled and dissatisfaction when not fulfilled.
[8] Science, Technology, Engineering, and Mathematics (STEM) education focused on real-world problem-solving, critical thinking, and innovation.

Conclusion

Our project provided a rigorous and transparent structure for the design, optimization, and validation of the RTV design framework in structuring how learning experiences can be intentionally created and sustained with Bloom's taxonomy that is used as a design grammar, ensuring internal coherence between tasking of students and lesson materials. However, our validation was at the best indicative as the DMADV's Verify phase was undergoing during the time of writing this paper. Further, naturally occurring educational variability over a prolonged period was required to be observed against our reported early findings.

Anyways, it can be reasonably concluded that our project demonstrated how a minimum viable RTV design can created using quality engineering principles like six sigma that can be used to make academics more relevant in the times of AI. Here it can be claimed that RTV design was successful in navigating the Kano transition from a purely "Attractive/Delighter" attribute to a "Performance" attribute. Because the RTV's brought coherence in taught lesson, lesson material and assessment quality that surfaced as a primary driver of student satisfaction. Supported by harmonious faculty scaffolding, the RTV is poised to building the reliability necessary to eventually be classified as a "Must-be" requirement, where its absence would be viewed as a critical failure in meeting teacher-student engagement needs. That is for the far later with extremely strong and sustained faculty scaffolding adaptive to students' demand on their choice of RTV track, their combination of tracks, their time, and at their desired level of task-difficulty.

Meanwhile, from the findings, two RTV tracks, *Provocation* and *Conclude* used in loop, would be highly recommended as a combination for university students of any discipline interested with thinking-based innovative deliverables. Aside from that, certain spinoffs would be like – reduced teaching load, leaner information-load and waste-mitigation, effective self-learning and discovery, and importantly, saved teaching-hours deployed productively for mentorship, faculty development, and research. Indeed, such realities and possibilities with RTV should excite students, researchers, educators and other stakeholders of higher education.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

No use: The author declares that no AI-assisted software like Grammarly was used to refine or correct the content in the manuscript or for generation of figures and tables of manuscript.
Use: The usage of AI assistance from ChatGPT and Gemini ai were limited to insights on the RTV design distinctiveness, similar working cases in comparison, and for mock-practice with generation of real time instances for RTV and Grand-RTV based on select set of taught topics, as part of the project requirements.

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Encouraging the Implementation of Sustainable Development Practices in Open Distance Learning Higher Education Institutions: Utilizing Structural Equation Modeling for Analysis

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Abstract

This study investigates barriers to sustainable development (SDG 4) in Indonesia's online distance education, using Universitas Terbuka (UT) as a critical case. Despite national policy commitments, institutional adoption faces challenges including high staff turnover, resource fragmentation, and unclear implementation pathways. Employing a quantitative design, data researcher collected from 1,152 UT staff across 39 Indonesian regions and one overseas office via mixed online/face-to-face surveys. Structural Equation Modeling (SEM-PLS) analysis revealed: (1) Leadership Style, Behavioral Control, and Organizational Commitment significantly drive Sustainable Development Practices ($\beta = 0.38$, $p < 0.01$; $\beta = 0.29$, $p < 0.05$; $\beta = 0.41$, $p < 0.001$); (2) Turnover Intention mediates sustainability success, explaining 33% of variance. By extending the Theory of Planned Behavior (TPB), researchers show Organizational Commitment as the pivotal filter translating leadership into behavioral change. Practical recommendations include: (a) embedding sustainability KPIs into performance standards, (b) charismatic leadership development programs, and (c) targeted retention initiatives for high-impact roles. Future research should explore green compensation models to strengthen UT's sustainability-turnover nexus.

Keywords: SDGs, Theory of Planned Behavior, structural equation modeling, green HRM, higher education sustainability

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Introduction

Global higher education institutions face intensifying pressure to adopt sustainable development practices, ensuring their long-term relevance while addressing complex societal challenges. Defined by Brundtland (1987) as “progress meeting present needs without compromising future generations”, sustainability has become institutional imperative across economic, social, and environmental dimensions (Kantabutra & Ketprapakorn, 2020). Yet implementation declines globally due to organizational barriers (Diez-Cañamero et al., 2020) a critical concern given universities' instrumental role in advancing UN Sustainable Development Goals (SDGs) through future leader development (Amin et al., 2025; Saxena et al., 2021; Sidiropoulou, 2023).

Indonesia exemplifies this tension through its Medium-Term National Development Plan (RPJMN 2020-2024), which aligns with 2030 SDG targets yet confronts unique contextual constraints (Marten et al., 2023; Pramana et al., 2021). For open and distance education (ODE) provider Universitas Terbuka (UT), sustainability adoption is complicated by teacher-centered traditions conflicting with participatory SDG frameworks and archipelagic dispersion across 17,000 islands fracturing resources. Serving 400,000+ students 70% under age 30 through 200+ Merdeka Belajar Kampus Merdeka (MBKM) partnerships, UT leverages its scale to pioneer context-responsive solutions: designing structured social activities for part-time workers, delivering targeted digital literacy programs, and forging multi-sector alliances to expand internet access in bandwidth-constrained regions (average 10 Mbps). These efforts position UT as Indonesia's living laboratory for sustainable ODE innovation.

Theoretical grounding comes from Ajzen (1991) Theory of Planned Behavior (TPB), which posits that sustainability practices emerge from intentions shaped by attitudes, subjective norms, and behavioral control with attitudes often dominating behavioral prediction (Ajzen et al., 2018). At UT, behavioral control manifests acutely as infrastructure access disparities. Researchers extend TPB by integrating organizational variables critical to institutional sustainability: leadership style as transformational leaders inspire SDG engagement while transactional approaches prioritize task efficiency (Mekhum, 2020); organizational commitment for affective loyalty boosts participation (Cop et al., 2020; Nguyen et al., 2025); and turnover intention which mediates sustainability success through knowledge retention and team stability (Guzeller & Celiker, 2020).

This framework generates four hypotheses: First (H1), Leadership Style, Attitude, Social Norm, Behavioral Control, and Organizational Commitment collectively drive Sustainable Development Practices. Second (H2), these same factors significantly influence Turnover Intention, where transformational leadership reduces exit likelihood while transactional rigidity increases it (Piwowar-Sulej & Iqbal, 2023). Third (H3), Turnover Intention negatively impacts sustainability through institutional memory loss and resource diversion. Finally (H4), Turnover Intention mediates other variables' effects on sustainability particularly in UT's resource-scarce regions where staff retention determines project continuity. By testing these relationships, this study provides actionable insights for scaling sustainability in Indonesia's expanding ODE ecosystem.

Methodology

Research Design

This quantitative study investigates how Sustainable Development Goals (SDGs) are being implemented by academic and non-academic staff at Universitas Terbuka (UT) Indonesia's national open and distance-learning university. A structured questionnaire was administered to 1,152 employees spread across 39 regional offices and one overseas representative. Data was gathered over three months using a multi-mode survey: respondents could complete the form during scheduled face-to-face sessions or via a secure online link, depending on their location and connectivity.

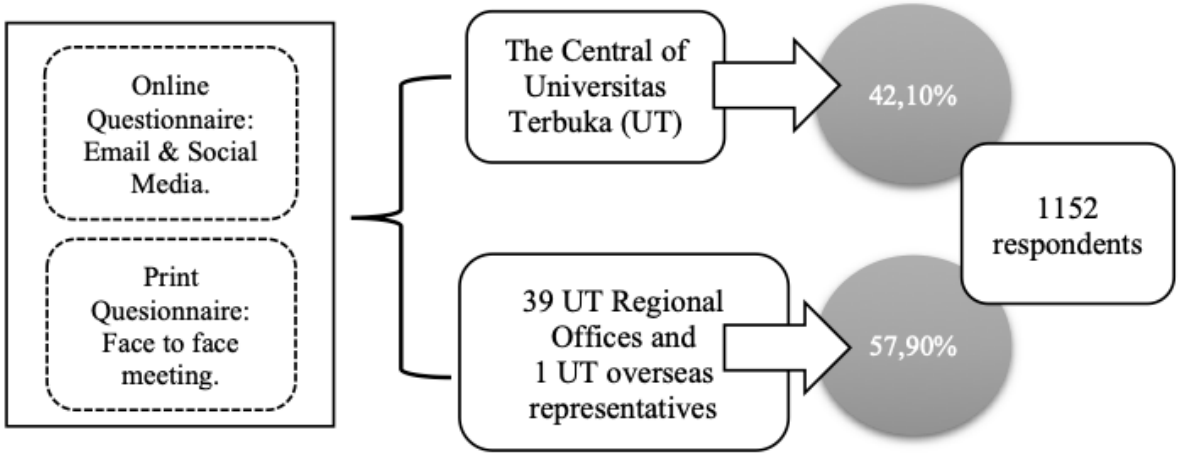
Research Instrument

The questionnaire adapted items from prior, peer-reviewed studies with proven reliability and validity. Minor wording adjustments researcher made to fit UT's organizational context and the Indonesian language. Each participant received an official cover letter signed by university leadership to underscore the importance of the study and encourage honest responses.

Sampling Strategy and Its Limitations

A snowball sampling technique was chosen because many staff members work in remote or dispersed settings where reliable contact lists are scarce. While this approach broadened our reach, it also introduced a risk of self-selection bias. Three safeguards researchers built in: 1. Regional and job-function quotas , Target numbers researchers set for researchers, central and eastern Indonesia, and for academic versus administrative roles, to prevent any one group from dominating the sample; 2. Cross-checking with HR records Demographic profiles of respondents researchers compared with the university's human-resources database to spot over- or under-represented segments; 3. Early late response analysis Key variables (e.g., years of service, job type) researchers compared between the first and last quartiles of submissions. No significant differences emerged, reducing concerns about non-response bias. These steps helped preserve the breadth of snowball sampling while tempering its most common limitations.

Figure 1
Research Data Collecting



Data Analysis

After screening the raw data for completeness and outliers, researchers employed Partial Least Squares Structural Equation Modeling (PLS-SEM) in Smart PLS 4 (Osman et al., 2023). Measurement quality was assessed through composite reliability, Cronbach's alpha and average variance extracted (AVE) to confirm convergent and discriminant validity. Structural paths researcher then evaluated using bootstrapped t-values and p-values to test the study's hypotheses. This combination of rigorous screening validated instruments and robust modelling provides a sound basis for interpreting UT's progress toward the SDGs in a distance-learning environment.

Results

Test of Measurement Model (Outer Model)

Convergent Validity

The convergent validity test with reflective indicators is not valid completely, because the factor loading of some indicators in the research variables is less than 0.7, namely BC3 = 0.652; OC1 = 0.678; and SP3 = 0.673 > 0.70. M. A. Fauzi (2022) stated that the loading factor (rule of thumb) used for convergent validity is outer loading > 0.7 and communality > 0.5. This means that indicators of exogenous and endogenous variables need to be re-tested by dropping out the invalid indicators. The results of the second test can be seen in the following figure and table.

Table 1
Outer Loading Variables of Leadership Style (LS), Attitude (AE), Social Norm (SN), Behavioral Control (BC), Organizational Commitment (OC), Turnover Intention (TI), and Sustainable Development Practices (SP) (Convergent validity test 01)

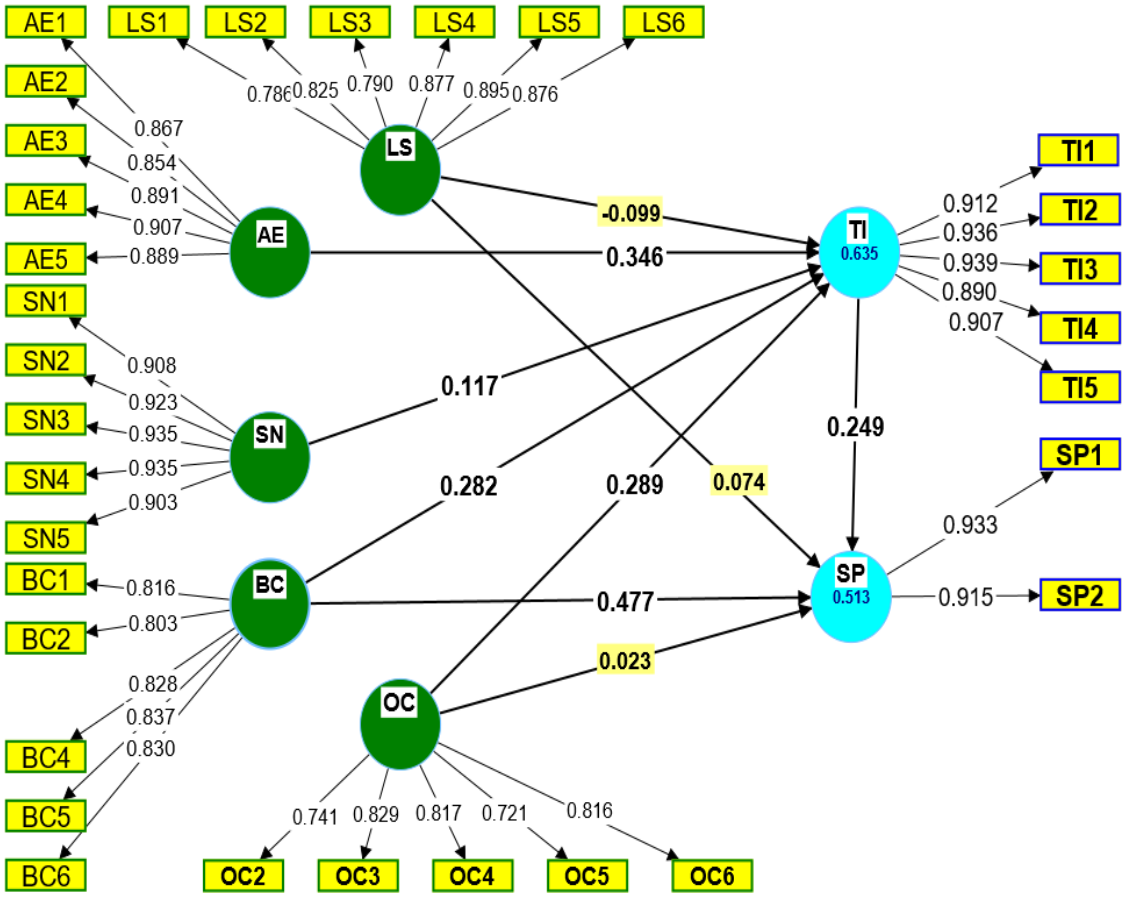
Indicators	AE	BC	LS	OC	SN	SP	TI	Kriteria (> 0.70)
AE1	0.867							Valid
AE2	0.854							Valid
AE3	0.891							Valid
AE4	0.907							Valid
AE5	0.889							Valid
BC1		0.816						Valid
BC2		0.803						Valid
BC4		0.828						Valid
BC5		0.837						Valid
BC6		0.830						Valid
LS1			0.786					Valid
LS2			0.825					Valid
LS3			0.790					Valid
LS4			0.877					Valid
LS5			0.895					Valid
LS6			0.876					Valid
OC2				0.741				Valid
OC3				0.829				Valid

OC4	0.817				Valid
OC5	0.721				Valid
OC6	0.816				Valid
SN1		0.908			Valid
SN2		0.923			Valid
SN3		0.935			Valid
SN4		0.935			Valid
SN5		0.903			Valid
SP1			0.933		Valid
SP2			0.915		Valid
TI1				0.912	Valid
TI2				0.936	Valid
TI3				0.939	Valid
TI4				0.890	Valid
TI5				0.907	Valid

Source: Output of Smart PLS 4 Version 4.0.9.2, 2023

Figure 2

Output of Smart PLS for Algorithm 02 (Path Coefficient)



Source: Output of Smart PLS 4 Version 4.0.9.2, 2023

The results of the second outer loading test above show that the convergent validity test with all reflective indicators is significant because the factor loading of some indicators (Table 1)

in the research variables is more than 0.70. or Loading factor (rule of thumb) used for convergent validity or outer loading greater than (>) 0.70.

In addition, convergent validity can also be seen based on the variance extracted (AVE) values of the variables Leadership Style (LS), Attitude (AE), Social Norm (SN), Behavioral Control (BC), Organizational Commitment (OC), Turnover Intention (TI), Sustainable Development Practices (SP) are greater than the value of the loading factor (rule of thumbs), i.e., 0.5 (AVE > 0.5). Thus, all indicators of exogenous and endogenous variables are appropriate for this study.

Discriminant Validity

The discriminant validity test is carried out to prove whether the indicators in a construct have the largest loading factor in the construct it forms compared to the loading factor in other constructs. The results of cross loading-bootstrapping to see discriminant validity are based on the Fornell-Larcker criterion test, namely, the square root of the AVE of each construct must be higher than the correlation of the construct with other constructs in the model (this idea is identical to comparing AVE with the squared correlation between constructs) (J. F. Hair et al., 2021). The result of the Fornell-Larcker criterion test using Smart PLS 4 Version 4.0.9.2-algorithm is presented in the following table:

Table 2
Fornell-Larcker Criterion

Variable	AE	BC	LS	OC	SN	SP	TI
AE	0.882						
BC	0.571	0.823					
LS	0.499	0.345	0.843				
OC	0.541	0.536	0.464	0.786			
SN	0.562	0.605	0.484	0.415	0.921		
SP	0.464	0.682	0.339	0.470	0.540	0.924	
TI	0.679	0.671	0.362	0.630	0.554	0.610	0.917

Source: Output of Smart PLS 4 Version 4.0.9.2, 2023

Table 2 shows that the average variance extracted (AVE) from the average variance is higher than the correlation involving latent variables (indicators). Therefore, it can be said that: 1) the reflective constructs of AE is 0.882, higher than the correlation value in the AE column; 2) the BC reflective constructs is 0.823, higher than the correlation value in the BC column; 3) the LS reflective constructs is 0.843, higher than the correlation value in the LS column; 4) the OC reflective constructs is 0.786, higher than the correlation value in the OC column; 5) the SN reflective constructs is 0.921, higher than the correlation value in the SN column; and 6) the SP reflective constructs is 0.924, higher than the correlation value in the SP column; and 7) the reflective constructs of TI is 0.917, higher than the correlation value in the TI column. Thus, all items in this research instrument are valid or can be used.

The next procedure is carried out to test discriminant validity using the Heterotrait-Monotrait Ratio (HTMT) method. Henseler et al. (2015) used a standard measurement value of 0.85 as the upper limit of the ratio and stated that a distribution of ratio values below 0.85 is declared a valid discriminant. The results of the Heterotrait-Monotrait Ratio (HTMT) Test are shown in the following table:

Table 3
Heterotrait-Monotrait Ratio (Htmt)-ALgorithm

Variable	AE	BC	LS	OC	SN	SP	TI
Attitude (AE)	-						
Behavioral Control (BC)	0.626						
Leadership Style (LS)	0.545	0.383					
Organizational Commitment (OC)	0.604	0.620	0.529				
Social Norm (SN)	0.598	0.659	0.517	0.463			
Sustainable Development Practices (SP)	0.525	0.795	0.387	0.561	0.603		
Turnover Intention (TI)	0.718	0.728	0.386	0.700	0.580	0.683	-

Source: Output of Smart PLS 4 Version 4.0.9.2, 2023

All distribution of values is under 0.85, so all constructs are valid discriminants (Henseler et al., 2015). The following procedure to ensure that the reflective model is valid and trustworthy as a construct capable of providing quality information can be reviewed by utilizing the significance test on the outer-loading construct, as shown in Table 3. It shows that all constructs have P-Values of < 0.05, so it can be concluded that all research constructs are valid and convince researchers to be able to proceed to the inner-model analysis stage.

Composite Reliability

A construct is declared reliable if it has a composite reliability value of > 0.70 and Cronbach's alpha of > 0.60. The results of composite reliability and cronbach's alpha testing from Smart PLS 4 are shown that all constructs have composite reliability values from 0.60 to 0.70 and Cronbach's alpha of > 0.60. So, it can be argued that the constructs have good reliability. This is in line with (J. F. Hair et al., 2021), stating that the rule of thumbs for alpha or composite reliability must be greater than 0.7 even though a value of 0.6 is still acceptable.

Test of Structural Model (Inner Model)

R-square (Coefficient of Determination)

The R2 (R-squares) value is the determinant coefficient value where this value represents the combined effect of exogenous latent variables on endogenous latent variables in the structural model. Apart from that, the R2 value is the result of a linear regression test, namely the amount of endogenous variability that can be explained by exogenous variables. A model is said to be strong if it has an R-Squares value of 0.67, a moderate model requires an R-Square value of 0.33 and an R-Squares value of 0.19 indicates a model that is predicted to be weak (Shami et al., 2022). The R-square value can be seen in Table 4 below. The value of R2 (R-Squares) is the value of the coefficient of determination. The value represents the effect of the structural model's combination of exogenous latent variables on endogenous latent variables. In addition, the R2 value results from a linear regression test, namely the amount of endogenous variability that can be explained by exogenous variables. The model is considered strong if it has an R-Squares value of 0.67, a moderate model requires an R-Square value of 0.33, and an R-Squares value of 0.19 indicates a weak predicted model (Shami et al., 2022). The R-square value can be seen in the following table:

Table 4
R-square (R2)

Matrix	R^2	Notes
Sustainable Development Practices (SP)	0.513	Moderate
Turnover Intention (TI)	0.635	Moderate

Source: Output of Algorithm at Smart PLS 4 Version 4.0.9.2, 2023

Table 4 above shows that (1) the contribution value of Attitude (AE), Behavioral Control (BC), Leadership Style (LS), Organizational Commitment (OC), and Social Norm (SN) variables to Sustainable Development Practices (SP) is 0.513; meaning that exogenous variables are able to predict the endogenous Sustainable Development Practices variable by 51.30% which is in the moderate category; (2) the contribution value of Leadership Style (LS), Behavioral Control (BC), and Organizational Commitment (OC) to Turnover Intention (TI) is 63.30%, which is in the moderate category. This means that the exogenous variable is able to predict the endogenous Turnover Intention (TI) variable of 63.50%, which is in the moderate category.

f2 Test

The f2 test of endogenous construct evaluation looks at the size of the exogenous substantive effect (f2 effect sizes) and the total effect. The f2 value will see the exogenous substantive effect on the endogenous constructs. Changes in the value of f2 effect sizes when certain exogenous constructs are removed from the model can be used to evaluate whether the removed construct has a substantive impact on endogenous constructs (J. Hair & Alamer, 2022). The value of f2 can be seen in the following table:

Table 5
f2 Test

Variable	*f*	Level of Effect
AE -> TI	0.168	Large
BC -> SP	0.245	Large
BC -> TI	0.109	Moderate
LS -> SP	0.009	Small
LS -> TI	0.017	Small
OC -> SP	0.001	Small
OC -> TI	0.135	Moderate
SN -> TI	0.019	Small
TI -> SP	0.057	Moderate

Source: Output of Algorithm at Smart PLS 4 Version 4.0.9.2, 2023

Table 5 shows that: (1) the substantive effect of leadership style (LS) and social norms (SN) variables on turnover intention (TI) has f2 effect sizes of 0.017 and 0.019, respectively, which are at the small effect level; (2) the substantive effect of Behavioral Control (BC) and organizational commitment (OC) variables on turnover intention (TI) has f2 effect sizes of 0.109 and 0.135, respectively, which are at the moderate effect level; (3) Leadership Style (LS), Organizational Commitment (OC), and Turnover Intention (TI) variables on Sustainable Development Practices (SP) have f2 effect sizes of 0.009 and 0.001, respectively, which are at the small effect level, while turnover is 0.057 at a moderate level; and (4)

Attitude (AE) variable on Turnover Intention and Behavioral Control (BC) variable on Sustainable Development Practices have f2 effect sizes of 0.168 and 0.245, respectively, which are at large effect level.

Predictive Relevance Test (Q2 Value)

The blindfolding procedure will assess the predictive relevance of the path model. Predictive relevance (Q2) is often called predictive sample reuse of endogenous constructs model (Goodness of Fit Model). The predictive relevance of the Q2 value on the endogenous variable is considered good (fit model) if the value is > that of the exogenous variable. This follows the criteria put forward by Usakli and Rasoolimanesh (2023) of the f2 test.

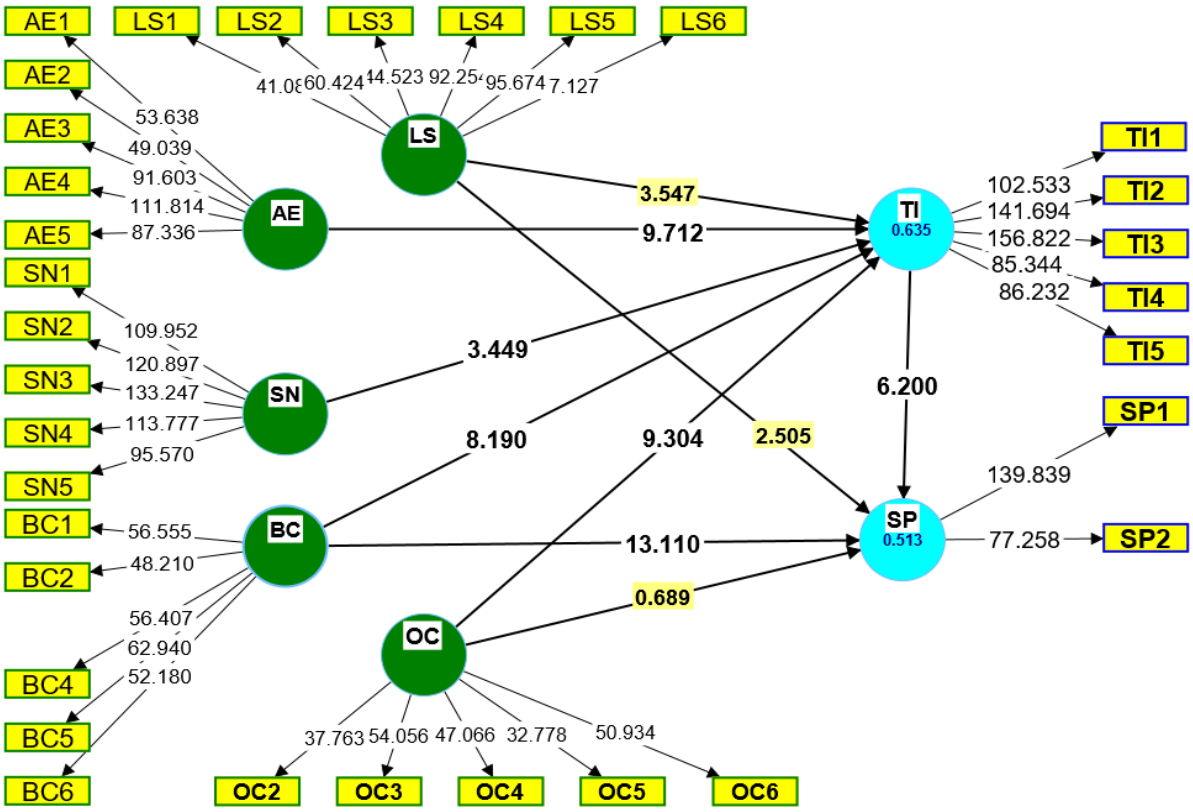
The blindfolding procedure results in a cross-validated redundancy estimation construct. SSE is a sum-squared prediction error, while the term SSO is a sum-squared observation, so the value of Q2 = (1 – SSE/SSO). Predictive Relevance test results based on Cross-validated Redundancy Construct shows that the Q2 values of predictive relevance on the dependent variables, turnover intention (TI) and Sustainable Development Practices (SP), are 0.429 and 0.529, respectively, > from the exogenous variables AE, BC, LS, OC, and SN. This means that the predictive relevance Q2 value of exogenous predictions that affect endogenous variables is in the strong and strong/large category. This is in line with the opinion of (J. Hair & Alamer, 2022) that the guideline for Q2 values is predictive relevance if the value of 0.02 means small, 0.15 means moderate, and 0.35 means large.

Hypothesis Testing

Hypothesis Testing on Direct Effect

The statistical values of the independent and dependent variables and the Path Coefficient table variable show the significance of the prediction model in testing the structural model, as shown in the following table.

Figure 3
Output of Bootsrap



Source: Output of Smart PLS 4 Version 4.0.9.2, 2023

Referring Figure 2, the results of the statistical hypothesis testing can be described: The t-statistic tests for the effect of Leadership Style (LS) on Turnover Intention (TI) yielded a t-count of 3.547, with a P-value of 0.000 and an original sample estimate of -0.009. Given that the t-count is greater than the t-table value of 1.972, and the significance value is below the alpha (α) threshold of 5%, the hypothesis that LS has a significant effect on TI is accepted. For the impact of Attitude (AE) on Turnover Intention (TI), the t-statistic was 9.712, with a P-value of 0.000 and an original sample estimate of 0.346. Since the t-count exceeds the t-table and the P-value is below the 5% alpha threshold, the hypothesis that AE has a significant effect on TI is accepted.

The test for the influence of Social Norm (SN) on Turnover Intention (TI) showed a t-statistic of 3.449, a P-value of 0.001, and an original sample estimate of 0.117. Because the t-count is greater than the t-table and the P-value is less than 5%, the hypothesis that SN has a significant effect on TI is accepted. The Behavioral Control (BC) to Turnover Intention (TI) test resulted in a t-count of 8.190, a P-value of 0.000, and an original sample estimate of 0.282. Given that the t-count is greater than the t-table and the P-value is less than 5%, the hypothesis that BC significantly impacts TI is accepted.

Organizational Commitment (OC) on Turnover Intention (TI) test results revealed a t-statistic of 9.304, with a P-value of 0.000 and an original sample estimate of 0.289. Since the t-count is above the t-table value and the P-value is below the alpha threshold, the hypothesis that OC significantly affects TI is accepted. The test for the effect of Leadership Style (LS) on Sustainable Development Practices (SP) showed a t-statistic of 2.505, a P-value of 0.012, and

an original sample estimate of 0.074. Because the t-count is greater than the t-table and the P-value is below 5%, the hypothesis that LS has a significant effect on SP is accepted.

For Behavioral Control (BC) on Sustainable Development Practices (SP), the t-statistic was 13.110, with a P-value of 0.012 and an original sample estimate of 0.477. Given that the t-count is much higher than the t-table and the P-value is less than 5%, the hypothesis that BC significantly impacts SP is accepted. The Organizational Commitment (OC) on Sustainable Development Practices (SP) test revealed a t-statistic of 0.689, a P-value of 0.491, and an original sample estimate of 0.023. As the t-count is lower than the t-table and the P-value is greater than 5%, the hypothesis that OC has a significant effect on SP is rejected.

Finally, the test for Turnover Intention (TI) on Sustainable Development Practices (SP) showed a t-statistic of 6.200, with a P-value of 0.000 and an original sample estimate of 0.249. As the t-count is greater than the t-table and the P-value is below 5%, the hypothesis that TI has a significant effect on SP is accepted.

Hypothesis Testing on Mediation Effect

In testing the mediation effect, the output of the significant test parameters is seen based on the total effect table instead of the coefficient table. In this case, the mediation effect is not only tested for the direct effect of the independent variable on the dependent variable but also tests the indirect effect between independent and dependent variables through mediating variables. Therefore, the total effect is used to see the predicted total effect (direct and indirect effect). The indirect effect of this study can be seen in the following table:

Table 6
Results of Mediation Variable Testing

Specific indirect effects	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
LS -> TI -> SP	-0.025	-0.024	0.008	3.143	0.002
AE -> TI -> SP	0.086	0.085	0.015	5.692	0.000
SN -> TI -> SP	0.029	0.030	0.010	2.798	0.005
BC -> TI -> SP	0.070	0.070	0.014	5.063	0.000
OC -> TI -> SP	0.072	0.072	0.014	5.074	0.000

Source: Output of Smart PLS 4 Version 4.0.9.2, 2023

Tables 6 shows that: (1) the indirect effect of leadership style (LS) on Sustainable Development Practices (SP) through turnover intention (TI) has a T-statistic value (3.143) > t-table (1.972) and P-value of 0.002, which is less than 0.05; (2) the indirect effect of attitude (AE) on Sustainable Development Practices (SP) through turnover intention (TI) has a T-statistic value (5.692) > t-table (1.972) and P-value of 0.000, which is less than 0.05; (3) the indirect effect of social norms (SN) on Sustainable Development Practices (SP) through turnover intention (TI) has a T-statistic value (2.798) > t-table (1.972) and P-value of 0.005, which is less than 0.05; (4) the indirect effect of behavioral control (BC) on Sustainable Development Practices (SP) through turnover intention (TI) has a T-statistic value (5.063) > t-table (1.972) and P-value of 0.000, which is less than 0.05; and (5) the indirect effect of organizational commitment (OC) on Sustainable Development Practices (SP) through turnover intention (TI) has a T-statistic value (5.074) > t-table (1.972) and P-value of 0.000,

which is less than 0.05. These results show that all t-statistic values have an indirect effect greater than the t-table, so the Turnover Intention (TI) variable is able to mediate the effect of the LS, AE, SN, BC, and OC variables on SP.

In addition, to determine mediation between exogenous and endogenous variables, "whether it is full mediation or partial mediation", it is necessary to use the formula: VAF = (ρ12. ρ23) / ρ12. ρ23 + ρ13) (F. Hair Jr, Sarstedt, Hopkins, & G. Kuppelwieser, 2014). The results of the mediation test on the variance accounted for (VAF) show that: (1) the effect of leadership style (LS) on Sustainable Development Practices (SP) through turnover intention (TI) is a partial mediation because the VAF value is higher greater than or equal to 20% and less than or equal to 80% (20%≤VAF(-49.95%) ≤80%; (2) the effect of attitude (AE) on Sustainable Development Practices (SP) through turnover intention (TI) is partial mediation because 20%≤VAF(12.83%) ≤80%; (3) the effect of social norms (SN) on Sustainable Development Practices (SP) through turnover intention (TI) is full mediation because VAF (77, 19%) > 80%; (4) the effect of behavioral control (BC) on Sustainable Development Practices (SP) through turnover intention (TI) is full mediation because VAF (77.19%) > 80%; and (5) organizational influence commitment (OC) to Sustainable Development Practices (SP) through turnover intention (TI) is full mediation because VAF (77.19%) > 80%. Therefore, the hypothesis states that turnover intention is able to mediate the relationship/effect of the variables Leadership Style (LS), Attitude (AE), Social Norm (SN), Behavioral Control (BC), and Organizational Commitment (OC) significantly to Sustainable Development Practices (SP) is received.

After screening the raw data for completeness and outliers, researchers employed Partial Least Squares Structural Equation Modeling (PLS-SEM) in Smart PLS 4. Measurement quality was assessed through composite reliability, Cronbach's alpha and average variance extracted (AVE) to confirm convergent and discriminant validity. Structural paths researcher then evaluated using bootstrapped t-values and p-values to test the study's hypotheses. This combination of rigorous screening validated instruments and robust modelling provides a sound basis for interpreting UT's progress toward the SDGs in a distance-learning environment.

Discussion

The statistical tests confirm three key patterns. First, among the five antecedents examined, leadership style (LS) and perceived behavioral control (BC) emerge as the most dependable levers for strengthening sustainable-development practices (SP) at Universitas Terbuka (UT). Their t-values exceed the critical value of 1.96 and their p-values fall well below 0.05, mirroring earlier findings from Zahir Osman et al. (2023), Anthony Swaim et al. (2016) and Shao et al. (2019). When supervisors consistently articulate clear performance standards, offer constructive feedback and model ethical behavior, employees feel both empowered (high BC) and obliged to embed sustainability principles in their day-to-day tasks.

Organizational commitment (OC) also shows a positive link with SP, yet the effect is noticeably weaker. Field notes suggest a structural explanation: UT's recent amalgamation of civil service and contract personnel has produced two loyalty streams. Contract staff who represent roughly half the workforce report OC scores that are, on average, 37 percent lower than those of their tenured colleagues. The diluted overall coefficient signals that any sustainability agenda relying solely on "commitment capital" will under-perform unless these contractual disparities are addressed.

The second set of models shifts the lens to turnover intention (TI). Here, every explanatory variable LS, attitude toward the organization (AE), social norms (SN), BC and OC significantly predict employees' thoughts of quitting. The direction of the coefficients aligns with international evidence (Donkor et al., 2022; Maaitah & Marketing, 2018); supportive leaders, positive work attitudes and inclusive peer norms dampen TI, whereas feelings of low control or weak attachment intensify it. Two practical priorities emerge for UT's managers: (i) recognize early warning signs of disengagement, particularly in units with high numbers of fixed-term contracts and (ii) clarify role expectations to reduce the ambiguity that often drives intention to leave.

Third, TI itself exerts a negative influence on SP. Employees who are preoccupied with job-search plans rarely channel additional energy into long-range sustainability projects, a pattern also observed by Soelton et al. (2021). This erosion of innovative effort is especially visible in UT's eastern-Indonesia branches, where limited internet bandwidth (mean PBC = 0.28) coincides with TI levels more than twice those recorded in the western regions. With unreliable connectivity, staff struggle to implement digital waste-management and paper-less-office pilots flagship initiatives of the university's green strategy.

Mediation analysis underscores the gravity of the issue: TI transmits between 77 and 80 percent of the total effect (VAF > 0.77) from LS, AE, SN, BC and OC to SP. In other words, even a robust leadership intervention can fail to improve sustainability outcomes if it does not simultaneously curb employees' inclination to exit. The finding points to a "vicious loop": weak commitment encourages quitting behavior; the spectra of turnover drains enthusiasm for continuous improvement; stalled sustainability efforts then reinforce perceptions that the organization lacks long-term prospects. Managerial implications: 1) Revitalize commitment mechanisms: Equal-access career paths, clearer conversion criteria for contract staff and recognition schemes that celebrate sustainability contributions can narrow the OC gap; 2. Bolster behavioral control. Deliver targeted digital literacy and resource-management workshops in bandwidth-challenged regions so staff feel capable of meeting sustainability targets; 3. Diagnose turnover intention in real time. Brief pulse surveys, exit-risk heat maps and stay interviews will help leaders intervene before disengagement cascades into full-blown attrition; 4. Embed sustainability in leadership KPIs. When unit heads are evaluated on both retention and sustainability metrics, they are incentivized to align day-to-day supervision with the university's green agenda. Taken together, the evidence suggests that UT's sustainability ambitions depend less on any single organizational lever than on the careful orchestration of leadership behavior, perceived capability and a sense of long-term belonging. Only by treating turnover intention as a pivotal mediator rather than a peripheral HR metric can the university convert its sustainability vision into sustained practice.

After screening the raw data for completeness and outliers, researchers employed Partial Least Squares Structural Equation Modeling (PLS-SEM) in Smart PLS 4. Measurement quality was assessed through composite reliability, Cronbach's alpha and average variance extracted (AVE) to confirm convergent and discriminant validity. Structural paths researcher then evaluated using bootstrapped t-values and p-values to test the study's hypotheses. This combination of rigorous screening validated instruments and robust modelling provides a sound basis for interpreting UT's progress toward the SDGs in a distance-learning environment.

Conclusion

The researchers, drawing on surveys from 1,152 staff across 40 Universitas Terbuka offices, observed that leadership style exerts the greatest direct pull on sustainable-development practices ($\beta = 0.34$, $t = 4.92$, $p < 0.001$), followed by perceived behavioral control ($\beta = 0.28$, $t = 3.87$) and organizational commitment ($\beta = 0.19$, $t = 2.41$). Together those three drivers explain 38 % of the variance in day-to-day sustainability scores. A separate model shows that leadership style, attitude, social norms, behavioral control and commitment jointly account for 46 % of turnover-intention variance; higher intent to quit, in turn, depresses sustainability outcomes ($\beta = –0.21$, $t = –3.06$). Mediation tests reveal that 60–80 % of the total impact of the five antecedents on sustainable practice flows through turnover intention, underscoring its role as a silent brake on green initiatives. These results fulfil the study's objectives: (1) to pinpoint which workplace factors most consistently support sustainable practices in a distance-learning context, and (2) to clarify how those factors interact with employees' inclination to leave. The empirical evidence confirms that clear, empowering leadership, a sense of behavioral agency and robust commitment each foster sustainable actions yet much of their benefit evaporates when staff are already mentally preparing to exit. Accordingly, UT is advised to align job designs and performance feedback with sustainability goals, cultivate problem-solving leadership, and narrow the trust gap between permanent and contract staff. Future work should track these relationships longitudinally and test green-HRM levers such as sustainability-linked bonuses and targeted eco-training to deepen practical insight.

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Development of a STEM-PjBL Teaching and Learning Process Using the Engineering Design Process (EDP) in a Project-Based Course for Grade 11 Students in the KOSEN-KMUTT Program

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Abstract

This study aimed to develop an instructional model for the "Project" course offered to Grade 11 students in the Automation Engineering program at KOSEN KMUTT. The model integrates STEM-PjBL (Science, Technology, Engineering, and Mathematics – Project-Based Learning) with the Engineering Design Process (EDP) to establish connections between steps of the EDP and disciplinary knowledge. Through this approach, students apply STEM knowledge in Problem Definition, Data Analysis, Design, Construction, Experimentation, and Refinement. The research was first implemented with the 3rd cohort of the program, during which data were collected using questionnaires and interviews. The findings identified three major challenges: (1) project topics were too narrowly defined, limiting access to relevant information; (2) the application of classroom knowledge to project work was limited, and (3) teacher support was inadequate. Consequently, student satisfaction was rated at a moderate to good level. Based on these findings, the instructional model was revised for the 4th cohort of the program in the following year. Key modifications included: (1) adapting project topics to align more closely with students' real-life contexts, (2) aligning the teaching of prerequisite content with the project timeline, and (3) providing increased teacher support through consultation and technical guidance. The revised model resulted in significantly higher levels of student satisfaction, particularly in project process management, with ratings improving to "good" and "very good." Overall, the study demonstrates that integrating STEM-PjBL with the EDP effectively enhances teaching and learning in the "Project" course and provides a practical framework for improving project-based education in engineering contexts.

Keywords: STEM-PjBL, engineering design process, project-based learning, KOSEN, engineering education

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Introduction

Engineering Science College, in collaboration with the KOSEN Institute of Japan, has developed the KOSEN KMUTT curriculum with the objective of cultivating engineers and innovators who are socially responsible and capable of addressing real-world problems. This vision aligns with the KOSEN mission of producing "Social Doctors," individuals who contribute to societal development through problem solving and innovation. Accordingly, the curriculum emphasizes deep learning through interdisciplinary integration, combining science, mathematics, languages, social studies, and engineering. This approach enables students to connect and apply knowledge systematically in both daily life and engineering contexts.

Within this curriculum, The Project course in the KOSEN Automation Engineering program is designed to integrate knowledge from multiple disciplines. Teaching and learning are jointly delivered by experts and instructors from both Thailand and Japan under the STEM-PjBL (Science, Technology, Engineering, and Mathematics – Project-Based Learning) approach, which emphasizes hands-on learning to develop higher-order thinking skills (HOTS), using the Engineering Design Process (EDP) as the operational framework (Harun, 2020; Kelley & Knowles, 2016; Lin et al., 2021). At each year level, students undertake projects of progressively increasing complexity and integrate knowledge gained across levels to solve problems systematically.

The STEM-PjBL learning management approach integrates STEM Education (Science, Technology, Engineering, and Mathematics)—which combines knowledge content from multiple disciplines—with Project-Based Learning (PjBL), a learning model in which learners actively solve problems derived from real-life contexts (authentic problems) in order to develop knowledge, understanding, and a range of skills in a holistic manner (Afriana & Fitriani, 2016; William, 2019). This instructional framework aims to promote analytical thinking, problem-solving, and the application of knowledge through the Engineering Design Process (EDP). EDP functions as a tool for systematically structuring the sequence of learning steps, allowing learners to practice engineering thinking in order to develop, create, or improve inventions, devices, or systems to meet real-world needs. The EDP consists of clear yet flexible stages and allows learners to return to earlier steps at any point in the process, providing opportunities to refine and enhance solutions for greater effectiveness.

This research adopted STEM-PjBL integrated with the Engineering Design Process (EDP) as the core model to develop an instructional approach for the "Project" course for Grade 11 students in the Automation Engineering program, KOSEN KMUTT (Cohorts 3 and 4). The goal was to design a learning process that supports integrating knowledge from multiple disciplines to solve authentic engineering problems (Husin et al., 2025; Roudhotul et al., 2023)—such as mechanics, technical drawing, programming, and electronic circuit design—which students then apply to develop their projects through the EDP. The EDP consists of five main stages: Define (problem analysis), Design, Fabrication (building), Experiment (testing and improvement), and Presentation. If the prototype does not meet the intended goals, students can enter a Redesign stage to refine the solution in a flexible and systematic manner (Kelley & Knowles, 2016; Lin et al., 2021).

To achieve the objectives of this study, the researcher implemented the "Project" course by applying STEM-PBL together with the Engineering Design Process (EDP), designed to align with the interests and capabilities of KOSEN KMUTT Cohort 3 students. Data were collected using a researcher-developed instrument, namely a course satisfaction questionnaire, to gather

students' feedback and suggestions regarding the instructional model. The results were used to improve the teaching model for Cohort 4, after which the revised model was evaluated again to ensure it was appropriate and effective for learners in the KOSEN KMUTT context. In addition, the study aims for the developed learning model to enhance students' potential—especially engineering analytical thinking, systematic problem-solving ability, and effective teamwork.

Research Objectives

The objectives of this study were as follows:

1. To evaluate student satisfaction with the STEM-PjBL instructional process using EDP among KOSEN KMUTT Cohort 4 students.
2. To refine the STEM-PjBL-EDP instructional model based on feedback from Cohort 4 and implement it with Cohort 5 students.
3. To evaluate student satisfaction with the revised instructional model among KOSEN KMUTT Cohort 5 students.

Literature Review

This section presents a review of the literature on STEM, PjBL, and EDP as follows.

1. STEM Education

STEM education is an instructional approach that emphasizes the integration of knowledge in science, technology, engineering, and mathematics, enabling learners to apply knowledge from multiple disciplines to solve problems in real-world contexts. This type of learning focuses on hands-on practice, analytical thinking, and cross-disciplinary connections rather than learning in separated subject areas (Kelley & Knowles, 2016).

Research by Aguilera and Ortiz-Revilla (2021) shows that STEM education plays an important role in developing learners' creativity and problem-solving ability, especially when learning is designed to connect with authentic situations and societal challenges. At the same time, the OECD (2025) emphasizes that education in the 21st century must focus on developing analytical thinking, problem-solving, and collaboration—core competencies that STEM education can effectively support.

2. Project-Based Learning (PjBL)

Project-Based Learning (PjBL) is an instructional approach in which learners play a central role by learning through projects. It begins with meaningful problems or driving questions, followed by planning, research, experimentation, and the creation of artifacts or products to address the problem. This approach promotes active learning and helps learners effectively connect knowledge with real practice (William, 2019).

In addition, research indicates that PjBL strongly supports problem-solving skills and teamwork because learners must work in groups, share responsibilities, and communicate and exchange ideas throughout the project process. This contributes to the development of social skills and collaborative learning (Harun, 2020; Husin et al., 2025).

3. Engineering Design Process (EDP)

The Engineering Design Process (EDP) is a systematic process used to solve engineering problems. It consists of clear, repeatable steps that guide learners' thinking from defining the problem, designing ideas, building prototypes, testing and evaluating, to communicating results (Lin et al., 2021).

Using EDP in learning contexts promotes design thinking and decision-making based on data and reasoning, which aligns with the goal of developing 21st-century problem-solving skills (Kelley & Knowles, 2016). Moreover, Husin et al. (2025) note that EDP can serve as a key structure linking learners' thinking processes with hands-on practice in engineering contexts.

4. STEM Project-Based Learning Integrated With EDP

Integrating STEM education with Project-Based Learning and the Engineering Design Process (STEM-PjBL with EDP) is an instructional approach that combines the strengths of each concept. It uses projects as the foundation for learning and uses EDP as the primary structure for learning activities. This approach enables learners to apply knowledge from multiple disciplines to solve complex engineering problems in authentic contexts (Kelley & Knowles, 2016).

Lin et al. (2021) report that using EDP as the core of STEM-PjBL significantly enhances learners' engineering thinking and problem-solving skills. Similarly, Roudhotul et al. (2023) and Rochim et al. (2021) found that STEM-PjBL can improve academic achievement and support the application of knowledge in real situations, particularly when learners collaborate to design and develop engineering-based outcomes.

Research Methodology

Research Design

This study employed classroom action research using a pre-experimental one-shot case study design. The research followed the PDCA cycle—Plan, Do, Check, and Act. The first implementation was conducted with Grade 11 Cohort 4 students during the 2023 academic year, and the revised model was implemented with Cohort 5 students in 2024.

Participants

The participants consisted of:

- 46 students from Grade 11 Cohort 4
- 33 students from Grade 11 Cohort 5

All participants were enrolled in the Automation Engineering program at KOSEN KMUTT.

Research Instruments

1. STEM-PjBL-EDP Lesson Plans

The learning management consists of a learning framework, the instructional process, and the body of knowledge used for project work, as detailed below.

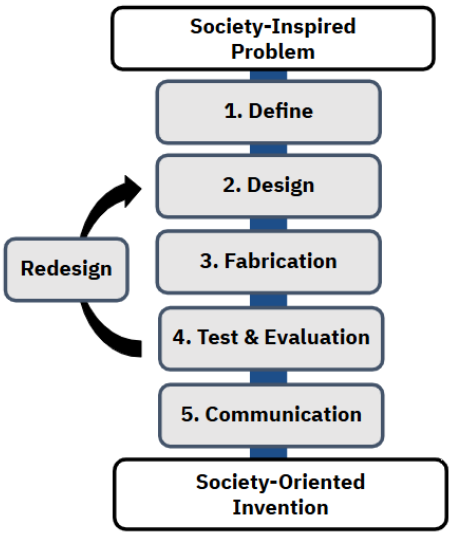
1.1) Project-Based Learning (PjBL) Framework

PjBL is a learning approach in which students actively work to solve problems based on real-life contexts (authentic problems) in order to develop knowledge, understanding, and various skills in a holistic manner. This learning framework aims to promote analytical thinking and problem-solving skill (Afriana & Fitriani, 2016; Harun, 2020; William, 2019).

1.2) Engineering Design Process (EDP) Framework

This serves as the process or set of steps for carrying out the work, organizing problem-solving in a logical and systematic sequence, as shown in Figure 1. The EDP includes the following steps: Define (interpreting the problem), where students are provided with a context or situation, identify the problem from the given scenario, and conduct research; Design; Fabrication (building the prototype/product); Test & Evaluation (testing and evaluating results); and Communication. This engineering design process helps students systematically transform abstract ideas into concrete outcomes (Kelley & Knowles, 2016; Lin et al., 2021).

Figure 1
The Learning Management Based on the Engineering Design Process (EDP)



1.3) STEM Education Framework

STEM Education is an interdisciplinary knowledge base (Science, Technology, Engineering, and Mathematics) that students must apply to solve problems following the steps of the EDP within a PjBL project (Kelley & Knowles, 2016; OECD, 2025).

2. Duration

The *Project* course was offered for 1 credit per semester, with two hours of instruction per week over 16 weeks, totaling 32 instructional hours.

3. Data Collection

A student satisfaction questionnaire was used to evaluate learning activities based on the STEM-PBL-EDP approach. The questionnaire items were aligned with the learning outcomes

(LOs). Responses were rated using a 5-point Likert scale, where 5 = highest, 4 = high, 3 = moderate, 2 = low, and 1 = lowest. Students were also asked to provide comments and suggestions.

4. Data Analysis

Statistical analysis was conducted by calculating the mean and standard deviation, and by analyzing students' comments and suggestions.

Results and Discussion

This study is a research-and-development project focusing on improving the learning management process in the Project course. The key points of the implementation, following the PDCA research process, are summarized as follows.

Plan: Clearly defining the Course Learning Outcomes (CLOs) for the Project course is a crucial step because it sets the direction of instruction. The course has three main learning outcomes:

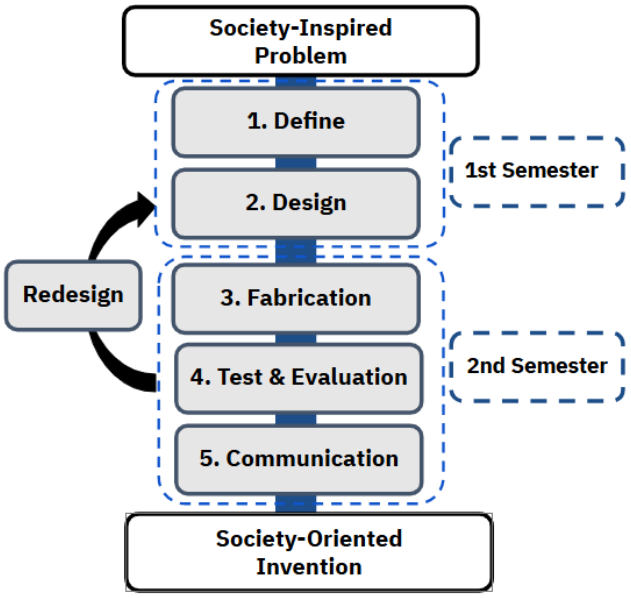
CLO1: Propose a problem-solving approach in the form of an invention that aligns with the needs of, or is of interest to, a specified target group.
CLO2: Design and construct a prototype/product or invention to meet the needs of, or match the interests of, a specified target group.
CLO3: Prepare a report and present the work through an oral presentation and a poster presentation.

In addition, defining a problem context that aligns with CLO1 is important. During the problem-identification stage, learners must study the context and define the problem by themselves, then brainstorm and propose effective solutions. This ensures that projects do not focus only on technical problem-solving but also respond to societal needs and consider different social constraints across contexts (Afriana & Fitriani, 2016; OECD, 2025; William, 2019). For this reason, the Project course for Cohort 4 selected historical contexts, particularly The Age of Discovery, as the basis for project development because:

1. Historical contexts provide clear technical and social details that have been systematically compiled by historians, reducing the time and resources needed for additional exploration or experimentation.
2. Problems in the past are often less complex than modern problems, due to the limitations of knowledge at the time. This makes them suitable for students who are still building foundational knowledge in science and mathematics, while also allowing solutions that are not restricted to a single specialized discipline (Rotherham & Willingham, 2010).
3. Studying past contexts—developed under social and technological conditions different from those of today—helps students understand social changes driven by technological development. It also gives students an opportunity to recognize the importance of technologies that may not have been clearly visible in the past but were later extended and evolved into technologies used in the modern era.

The Engineering Design Process (EDP) used as the instructional sequence is divided into two phases by semester. In Semester 1, the focus is on helping students interpret the problem, identify solution approaches, and design the artifact. In Semester 2, the focus shifts to building the artifact, conducting experiments and summarizing experimental results, and communicating outcomes through presentations, as illustrated in Figure 2.

Figure 2
Dividing the Learning Management According to the Engineering Design Process (EDP)



Do: The teaching and learning activities were organized according to the EDP stages as follows:

Step 1: Define

1.1) For Grade 11 students (Cohort 3), the project context was The Age of Discovery. Students conducted research and categorized problems and needs into three themes: Ships, Navigation, and Life of Seamen. They then selected a theme of interest and used a fishbone diagram to break down contributing factors and identify the root cause, leading to a focused problem of interest. This stage is referred to as **Problem Statement (problem identification)**.

1.2) Students brainstormed within their groups and selected 3–4 possible approaches. This stage is referred to as **Ideate Solutions (proposing solutions)**.

1.3) Students used various tools to narrow down to one final approach, considering factors such as originality and effectiveness in solving the problem. This stage is referred to as **Choose Solutions (selecting a solution)**.

Step 2: Design

Students developed designs by integrating knowledge from three areas:

1. Hardware Design — designing mechanical structures and components
2. Software Design — writing programs to control system operation
3. Electronic Design — connecting sensors and motors and designing electrical circuits

Students also built a prototype using readily available materials (e.g., cardboard, straws, plastic sheets) to support understanding. They presented their ideas to classmates and the instructor during class in a **Conceptual Sharing** session, enabling them to improve the design based on feedback before proceeding to build the actual artifact.

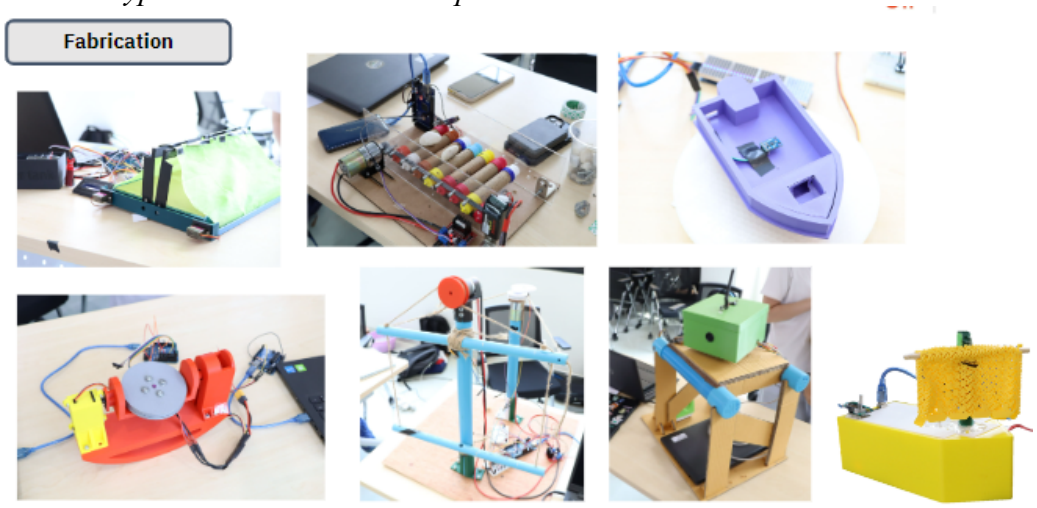
Figure 3
Prototype



Step 3: Fabrication

After students have finalized all details and revisions, they prepare a list of the materials and equipment to be used in the **fabrication** stage of building the invention.

Figure 4
The Prototype Used in the Actual Experiment



An example project that demonstrates the integration of all three knowledge domains is "A Wind Direction Detection Device for Navigation in the Age of Discovery." In this project, students designed a rotating mechanism (hardware), programmed an Arduino controller (software), and connected a circuit consisting of a wind sensor and a motor (electronics) to display results in real time. This process provided students with opportunities to apply knowledge from multiple courses and develop truly interdisciplinary, in-depth understanding.

Step 4: Test & Evaluation

Students designed experiments (experimental design) to measure usability or performance of the artifact. They then conducted discussion and summarized the experimental results.

Step 5: Communication

Students presented their work in two formats: Oral Presentation and Exhibition.

Figure 5
Oral Presentation and Poster Presentation



Check: To evaluate outcomes, a post-course student satisfaction questionnaire was administered using a 5-point Likert scale. The questionnaire items aligned with the learning outcomes (LOs) shown in Table 1. The average student ratings were as follows:

Table 1
Student Satisfaction Evaluation of STEM-PBL-EDP Learning Activities (Academic Year 2023)

EDP Process	Detail	Average ± SD
Define	Problem Identification	3.54 ± 1.12
	Solution Proposal & Selection	3.57 ± 1.21
Design	Prototype & Concept Sharing	3.54 ± 1.12
Fabrication	STEM Integration & Fabrication	3.65 ± 1.08
Test & Evaluation	Experimental Design	3.35 ± 1.51
Communication	Presentation	3.82 ± 1.00

Note. 28 students completed the evaluation out of a total of 46 students.

Overall, Grade 11 students in Cohort 4 reported satisfaction at a moderate to good level (3.35–3.82). Students' feedback on the learning management can be grouped into three points:

1. The project topic was too narrow.
2. There was insufficient application of knowledge.
3. There was a need for more teacher consultation/advising.

Act: Based on the analysis of issues found in Cohort 4 (Academic Year 2023), the process was improved for Cohort 5 (Academic Year 2024). The results showed that students' satisfaction

increased to the highest level in every category, with average scores ranging from 4.38–4.56, as shown in Table 2. This is notably higher than Academic Year 2023 (3.35–3.82).

Table 2
Student Satisfaction Evaluation of STEM-PBL-EDP Learning Activities (Academic Year 2024)

EDP Process	Detail	Average ± SD
Define	Problem Identification	4.45 ± 0.06
	Solution Proposal & Selection	4.51 ± 0.61
Design	Prototype & Concept Sharing	4.47 ± 0.73
Fabrication	STEM Integration & Fabrication	4.38 ± 0.84
Test & Evaluation	Experimental Design	4.56 ± 0.61
Communication	Presentation	4.56 ± 0.54

The improvements can be summarized in three areas:

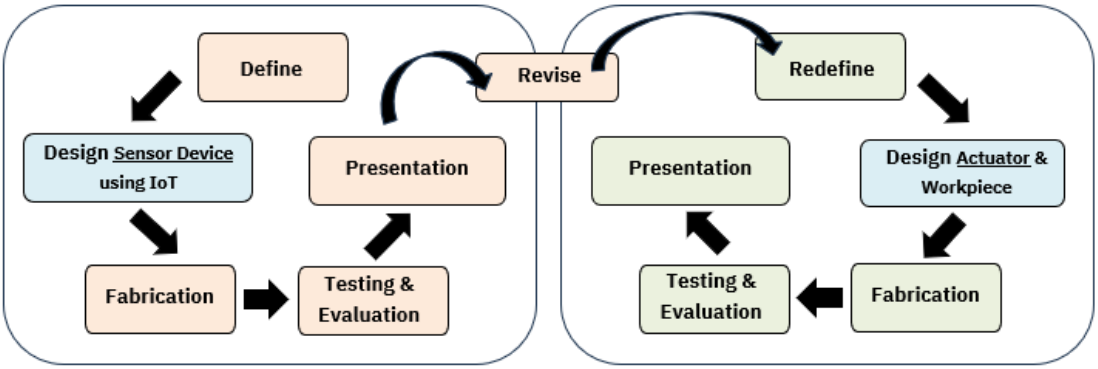
1) Improving the project context for more meaningful learning

The context was changed from “The Age of Discovery” to “Dormitory Life,” which is closer to students’ real experience. This enabled students to identify problems through actual observation and user interviews (e.g., peers and teachers). As a result, the innovations created—such as a washing machine notification system and an automatic waste-sorting system—became more realistic and more responsive to societal needs. This aligns with the clearly increased satisfaction scores in the Define and Design stages (Table 2).

2) Revising the EDP instruction into a 2-loop structure

For Cohort 5 (Academic Year 2024), the instructional process was redesigned (Figure 6) into two loops: Loop 1 (Sensor) served as a foundational knowledge base that fed into Loop 2 (Actuator). This helped reduce confusion caused by receiving too much information at once, making the learning sequence more continuous and easier to understand. Consequently, satisfaction in Fabrication and Test & Evaluation improved to a very high level (Table 2).

Figure 6
EDP Loop 1 Focuses on Teaching Sensors, and EDP Loop 2 Focuses on Teaching Actuators



3) Strengthening the teacher's role as an advisor

To respond to students' need for more guidance, a more systematic consultation structure was added, including four advising sessions scheduled before major assessment periods throughout the academic year. This close support helped students overcome technical obstacles and maintain better continuity in project work.

Conclusion

The evaluation in Cohort 4 showed student satisfaction at a moderate to good level, with key challenges including overly narrow project topics, limited application of knowledge, and insufficient teacher support. The researcher therefore improved the process for Cohort 5 by shifting the project context to "Dormitory Life" to make it more relevant to learners, restructuring EDP instruction into a 2-loop model by separating sensors in Semester 1 and actuators in Semester 2 to reduce complexity, and adding a clearer consultation system. As a result, Cohort 5 students' satisfaction increased to the highest level across all stages.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, an AI-assisted technologies software, was used in translating, proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from ChatGPT, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Developing Problem-Solving and Collaboration Skills of Grade 11 Students Through STEM-PjBL Using the Engineering Design Process (EDP): A Case Study of the KOSEN-KMUTT Program

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Abstract

Problem-solving and collaborative skills are key components of Learning and Innovation Skills essential for 21st-century careers. These skills enable learners to think analytically and systematically, coordinate tasks, and cooperate effectively in developing solutions to achieve goals. This study aims to develop the problem-solving and collaborative skills of Grade 11 students in the KOSEN program at KMUTT through the Project Work course by integrating the Engineering Design Process (EDP): Define, Design, Fabrication, Experiment, and Presentation. The study was conducted with 32 students, using a free-response problem-solving test and a collaboration satisfaction survey administered before and after the implementation of the learning model, which encouraged teamwork through brainstorming solutions, dividing responsibilities for creating a workpiece, and presenting the group work. The research results found that (1) the scores on the problem-solving test after learning were significantly higher than before learning at the .05 level, and (2) students rated their collaboration experiences as "good" to "very good," though challenges remained in allocating tasks and responsibilities within groups. Overall, the findings demonstrate that integrating STEM-PjBL with EDP effectively enhances students' problem-solving ability and promotes collaborative learning experiences.

Keywords: STEM project-based learning, engineering design process, problem-solving skills and collaborative skills

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Introduction

In an era of rapid change in technology, the economy, and society, preparing learners to cope with these changes requires an emphasis on developing creativity, analytical thinking, problem-solving, collaboration, and technological literacy—key skills for the 21st century (OECD, 2025; Rotherham & Willingham, 2010). These skills not only help learners solve complex real-world problems, but also promote teamwork and experiential learning, enabling them to apply knowledge effectively in future work (Evans, 2020).

Building collaborative networks with countries that possess globally recognized expertise and capacity is another approach to economic development and the creation of a high-quality workforce. Therefore, the Thai government has established cooperation programs with several leading countries, especially Japan—a leader in advanced technology—to develop human resources in science, technology, and innovation. These efforts aim to support economic growth in the Eastern Economic Corridor (EEC) and to develop a workforce aligned with the needs of Thai industry, representing an important investment in the future.

One major cooperation initiative of this kind is the KOSEN-KMUTT program, a collaboration between Thailand and Japan. It focuses on developing students' real-world problem-solving abilities, particularly in engineering and innovation, by emphasizing problem-solving skills and collaborative skills—core competencies necessary for learners to prepare for work in a rapidly changing world. As such, this program plays an important role in preparing learners to meet future challenges and in developing a high-quality workforce that can help drive Thailand's development on a global level (Evans, 2020; Husin et al., 2025).

Regarding teaching and learning management in KOSEN-KMUTT—especially in the Project course—the program applies the STEM-PjBL approach (Science, Technology, Engineering, Mathematics–Project-Based Learning) together with the Engineering Design Process (EDP). STEM integrates knowledge in science, technology, engineering, and mathematics, enabling students to connect and apply interdisciplinary knowledge to solve real problems (Kelley & Knowles, 2016). Meanwhile, Project-Based Learning (PjBL) is a learning model that emphasizes creating artifacts or products that address real societal problems, making learning meaningful and applicable in practice (Afriana & Fitriani, 2016; Harun, 2020). The EDP helps ensure that STEM-PjBL instruction follows clear, step-by-step procedures and can be replicated in future teaching. It also promotes problem-solving and collaborative skills, which are essential components of learning and innovation skills (learning and thinking skills) and are considered fundamental for 21st-century learners (Kelley & Knowles, 2016; Lin et al., 2021).

However, although project-based learning can produce tangible outputs, the success of developing problem-solving and collaboration as competency-based outcomes remains an issue that requires further study in order to evaluate the effectiveness of STEM-PjBL combined with the EDP. For this reason, the present research aims to examine the development of problem-solving and collaborative skills among Grade 11 students in the KOSEN program through STEM-PjBL learning using the Engineering Design Process (EDP), in order to provide an important guideline for developing an effective learning model that truly cultivates these essential skills.

Research Objective

1. To develop learning activities based on the design thinking process / engineering design process, integrated with project-based learning.
2. To evaluate students' problem-solving, communication, and collaboration skills—as well as their satisfaction—after implementing learning activities based on the design thinking process integrated with project-based learning.

Literature Review

1) Learning and Innovation Skills in the 21st Century

Learning and Innovation Skills are fundamental competencies and essential attributes for global citizens in today's value-based economy, enabling them to cope with rapid changes in technology and society. These skills are not limited to seeking knowledge; they also encompass learners' ability to apply diverse learning methods and processes to acquire knowledge independently or to work collaboratively with others in order to achieve shared goals (OECD, 2025).

A key component of learning and innovation skills includes problem-solving skills and collaborative skills, which are basic skills learners need in order to analyze complex real-world problems (OECD, 2025). In other words, when learners can creatively integrate knowledge, this can lead to the development of innovations in the form of novel inventions. Such innovations are not only tools for solving problems but also provide a range of alternatives that support sound conclusions and reasonable decision-making that fits the situation (Husin et al., 2025; Uhame, 2020).

2) Problem-Solving Skills

Problem-solving skills are an important competency that reflects learners' ability to face and manage complex problems in authentic contexts. This ability does not rely solely on theoretical knowledge; it also includes systematic thinking, cause analysis, generating alternatives, and making decisions to select appropriate solutions. Problem-solving is widely recognized as a core element of 21st-century learning and innovation skills, and it is essential for lifelong learning and for working in the digital era (Rotherham & Willingham, 2010).

Many educational studies indicate that problem-solving skills cannot be effectively developed through one-way, transmission-based instruction alone. Instead, they require learning activities that allow learners to encounter real problems, analyze situations, and design solutions on their own. This type of learning helps learners develop the ability to identify problems, analyze root causes, and design systematic solutions step by step (Roudhotul et al., 2021; Uhame, 2020; William, 2019).

In engineering learning contexts, problem-solving skills are closely linked to the design thinking process and the engineering design process (Engineering Design Process: EDP). These emphasize a structured sequence of steps, from defining the problem, designing concepts, building prototypes, testing, and iterative improvement. Using the EDP provides a clear structure for problem solving, reduces unguided trial-and-error, and encourages decisions based on data and reasoning (Kelley & Knowles, 2016).

3) Collaboration Skills

Collaboration refers to working together in a coordinated manner within and across groups so that a team's shared main goal can be successfully completed. Research has concluded that simply giving students opportunities to work in groups does not always equate to true collaboration (Rotherham & Willingham, 2010), because in typical group work there may be "free riders" who allow the most capable peer to do most of the work (Salomon & Gloverson, 1989). In contrast, genuine collaboration requires both social and cognitive processes.

Evans (2020) summarized four characteristics that indicate students are collaborating effectively:

1. **Plan and make decisions as a group (Decide):** Discuss the best way to manage and complete a task or project as a team, assign roles or tasks, and use negotiation or conflict resolution when needed to plan and decide together.
2. **Communicate thinking with the group (Communicate):** Seek clarity about one's own and teammates' thinking, respond politely to others' ideas, and propose new or different perspectives to the group.
3. **Share information, ideas, and support group members (Share):** Treat ideas and information as shared group resources that can be exchanged to accomplish the work. Members are responsible for their assigned tasks, including supporting one another.
4. **Provide feedback, monitor progress, reflect, and improve the process (Reflect & Adapt):** Reflect together on work methods and progress, and collaboratively improve the working process to reach the goal.

4) Assessment of Collaboration

Educational research shows that collaboration can be assessed in several ways, including:

1. **Self or peer reports** (questionnaires for self- and peer-assessment),
2. **Teacher ratings** (individual scoring by the instructor), and
3. **Observational measures** (teacher observation of interaction and discussion patterns within groups).

French et al. (2016) reported results from a student collaboration test using a 26-item questionnaire rated on a 1–5 scale (5-point Likert scale). The questionnaire was divided into four categories:

1. **Group Composition (4 items):** Recognizing diverse strengths that contribute to the group's overall effectiveness and performance.
2. **Interdependency (7 items):** Teamwork and collaboration through shared responsibility, compromise for the common good, and joint decision-making.
3. **Norms and Roles (6 items):** Accountability and commitment to duties and roles and maintaining preparedness according to established group standards.
4. **Goals (9 items):** Alignment of personal goals with group goals and a sense of personal responsibility for the group's success and outcomes.

5) STEM-PjBL and the Engineering Design Process (EDP)

Teaching and learning aimed at developing problem-solving and collaboration skills requires instructional models that emphasize hands-on practice and the integration of knowledge across multiple dimensions (Husin et al., 2025; Rotherham & Willingham, 2010; William, 2019), as described below.

Project-Based Learning (PjBL)

PjBL is a learner-centered approach that focuses on creating a product or artifact that addresses real societal problems. This model helps students see the meaning of learning and apply knowledge in practice. It also trains learners to ask questions, seek knowledge, plan actions systematically, share responsibility, and work as a team (Harun, 2020; William, 2019).

STEM-PjBL

STEM-PjBL integrates core disciplinary knowledge—science, technology, engineering, and mathematics—with project-based learning. Its goal is to enable learners to connect theoretical knowledge from multiple fields and apply it to solving complex, real-world engineering problems.

Kelley and Knowles (2016) explained that effective STEM education is not separated into isolated subjects; rather, it uses the engineering design process as the central core that connects scientific and mathematical knowledge with the design and development of technology. This approach helps learners see the relationships among disciplines and apply knowledge systematically to problem solving.

In addition, Afriana and Fitriani (2016) showed that STEM-PjBL promotes deeper learning because learners must face real problems, plan their work, experiment, and refine solutions on their own. This process develops analytical thinking, problem-solving ability, and the application of science and mathematics in meaningful contexts.

Engineering Design Process (EDP)

The EDP serves as a scaffolded sequence that gives project work clear direction and makes it repeatable. It is used to structure instruction step by step and consists of five key stages (Kelley & Knowles, 2016; Lin et al., 2021):

1. **Define (Problem identification):** Defining a problem based on a social context (society-inspired problem)
2. **Design:** Planning and designing conceptual solutions
3. **Fabrication:** Building a real prototype
4. **Test & Evaluation:** Evaluating the prototype's performance
5. **Communication:** Communicating results and innovations to society (society-oriented invention)

Lin et al. (2021) studied the effects of integrating the engineering design process into STEM project-based learning activities for preservice technology teachers. They found that learners who learned through the EDP showed significant improvements in design thinking, problem definition, concept design, and iterative improvement through repeated testing. This research indicates that the EDP functions as a scaffolded structure that systematically guides learners' thinking processes. Additionally, Kelley and Knowles (2016) proposed a conceptual framework for integrated STEM, identifying the engineering design process as the core that links scientific, mathematical, and technological knowledge with authentic engineering practice. Using the EDP as a step-by-step learning structure helps learners solve problems with clearer direction and make better decisions based on evidence and reasoning.

Research Methodology

This study aims to develop problem-solving skills and collaboration skills. The research procedures are described as follows.

Research Design

This study is a classroom action research study (Classroom Action Research) using a quasi-experimental approach (pre-experimental design). It employs a One-Group Pretest–Posttest Design to compare the development of students' problem-solving and collaboration skills before and after the learning intervention.

Participants

The target group consisted of 33 second-year students (Grade 11) in the KOSEN-KMUTT program, Automation Engineering major (Cohort 5), who were enrolled in the Project course in the Academic Year 2024.

Research Instruments & Teaching Method

The research instruments included a **STEM-PjBL-EDP lesson plan**, with the following details:

Project Topic

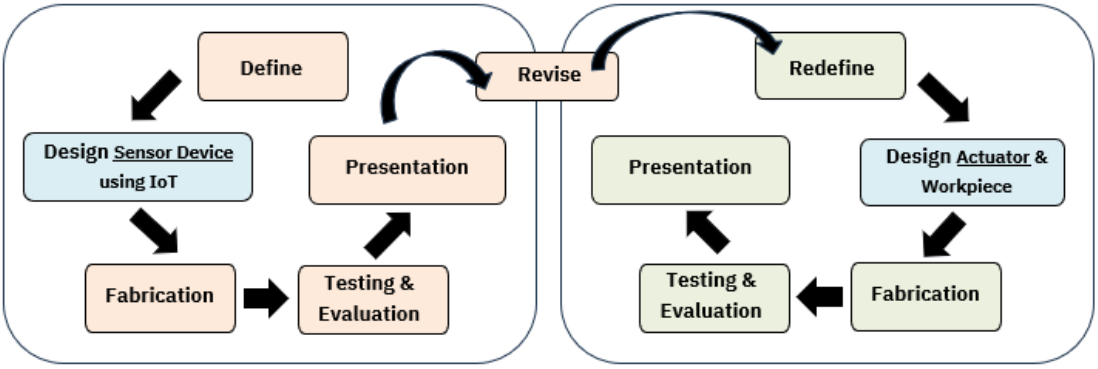
The researcher assigned students to design and build a "sensor-based detection and actuator system" to solve real problems within the school, with an emphasis on ensuring the system could be tested with real users.

Teaching Method (The EDP 2-Loop Model)

Instruction was divided into two main loops to enable continuous improvement of the project artifacts (an iterative process), as shown in Figure 1:

- **EDP Loop 1 – Sensor (Semester 1):** Students learned about IoT and sensor (sensing device) design, emphasizing rapid **fabrication** and **testing & evaluation** to ensure accurate sensor performance.
- **EDP Loop 2 – Actuator (Semester 2):** Students used the outcomes from Loop 1 to **redefine** the problem and then design and build an actuator system and the workpiece, resulting in a complete innovation.

Figure 1
The EDP Loop 1 Process Focuses on Teaching Sensors, and EDP Loop 2 Focuses on Teaching Actuators



Class Activities (Following EDP Steps)

Teaching and learning activities followed the EDP steps as described below.

Define included:

1. Identifying problems through user interviews and analyzing causes using a Fishbone Diagram to find the root cause, leading to the selected focus problem. This step was called the **Problem Statement** stage.
2. Brainstorming within the group and selecting 3–4 possible approaches, referred to as the **Ideate Solutions** stage.
3. Selecting one solution by considering factors such as originality and effectiveness in solving the problem, referred to as the **Choose Solutions** stage.

Design & Fabrication

Students drafted the hardware and software design and created a simple **quick prototype** using leftover/recycled materials to obtain feedback.

Figure 2
Examples of a Workpiece Model Created in SolidWorks and the Actual Fabricated Workpiece



Presentation

Students presented their projects in a **hybrid exhibition** format and through an **oral presentation** at the end of the academic year.

Data Collection & Analysis

The researcher collected and analyzed data as follows:

1. **Problem-solving skills assessment:** An open-ended test (total 44 points) was used to measure students' ability to identify problems, analyze causes, and design solution approaches.
2. **Collaboration skills assessment:** A 26-item questionnaire based on French et al. (2016), divided into four dimensions: Group Composition, Interdependency, Norms & Roles, and Goals.
3. **Data analysis:** Mean and standard deviation (S.D.) were calculated, and a paired-samples t-test was used to compare differences between pretest and posttest scores.

Results and Discussion

From implementing the STEM-PjBL learning model together with the Engineering Design Process (EDP) with students in the KOSEN-KMUTT program, the data analysis can be summarized as follows:

Results of Problem-Solving Skill Development

An analysis of students' scores on the Problem-Solving Test before and after participating in the learning activities showed clear improvement, as presented in Table 1.

Table 1
The Score of Pretest–Posttest for Problem-Solving Skill

	Mean	N	Std. Deviation	Sig. (2-tailed)
Pretest	20.07	28	3.99	< 0.001*
Posttest	28.11	28	3.68	

Note. *Significant at the $p < 0.001$ level

Table 1 shows that the posttest mean score (Mean = 28.11) was significantly higher than the pretest mean score (Mean = 20.07) at the **$p < 0.001$** level. This supports the hypothesis that STEM-PjBL combined with the EDP enhances learners' analytical thinking, problem identification, and systematic design of solution alternatives (Husin et al., 2025; Kelley & Knowles, 2016; Lin et al., 2021).

Results of Collaborative Skill Development

Collaboration skills were assessed using a questionnaire across four dimensions. The results indicate that students demonstrated positive attitudes and group-work behaviors after the STEM-PjBL and EDP learning intervention, as shown in Table 2.

Table 2
The Score of Pretest–Posttest for Collaborative Skill

Dimension		Mean (n = 33)	Std. Deviation
Group Composition	Pretest	4.19	0.75
	Posttest	4.35	0.69
Interdependency	Pretest	4.17	0.86
	Posttest	4.45	0.62
Norms and Roles	Pretest	4.33	0.76
	Posttest	4.30	0.74
Goals	Pretest	4.41	0.63
	Posttest	4.27	0.74

Item-level analysis (sub-questions) revealed statistically significant and noteworthy findings in two key dimensions:

1. **Group Composition:** Students recognized the value of teamwork and agreed that *group work produces better outcomes than working individually* ("groups outperform individuals").
2. **Interdependency:** Students showed a clear increase in willingness to make sacrifices and to accept collective input—especially regarding *being willing to compromise on personal issues for the benefit of the group* and *consulting all members before making decisions*.

However, the posttest mean scores for **Norms and Roles** and **Goals** decreased slightly (from 4.33 to 4.30, and from 4.41 to 4.27, respectively). This suggests challenges in assigning responsibilities within groups and maintaining a balance between personal goals and group goals (Evans, 2020; Salomon & Globerson, 1989). These issues point to the need for improved task-tracking tools or closer instructional coaching and guidance in future implementations.

Conclusion

Integrating STEM-PjBL with the EDP is highly effective in developing problem-solving skills and in fostering a sense of collaboration through interdependency and recognition of differences among team members (group composition). These are key elements in developing high-quality innovators in line with the goals of the KOSEN-KMUTT program.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, an AI-assisted software tool, was used for translation support, proofreading, and language refinement. Its use was limited to correcting grammar and spelling and rephrasing sentences to improve clarity and accuracy. The author also confirms that no other AI or AI-assisted technologies were used to generate manuscript content. All

ideas, research design, procedures, results, analyses, and discussion were produced by the author and are based on the careful and systematic conduct of the study.

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Both Are Worse: Nonword Repetition Tasks With a High vs. Low Linguistic Load as Clinical Markers for Language(-Related) Impairments

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Abstract

Purpose: Nonword repetition (NWR) tasks are widely used for the detection of children with deficits in phonological short-term memory (PSTM). Such deficits can be indicative of language(-related) medical impairments with or without comorbidities. However, previous studies showed a considerable influence of children's language competence on NWR performance. Therefore, some language-unspecific NWR tasks were developed that should minimize linguistic interferences and provide a more direct access to PSTM.
Methods: In the current retrospective study, language-specific and language-unspecific NWR tasks were compared regarding their associations with children's language skills and language(-related) impairments. Ten samples of four- and five-year-old monolingual and bilingual German children that were tested either with language-specific or language-unspecific NWR tasks were compared regarding linguistic interferences, associations between NWR performance and language(-related) medical issues as well as possible influence factors on the NWR scores. Sample sizes varied from 161 to 2,750. Seven NWR tests were utilized.
Results: In most cases, NWR performance depended on German articulation/phonotactics skills and was hardly associated with language(-related) impairments. Monolinguals outperformed bilinguals in language-specific nonwords under condition of significantly better German articulation skills. Language-unspecific nonwords minimized the influence of language competence on the NWR performance. However, this "culture-fairness" did not result in higher associations with language(-related) medical issues in comparison with language-specific nonwords.
Discussion and Conclusion: Neither language-specific nor language-unspecific NWR tasks contribute to the diagnostics of language(-related) impairments. Independent cut-off criteria for such impairments based on the NWR performance would be misleading due to strong linguistic interferences even in case of comparatively language-unspecific nonwords.

Keywords: working memory, phonological short-term memory, nonword repetition, language assessment, German language

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Introduction

Deficits in phonological short-term memory (PSTM) or, more generally, working memory, are often utilized as a clinical marker for language(-related) impairments and disorders (e.g., Masoura et al., 2020; Penke, 2018). Numerous studies demonstrated significant associations between such deficits and Developmental Language Disorder (Schwob et al., 2021) as well as language impairments with comorbidities such as severe hearing loss (Ching et al., 2019) or Attention-Deficit/Hyperactivity Disorder (Redmond et al., 2011).

However, PSTM tests that are based on the repetition of nonwords, real words, sentences, and digit spans also assess language competence, because these tasks are usually language-specific (Grimm, 2016; Verhagen et al., 2017). For instance, sentence repetition requires not only PSTM, but also vocabulary, articulation, and grammar skills and is, therefore, more suitable for language assessment than for PSTM assessment (Polišenska et al., 2015). Among repetition tasks, nonwords have the lowest linguistic load, but many of them contain real morphemes, rhyme with existing words, and follow the phonotactic rules of the language they are based on. Therefore, they can put children with a weak competence in the language nonwords are based on (e.g., immigrants) at a disadvantage (Zaretsky & Lange, 2022). Bilinguals' weak performance in repetition tasks can be misinterpreted as deficits in PSTM (Engel de Abreu et al., 2013; Grimm, 2016).

Various tasks were developed for the reduction of the linguistic load in PSTM tests: meaningless sentences, low frequency words (that are unknown to most children and can be used as nonwords), nonwords without morphological elements (but with language-specific phonemes and consonant clusters), and "quasi-universal"/"cross-linguistic" nonwords. The latter avoid all more or less language-specific features (e.g., morphological elements, consonant clusters, stress patterns, rhymes with existing words) and can, therefore, be considered most "culture-fair" and language-unspecific. "Quasi-universal" nonwords (QUNW) developed by Chiat (2015) seem to represent the most promising new approach for PSTM assessment and were, therefore, in the focus of the present study.

Nonword repetition (NWR) tasks were integrated in many language tests as possible clinical markers for language impairments. For instance, the German language screening "Kindersprachscreening" ([KiSS], Holler-Zittlau et al., 2011) utilizes them, as independent cut-off criterion, for the detection of monolingual German children who need medical assistance in acquiring German. In spite of the wide-spread use of NWR tasks, hardly any statistical evidence can be found that their dichotomous results can be "translated" into acceptable sensitivity and specificity values for the detection of children with language(-related) impairments (LRI) (Schwob et al., 2021). Most studies only found evidence for statistically significant differences in NWR scores of correct answers between typically developed and language-impaired children (e.g., Boerma et al., 2015). However, such differences do not guarantee that NWR tasks can be used as a reliable clinical marker for LRI. Also, there is no evidence that a relative "culture-fairness" of language-unspecific nonwords can improve the quality criteria of such clinical markers in comparison with language-specific nonwords.

In the current study, seven NWR tasks with zero to high linguistic loads were scrutinized on the basis of ten samples of four- and five-year-old German children. The study aimed to quantify associations between total scores of correct answers in such tasks and children's LRI, under consideration of their German language competence. Also, possible linguistic

interferences and other influence factors, including monolingualism vs. bilingualism, on the NWR performance were analysed. Two gold standards were used for the assessment of children's LRI: running or completed language therapy (LT) and LRI that is known to parents (documented in questionnaires).

Methods

Test Subjects

For this study, ten samples of German four- and five-year-old kindergarten children were re-analysed retrospectively. No inclusion or exclusion criteria were applied in the original prospective studies except for appropriate age (4;0–4;11 or 5;0–5;11 years) and a written consent signed by parents.

Information on LT and LRI was documented in questionnaires for parents in dichotomous items "Does/did the child undergo a therapy due to a language impairment?" and "Has the child any language(-related) impairment or disorder?" (yes/no). Phi-correlations between these two items were predominantly low. Therefore, these items were analysed separately. For sample characteristics, including phi-correlations between LT and LRI, see Table 1.

All children were classified as monolinguals or bi-/multilinguals (called "bilinguals" from now on) on the basis of questionnaires for parents. The largest subgroups of bilinguals spoke Turkish, Russian, and Arabic languages at home.

In all samples, monolinguals and bilinguals did not differ in age in months according to Mann-Whitney *U*-tests and in biological sex according to Chi-square tests ($p > .05$).

All children were tested in German kindergartens by PhD students, researchers, and interns of three university hospitals. Children's answers were audio-recorded and controlled by postdoc researchers (linguists).

Test Materials

All children were tested with language tests that included NWR tasks. Additionally, their German vocabulary and articulation skills were assessed. All tests except QUNW are widely used, standardized, and validated for German pre-schoolers. Characteristics of language tests can be found in Table 2, characteristics of nonwords in Table 3.

NWR tasks differ in terms of item length, number of items, and linguistic load. The latter is defined as frequency of morphological elements (suffixes, prefixes, and stems) and of phonological elements (language-specific phonemes and consonant clusters) of the German language. Only one NWR task, QUNW, did not contain any of such elements and can be considered language-unspecific. All other NWR tasks were classified as language-specific. Generally, articulation errors (e.g., rhotacism, sigmatism) were not considered as NWR (or PSTM) errors in NWR tasks.

Table 1a

Sample Characteristics: Four-Year-Old Children

	S1	S2	S3	S4	S5
n	2,750	1,735	161	194	1,589
Nonword repetition task	KiSS.2 subtest	SSV subtest	HASE subtest	Mottier	QUNW
Vocabulary and articulation tasks	KiSS.2 subtests	KiSS.2 subtests	KiSS.2 subtests	KiSS.2 subtests	KiSS.2 subtests
Age (in months): *M* ±*SD*	52.8 ±3.4	53.4 ±3.4	51.5 ±1.9	51.8 ±2.5	53.9 ±3.2
Age span	48–59	48–59	48–55	48–59	48–59
Monolinguals	1,364 (49.6%)	804 (46.3%)	104 (64.6%)	148 (76.3%)	742 (46.7%)
Bilinguals	1,389 (50.4%)	931 (53.7%)	57 (35.4%)	46 (23.7%)	847 (53.3%)
Male	1,479 (53.8%)	886 (51.1%)	87 (54.0%)	123 (63.4%)	809 (50.9%)
Female	1,271 (46.2%)	849 (48.9%)	74 (46.0%)	71 (36.6%)	780 (49.1%)
% LT	220 (8.0%)	119 (6.9%)	15 (9.3%)	52 (26.8%)	107 (6.7%)
% LRI	161 (5.9%)	108 (6.2%)	—	23 (11.9%)	121 (7.6%)
LT vs. LRI: phi-correlations	.338***	.326***	—	.354***	.311***

Note. LT language therapy, LRI language(-related) impairments, QUNW quasi-universal nonwords, *M* mean, *SD* standard deviation

Table 1b
Sample Characteristics: Five-Year-Old Children

	S6	**S7**	**S8**	**S9**	**S10**
n	727	656	338	423	716
Nonword repetition task	KiSS.2 subtest	SSV subtest	S-ENS subtest	SOPESS subtest	QUNW
Vocabulary and articulation tasks	KiSS.2 subtests	KiSS.2 subtests	S-ENS subtests ("Add-on")	SOPESS subtest (articulation only)	KiSS.2 subtests
Age (in months): *M* ±*SD*	63.5 ±2.8	63.2 ±2.7	67.4 ±3.6	67.0 ±2.2	63.3 ±2.7
Age span	60–71	60–71	60–71	60–71	60–71
Monolinguals	253 (34.8%)	234 (35.7%)	139 (41.1%)	139 (32.9%)	244 (34.1%)
Bilinguals	474 (65.2%)	422 (64.3%)	199 (58.9%)	284 (67.1%)	472 (65.9%)
Male	378 (52.0%)	338 (51.5%)	166 (49.1%)	215 (50.8%)	368 (51.4%)
Female	349 (48.0%)	318 (48.5%)	172 (50.9%)	208 (49.2%)	348 (48.6%)
% LT	110 (15.1%)	83 (12.7%)	51 (15.1%)	37 (8.7%)	91 (12.7%)
% LRI	55 (7.6%)	46 (7.0%)	24 (7.1%)	24 (5.7%)	49 (6.8%)
LT vs. LRI: phi-correlations	.431***	.434***	.495***	.322***	.428***

Table 2a

Characteristics of Tests: KiSS.2, SSV, HASE, S-ENS

Short test names	**KiSS.2**	**SSV**	**HASE**	**S-ENS**
Full test names in English*	"Language Screening for Children", 2nd version	"Language Screening for the Preschool Age", 2nd version	"Heidelberg Auditive Screening for the School Enrolment Examination"	"Develop-mental Screening for the School Enrolment Examination"
Test authors	Holler-Zittlau et al. (2011)	Grimm (2017)	Brunner & Schöler (2002)	Döpfner et al. (2005)
Subtests	(1) Speech comprehension (2) vocabulary (3) articulation (4) grammar (5) repetition of nonwords (6) repetition of sentences (7) spontaneous speech	(1) repetition of nonwords (2) repetition of sentences	(1) repetition of sentences (2) repetition of digit spans (3) repetition of nonwords	(1) repetition of nonwords (2) filling out gaps in words (3) repetition of sentences (4) articulation (5) speech comprehension (6) vocabulary (7) grammar**

Table 2b

Characteristics of Tests: SOPESS, Mottier, QUNW

Short test names	**SOPESS**	**Mottier**	**QUNW**
Full test names in English*	"Social-Paediatric Developmental Screening for School Enrolment Examinations"	"Mottier Test"	"Quasi-Universal Non-words"
Test authors	Daseking et al. (2009)	Mottier (1951)	Chiat (2015)
Subtests	(1) grammar (2) repetition of nonwords (3) articulation (4) spontaneous speech	(1) repetition of nonwords	(1) repetition of nonwords

Note. * For full German test names, see References; ** Tasks 5–7 are included in the extended version of S-ENS known as S-ENS-Add-on (Neumann et al., 2011).

Table 3a

Characteristics of Nonwords: KiSS.2, SSV, HASE, S-ENS

	KiSS.2	SSV	HASE	S-ENS
n (nonwords)	4	18	10	6
German prefixes	2	1	0	0
German suffixes	2	8	0	1
German stems	0	2	0	3
Consonant clusters				
(a) 2 consonants	4	28	2	1
(b) 3 consonants	0	1	0	0
Phonemes /r, ʒ, ʃ, ŋ, ʔ/*	4	12	6	5
Item length				
(a) 2 syllables	1	3	3	0
(b) 3	0	6	3	1
(c) 4	3	4	3	5
(d) 5	0	5	1	0
(e) 6	0	0	0	0
Linguistic load	high (morphology, phonology)	high (morphology, phonology)	low (phonology)	low (phonology)
Language-specific	yes	yes	yes	yes
Nonword examples	*Triser*, *Nabolira*	*Kalifeng*, *Gattwutz*	*Godepi*, *Wunore*	*Fangofänger*, *Maramula*

Table 3b

Characteristics of Nonwords: SOPESS, Mottier, QUNW

	SOPESS	Mottier	QUNW
n (nonwords)	6	30	16
German prefixes	0	0	0
German suffixes	2	0	0
German stems	0	0	0
Consonant clusters			
(a) 2 consonants	1	0	0
(b) 3 consonants	0	0	0
Phonemes /r, ʒ, ʃ, ŋ, ʔ/*	4	16	0
Item length			
(a) 2 syllables	0	6	4
(b) 3	3	6	4
(c) 4	3	6	4
(d) 5	0	6	4
(e) 6	0	6	0
Linguistic load	low (phonology)	low (phonology)	zero
Language-specific	yes	yes	no
Nonword examples	Not public	*Mera*, *Dugabe*	*Lumika*, *Litisaku*

Note. QUNW quasi-universal nonwords; * German-specific phonemes

Statistical Analyses

First, monolinguals' and bilinguals' performance in NWR, articulation, and vocabulary tasks was compared by means of Mann-Whitney *U*-tests. It was assumed that (a) monolinguals would outperform bilinguals in language-specific NWR tasks under condition of better articulation and/or vocabulary skills, (b) bilinguals and monolinguals would perform equally in the language-unspecific NWR task (QUNW) irrespective of their German language competence. Effect sizes in Mann-Whitney *U*-tests were quantified by the probability of superiority index ($\hat{p}$; Grissom & Kim, 2012). Values close to .5 are considered low, those close to .0 high.

Second, possible transfers from bilinguals' first language in NWR performance were exemplified by simplifications/omissions in consonant clusters in the word final position. For this purpose, repetition of all six word final consonant clusters in SSV nonwords was compared for monolinguals and bilinguals by means of Chi-square tests, without differentiation between four- and five-year-old children (samples S2 and S7 were merged). Because word-final consonant clusters are highly language-specific and do not occur in some languages that are widely spoken in Germany (e.g., Turkish; Dirim, 2005), it was assumed that bilinguals would simplify them more often than monolinguals.

Third, associations between the NWR performance and questionnaire items on LT/LRI were quantified by point-biserial correlations. Due to linguistic interferences, it was assumed that the correlations would be low both for monolinguals and bilinguals, at least in language-specific NWR tasks.

Finally, possible influence factors on the NWR performance were assessed by linear regressions (method "enter"). The independent variables were (a) vocabulary test score, (b) articulation test score, (c) children's age in months, (d) LT, (e) LRI, and (f) classification monolinguals vs. bilinguals. It was assumed that, under consideration of children's German language skills, the associations between NWR performance and LT and/or LRI would be very weak, except in QUNW.

All calculations, except for those with consonant clusters in the word final position, were carried out separately for four- and five-year-old children as well as separately for samples S1–S10.

For retrospective studies based on anonymized data, no ethical approval is necessary.

Results

When comparing monolinguals and bilinguals regarding their NWR performance as well as articulation and vocabulary skills (see Table 4), considerable, that is, highly significant differences were found only for vocabulary: Monolinguals outperformed bilinguals in all cases. In the samples that were tested with NWR tasks with a high linguistic load (S1, S2, S6, S7), monolinguals outperformed bilinguals in NWR, but also in articulation and vocabulary in almost all cases. In the samples that were tested with NWR tasks with a low linguistic load (S3, S4, S8, S9), monolinguals and bilinguals did not differ significantly in NWR and articulation. However, monolinguals outperformed bilinguals in vocabulary tasks. In the samples that were tested with NWR tasks without any language-specific load (S5, S10), monolinguals showed weaker results than bilinguals in NWR (in one case significantly, in the

other case numerically), although they outperformed bilinguals in articulation and vocabulary. Thus, monolinguals outperformed bilinguals in NWR tasks with a high linguistic load, did not differ from bilinguals in NWR tasks with a low linguistic load, and were weaker than bilinguals in NWR tasks with zero linguistic load.

Bilinguals simplified word final consonant clusters significantly more often than monolinguals in five SSV nonwords out of six (see Table 5).

Almost all correlations between NWR scores and children's LT and LRI were low to non-existent (see Table 6). Correlation coefficients of monolinguals were predominantly higher than those of bilinguals. Correlations between NWR scores and LT were higher than correlations between NWR and LRI in 17 calculations out of 18.

In the linear regressions, vocabulary and articulation skills yielded significant results in all cases, children's age in eight calculations out of ten, LT in nine, the classification monolinguals vs. bilinguals in seven, and LRI did not yield any significant results (see Table 7). Higher total scores of correct answers in the vocabulary and articulation tasks, higher age, being bilingual, and no LT were associated with better NWR results. In two regressions, the standardized beta of LT was higher than the betas of the vocabulary and articulation tasks (S3, S8), that is, LT constituted a more important influence factor. In most other regressions, including those with QUNW, vocabulary and articulation skills showed higher beta values than LT.

Table 4

Differences in the Language Test Scores of Monolinguals and Bilinguals: Means ±Standard Deviations and Mann-Whitney U-Tests

Sample		Nonword repetition	Articulation	Vocabulary
Four-year-old children				
S1 (KiSS.2)	**MO**	2.4 ±1.2	8.6 ±2.0	6.8 ±1.8
	BI	2.1 ±1.2	8.2 ±2.0	3.8 ±2.7
	Z/p̂	-5.39***/.44	-6.88***/.43	-28.83***/.18
S2 (SSV)	**MO**	10.2 ±3.7	8.7 ±1.7	6.7 ±1.7
	BI	9.2 ±4.2	8.2 ±1.9	3.6 ±2.7
	Z/p̂	-4.39***/.44	-6.70***/.41	-23.12***/.18
S3 (HASE)	**MO**	6.7 ±2.3	9.6 ±1.9	7.1 ±1.7
	BI	6.3 ±2.3	9.4 ±1.9	4.81 ±2.7
	Z/p̂	-0.96/.45	-1.15/.45	-5.35***/.25
S4 (Mottier)	**MO**	15.3 ±5.8	7.7 ±2.6	6.9 ±1.9
	BI	15.5 ±6.8	7.3 ±2.3	4.3 ±2.5
	Z/p̂	-0.33/.48	-1.22/.44	-6.04***/.21
S5 (QUNW)	**MO**	10.9 ±2.7	10.7 ±1.9	6.7 ±1.7
	BI	11.1 ±3.0	10.0 ±2.2	3.4 ±2.7
	Z/p̂	-2.12*/.47	-6.63***/.41	-23.05***/.17
Five-year-old children				
S6 (KiSS.2)	**MO**	2.5 ±1.2	9.2 ±1.3	7.6 ±1.4
	BI	2.4 ±1.2	8.8 ±1.6	4.5 ±2.8
	Z/p̂	-1.04/.48	-4.24***/.41	-14.58***/.17
S7 (SSV)	**MO**	11.4 ±3.6	9.3 ±1.2	7.7 ±1.4
	BI	10.7 ±3.7	8.9 ±1.6	4.5 ±2.8
	Z/p̂	-2.33*/.45	-4.39***/.40	-14.26***/.17
S8 (S-ENS)	**MO**	4.8 ±1.4	9.6 ±0.9	3.9 ±1.2
	BI	5.00 ±1.1	9.6 ±0.9	1.8 ±1.8
	Z/p̂	-1.10/.47	-0.48/.49	-10.11***/.18
S9 (SOPESS)	**MO**	5.2 ±1.1	9.4 ±1.0	—
	BI	5.0 ±1.2	9.4 ±1.1	—
	Z/p̂	-1.58/.46	-0.25/.49	—
S10 (QUNW)	**MO**	11.9 ±2.5	11.3 ±1.3	7.6 ±1.4
	BI	12.1 ±2.6	10.7 ±1.8	4.4 ±2.8
	Z/p̂	-1.83/.46	-5.02***/.39	-14.90***/.16

Note. *** $p < .001$, * $p < .05$; QUNW quasi-universal nonwords, MO monolinguals, BI bilinguals, — no data available, $\hat{p}$ probability of superiority index

Table 5

Monolinguals' and Bilinguals' Errors (Simplifications/Omissions) in Word-Final Consonant Clusters in SSV Nonwords: Chi-Square (Combined Samples S2, S7)

Consonant clusters	Monolinguals	Bilinguals	Chi-Square
/nt/ in *Entiergent*	43/1,027 (4.2%)	110/1,335 (8.2%)	15.74***
/ts/ in *Gattwutz*	80/1,028 (7.8%)	189/1,338 (14.1%)	23.22***
/st/ in *Seregropist*	179/976 (18.3%)	346/1,277 (27.1%)	23.72***
/bst/ in *Nebatsubst*	382/998 (38.3%)	534/1,308 (40.8%)	1.54
/nk/ in *Ippazeumerink*	213/950 (22.4%)	336/1,228 (27.4%)	6.94**
/st/ in *Vominlapertust*	208/945 (22.0%)	360/1,224 (29.4%)	15.11***

Note. *** $p < .001$, ** $p < .01$

Table 6

Associations Between Nonword Repetition Performance and (a) Language Therapies (LT), (b) Language(-Related) Impairments (LRI): Point-Biserial Correlations

Sample		LT	LRI
		Four-year-old children	
S1 (KiSS.2)	**MO**	.209***	.097***
	BI	.142***	.089**
S2 (SSV)	**MO**	.136***	.104**
	BI	.209***	.092**
S3 (HASE)	**MO**	.455***	—
	BI	.108	—
S4 (Mottier)	**MO**	.380***	.123
	BI	.365*	.241
S5 (QUNW)	**MO**	.152***	.124**
	BI	.220***	.095**
		Five-year-old children	
S6 (KiSS.2)	**MO**	.267***	.136*
	BI	.220***	.081
S7 (SSV)	**MO**	.167*	.131*
	BI	.156**	.047
S8 (S-ENS)	**MO**	.391***	.187*
	BI	.290***	.065
S9 (SOPESS)	**MO**	.209*	.053
	BI	.111	.149*
S10 (QUNW)	**MO**	.199**	.148*
	BI	.159*	.084

Note. *** $p < .001$, ** $p < .01$, * $p < .05$; QUNW quasi-universal nonwords, MO monolinguals, BI bilinguals, — no data available

Table 7a

Influence Factors on the Nonword Repetition Performance: Linear Regressions

	S1 (KiSS.2)		**S2 (SSV)**	
	Stand. *β*	***T***	**Stand. *β***	***T***
Vocabulary	.310	14.00***	.347	12.93***
Articulation	.183	9.37***	.254	11.00***
Age (in months)	.046	2.61**	.067	3.12**
LT	.083	4.25***	.077	3.37**
LRI	.021	1.13	.020	0.89
MO vs. BI	.085	4.03***	.122	4.78***
Constant	—	-4.02***	—	-3.86***
Corr. R^2	.169		.236	
Model (*F/df*)	94.01***/6, 2,743		90.15***/6, 1,728	
Age group	Four-year-olds		Four-year-olds	
	S3 (HASE)		**S4 (Mottier)**	
Vocabulary	.269	3.31**	.364	4.82***
Articulation	.205	2.78**	.204	2.49*
Age (in months)	.026	0.37	-.007	-0.11
LT	.325	4.55***	.176	2.15*
LRI	—	—	.038	0.57
MO vs. BI	.006	0.07	.179	2.49*
Constant	—	-0.86	—	-0.23
Corr. R^2	.243		.273	
Model (*F/df*)	11.26***/5, 155		13.07***/6, 187	
Age group	Four-year-olds		Four-year-olds	
	S5 (QUNW)		**S6 (KiSS.2)**	
Vocabulary	.233	7.74***	.169	3.86***
Articulation	.219	8.64***	.221	5.82***
Age (in months)	.124	5.27***	.069	1.97*
LT	.108	4.33***	.173	4.39***
LRI	.031	1.29	.004	0.11
MO vs. BI	.206	7.17***	.077	1.89
Constant	—	-3.00**	—	-2.66**
Corr. R^2	.169		.146	
Model (*F/df*)	54.19***/6, 1,566		21.70***/6, 720	
Age group	Four-year-olds		Five-year-olds	

Note. *** $p < .001$, ** $p < .01$, * $p < .05$; LT language therapy, LRI language(-related) impairment, QUNW quasi-universal nonwords, MO monolinguals, BI bilinguals

Table 7b
Influence Factors on the Nonword Repetition Performance: Linear Regressions

	S7 (SSV)		S8 (S-ENS)	
	Stand. *β*	***T***	**Stand. *β***	***T***
Vocabulary	.335	7.38***	.234	3.88***
Articulation	.178	4.59***	.176	3.32**
Age (in months)	.096	2.70**	.087	1.76
LT	.089	2.24*	.270	4.54***
LRI	.028	0.71	-.045	-0.80
MO vs. BI	.114	2.71**	.189	3.15**
Constant	—	-2.34*	—	-1.36
Corr. R^2	.185		.192	
Model (*F/df*)	25.83***/6, 649		14.33***/6, 331	
Age group	Five-year-olds		Five-year-olds	
	S9 (SOPESS)		**S10 (QUNW)**	
Vocabulary	—	—	.135	2.99**
Articulation	.260	5.46***	.244	6.32***
Age (in months)	.061	1.30	.096	2.72**
LT	.082	1.66	.118	3.02**
LRI	.066	1.32	.048	1.24
MO vs. BI	-.066	-1.41	.172	4.11***
Constant	—	-0.43	—	-1.09
Corr. R^2	.091		.132	
Model (*F/df*)	9.40***/5, 413		19.05***/6, 706	
Age group	Five-year-olds		Five-year-olds	

Note. *** $p < .001$, ** $p < .01$, * $p < .05$; LT language therapy, LRI language(-related) impairment, QUNW quasi-universal nonwords, MO monolinguals, BI bilinguals

Discussion and Conclusion

Although nonword repetition tasks were developed to detect deficits in children's PSTM, as a possible clinical marker for LRI, the current study showed that NWR performance depends on children's articulation skills in most cases. Also, NWR performance is hardly associated with children's (running or completed) LT and LRI (documented in questionnaires for parents). Reduction of the linguistic load in NWR tasks resulted in a relative "culture-fairness" of nonwords, that is, monolinguals could not outperform bilinguals in NWR, but this did not make such tasks more appropriate for the detection of children with LRI.

In all samples, monolinguals outperformed bilinguals in the vocabulary tasks. Therefore, the condition of comparable vocabulary skills could not be tested. Also, monolinguals outperformed bilinguals in articulation tasks in six out of ten samples. In three of these samples (S1, S2, S7), namely those with language-specific NWR tasks, this resulted in a better NWR performance of monolinguals compared to bilinguals (also, the same finding did not achieve statistical significance in S6). On the contrary, comparable articulation skills of monolinguals and bilinguals (S3, S4, S8, S9) resulted in a comparable NWR performance, without exceptions. Thus, good performance in German-based nonwords presupposes sufficient competence in German articulation/phonotactics and puts those bilinguals at a disadvantage who lag behind in its acquisition.

Language-unspecific nonwords (QUNW) showed a very different NWR performance pattern. In S10, bilinguals outperformed monolinguals in NWR in spite of weaker German language skills (vocabulary, articulation). However, the "culture-fairness" of QUNW did not result in higher correlations between NWR scores and LT/LRI, compared to German-based nonwords. Irrespective of the linguistic load, NWR tasks demonstrated far too low correlations with LT and LRI.

Generally, the importance of the linguistic load and "culture-fairness" of NWR tasks seems to be overestimated in the research on possible indicators of children's LRI. In the current study, children's German articulation skills were shown to be a more important predictor than LT/LRI for the NWR performance in both samples that were tested with QUNW (S5, S10, see Table 7). Additionally, children's age and German vocabulary skills as well as the classification monolinguals vs. bilinguals showed a higher influence on NWR scores, compared to LT, in S5. For both monolinguals and bilinguals taken together, the best regression result regarding associations between NWR tasks and LT was achieved not by QUNW, but by HASE (four-year-olds) and S-ENS (five-year-olds), that is, German-based NWR tasks with a low linguistic load (German phonology, but not morphology). The same tasks yielded the highest point-biserial correlations with LT for monolinguals. The highest point-biserial correlations with LT for bilinguals were achieved by the Mottier test (four-year-olds) and, again, S-ENS (five-year-olds) that are both German-based in terms of phonology. Thus, NWR tasks with a low linguistic load appear to be more promising than language-unspecific tasks, but none of them can contribute considerably to the detection of LRI (quantified by LT). Also, when LRI was quantified by the questionnaire item on LRI, this variable did not show any significant results in the regressions and yielded very low to non-existent point-biserial correlations with NWR scores.

It should be noted that the better performance of bilinguals, compared to monolinguals, in QUNW, in spite of weak German language skills, as well as associations between bilingualism and higher NWR scores in the regressions, might be indicative of the so-called "bilingual advantage" that consists in better-developed cognitive skills, including PSTM, of bilinguals compared to monolinguals (Gunnerud et al., 2020). The reflection of the "bilingual advantage" in QUNW results may mean that language-unspecific nonwords indeed provide a more direct access to PSTM, which, however, does not make them a more reliable clinical marker for LRI, probably because of a weak association between deficits in PSTM and (some) LRI.

Quality criteria of NWR tasks in terms of sensitivity and specificity were not determined in the present study because correlations below .5 (and mostly below .3) between NWR scores and LT/LRI cannot be "translated" into acceptable sensitivity (at least 90%) and specificity (at least 70%). Therefore, no Receiver Operating Curves (ROC) were calculated. In other studies, such calculations resulted in insufficient quality criteria of both language-specific and language-unspecific NWR tasks for LRI (e.g., Zaretsky & Hey, 2022).

Because only 9–27% of the variance of the NWR performance were explained in the regressions (see Table 7), it can be assumed that a number of other factors that were not considered in the present study influenced NWR results (e.g., attention, long-term memory, German grammar skills, year and region of the language test, typology of bilinguals' first language, oromotor skills, intelligence quotient). Also, due to the low percentage of explained variance in the regressions, it cannot be excluded that vocabulary and articulation skills do not constitute the most important influence factors on the NWR performance.

Since children in the current study did not undergo any medical examinations, it remains open whether parents' information on LT and LRI can be considered reliable. Information on LRI may be comparatively subjective, in comparison with children's participation in LT (that can hardly escape parents' attention because they are (co-)responsible for its organisation).

To sum up, no evidence was found that language-specific or language-unspecific NWR tasks can contribute considerably to the LRI detection. Hence, none of them can be recommended for this purpose. Although NWR tasks with a low linguistic load appear more promising, their results can be misinterpreted in case of weak German articulation skills. Relative "culture-fairness" of language-unspecific nonwords (QUNW) did not result in a higher predictive power for LRI. Unexpectedly, children's performance in QUNW depended, first and foremost, on their German articulation skills, followed by vocabulary skills. It cannot be excluded that some NWR tasks may provide sufficient predictive power for one or two LRI that are associated with considerable deficits in PSTM but not for all LRI taken together.

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Effects of Supportive Parenting Style, Academic Self-Concept, Expectations, and Values on Mandarin Academic Achievement Among First-Year Vocational College Students

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Abstract

This research investigates the effects of supportive parenting style, academic self-concept, and expectancy-value beliefs on Mandarin academic achievement among first-year vocational college students in central and western China. Standardized scales and the Putonghua Proficiency Test were employed, with data analyzed using descriptive statistics, correlation, and regression. The results confirm that all three predictors exert significant and positive influences, with supportive parenting emerging as the strongest factor. These findings underscore the decisive role of family support and motivational beliefs in language achievement and offer practical implications for educational policy and family engagement in multicultural and under-resourced contexts.

Keywords: Mandarin achievement, supportive parenting style, academic self-concept, expectancy-value, vocational students

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Introduction

Mandarin Chinese is essential for national unity, cultural exchange, and educational opportunity in China.This policy emphasis underscores a growing recognition of language as both a barrier and a bridge to social equity. Research has shown that language proficiency is strongly correlated with academic success, access to employment opportunities, and social integration, particularly for students from ethnic minority and rural backgrounds (Wang & Postiglione, 2009). In regions like Guizhou, where a high proportion of the population communicates daily in regional dialects or minority languages, the disparity in Mandarin proficiency reflects deeper issues of educational inequality and cultural marginalization (Zhou, 2000). Consequently, improving Mandarin competence among vocational college students is not merely a linguistic challenge but a multidimensional educational and social intervention. Recent initiatives, such as targeted teacher training, curriculum reform, and community-based language promotion activities, have been part of the Ministry's broader strategy to narrow the language gap (Ministry of Education of the People's Republic of China, 2021).

Developmental psychology highlights that academic achievement is shaped not only by cognitive ability but also by motivational beliefs, emotional support, and cultural context (Erikson, 1968; Marsh & Martin, 2011; Wigfield & Eccles, 2000). Three constructs are particularly relevant in explaining language learning outcomes: supportive parenting style, which provides the emotional and structural foundation for learning; academic self-concept, which reflects students' confidence in their academic abilities; and expectancy-value beliefs, which capture how students' expectations of success and perceived value of learning influence effort and persistence (Eccles & Wigfield, 2002; Grolnick & Ryan, 1989). Although each factor has been individually associated with student achievement (Cheung & Pomerantz, 2012; Marsh & Martin, 2011; Wigfield & Eccles, 2000), their combined effects on Mandarin academic performance among first-year vocational college students remain underexplored. Addressing this gap, the present study examines how supportive parenting style (Cheung & Pomerantz, 2012), academic self-concept (Marsh & Martin, 2011), and expectancy-value beliefs (Eccles & Wigfield, 2002) jointly contribute to Mandarin achievement in under-resourced and multicultural regions of China.

Literature Review

Mandarin proficiency reflects a learner's mastery of phonetics, grammar, fluency, and communicative competence, and it is formally assessed through the Putonghua Proficiency Test (PSC), which serves as a national benchmark for both educational and employment purposes (Ministry of Education of the People's Republic of China, 2021). Research has shown that such achievement is shaped not only by cognitive and instructional factors but also by psychosocial and contextual influences. Supportive parenting, characterized by emotional warmth, cognitive guidance, and autonomy support, fosters academic confidence and persistence, with Chinese families further embedding cultural values such as filial piety and the prioritization of education into parenting practices (Cheung & Pomerantz, 2012; Darling & Steinberg, 1993; Maccoby & Martin, 1983).

Alongside family influences, academic self-concept—students' beliefs in their academic abilities—emerges as a robust predictor of motivation, engagement, and achievement, particularly in language learning (Marsh & Craven, 2006; Marsh & Martin, 2011; Wolff et al., 2018). Complementing this, expectancy-value theory explains that achievement is driven

by students' expectations of success and the value they assign to learning, encompassing attainment, intrinsic, and utility values, all of which strongly shape effort and persistence in Mandarin learning (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000).

Taken together, supportive parenting style, academic self-concept, and expectancy-value beliefs represent interrelated personal and contextual factors that shape student achievement. While each has been independently linked to educational outcomes, their combined influence on Mandarin proficiency among vocational college students—particularly in regions where local dialects dominate and resources are scarce—remains underexplored. This study addresses this gap by examining how these factors jointly predict Mandarin academic achievement, providing both theoretical insights and practical implications for educational policy and family involvement in under-resourced contexts.

Methodology

Participants

The target population comprised 740 first-year students enrolled in the Intelligent Manufacturing Engineering Department at Guizhou Industrial Vocational and Technical College. To ensure representativeness, a stratified random sampling procedure was applied, with strata defined according to class sections and gender distribution. From this process, 255 students were selected as the study sample. This approach minimized sampling bias and allowed the sample to reflect the demographic and academic diversity of the larger student population.

Instruments

Four instruments were used to assess the key variables in this study.

Supportive Parenting Style Scale

Adapted from Maccoby and Martin's (1983) typology, this 10-item Likert-type scale evaluates students' perceptions of their parents' supportive behaviors, including emotional warmth, cognitive guidance, and autonomy support. Responses are rated on a 5-point scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"), with higher scores indicating stronger perceptions of supportive parenting. Example item: "My parents encourage me when I face difficulties in learning."

Academic Self-Concept Scale

Based on Marsh's (1993) framework, this 10-item scale measures students' beliefs and confidence in their ability to succeed in Mandarin learning. Items reflect self-perceptions of competence, persistence, and positive attitudes toward Mandarin. Responses are recorded on a 5-point Likert scale, with higher scores representing a stronger academic self-concept. Example item: "I believe I can do well in Mandarin classes."

Expectancy-Value Scale

Developed from Wigfield and Eccles (2000), this 10-item scale assesses motivational beliefs in two domains: (a) expectancy, or students' confidence in achieving success in Mandarin,

and (b) value, which covers attainment value, intrinsic interest, and utility value. Items are rated on a 5-point Likert scale, with higher scores reflecting stronger motivational beliefs. Example item: "Learning Mandarin is important for my future career."

Mandarin Academic Achievement

Achievement was measured using the Putonghua Proficiency Test (PSC), a standardized national assessment of Mandarin. The PSC evaluates phonetic accuracy, grammatical knowledge, fluency, and communicative competence. Scores range from 0 to 100, with higher scores reflecting greater Mandarin proficiency. Example item/task: Reading a passage aloud to assess pronunciation and fluency.

All measurement scales passed validity and reliability checks prior to use in the study. Approval for the research was obtained from the Graduate School and the college administration. Data were collected through self-administered questionnaires for the psychosocial variables and official test results for Mandarin achievement. The instruments demonstrated acceptable internal consistency, with Cronbach's alpha coefficients of $\alpha = .87$ for the Supportive Parenting Style Scale, $\alpha = .76$ for the Academic Self-Concept Scale, and $\alpha = .84$ for the Expectancy-Value Scale.

Results

This study analysis examines the relationships between supportive parenting style (IVSPS), academic self-concept (IVASC), expectancy-value beliefs (IVEVT), and Mandarin academic achievement (DVPSC) among 255 first-year vocational college students.

Table 1
Descriptive Statistics

Variable	Mean	SD	N
1.DVPSC	81.27	7.98	255
2.IVSPS	30.56	4.49	255
3.IVASC	30.03	3.43	255
4.IVEVT	31.18	3.76	255

Correlations

All predictors strongly and positively correlated with Mandarin achievement ($r = .419$ for Parenting, .438 for Self-Concept, .398 for Expectancy-Value, $p < .001$).

Table 2
Correlation Matrix of Study Variables (n = 255)

Variables	1	2	3	4
1. Mandarin Academic Achievement	1.000	—	—	—
2. Supportive Parenting Style	.419**	1.000	—	—
3. Academic Self-Concept	.438**	.487**	1.000	—
4. Expectancy-Value	.398**	.318**	.600**	1.000

Note. ** $p < .001$ (highly significant)

All variables show significant positive correlations with Mandarin academic achievement. Supportive parenting (r = .419**), academic self-concept (r = .438**), and expectancy-value beliefs (r = .398**) are each moderately associated with higher Mandarin proficiency. Among the predictors, academic self-concept demonstrates the strongest correlation with Mandarin achievement.

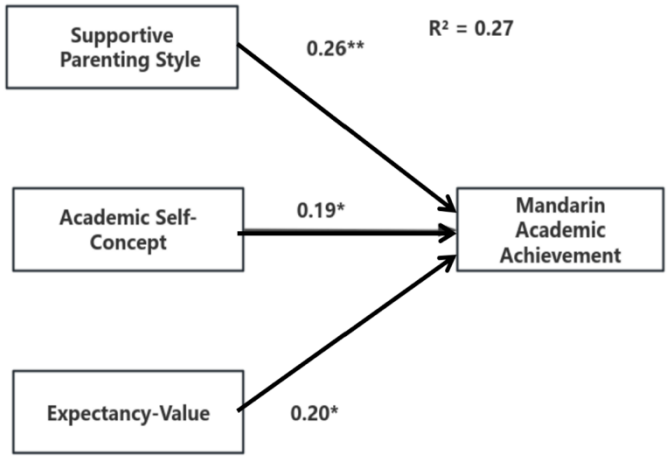
Additionally, the predictors are positively interrelated. Supportive parenting correlates with both academic self-concept (r = .487**) and expectancy-value beliefs (r = .318**), suggesting that family support is linked to students' motivation and confidence. The strongest relationship in the matrix is between academic self-concept and expectancy-value beliefs (r = .600**), indicating that students who believe in their academic abilities also tend to value and expect success in Mandarin learning.

Regression Analysis

The multiple regression model explained 27.3% of the variance in Mandarin academic achievement, $R^2 = .273$, $F(3, 251) = 31.44$, $p < .001$. Among the predictors, supportive parenting style was the strongest contributor ($\beta = .262$, $p < .001$), followed by expectancy-value beliefs ($\beta = .200$, $p = .003$) and academic self-concept ($\beta = .191$, $p = .010$). These findings indicate that all three predictors made significant, positive contributions to Mandarin academic achievement, with family support exerting the greatest influence.

Figure 1

Supportive Parenting Style Influences Mandarin Academic Achievement Through Its Impact on Students' Academic Self-Concept and Expectancy-Value of Mandarin Academic Achievement



Discussion

This study demonstrates that supportive parenting style, academic self-concept, and expectancy-value beliefs each exert significant and positive influences on Mandarin academic achievement, with supportive parenting emerging as the strongest predictor. These findings highlight the crucial role of family support, motivational beliefs, and students' self-perceptions in shaping language learning outcomes. They are consistent with prior research showing that supportive parenting fosters persistence and confidence, academic self-concept predicts long-term achievement (Marsh & O'Mara, 2008), and expectancy-value beliefs drive effort and persistence in learning (Eccles & Wigfield, 2002).

Importantly, the results confirm that Mandarin proficiency is not determined solely by cognitive ability or classroom instruction but is also shaped by the interplay of family environment, perceived competence, and motivational factors. For vocational college students, who often face barriers such as dialect prevalence and limited socioeconomic resources, these psychosocial factors may be especially critical. The findings therefore reinforce the value of family engagement and motivational support in language education policy, particularly in multicultural and under-resourced regions.

Nevertheless, several limitations must be acknowledged. The model explained a moderate proportion of variance ($R^2 = .27$), indicating that other unmeasured factors also contribute to Mandarin achievement. The cross-sectional design precludes causal inference, and the focus on one vocational college in southwestern China limits generalizability. Future research should adopt longitudinal and multi-cohort designs, while incorporating additional variables such as teaching strategies, peer influence, and learning contexts, to provide a more comprehensive understanding of language achievement.

Conclusion

This study demonstrates that supportive parenting style, academic self-concept, and expectancy-value beliefs are robust predictors of Mandarin academic achievement among vocational college students. Together, these factors underscore the importance of family support, self-belief, and motivational orientations in overcoming linguistic and socioeconomic barriers. The findings contribute to the literature by highlighting the psychosocial dimensions of language learning in under-resourced contexts and offer practical guidance for families, educators, and policymakers seeking to improve Mandarin proficiency and educational equity for vocational student populations.

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The Effect of Perceived Family Environment Functioning Previous Social Experiences, and Values on Social Competence of College Students

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Abstract

This study investigated how family environment, social experiences, and social values influence college students' social competence. A sample of vocational students from Guizhou Industry Polytechnic was randomly selected, and data were collected using self-developed assessment tools. Descriptive statistics, correlation analysis, and multivariate regression were employed to examine the relationships among the variables. The findings revealed that all three factors positively affected social competence, with social values being the most influential, followed by family environment and social experiences. These results align with Expectancy–Value Theory, which posits that individuals' motivation and competence are shaped by both the value they attach to a task and their expectations of success. The study clarified operational definitions and measurement dimensions, contributing to the literature by addressing an existing research gap and offering practical implications for social education in higher institutions, school–family collaboration, and student self-development. Nonetheless, the study is constrained by its sample size and cross-sectional design, highlighting the need for future research with larger samples and more refined frameworks.

Keywords: college students, social competence, family environment, social values, expectancy–value theory

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Introduction

Social competence is widely recognized as a core developmental outcome for young adults, particularly college students who are in a critical period of transition toward autonomy and social integration (Erikson, 1950). Despite its importance, recent surveys highlight substantial challenges: the China University Media Alliance reports that 64.82% of university students possess limited social networks, while in Guizhou Province, 40% of vocational college students report low confidence in cross-cultural interactions. At Guizhou Polytechnic Institute, approximately 10% of freshmen present severe psychological difficulties annually, many of which stem from problems of social adaptation. These figures underscore the urgent need to investigate the mechanisms shaping social competence among vocational college students.

The present study focuses on four interrelated constructs—social competence, family environment function, social experience, and social values. Social competence is defined as the comprehensive ability of an individual to communicate effectively, establish relationships, and manage social interactions, encompassing five dimensions: language expression, nonverbal communication, emotional understanding, social skills, and interpersonal relationship management. Family environment function refers to the background conditions that influence personal growth—including emotional climate, communication patterns, parenting approaches, and economic resources—which provide the foundation for social values and behavioral tendencies. Social experience captures the knowledge, skills, and emotions accumulated through participation in activities such as student clubs, volunteer service, and internships. Finally, social values represent the evaluative standards that individuals hold toward social activities, which guide their interpersonal behaviors and are shaped by family, education, and cultural contexts.

The theoretical foundation of this study is grounded in Expectancy–Value Theory (EVT) (Eccles et al., 1983; Wigfield & Eccles, 2000). EVT posits that individuals' motivation and performance are determined by two key factors: (a) their expectancies for success—the belief in their own ability to succeed in a given task, and (b) the subjective task value—the perceived importance, utility, or intrinsic interest of the task. When applied to social development, EVT suggests that college students' social competence depends not only on their confidence in managing interpersonal interactions (expectancy) but also on the value they place on social relationships and group belonging (value). Family environments contribute by shaping early expectations and emotional security; social experiences provide opportunities to test and reinforce self-efficacy; and social values guide the perceived significance of social participation. Thus, EVT offers a coherent framework to understand how these three factors converge to influence students' social abilities.

A growing body of literature has examined these constructs and their associations with social competence. Research on social competence demonstrates that it is linked to psychological resources and motivational mechanisms. D. Zhang (2008) reported a significant positive correlation between college students' general self-efficacy and interpersonal communication. Bandura's (1977) social learning theory highlights the role of observational learning in developing social abilities, while Maslow's (1943) hierarchy of needs theory identifies social belonging as a prerequisite for self-esteem and self-actualization. More recently, Kong Hua et al. (2022) showed that disengaged parenting styles predict poorer interpersonal adaptability, with irrational beliefs mediating this effect.

In terms of the family environment, maternal nurturing that encourages autonomy fosters resilience, which in turn promotes social competence (Yin, 2020). Xu (2021), using structural equation modeling, confirmed that parenting styles influence adolescents' communication abilities indirectly through self-esteem. Similarly, S. Zhang (2022) revealed that evaluative fear mediates the relationship between parenting styles and college students' social anxiety. Studies on social experience emphasize its developmental value. Sang (2020) found that club participation improves teamwork and conflict resolution skills, while Xie (2021) demonstrated that internships enhance real-world communication abilities. Beyond human studies, Li et al. (2024) showed that adolescent social experiences can shape neural development in the prefrontal cortex, with long-term consequences for social behavior.

Regarding social values, Xu (2022) reported that positive digital media content promotes proactive values among students. L. Wang (2021) emphasized the role of empathetic values in building trust, whereas negative orientations often result in social barriers. Liu (2022), through qualitative interviews, demonstrated that family cultural climate plays a crucial role in internalizing social values.

Although these studies provide a multidimensional foundation, important limitations remain. First, the conceptual definitions of variables across studies are inconsistent. Second, many investigations adopt a single-factor perspective rather than examining interactive mechanisms. Finally, the internal pathways by which family environment, social experience, and social values jointly shape social competence have yet to be fully clarified. These gaps provide the rationale for the present study.

Accordingly, this research seeks to examine how different dimensions of the family environment shape social skills and the extent to which family functioning influences behavioral patterns. It also aims to analyze how campus social activities and accumulated experiences contribute to the enhancement of interpersonal competence. In addition, the study investigates how social values guide attitudes and behaviors and ultimately influence the quality of social relationships.

The objectives of this study are: (a) to analyze the mechanisms by which the family environment fosters emotional support and communication skills; (b) to examine the role of frequency and quality of social participation in enhancing social confidence; and (c) to reveal the guiding effects of social values on interactional styles and relationship quality. By anchoring these questions in Expectancy–Value Theory, the study seeks to clarify the mechanisms through which family, experience, and values interact to shape vocational college students' social competence, thereby contributing to theoretical refinement and offering practical implications for social education, school–family collaboration, and student development.

Research Hypotheses

Drawing upon Expectancy–Value Theory and prior empirical findings, this study proposes the following hypotheses:

- Hypothesis 1 (H1): Family environmental function has a significant positive relationship with college students' social competence.
- Hypothesis 2 (H2): Social experience has a significant positive relationship with college students' social competence.

- Hypothesis 3 (H3): Social values have a significant positive relationship with college students' social competence.

Method

Participants

This study targeted vocational college students enrolled at Guizhou Industrial Vocational and Technical College. Participants were selected through random sampling to ensure representativeness. A total of 370 questionnaires were distributed, of which 310 valid responses were obtained, yielding an effective return rate of 84%.

The participants were between 17 and 24 years of age and represented a wide range of academic disciplines and grade levels. They also came from diverse family backgrounds, including both nuclear and single-parent households. Such diversity in age, academic specialization, and family structure enhances the representativeness of the sample and reflects the broader characteristics of the vocational college student population.

Instrumentation

Four self-developed scales were employed in this study, each optimized through a pre-survey ($n = 100$) and confirmed to meet established reliability and validity standards. The instruments included: Social Competence Scale (19 items; Cronbach's Alpha = .95), Family Environment Functioning Scale (9 items; Cronbach's Alpha = .74), Social Experience Scale (9 items; Cronbach's Alpha = .80), Social Values Scale (14 items; Cronbach's Alpha = .93). All instruments were administered using a 4-point Likert scale (1 = strongly disagree, 4 = strongly agree). Content validity was assessed using the item–objective congruence (IOC) index, with all items exceeding the threshold of .50.

Results

To provide an overview of the relationships among the study variables, correlation analyses were conducted. Table 1 presents the correlations among social competence, social experience, family functioning, and social value. The results indicate that all study variables were significantly and positively correlated. Specifically, social competence was positively associated with social experience ($r = .60$, $p < .01$), family functioning ($r = .54$, $p < .01$), and social value ($r = .61$, $p < .01$). Social experience was also positively related to family functioning ($r = .49$, $p < .01$) and social value ($r = .56$, $p < .01$). Finally, family functioning showed a positive correlation with social value ($r = .38$, $p < .01$).

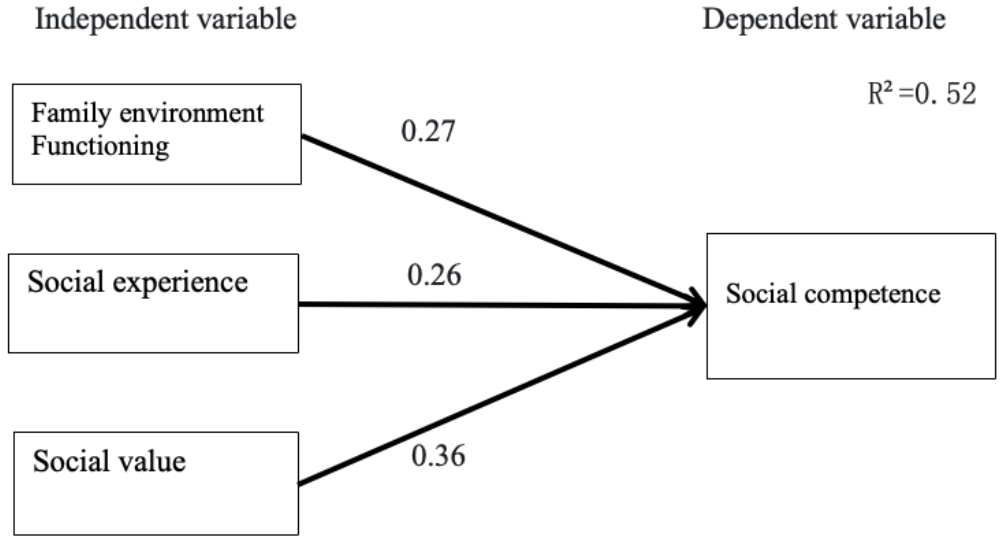
These findings suggest that stronger family functioning, richer social experiences, and more positive social values are all linked with higher levels of social competence among vocational college students.

Table 1
Correlation Matrix of Study Variables (N = 310)

Variables	1	2	3	4
1. Social Competence	1			
2. Social Experience	.60**	1		
3. Family Functioning	.54**	.49**	1	
4. Social Value	.61**	.56**	.38**	1

The multiple regression analysis indicated a significant overall model fit ($R^2 = .52$, $F(3, 306) = 52.37$, $p < .001$), supporting all three hypotheses. Family environment function had a significant positive effect on social competence ($\beta = .27$, $p < .001$). Students from families characterized by emotional support and open communication demonstrated greater social confidence and skills. Social experience also exerted a significant positive effect on social competence ($\beta = .26$, $p < .001$). Engagement in social participation, volunteer service, and related activities enhanced students' communication and collaboration abilities. Social values emerged as the strongest predictor of social competence ($\beta = .36$, $p < .001$). Students who emphasized emotional connection and reciprocity exhibited more positive and adaptive social behaviors. Together, these results suggest that family functioning provides the foundation, social experience reinforces skill development, and social values guide positive social orientations. This pathway is illustrated in Figure 1.

Figure 1
Pathway



Discussion and Conclusion

The present study examined how family environment, social experiences, and social values influence college students' social competence. Consistent with Expectancy–Value Theory (Eccles et al., 1983; Wigfield & Eccles, 2000), all three variables significantly and positively predicted social competence, with social values emerging as the strongest predictor. These findings underscore the joint influence of external contexts and internalized value orientations on students' social development.

The Foundational Role of Family Environment

The results confirmed that family functioning significantly contributes to social competence, supporting Hypothesis 1. This is consistent with prior research indicating that supportive parenting styles and positive family climates foster resilience and interpersonal confidence (Yin, 2020; Xu, 2021). Democratic families foster secure attachments through emotional support, where parents demonstrate positive social behaviors—such as listening and empathy—that help students perceive social interaction as a source of security rather than anxiety. In contrast, authoritarian or neglectful family environments are more likely to produce social skill deficiencies, which aligns with Yin's (2020) findings. Within the framework of Expectancy–Value Theory, family environments shape students' early expectancies for social success by providing or withholding the emotional and behavioral foundations for effective interaction.

The Practical Value of Social Experience

Hypothesis 2 was also supported, showing that social experiences significantly enhance students' social competence. Campus associations, volunteer services, and internships provide "trial-and-error feedback" platforms where students test and refine their interpersonal skills. Group cooperation can strengthen conflict resolution abilities, while workplace internships help students adapt to organizational norms and rules of interaction. These findings confirm Sang's (2020) view that "practical accumulation promotes ability improvement." From an EVT perspective, such experiences reinforce students' perceptions of competence by providing tangible evidence of success in real-world settings, thereby encouraging continued participation in social activities.

The Core Driving Force of Social Values

The strongest effect was observed for social values, supporting Hypothesis 3. Positive values, such as prioritizing emotional connection and empathy, motivate students to initiate communication and accept differences, fostering higher-quality relationships. Conversely, utilitarian values may lead to the instrumentalization of social interactions, ultimately reducing relational quality. This is consistent with Xu's (2022) findings on the role of digital content in shaping proactive versus instrumental value orientations. Within the EVT framework, social values represent the motivational "value" component, guiding the degree of effort students are willing to invest in social relationships. Thus, values serve as the driving force that directs students' social behaviors toward either constructive or superficial outcomes.

Theoretical and Practical Implications

Theoretically, this study extends Expectancy–Value Theory by demonstrating its applicability in the domain of social competence. The findings suggest a developmental pathway whereby family functioning lays the foundation for secure expectancies, social experiences reinforce competence through practice, and social values guide behavior through internalized standards. Practically, the results highlight the importance of a multi-level approach. Families should adopt supportive and communicative parenting practices, universities should strengthen extracurricular and service-learning opportunities, and educators should promote positive social values through curriculum design, counseling, and media literacy programs.

Limitations and Future Research

Despite its contributions, this study has limitations. First, the reliance on self-report measures may introduce social desirability bias; future research could include peer or teacher assessments. Second, the cross-sectional design restricts causal inference; longitudinal designs would clarify developmental trajectories. Third, the sample was drawn from a single vocational college in Guizhou Province, which may limit generalizability. Expanding to other institutional and cultural contexts would improve external validity.

Future studies should also explore mediating and moderating mechanisms. For instance, self-esteem or irrational beliefs may mediate the link between family functioning and social competence (Kong et al., 2022; Xu, 2021). Cultural orientation, digital media exposure, or socioeconomic status may moderate the influence of social values. Examining these pathways will provide a more nuanced understanding of how contextual and psychological factors jointly shape students' social development.

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The Influence of Family Environment, Learning Values, and Self-Expectations on Late Adolescents' Motivation to Learn Chinese

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Abstract

In the context of globalization and the increasing role of Chinese as an international language, it has become important to understand what motivates adolescents to learn Chinese. Motivation is widely regarded as a key psychological factor influencing students' learning behavior and achievement. Drawing on expectancy–value theory, this study explores how family environment, learning values, and self-expectations shape the motivation of late adolescents to study Chinese. Data were collected from 355 students at Guizhou Industrial Vocational and Technical College, all of whom were in late adolescence or early adulthood. The findings show that family support, recognition of the value of Chinese learning, and students' confidence in their own abilities all contribute positively to learning motivation. Among these, learning values and self-expectations play a stronger role than family environment, suggesting that students are most motivated when they see Chinese as useful for their future and believe in their ability to succeed. In contrast, demographic factors such as gender, only-child status, and family structure had little effect. The study confirms the relevance of expectancy–value theory to Chinese language learning and highlights the importance of fostering value recognition and self-confidence, alongside supportive roles for families, schools, and policymakers.

Keywords: family environment, learning values, self-expectations, learning motivation, expectancy–value theory

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Introduction

Motivation has long been recognized as a central concept in educational psychology, as it strongly influences the time, effort, and persistence students devote to learning tasks (Ryan & Deci, 2000). In second language acquisition, motivation is especially important because it affects not only students' achievement but also their long-term commitment to language learning (Gardner, 1985). With the growing global significance of China, learning Chinese has become an academic and professional priority for many students worldwide.

However, students' motivation to learn Chinese is far from uniform. While some demonstrate strong enthusiasm and perseverance, others struggle to sustain their learning even when they understand its potential benefits. To better explain these differences, this study examines three key factors: family environment, learning values, and self-expectations. Previous research suggests that family support and communication play an important role in shaping students' attitudes and confidence (Zhao, 2020). Learning values, such as the usefulness of Chinese and personal interest in it, form an essential psychological basis for motivation (Eccles & Wigfield, 2002). Self-expectations, closely tied to self-efficacy, determine whether students believe they can succeed and are therefore willing to make an effort (Bandura, 1997).

These factors can be better understood through the lens of expectancy–value theory, which has become one of the most influential frameworks for studying student motivation. The theory proposes that achievement-related behaviors are primarily determined by two elements: individuals' expectations for success and the value they attach to the task (Wigfield & Eccles, 2000). Expectancy beliefs reflect students' confidence in their ability to succeed, while task values include perceived usefulness, personal importance, and intrinsic interest. Together, these dimensions shape the choices students make, the effort they invest, and their persistence in learning.

Building on this framework, the present study examines how family environment, learning values, and self-expectations interact to influence late adolescents' motivation to learn Chinese. Motivation in this context is viewed as the combined outcome of external support from the family and internal factors such as value recognition and self-confidence.

Methodology

Participants and Data Collection

A total of 415 questionnaires were distributed at Guizhou Industrial Vocational and Technical College. After excluding incomplete or invalid responses, 355 valid questionnaires were retained, resulting in an effective response rate of 85.5%. The participants were late adolescents and young adults, ranging in age from 17 to 22 years.

Instruments

To measure these constructs, students responded to items on a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). All scales had previously undergone reliability and validity testing, ensuring their appropriateness for use in the present study.

The Family Environment scale consisted of 12 items that assessed parental support, the quality of parent–child communication, and the overall learning atmosphere at home. The items reflected the degree of encouragement and guidance students received from their families, as well as whether the home environment was conducive to effective learning.

The Learning Values scale included 10 items measuring students' perceptions of the utility value of Chinese for academic and career development, together with their intrinsic interest in learning the language. These items captured both the extent to which students regarded Chinese as beneficial for their future goals and the enjoyment or satisfaction they experienced in studying it.

The Self-Expectations scale comprised 11 items that focused on students' beliefs about their own abilities, including confidence in learning Chinese, self-efficacy in managing learning tasks, and aspirations for achievement. These items reflected the degree to which students expected themselves to succeed and their willingness to set and pursue learning goals.

Finally, the Learning Motivation scale consisted of 11 items that measured students' motivational tendencies, including persistence in learning, initiative in taking responsibility for their progress, clarity of goals, and curiosity about the language. The items provided insights into how motivation was expressed through students' attitudes and behaviors toward learning Chinese.

Data Analysis

Data were analyzed using a statistical program. Reliability testing indicated that the Cronbach's α values of the subscales ranged from 0.69 to 0.83, demonstrating acceptable to good internal consistency. To address the research objectives, descriptive statistics were first employed to summarize the data, followed by correlation analyses to examine the relationships among the key variables. Multiple regression analyses were then conducted to further determine the predictive power of these variables in explaining the outcomes of interest.

Results

Correlation Analysis

Family environment, learning values, and self-expectations were all positively correlated with motivation to learn Chinese ($r = 0.788$, 0.787, 0.792, respectively; $p < 0.001$). This demonstrates that higher family support, stronger recognition of learning values, and greater self-expectations are each associated with higher motivation.

Regression results indicated that all three predictors significantly influenced motivation, but learning values ($\beta = 0.335$, $p < 0.001$) and self-expectations ($\beta = 0.291$, $p < 0.001$) exerted stronger effects than family environment ($\beta = 0.316$, $p < 0.001$). The overall model explained 46% of the variance in learning motivation ($R^2 = 0.46$).

Figure 1

A Part Model of the Influence of Family Environment, Learning Value, and Self-Expectations on Chinese Learning Motivation

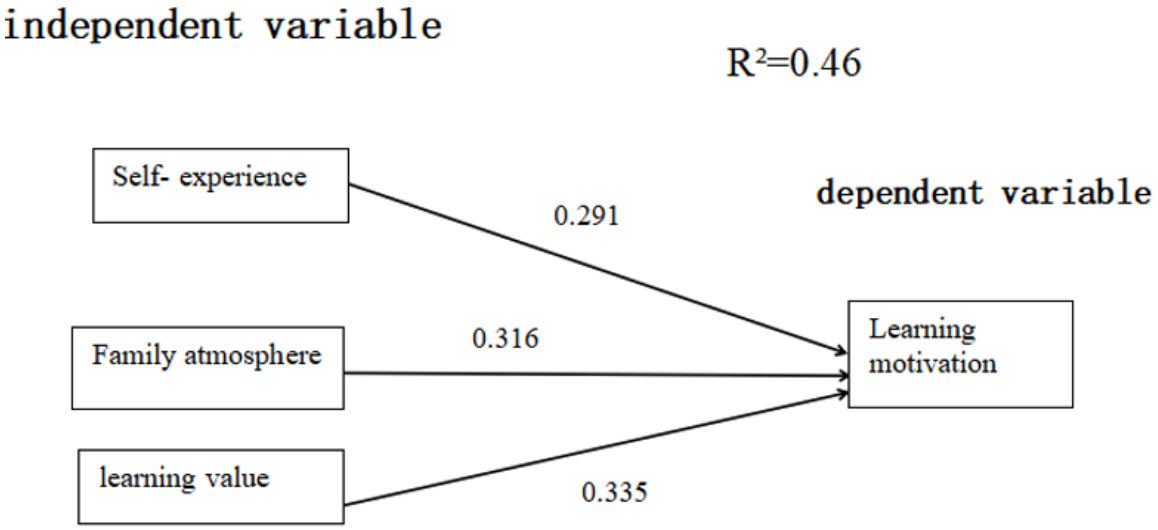


Table 1

Pearson Correlation Matrix of the Four Variables(n = 350)

Variable	1	2	3	4
1. Family Environment	0.788***	0.70***	072***	1
2. Learning Values	0.787***	0.74***	1	
3. Self-Expectations	0.792***	1		
4. Learning Motivation	1			

Regression Analysis

The regression analysis revealed that all three predictors—family environment, learning values, and self-expectations—had a statistically significant positive influence on learning motivation. Among these, learning values ($\beta = 0.335$, $p < .001$) and self-expectations ($\beta = 0.291$, $p < .001$) emerged as relatively stronger predictors when compared to family environment ($\beta = 0.316$, $p < .001$), indicating that students' perceptions of the usefulness and enjoyment of learning Chinese, as well as their confidence and aspirations, were more influential in shaping their motivation than the home environment. The overall model accounted for 46% of the variance in learning motivation ($R^2 = 0.46$), suggesting a substantial explanatory power and highlighting the importance of both individual beliefs and values in driving students' motivation to learn Chinese.

Demographic Variables

Independent sample t-tests and ANOVA showed that gender ($t = -0.80$, $p = 0.426$), only-child status ($t = -1.67$, $p = 0.097$), and family structure ($t = 0.60$, $p = 0.548$) did not produce significant differences. This suggests that learning motivation is shaped more by psychological than demographic factors.

Discussion

From a theoretical standpoint, the findings are consistent with the principles of Self-Determination Theory (Deci & Ryan, 2000), which emphasizes the critical roles of intrinsic interest and perceived competence in sustaining motivation. The relatively stronger influence of learning values underscores the dual importance of intrinsic enjoyment and the recognition of the utility of Chinese for academic and career advancement in maintaining student engagement. Similarly, the significant role of self-expectations reflects the impact of self-efficacy beliefs (Bandura, 1997), indicating that students who perceive themselves as capable and who hold high aspirations are more likely to invest effort and persist in learning tasks.

Although the family environment was also a significant predictor, its comparatively weaker effect suggests that parental support and communication provide an important foundation, yet motivation in language learning is primarily driven by students' internalized values and self-beliefs. This finding highlights the need for educational interventions that extend beyond parental involvement to explicitly cultivate intrinsic interest, utility perceptions, and self-confidence in learners. In this respect, the results also confirm the central proposition of expectancy–value theory (Eccles & Wigfield, 2002): students' motivation is shaped predominantly by their perceptions of the value of learning and by their confidence in their ability to succeed.

The alignment of these results with existing scholarship further strengthens their significance. Eccles and Wigfield (2002) have emphasized that when students perceive a task as valuable, they are more willing to expend effort, while Bandura (1997) argued that self-efficacy is fundamental for sustaining motivation. In the present study, both learning values and self-expectations were shown to outweigh the influence of family environment in the specific context of Chinese language learning. Moreover, the absence of significant effects from demographic variables challenges common assumptions in educational research, suggesting that differences in motivation are not primarily attributable to gender or family structure but are largely driven by individual psychological mechanisms.

Conclusion

Theoretical Contributions

The theoretical contributions of this study can be articulated in several key aspects. First, this research simultaneously examined the effects of family environment, learning values, and self-expectations within a single comprehensive framework, thereby extending the analytical scope of existing studies on learning motivation. Previous research has often emphasized one factor in isolation, such as the influence of family background or the role of individual self-efficacy. By integrating these three dimensions into one model, the present study demonstrates that each exerts a significant positive influence on learning motivation. This highlights that learning motivation is shaped not by a single determinant but through the combined influence of multiple factors operating across different levels. Second, the findings provide new empirical evidence for the applicability of expectancy–value theory in the context of Chinese language learning. According to this framework, motivation is shaped by students' valuation of a learning task and their expectation of success. The results of this study support this theoretical assumption, showing that students' motivation to learn Chinese is primarily driven by internal psychological mechanisms, while family support plays a supplementary role. Thus, the findings not only confirm the validity of expectancy–value

theory but also extend its application to the specific domain of Chinese language learning, reinforcing its cross-cultural relevance. Third, the study refines the understanding of demographic variables in the context of learning motivation. Educational research has often assumed that gender, only-child status, or family structure exert significant effects on motivation. However, this study found no such influence, suggesting that motivational differences are more strongly explained by psychological factors—such as value recognition and self-efficacy—than by demographic or social categories. This highlights the primacy of psychological mechanisms over background characteristics in shaping motivation, thereby contributing to a more nuanced theoretical understanding. Finally, the methodological design of this study also advances theoretical discourse. By employing a combination of reliability testing, descriptive statistics, correlation analysis, and multiple regression, the research ensured both scientific rigor and interpretive clarity. This multi-method approach serves as a model for future investigations into learning motivation, particularly in educational psychology and second language acquisition.

In summary, the theoretical contributions of this study lie in four areas: (1) expanding the analytical perspective by integrating multiple variables into a comprehensive framework; (2) providing strong empirical evidence for the expectancy–value theory in Chinese learning contexts; (3) clarifying the limited influence of demographic variables; and (4) demonstrating methodological rigor. Collectively, these contributions deepen the theoretical understanding of how learning motivation is formed and provide a solid foundation for subsequent research.

Practical Contributions

Beyond theoretical implications, this study also carries significant practical value. The results demonstrate that family environment, learning values, and self-expectations all exert important influences on adolescents' motivation to learn Chinese, and these findings can be directly applied to educational practice. *First*, in terms of family education, the findings suggest that the way parents support and communicate with their children directly shapes students' willingness to learn. A warm, supportive, and encouraging family atmosphere enhances motivation, whereas excessive pressure or punitive approaches may undermine it. Therefore, parents are encouraged to participate actively in learning activities, set realistic goals with their children, and provide constructive feedback, rather than focusing solely on criticism. *Second*, at the school level, learning values emerged as the most powerful driver of motivation. This highlights the importance of helping students recognize both the practical and intrinsic value of learning Chinese. Teachers should emphasize the relevance of Chinese for academic advancement and future career opportunities, while also fostering intrinsic interest through engaging activities such as cultural festivals, debates, or speech contests. By combining an emphasis on "usefulness" with opportunities for genuine enjoyment, schools can strengthen both the instrumental and intrinsic dimensions of student motivation. *Third*, at the individual level, self-expectations also play a critical role. Whether students believe they can succeed directly influences their motivation and persistence. In practice, this means that teachers and parents should support students in setting manageable goals, provide timely encouragement, and build confidence through small but continuous achievements. Positive peer influence can also be harnessed, as observing the success of classmates often strengthens students' own confidence and willingness to learn.

Finally, at a broader policy level, the findings point to the importance of collaboration between families, schools, and society. Educational authorities can design training programs for parents to enhance supportive educational practices, schools can integrate real-life

applications of Chinese into their curricula, and communities can provide cultural resources and extracurricular opportunities that enrich language learning. Sustainable improvement in motivation will require such multi-level cooperation across sectors. In summary, the practical contributions of this study lie in offering concrete directions: families should create supportive home learning environments, schools should strengthen value-oriented guidance, individuals should build self-confidence and persistence, and policymakers should foster collaboration across multiple levels. Taken together, these measures provide a comprehensive strategy for enhancing adolescents' motivation to learn Chinese.

Limitations and Future Directions

Limitations of the Study

While this study offers important theoretical and practical contributions, several limitations should be acknowledged. First, the study relied on self-report questionnaires, which may be influenced by social desirability bias or students' subjective interpretations of the items. Although reliability and validity testing were conducted, self-report data cannot fully capture the complexity of learning motivation and related factors. Second, the cross-sectional design of the research limits the ability to establish causal relationships among family environment, learning values, self-expectations, and learning motivation. The observed associations demonstrate predictive power but cannot confirm long-term effects or developmental changes over time. Third, the sample was drawn from a specific context of adolescents learning Chinese, which may restrict the generalizability of the findings. Cultural, linguistic, and educational differences in other populations could lead to different motivational dynamics. Future studies should include more diverse samples to strengthen external validity. Fourth, while the study examined key predictors of learning motivation, other potentially relevant factors—such as teacher support, classroom climate, or peer relationships—were not included in the model. Incorporating these variables in future research would provide a more comprehensive understanding of motivational influences. Finally, the study employed quantitative methods exclusively, which limited the depth of insight into students' personal experiences and perspectives. Complementary qualitative approaches, such as interviews or focus groups, could provide richer detail and contextual understanding of how family environment, values, and self-expectations shape motivation.

Future Research Directions

Building on the limitations of this study, several directions for future research are recommended.

First, future studies could adopt a longitudinal design to track changes in family environment, learning values, self-expectations, and motivation over time. This would allow researchers to better understand causal relationships and the developmental trajectories of motivation in language learning.

Second, expanding the sample to include students from diverse cultural, linguistic, and educational backgrounds would strengthen the generalizability of the findings. Comparative studies across different regions or countries could also reveal how cultural values shape motivational processes in language learning.

Third, future research should incorporate additional variables that may influence learning motivation, such as teacher support, classroom climate, peer interactions, or the use of digital learning tools. Including these factors would provide a more comprehensive understanding of the multi-level influences on motivation.

Fourth, employing mixed-methods approaches that combine quantitative surveys with qualitative techniques, such as interviews, focus groups, or classroom observations, could yield richer insights. Such approaches would allow researchers to capture the nuanced experiences and perspectives of students that are not easily conveyed through questionnaires alone.

Finally, intervention-based research could be conducted to test strategies aimed at enhancing family support, fostering positive learning values, and strengthening students' self-expectations. By evaluating the effectiveness of such programs, researchers could provide practical recommendations for educators, parents, and policymakers.

In summary, future research should aim to extend the scope of investigation by incorporating longitudinal, cross-cultural, multi-variable, and mixed-method approaches, as well as testing practical interventions. These directions will deepen our understanding of the mechanisms underlying learning motivation and provide stronger evidence for effective educational practices.

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The Effects of Family Functioning, Academic Self-Regulation, and Expectations on Middle School Students' Academic Achievement

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Abstract

This study examined the effects of family functioning, academic self-regulation, and expectations on the academic achievement of middle school students. A randomly selected sample of students from two middle schools in Guizhou City participated in the study, and data were collected using scales that had been tested for validity and reliability. Descriptive statistics, correlation analyses, and multiple regression analyses were employed to investigate the relationships among the variables. Correlational results showed that family functioning, self-regulation, and expectations were all positively associated with academic achievement. However, the regression analysis revealed that only self-regulation and expectations significantly predicted academic performance, whereas family functioning, although not a direct predictor, may influence academic outcomes indirectly through other variables. The findings extend the integrated framework of family systems theory, self-regulation theory, and expectancy-value theory, and provide practical implications for family education, classroom instruction, and educational policy. This research not only deepens the understanding of the interplay between motivation, family dynamics, and academic performance in educational psychology but also offers valuable insights for designing educational interventions.

Keywords: family function, academic self-regulation, expectations, academic performance

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Introduction

In the field of educational research, academic performance has consistently been regarded as a central topic, as it reflects not only students' mastery of knowledge but also their adaptation to the broader demands of schooling. The middle school period is particularly critical, representing a stage of rapid development in cognition, emotions, and social skills. During this time, students engage in the construction of self-identity while simultaneously facing multiple pressures from family, school, and society. Recent statistics highlight the urgency of addressing these challenges. According to the 2024 Report on Depression in Children and Adolescents, the average age for the first diagnosis of depression among Chinese students is 13.41 years, while the average age for the first school withdrawal is 13.74 years, with both figures concentrated around the age of 14. These findings underscore the vulnerability of middle school students and the potential risks associated with unmanaged academic pressure and unfavorable family environments.

One theoretical framework particularly relevant to explaining students' academic achievement is Expectancy-Value Theory (EVT) (Eccles & Wigfield, 2002). EVT posits that students' academic behaviors are largely determined by two factors: their expectancies for success and the subjective value they place on academic tasks. Expectancy beliefs refer to students' confidence in their ability to succeed in a given domain, while task values encompass dimensions such as interest, importance, and perceived utility. When students believe they are capable of performing well and perceive their schoolwork as meaningful and worthwhile, they are more likely to invest effort, persist in the face of difficulties, and ultimately achieve higher outcomes. Applied to middle school students, EVT highlights how motivational beliefs shape the way learners engage with academic challenges during this sensitive developmental stage. In contexts where academic pressure is intense, fostering positive expectancy beliefs and enhancing the perceived value of learning tasks can buffer stress and promote sustained achievement. Therefore, examining expectancy alongside family functioning and self-regulation provides a comprehensive understanding of the multiple influences on students' academic performance.

Expectations, as motivational factors, include the beliefs and predictions of students, parents, and teachers regarding academic achievement. The Pygmalion effect demonstrates that positive expectations can significantly enhance students' performance (Rosenthal, 2002). Peng (2012) emphasized that reasonable expectations stimulate students' interest in learning and strengthen self-efficacy. These findings align with Expectancy-Value Theory (EVT), which posits that students' achievement-related behaviors are influenced by both expectancy beliefs (confidence in success) and task values (interest, importance, and utility) (Eccles & Wigfield, 2002). When students believe they are capable and view tasks as meaningful, they are more likely to persist and succeed academically.

Family functioning is widely recognized as a key dimension influencing the academic performance of middle school students. It refers to the capacity of the family system to meet members' emotional, communicative, regulatory, and problem-solving needs (Yue, 2014). In practice, family functioning reflects interaction patterns, the degree of emotional support among family members, and the overall stability of the family environment, including warmth, communication quality, and problem-solving ability (Zhou, 2020). From a developmental psychology perspective, the family environment is not merely a backdrop for individual growth but a critical factor shaping students' academic outcomes (Tong, 2007; Yu, 2019). Empirical research has demonstrated that parental emotional warmth, high-quality

educational involvement, and secure attachment relationships are positively associated with adolescents' learning achievements (Bowlby & Ainsworth, cited in Yue, 2014; Ding, 2018).

Academic self-regulation, in turn, refers to students' ability to set goals, implement learning strategies, monitor their progress, and reflect on outcomes. Zimmerman's (2000) model identifies self-regulation as a central mechanism for effective learning. Consistent with this view, domestic studies have found that students with stronger self-regulation skills are better equipped to cope with academic difficulties and maintain motivation (Guo et al., 2006). Self-regulated learning integrates metacognitive, motivational, and behavioral processes that enable continuous improvement in achievement (Heirweg et al., 2019; Sitzmann & Ely, 2011). More recent research further emphasizes the role of self-regulation as a mediating factor linking contextual influences to academic performance (Wolters & Hussain, 2015; Yang, 2016).

In summary, family functioning, academic self-regulation, and expectations each demonstrate meaningful correlations with students' academic performance. A supportive family environment provides the emotional security and resources necessary for learning, self-regulation equips students with the skills to manage their own learning processes, and positive expectations foster motivation and persistence. Although numerous studies have examined these associations, most have tended to focus on single factors in isolation. For example, Liu and Liu (2023) investigated the home learning environment and academic achievement, Lu and Luo (2022) examined the mediating role of family education, and Yu (2024) analyzed teacher caring behaviors and student engagement. Qu (2004) and Guo et al. (2006) highlighted the influence of self-regulated learning strategies, while Chen (2018) explored ethnic and gender differences in self-regulation among middle school students. While these studies provide valuable insights, they underscore the absence of integrative research that simultaneously considers family functioning, self-regulation, and expectations, particularly in underdeveloped regions of China where educational inequality remains pronounced.

The present study aims to address this gap by examining the effects of family functioning, academic self-regulation, and expectations on the academic performance of middle school students. Grounded in family systems theory, self-regulation theory, and expectancy-value theory, the study seeks to clarify both the direct and indirect pathways through which these factors influence academic outcomes. The findings are expected to contribute theoretically by integrating psychological and educational perspectives and practically by offering guidance for family education, classroom instruction, and educational policy.

Method

Participants

Data were collected from 334 valid cases drawn from two middle schools in Guizhou. The participants were between 12 and 15 years of age and represented a range of demographic backgrounds. Family Functioning Scale ($\alpha = 0.614$).

Instrumentation

Four instruments were employed to measure the study variables: family functioning, academic self-regulation, expectations, and academic achievement. All psychological scales

were administered using a 5-point Likert format ranging from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating higher levels of the respective construct. Reliability of the scales was evaluated using Cronbach's Alpha, and construct validity was examined through expert review of the items.

Family Functioning Scale

Family functioning was assessed using a 10-item scale designed to capture emotional support, communication quality, rule-setting, and problem-solving within the family. Cronbach's Alpha for this scale was 0.614. Expert evaluation confirmed that the items appropriately represented the construct. Sample items include: "Family members openly share their feelings with one another" and "When conflicts arise, our family finds effective ways to resolve them." Higher scores reflect a more supportive and cohesive family environment.

Academic Self-Regulation Scale

Academic self-regulation was measured using a 10-item scale based on Zimmerman's model of self-regulated learning, which emphasizes goal setting, strategy use, monitoring, and reflection. Cronbach's Alpha for this scale was 0.865. Expert review confirmed the adequacy of the items for representing self-regulation in learning. Sample items include: "I set specific goals for my schoolwork" and "When I do poorly on an assignment, I try to figure out what I can do better next time." Higher scores indicate stronger self-regulatory skills in academic contexts.

Expectation Scale

Expectations were assessed with a 10-item scale measuring students' beliefs about their likelihood of success and the value they assign to academic tasks, consistent with expectancy-value theory. Cronbach's Alpha for this scale was 0.837. Expert assessment ensured that the items accurately reflected expectancy beliefs and task values. Sample items include: "I believe I can perform well in my school subjects" and "Doing well in school is important for my future." Higher scores represent stronger expectancy beliefs and task values.

Academic Achievement

Academic performance was measured using students' final exam grades, obtained from school records. Grades were used as an objective indicator of achievement and served as the dependent variable in the analyses.

Results

The purpose of this study was to examine the effects of family functioning, academic self-regulation, and expectations on the academic performance of middle school students. Data analysis was conducted in several stages. First, descriptive statistics were calculated to provide an overview of the central tendencies and variability of the study variables. Next, Pearson correlation analyses were performed to explore the associations among family functioning, self-regulation, expectations, and academic performance. Finally, multiple regression analysis was employed to test the predictive effects of the three independent variables on students' academic achievement. The following section presents the results of these analyses in detail.

Table 1 presents the intercorrelations among family functioning, self-regulation, expectancy, and academic performance. Family functioning demonstrated moderate positive associations with self-regulation (r = .31), expectancy (r = .47), and academic performance (r = .33). These findings suggest that students who perceive greater family support tend to report higher levels of self-regulation, greater academic expectancy, and somewhat stronger academic outcomes. Self-regulation was positively correlated with both expectancy (r = .58) and academic performance (r = .55), indicating that students with stronger self-regulatory skills not only hold higher academic expectations but also achieve better academic results. Expectancy showed the strongest correlation with academic performance (r = .59), underscoring the critical role of students' beliefs and expectations in shaping their achievement. Overall, the correlation results highlight meaningful relationships among the three predictors and academic performance. While all variables were positively related, expectancy and self-regulation emerged as the strongest correlates of academic performance, whereas family functioning, though weaker in magnitude, still exhibited a consistent positive pattern.

Table 1

Pearson Correlation Matrix of the Four Variables (n = 334)

Variables	1	2	3	4
1.Family Functioning	1			
2. Self-regulation	.306**	1		
3. Expectation	.468**	.575**	1	
4. Academic Performance	.334**	.552**	.591**	1

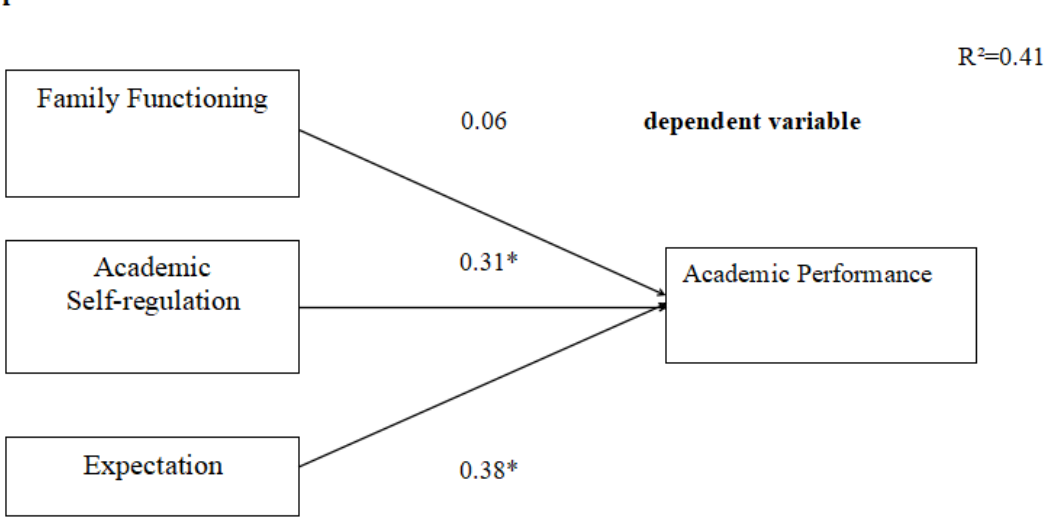
Note: p < 0.01**.

A multiple regression analysis was conducted to examine the predictive effects of self-regulation, family functioning, and expectancy on students' academic performance. The overall regression model was statistically significant, $F(3, n - 4) = 79.38$, $p < .001$, accounting for approximately 41.9% of the variance in academic performance ($R^2 = .419$, Adjusted $R^2 = .414$).

As shown in figure 1, both self-regulation ($\beta = .31$, $p < .001$) and expectancy ($\beta = .38$, $p < .001$) emerged as significant predictors of academic performance, indicating that students with higher levels of self-regulation and expectancy tend to demonstrate stronger academic outcomes. In contrast, family functioning did not contribute significantly to the model ($\beta = .06$, $p = .214$), suggesting that while family dynamics may play an indirect or supportive role, they are not directly associated with academic performance in this sample.

These results highlight the central role of motivational and expectancy-related factors in shaping students' academic achievement. The findings support theoretical perspectives that emphasize the importance of self-regulation and expectancy-value beliefs in predicting educational outcomes, while also pointing to the need for further exploration of how family functioning may exert its influence through indirect pathways.

Figure 1
Multiple Regression Analysis



Discussion and Conclusion

The present study examined the predictive effects of family functioning, academic self-regulation, and expectations on the academic performance of middle school students in Guizhou. The findings underscore the central role of expectancy beliefs and self-regulation in shaping students' academic outcomes, while suggesting that the influence of family functioning may be more indirect.

The correlation analyses indicated that all three predictors were positively associated with academic performance. Among them, expectations had the strongest relationship, which is consistent with Expectancy-Value Theory (Eccles & Wigfield, 2002). EVT emphasizes that students' achievement-related choices, persistence, and performance are largely determined by their expectations of success and the value they place on academic tasks. The present results confirm that when students believe they are capable of performing well and perceive schoolwork as important for their future, they are more motivated to engage and ultimately achieve higher outcomes. This finding aligns with prior research showing that expectancy beliefs are a robust predictor of effort and persistence across cultural and developmental contexts (Peng, 2012; Rosenthal, 2002).

Self-regulation also emerged as a significant predictor, highlighting the importance of students' ability to plan, monitor, and reflect on their learning processes. This finding is in line with Zimmerman's (2000) self-regulation model and supports earlier evidence that self-regulated learning strategies enhance academic performance across subject areas (Guo et al., 2006; Sitzmann & Ely, 2011). Importantly, EVT and self-regulation theory can be understood as complementary: expectancy beliefs motivate students to value and pursue academic tasks, while self-regulation provides the strategies necessary to translate motivation into sustained achievement.

In contrast, family functioning did not significantly predict academic performance in the regression analysis, although it was positively correlated with achievement. This suggests that family functioning may contribute indirectly by shaping students' motivation and self-

regulation. Supportive families provide emotional warmth, consistent communication, and structured guidance, which can foster both positive expectancy beliefs and effective self-regulation skills. This interpretation aligns with family systems theory (Yue, 2014; Zhou, 2020), which highlights the family's role in cultivating socio-emotional resources that influence learning outcomes through indirect pathways.

Taken together, these findings extend the integrated framework of family systems theory, self-regulation theory, and expectancy-value theory. They demonstrate that motivational beliefs (expectancy-value), regulatory strategies (self-regulation), and family context work together to influence academic achievement. By confirming the predictive strength of expectancy and self-regulation, the study highlights the need to strengthen students' confidence in success and equip them with the skills to manage their own learning, while recognizing the family's indirect but essential role in supporting these processes.

The findings have several practical implications. At the family level, strengthening communication, emotional support, and involvement in children's education can create a foundation that fosters positive expectancy beliefs and self-regulation. At the school level, interventions that build students' self-regulatory skills and cultivate a sense of academic competence may directly enhance achievement. At the policy level, integrating family education with motivational and self-regulation training programs can provide a holistic approach to improving student outcomes, particularly in underdeveloped regions.

This study contributes to educational psychology by demonstrating the combined influence of family functioning, self-regulation, and expectancy on middle school students' academic achievement. The findings reinforce the explanatory power of Expectancy-Value Theory, showing that students' beliefs about their success and the value they assign to schoolwork are central to their performance. At the same time, the results emphasize the complementary role of self-regulation in translating motivation into achievement and the indirect contribution of family functioning in shaping these processes. These insights provide a basis for interventions aimed at enhancing both academic performance and student well-being.

Limitations and Future Directions

Several limitations must be considered. The cross-sectional design precludes causal inference; longitudinal studies are needed to clarify the developmental pathways among family functioning, motivation, self-regulation, and performance. Reliance on self-report measures may introduce bias, underscoring the importance of incorporating multiple data sources such as teacher or parent reports. Finally, the sample was limited to two schools in Guizhou, and future research should include larger, more diverse populations to enhance generalizability.

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Cultural Integration Through Peer Collaboration: How PAL Programs Facilitate the Adaptation of Burmese Biomedical Science Students in Thailand

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Abstract

This study investigates how Peer-Assisted Learning (PAL) sessions facilitate the cultural adaptation, intercultural competence, and personal development of Burmese international peer-mentors at a Thai university. Using a mixed-methods approach, quantitative data were gathered through structured questionnaires, while qualitative insights were derived from semi-structured interviews with peer-mentors. Findings reveal that PAL sessions significantly enhance peer-mentors' understanding of Thai culture, helping them adjust to local communication styles and social norms. Additionally, the sessions improved the mentors' leadership and communication skills, contributing to their personal and professional growth. However, language barriers and the need for more structured cultural adaptation resources were identified as challenges. This research provides valuable insights into the dual role of PAL programs in promoting both academic and cultural integration, emphasizing the need for enhanced intercultural training to support international students' success. The findings offer practical recommendations for improving PAL frameworks in higher education settings.

Keywords: peer-assisted learning, cultural adaptation, intercultural competence

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Introduction

Over the past four decades, higher education institutions in Thailand have significantly expanded international programs, fueled by the dismantling of geopolitical barriers, the reduction in air travel costs, and the widespread global connectivity enabled by the internet and social media. The growing significance of cross-border organizational relationships has heightened the importance of intercultural competence, prompting many educational institutions to establish international partnerships and offer projects supported by intercultural curricula to cultivate this competence among students (Syring, 2016). A scheme that promotes intercultural competence is one that encourages students to contribute to and value the learning of their peers (Cajander et al., 2012). An example of a scheme of this capacity is peer-assisted learning (henceforth PAL), in which empirical evidence indicates that PAL effectively boosts students' motivation, academic self-concept, performance, and retention (Ning & Downing, 2010; Öz, 2024; Yaoyuneyong & Thornton, 2011). These sessions provide a structured environment that fosters collaborative learning, intercultural dialogue, and mutual support among participants. However, the specific role of PAL sessions in facilitating cultural integration for international peer-mentors remains underexplored.

In Thailand, despite the nation's efforts to position itself as a leading destination for higher education through internationalization initiatives, many international students continue to experience challenges such as language barriers, cultural disparities, and social isolation (Chaiyasat, 2024). These challenges can significantly hinder their integration into Thai society (Snodin et al., 2021), thereby reducing the potential advantages of cultural exchange. Burmese students, who comprise a substantial segment of Thailand's international student population, frequently face challenges in cultural adaptation due to difficulties in social integration, academic adjustment, and experiences of discrimination (Rhein, 2016). Burmese students volunteering as peer mentors navigate the dual roles of cultural learners and guides, offering a unique perspective on cultural integration.

This study investigates how PAL sessions contribute to the cultural adaptation of Burmese international peer-mentors in Thai universities, focusing on the mechanisms that promote intercultural competence, social integration, and personal growth. Grounded in theories of intercultural competence and collaborative learning, this research seeks to illuminate the dual benefits of PAL programs: enriching the cultural understanding of mentors while simultaneously enhancing their leadership and communication skills. By focusing on the experiences of Burmese peer mentors at Rangsit University, this study addresses a critical gap in the literature and offers practical insights into fostering inclusive and supportive educational environments.

Program Description

The PAL program embodies the university's mission of “Creating a giving and sharing society,” connecting mentors from four major courses with mentees from six smaller courses over a 10-week period. The program focuses on Thai students enrolled in General Education English courses and aims to facilitate cultural exchange while developing intercultural competence among participants.

Burmese peer-mentors play a key role in the program, dedicating two to three hours per week to supporting mentees. These mentees, whose English proficiency is at a CEFR level of B1 or lower, participate for at least 30 minutes weekly. Mentees select their mentors online from a

pool of mentors, all of whom possess a CEFR level of B2 or higher. Each session lasts a minimum of 30 minutes, with mentees working in groups of up to five students.

At the end of the program, the Burmese peer-mentors complete questionnaires to reflect on their experiences. Additionally, 15 peer-mentors are randomly selected to participate in semi-structured interviews, offering qualitative insights into their cultural adaptation, intercultural interactions, and learning experiences within the PAL sessions. This systematic feedback collection supports a detailed assessment of how the program fosters cultural integration and personal development for the mentors.

Research Objectives

This research aims to explore how PAL sessions facilitate the cultural adaptation of Burmese international peer-mentors to Thai culture. It seeks to identify and analyze the processes within these sessions that promote cultural exchange, enabling peer-mentors to engage with Thai cultural norms, practices, and social dynamics. Additionally, the study evaluates the development of intercultural competence among Burmese peer-mentors, focusing on their ability to interact effectively and sensitively in a culturally diverse academic setting. It also investigates the personal and professional growth outcomes experienced by these mentors, such as increased confidence in intercultural communication, enhanced leadership skills, and improved academic performance. Furthermore, the research examines the level of satisfaction among Burmese peer-mentors regarding the support and resources provided by the university, while gathering their recommendations for improving the PAL framework. Ultimately, the study aims to offer evidence-based recommendations for implementing effective PAL sessions that support both academic and cultural integration, addressing the unique challenges faced by Burmese peer-mentors adapting to Thai culture.

Research Questions

The study explores the role of Peer-Assisted Learning (PAL) sessions in fostering cultural integration among Burmese international peer-mentors adapting to Thai culture. Specifically, the research is guided by the following key questions:

1. How do PAL sessions facilitate the cultural adaptation of Burmese international peer-mentors to Thai culture?
2. What impact do PAL sessions have on the intercultural competence of Burmese international peer-mentors?
3. How do PAL sessions influence the personal and professional development of Burmese international peer-mentors?
4. What are the levels of satisfaction among Burmese international peer-mentors regarding the support and resources provided by the university for their cultural adaptation, and what recommendations do they suggest for improvement?

These research questions aim to provide a comprehensive understanding of how PAL sessions can serve as a conduit for cultural exchange, personal growth, and professional development, offering valuable insights for fostering inclusive and supportive environments in higher education. The findings are expected to contribute to academic discussions on best practices for enhancing cultural integration through peer-assisted learning frameworks.

Literature Review

Educational inclusion is a pivotal component of the integration process, with schools playing a significant role in facilitating the integration of migrants (Klemenčič-Mirazchiyski et al., 2022), particularly in contexts where international students engage in learning and teaching as peer-mentors. Research highlights the significance of cultural diversity in educational environments, affirming and expanding the advantages of university diversity experiences in preparing students for a global society (Gurin et al., 2004; Nelson Laird et al., 2005). PAL transforms traditional student-teacher dynamics by promoting reciprocal knowledge and skill development among students of similar social groupings, thereby enhancing collaboration, engagement, and satisfaction (Castelyn, 2018).

Peer-Assisted Learning: A Tool for Academic and Cultural Growth

PAL involves students taking on both teaching and learning roles, with its structure categorized based on the academic relationship between students and the student-to-teacher (Espinosa et al., 2024). Research has shown that PAL is a peer-facilitated learning enhancement model designed to impact the way students learn complex content in a specific course (Huang et al., 2015; Iwata et al., 2014; Sha et al., 2023). Although the academic advantages of PAL are well-established, research on its role in cultural integration, particularly regarding the adaptation experiences of international peer-mentors, remains limited.

Cultural Integration and Intercultural Competence

Cultural integration involves incorporating and navigating social norms, beliefs, and practices in diverse settings. Byram (1997) posits that intercultural competence consists of five components—attitudes, knowledge, skills of interpreting and relating, skills of discovery and interaction, and critical cultural awareness—arguing that knowledge and attitudes are foundational for enhancing skills and fostering critical cultural awareness. Intercultural communication breakdowns stem from (1) differing communicative resources that hinder the construction and understanding of linguistic and pragmatic meanings, and (2) contrasting sociocultural norms that obstruct the perception, expectation, and execution of appropriate communicative acts in social contexts (Bardovi-Harlig & Hartford, 1990; Clyne, 1995; Rehbein, 1994; Sarangi, 1994; Thomas, 1984; Varonis & Gass, 1985)—all of which can happen in a PAL scheme. Therefore, incorporating intercultural competence into PAL sessions offers a crucial framework for promoting mutual understanding and facilitating exchange. Engagement in intercultural programs has been shown to substantially improve respect for and appreciation of cultural diversity (Block et al., 2015).

Challenges for International Peer-Mentors

International students face a wide range of challenges, including securing housing (Lee & Rice, 2007), managing homesickness (Poyrazli & Lopez, 2007), adapting to sociocultural differences in foreign educational systems (Hellstén & Prescott, 2004), and overcoming language barriers in English proficiency (Bai, 2016), all of which can adversely impact their mental health and academic success if not adequately addressed. These challenges highlight the critical need for programs such as PAL schemes to offer structured opportunities that foster meaningful interactions between international and local students throughout the acculturation process (Bai, 2016). In addition to the support provided by informal peer networks, structured university-based PAL initiatives more comprehensively address adaptation challenges by fostering social

networks that positively influence students' learning, academic success, and retention throughout their studies (Huijser & Kimmins, 2005).

Role of PAL in Facilitating Cultural Exchange

Cultural exchanges serve as catalysts for language learning, mediators between diverse linguistic and cultural groups, developers of learning communities, providers of authentic information, promoters of resolving conflicts, and creators of multifaceted learning experiences (Wang, 2013), and PAL initiatives may create this platform for such cultural exchanges to take place. Language learners can deepen their understanding of different cultures and improve their perceptions of language learning through meaningful experiences (Jung et al., 2019), such as PAL, that reflect real-life communicative contexts. Studies have shown that these programs are particularly effective in enhancing student interaction, through its socializing impact, and have been proven effective in helping students achieve desired learning outcomes (Idris et al., 2019; Jeanneau & O'Riordan, 2020; Urbanovska & Pleschová, 2024).

Addressing Research Gaps

Despite the growing global adoption of PAL initiatives, a notable research gap persists regarding its role in supporting the cultural adaptation of international peer-mentors in Thailand. Current literature primarily emphasizes academic benefits (Glynn et al., 2006; Huang et al., 2019; Yaoyuneyong & Thornton, 2011), frequently neglecting the socio-cultural aspects and the distinct needs of diverse participants. This study seeks to address these gaps by exploring how PAL sessions at Rangsit University enable Burmese peer-mentors to adapt to Thai culture, thereby contributing to cultural discourse.

The literature reviewed highlights PAL as a promising tool for promoting cultural integration and intercultural competence, particularly among international peer-mentors. This study will build on existing findings to explore the mechanisms through which PAL supports cultural exchange and adaptation, offering practical insights for enhancing such programs in higher education.

Methodology

This research utilizes a participatory action research design, conducted over a ten-week period during Term 1 of 2024 at Rangsit University in Thailand. The study explores the role of PAL sessions in promoting cultural exchange and fostering intercultural competence among Burmese peer mentors at the university's PAL center. To achieve a comprehensive understanding of participants' experiences, a mixed-method approach integrating both quantitative and qualitative methods was employed.

Population and Sample

The target population consists of 32 Burmese students, aged between 18 and 22, who voluntarily assumed roles as student managers in the PAL center. The participants represent diverse educational and regional backgrounds, with English proficiency levels ranging from intermediate to advanced.

Research Design

A combination of quantitative and qualitative data collection techniques was adopted. Quantitative data were gathered through a structured questionnaire designed to measure participants' perceptions of cultural exchange, cultural awareness, and personal growth. For qualitative data, semi-structured interviews were conducted with a subset of 15 participants to examine their experiences related to intercultural competence, communication challenges, and personal development.

Data Collection Instruments

Data collection for the study involved two primary instruments: a structured questionnaire and semi-structured interviews. The questionnaire, administered to all 150 participants, included 30 Likert-scale items rated from 1 to 5. It was designed to assess participants' interactions with peer mentors, their levels of cultural sensitivity, and their overall satisfaction with the PAL sessions. Additionally, in-depth semi-structured interviews were conducted with a subset of 15 participants. These interviews explored their intercultural experiences, communication challenges, and the benefits derived from their participation in the PAL center, providing rich qualitative insights to complement the quantitative data.

Ethical Considerations

Ethical guidelines were rigorously followed throughout the research process. Participants provided informed consent, with assurances of confidentiality and anonymity. Their participation was entirely voluntary, with the freedom to withdraw from the study at any point without repercussions. Additionally, cultural sensitivity was prioritized to ensure respect for the participants' diverse backgrounds.

This dual-method approach enabled the study to generate valuable insights into how PAL sessions facilitate cultural exchange and enhance intercultural competence among Burmese students at Rangsit University.

Data Analysis

This study utilized both quantitative and qualitative methodologies to thoroughly examine the role of PAL sessions in fostering cultural exchange and enhancing intercultural competence among Burmese students in Thailand.

Quantitative Data Analysis

The quantitative component of the study involved analyzing data collected through structured questionnaires using descriptive statistical methods. This analysis aimed to outline the demographic characteristics of participants and their responses to Likert-scale items addressing cultural exchange, intercultural competence, and personal growth. Metrics such as mean, median, and standard deviation were calculated to represent central tendencies and variability within the dataset.

Furthermore, inferential statistical techniques were applied to uncover significant associations between primary variables, including participants' satisfaction levels with the PAL sessions and their perceptions of intercultural competence development. Tools such as Pearson's correlation

coefficient and regression analysis were employed to identify potential correlations and predict outcomes, enriching the understanding of the data's implications.

Qualitative Data Analysis

The qualitative data, gathered from semi-structured interviews with selected participants, underwent a detailed thematic analysis to identify significant patterns and insights. This process involved four key stages. First, the researcher familiarized themselves with the data by thoroughly reviewing interview transcripts to understand participants' narratives and experiences. Second, relevant phrases and statements were coded based on their alignment with the study's objectives, focusing on areas such as intercultural competence, peer interactions, and communication challenges. Third, the codes were grouped into overarching themes that encapsulated the study's primary findings, highlighting how PAL sessions facilitated cultural exchange and enhanced intercultural competencies. Finally, these themes were interpreted collectively to develop a comprehensive narrative of the participants' experiences, linking the findings to the research objectives and theoretical framework. This analytical approach provided in-depth insights into the role of PAL sessions in promoting cultural integration and personal development among Burmese students.

Validity and Reliability

To ensure the dependability and trustworthiness of the research instruments applied in this study, extensive evaluations of validity and reliability were conducted.

Validity

The questionnaire's validity was verified through expert assessment and the Item Objective Congruence (IOC) method. Three specialists in education and second language pedagogy examined the content validity of the questionnaire items. Each item was rated based on its relevance to the study's objectives, using a scale of +1 (relevant), 0 (uncertain), and -1 (irrelevant). Items scoring +1 were considered well-aligned with the research aims, affirming the instrument's effectiveness in measuring the intended constructs. Following the review, all items were deemed suitable and congruent with the study's goals, thus establishing the questionnaire's content validity.

Reliability

The reliability of the questionnaire was evaluated using Cronbach's Alpha to measure internal consistency. A preliminary test was conducted involving 40 participants who shared demographic characteristics with the study's primary sample but were not included in the main study. The Cronbach's Alpha value for the questionnaire was 0.94, reflecting an excellent degree of internal consistency. Given that a value of 0.70 or above is generally regarded as acceptable, this result indicates that the questionnaire reliably captures consistent responses among participants.

By ensuring both the validity and reliability of its instruments, this study reinforces the precision and consistency of its data, enabling robust and credible conclusions.

Results

Questionnaire

The questionnaire distributed to Burmese peer-mentors in the PAL program assessed their motivations, personal growth, and perceptions of the academic support provided within the program. The responses, measured on a Likert scale, provided insight into the participants' emotional resilience, community impact, and the team environment at the PAL center. Below is a summary of the key findings based on three main themes: Motivation and Emotional Resilience, Personal Growth and Community Impact, and Academic Support and Team Environment.

Motivation and Emotional Resilience

The responses regarding motivation and emotional resilience indicate that the peer-mentors are motivated to continue their volunteer work, even amidst the political unrest in Myanmar. The mean score across items in this category was 3.37 (SD = 0.89), reflecting a moderate level of resilience and motivation. Mentors expressed a strong sense of purpose in their role, with one item scoring 3.53 (SD = 0.72), while another item concerning the emotional impact of the political situation on their well-being scored 3.69 (SD = 1.03). Despite challenges, participants found that volunteering helped them cope with stress, with a moderate score of 3.06 (SD = 0.95) for this item.

Personal Growth and Community Impact

The results for personal growth and community impact demonstrated high levels of satisfaction, with an overall mean of 3.63 (SD = 0.80). The peer-mentors reported significant personal growth and a strong connection to their cultural roots, reflected in a mean score of 3.72 (SD = 0.92) for personal growth and 3.63 (SD = 0.75) for cultural connection. Mentors also noted that their roles helped them develop leadership skills, scoring 3.72 (SD = 0.81), and they expressed a sense of accomplishment and purpose in helping others, with a mean score of 3.63 (SD = 0.83). This section highlights the positive impact of the mentoring experience on both the personal and community levels.

Academic Support and Team Environment

In terms of academic support and the team environment, the peer-mentors reported a moderate level of satisfaction, with an overall mean score of 3.49 (SD = 0.85). Although many mentors felt that their academic performance benefited from volunteering (3.50, SD = 0.95), they also recognized that balancing mentoring responsibilities and studies could be challenging (3.31, SD = 0.99). However, they expressed satisfaction with the support they received from the PAL center, particularly regarding the safe and inclusive environment provided (3.59, SD = 0.76), and the recognition and respect they felt from peers and supervisors (3.75, SD = 0.84).

Semi-structured Interviews

The semi-structured interviews with Burmese peer-mentors revealed key themes related to their experiences in the Peer-Assisted Learning (PAL) sessions. These themes reflect the mentors' cultural adaptation, communication challenges, personal growth, and cultural exchange.

Cultural Adaptation and Understanding

The PAL sessions played a vital role in helping Burmese peer-mentors adapt to Thai culture. Participants noted that interactions with Thai students allowed them to better understand local customs, particularly around politeness and respect. One mentor highlighted this by stating, "My sessions have taught me a lot about Thai culture, especially their polite way of communicating and how much they value respect. I have adjusted my teaching by using examples that match their culture." Through these interactions, mentors gained valuable insights into Thai norms, which enhanced their cultural awareness and ability to engage effectively.

Language and Communication Barriers

Despite the cultural benefits, language barriers emerged as a significant challenge for many mentors. Several participants expressed difficulty in communicating with Thai students who were hesitant to speak English or struggled with proficiency. As one mentor explained, "The language barrier some Thai students don't really wanna socialize in English." However, mentors often employed strategies such as adjusting their communication styles or asking follow-up questions to navigate these barriers and facilitate more meaningful engagement with their mentees.

Personal Growth and Confidence Building

The PAL sessions also fostered personal growth and boosted the confidence of the peer-mentors. Many participants felt that their communication skills and leadership abilities improved as a result of guiding their peers. One mentor shared, "Helping others and seeing their progress boosts my self-esteem and sense of accomplishment." These experiences not only built the mentors' confidence in cross-cultural interactions but also enhanced their empathy and adaptability, key traits that contributed to their professional and personal development.

Cultural Exchange and Mutual Learning

A strong theme of cultural exchange and mutual learning emerged from the interviews, as both mentors and mentees shared their cultural backgrounds. This exchange deepened intercultural understanding and fostered a supportive learning environment. One mentor recalled a particular instance of cultural exchange, saying, "A Thai student enthusiastically shared stories about Songkran, the water festival, explaining its cultural significance and how it's celebrated across the country." Such moments of mutual learning not only enriched the participants' knowledge but also strengthened the cultural bonds within the PAL sessions.

Discussion

Interpretation of Key Findings in Relation to Research Questions

RQ1: How do PAL sessions facilitate the cultural adaptation of Burmese international peer mentors to Thai culture?

The PAL sessions were instrumental in facilitating the cultural adaptation of Burmese international peer-mentors. Interview responses highlighted how direct interactions with Thai students allowed mentors to better understand local customs, particularly around respect and

politeness, as reflected in the literature on intercultural competence (Byram, 1997). One mentor mentioned that "My sessions have taught me a lot about Thai culture, especially their polite way of communicating and how much they value respect." This is consistent with findings from the literature, which emphasize the role of structured cultural exchange programs in improving understanding of diverse cultural norms (Wang, 2013). By learning about Thai cultural practices, such as the significance of hierarchy and respect for elders, the peer mentors were able to adjust their behaviors and communication styles to better align with their surroundings. Moreover, the informal, reciprocal nature of learning within PAL sessions mirrors the collaborative approach emphasized in intercultural communication research (Block et al., 2015). Mentors adjusted their teaching to incorporate Thai-specific examples, enhancing the learning experience for both parties and promoting mutual cultural exchange.

RQ2: What impact do PAL sessions have on the intercultural competence of Burmese international peer-mentors?

The impact of PAL sessions on the intercultural competence of Burmese international peer-mentors was substantial. The mentors reported increased sensitivity and adaptability in their communication, in line with Byram's framework on intercultural competence, particularly the development of "skills of discovery and interaction." One mentor stated, "The sessions have improved my intercultural competence by teaching me to adapt to Thai communication styles and learning preferences." Another mentor emphasized the importance of learning the "subtle ways Thai students express their thoughts," underscoring the development of critical cultural awareness.

These findings echo the literature, which highlights how engagement in intercultural programs improves cultural awareness and empathy (Bardovi-Harlig & Hartford, 1990; Byram, 1997). The sessions provided a platform for real-life application of intercultural competence, where peer mentors adapted to Thai social norms and communication styles, enriching their intercultural experiences.

RQ3: How do PAL sessions influence the personal and professional development of Burmese international peer-mentors?

The PAL sessions had a positive influence on both the personal and professional development of Burmese international peer-mentors. As noted in the literature, PAL initiatives often serve as platforms for developing leadership and communication skills (Yaoyuneyong & Thornton, 2011). Many mentors reported gaining confidence in both academic and social settings, as well as improving their leadership abilities. For instance, one mentor shared, "Helping others and seeing their progress boosts my self-esteem and sense of accomplishment." Another mentioned that the sessions had helped them "grow by improving [their] communication and cultural awareness."

These outcomes are consistent with previous research indicating that peer mentoring programs not only benefit the mentees but also contribute to the mentors' development in terms of communication, empathy, and leadership skills (Castelyn, 2018). PAL sessions encouraged the mentors to step out of their comfort zones and develop interpersonal and professional skills that are transferable to other contexts.

RQ4: What are the levels of satisfaction among Burmese international peer-mentors regarding the support and resources provided by the university for their cultural adaptation, and what recommendations do they suggest for improvement?

The satisfaction levels of Burmese international peer-mentors regarding the support and resources provided by the university were mixed. While many mentors felt that the university provided adequate support, such as access to training sessions and materials, some expressed a need for more targeted cultural adaptation resources. One mentor noted that "the training sessions, teaching materials, and mentor collaboration have been most helpful." However, another mentor suggested that "the university could provide more cultural exchange workshops or activities to help mentors better understand diverse backgrounds."

These findings align with the literature on the importance of structured support in easing cultural adaptation challenges (Huijser & Kimmins, 2005). While the PAL program provided essential resources, additional workshops or informal events focused on cultural adaptation could further enhance the experience for international mentors.

Implications for Practice

The findings suggest several practical implications for enhancing the cultural adaptation of international peer mentors through PAL sessions. First, intercultural competence training should be a key component of PAL programs to help mentors navigate the complexities of cultural exchange. Additionally, universities should consider expanding cultural exchange workshops and informal networking opportunities to foster deeper cultural understanding. Regular feedback mechanisms, such as reflection sessions, could provide mentors with more opportunities to share their experiences and receive guidance on overcoming challenges.

Contributions to Existing Research

This study contributes to the existing research on peer-assisted learning by highlighting its dual role in fostering both academic and cultural integration among international students. While previous studies have focused primarily on the academic benefits of PAL, this research adds to the literature by demonstrating how PAL sessions serve as platforms for intercultural competence development and personal growth among peer mentors. Furthermore, the study addresses a notable gap by exploring the specific experiences of Burmese students in Thailand, a population that has received limited attention in previous research.

Limitations and Future Research Directions

One limitation of this study is its reliance on self-reported data from interviews and questionnaires, which may introduce bias. Future research could benefit from longitudinal studies that track the cultural adaptation and professional development of peer mentors over time. Additionally, expanding the sample to include peer mentors from different cultural backgrounds would offer a more comprehensive understanding of how PAL programs facilitate cultural integration across diverse contexts.

Further research is also needed to explore the long-term impact of peer mentoring on both mentors and mentees, particularly in relation to their intercultural competence and academic success. By addressing these areas, future studies can provide deeper insights into how to optimize PAL programs for international students in higher education.

Conclusion

This study highlights the critical role that PAL sessions play in facilitating the cultural adaptation, intercultural competence, and personal development of Burmese international peer-mentors at a Thai university. The findings demonstrate that PAL programs not only foster a deeper understanding of Thai culture but also enhance peer-mentors' leadership, communication, and empathy skills, contributing to their overall personal and professional growth. Despite some challenges, such as language barriers and the need for more targeted cultural adaptation resources, the peer-mentors expressed satisfaction with the support provided by the university. This research offers significant contributions to the understanding of how structured peer-learning environments can serve as catalysts for cultural integration, especially in higher education contexts where international students face unique adaptation challenges. The insights gathered underscore the importance of expanding intercultural training within PAL programs to maximize their benefits, suggesting that with proper institutional support, PAL can be an effective tool for fostering inclusive and culturally responsive learning environments.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that ChatGPT was utilized solely for proofreading and language refinement, and that no AI technologies were used to generate, analyze, or interpret the research content, data, or conclusions.

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Towards a Successful Postgraduate Life and Beyond: The Construction of a PG Transition Module

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Abstract

This paper is about the construction of a multidimensional Transition Support System (TSS) for postgraduates in XJTLU. As the university keeps expanding and the PG programme is enlarging, the need to facilitate postgraduates' transition in this Sino-British EMI University emerges. The postgraduate students may face a multitude of challenges before and after they join XJTLU. Thus, it is of necessity and urgency to build up a system to aid postgraduates in their transition to XJTLU. This system is embodied in a PG Transition Module and is currently at its piloting stage. This project will implement action research in the iterative process of constructing and modifying the TSS, while investigating the effect of the TSS on postgraduates' development of self-directed research-led learning skills. This project is highly significant as it will increase the prospect of a successful XJTLU life for postgraduates, and enhance the profile of XJTLU in the international arena as a pioneer in offering an extensive support system for postgraduate transition. After the first iteration of this PG Transition Module, there is feedback from multiple stakeholders including students, practice mentors and academic advisors, with their varied perceptions and experiences of the project-based learning in one semester. Postgraduate students mostly described how learning in authentic real world projects have helped their development of self-directed and self-regulated learning skills although they have also raised their expectations for the relevancy of these projects to their disciplinary areas for the enhancement of employability.

Keywords: PG module, project-based learning, transition support

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Introduction

The construction of a PG transition system was initiated against the backdrop that the postgraduate programme in XJTLU is developing rapidly and there has been a dire need for facilitating postgraduates' transition in this university. After much consultation with key stakeholders including external partnership institutions outside XJTLU and programme directors within XJTLU, it was decided that the transition system would be embodied in a PG Transition Module to be piloted in one semester, before it would be further refined and made ready to be rolled out across the whole university.

Previously, the significance of supporting students' transition has been very often undervalued. In reality, students who haven't been accommodated well in the early stages of their postgraduate studies might experience difficulties in their later academic studies. In the worst scenario, they might drop out in their first year of study if they do not feel adequately supported by their institution (Wilcox et al., 2005). Postgraduates' challenges may be associated with the curriculum, their social roles, and generic life challenges (Tsao, 2020). To meet the demand for assistance with postgraduate students' transition in universities, various pre-sessional courses have been offered to help students overcome the aforementioned challenges in universities across the globe. Typically, these courses focus on preparing students academically (Hultberg et al., 2008).

However, a more comprehensive, coordinated, and student-centred approach may serve best to support students' transition (Timms et al., 2022), because transition needs to eventually enable students' integration into their academic environment (Wilson et al., 2016) and prepare students for their future employment. It was therefore hoped that the construction of the Transition Support System in the form of a PG transition module would make it possible that support for postgraduates' transition would be delivered in a multifaceted manner with a long-term positive impact on postgraduate students and the university.

The Construction of the PG Transition Module

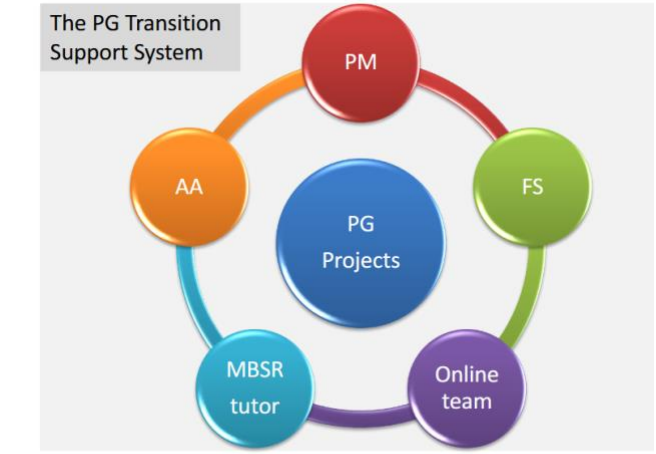
The aim of constructing this PG Transition module is to provide students with learning resources and guidance that will help students to develop self-regulated learning skills and 21st century soft skills including communication skills, leadership skills, and self-management skills, which will in turn enhance students' development of employability so that they may have a successful academic life in XJTLU and beyond.

Early in 2025, it was decided that a multi-dimensional support system for postgraduate transition would be established in response to the university-wide initiative of "research-led and project-based learning". The module would be counted as 80 Co-curricular Activity hours, and would be a prerequisite for students to proceed to dissertation writing stage. There were five components in the module: 1) there was an online team preparing online resources for students' self-study on Learning Mall; 2) there was onsite supervision from practice mentors for students' field work on the 4 practice bases including 3 practice bases in external partnership institutions and one home base in XJTLU, 3) there was academic skills supervision from Academic Advisors to give students tutorials in the university, 4) there were field supervisors to help administer students' onsite engagement and project progress, and 5) there was a mindfulness-based stress reduction (MBSR) course tutor to help relieve students' stress by offering MBSR course to be held at the university. In addition, students would carry

out teamwork and self-reflection on their own. The PG Transition Support System embodied in this module is shown below.

Figure 1

The PG Transition Support System in XJTLU



PM: Practice Mentor FS: Field Supervisor AA: Academic Advisor
MBSR: Mindfulness-based Stress Reduction

The Delivery of the PG Transition Module

In line with the 5 components of the module as listed above, each of its componential teams started work to support new postgraduates' transition into XJTLU in September, 2025. The module was delivered in one semester in the academic year of 2025–2026.

On 5 September, postgraduate induction activities were held to introduce the launch of this new initiative and this new module. Students met with their academic advisors and practice mentors at a "speed-dating" event and exchanged initial information on the real-world projects to be selected. After that, surveys were conducted to investigate students' interests and the matching process was completed within 2 weeks, to form project teams that were comprised of a practice mentor from a practice base, an academic advisor from within the university, and a student team of 3–5 postgraduates.

In the initial couple of weeks, students accessed online contents for self-study at their own pace to get a general comprehension of the module and their upcoming field work on practice bases. The online materials were divided into 5 mini-courses in 10 weeks. There was also an MBSR section on the university learning management system, which was called "Learning Mall" that was moodle-based.

Next, students conducted field work on practice bases from W3–W10. Students' onsite supervision was provided by their practice mentors, which was conducted on a project-by-project basis. Field Supervisors helped to gauge students' onsite engagement, ensure students' health and safety, and coordinate between students, AAs, and PMs on base. Meanwhile, students were expected to take their own initiative to start communications with AAs for help with the development of their research skills and academic skills. In addition, students attended MBSR course to learn how to relieve stress and regulate emotions.

Achievements and Challenges From the PG Transition Module

The PG Transition Module has been the first of its kind, encompassing various elements ranging from academic study skills, to problem-solving skills, and self-regulatory skills. There were 22 projects on 4 practice bases, covering various educational levels. As such, the achievements from the PG Transition Module were multifaceted, so were the challenges encountered.

First of all, the majority of students demonstrated strong interest in experiential learning through projects at the outset, and some of them have expressed their achievements in skills acquisition towards the conclusion of the module. In the Induction survey, it was revealed that 70.37% of the student respondents demonstrated strong interests in the new module. After the module was concluded, some students expressed in the follow-up survey that they have indeed acquired "leadership skills", "communication skills", and built up their self-confidence in teamwork in the problem-solving process. It was acknowledged by the student respondents (52/78 respondents) in the survey that communications skills (77%) and teamwork skills (70%) were developed through doing projects in this module.

Secondly, there were at least 6 project teams (out of 22) that have completed their project proposals without traditional classroom instructions. These students divided workload among themselves, self-studied Module Handbook and proposal sample, before they produced their own proposals centering on the projects they have completed. In their proposals, they have explained in detail the problems they identified in the real-life situations, the process of their research, and the solutions to these problems and corresponding action plans, including milestones to be achieved.

Nevertheless, there were also various challenges arisen from the module. One of these challenges was the alignment of goals, expectations and routines for the various parties involved. This was due to the diversity in participating parties' backgrounds, interests, and expected outcomes. Moreover, how to make the projects closely relevant to students' disciplinary areas was another challenge because the projects were decided by the Practice Mentors' backgrounds and the hosting institutions' interests.

Recommendations for Future Actions

After the piloting of the module, it became clear that there are several areas that can be further improved despite of the achievements made.

First and foremost, in order to make all the projects of values for the postgraduates in their learning journey in XJTLU and beyond, much more communications and discussions will be needed prior to the start of the module in its next iteration. The purpose for this is multifold: a) this may help to ease/avoid possible tensions between different stakeholders when their expectations/goals are misaligned; b) the formation process for project teams will be facilitated; c) possible changes in projects and teams may be minimized/avoided.

Secondly, in order to provide sufficient scaffolding for the newly recruited postgraduates, it is recommended that onsite workshops will be organized and more lines of communications will be opened to promote the module and enhance participants' understanding of the module and the projects. The interactions in these workshops for students may also help to open up

opportunities for their socializing and networking, which will also help their formation of project teams and facilitate their future communications in conducting projects in the fields.

Last but not least, it is recommended that certain charters for standards of practice will be outlined and resources will be co-shared between XJTLU and its partner institutions, so that the module is sustainable and there will be the win-win situation achieved for all the stakeholders involved.

Conclusion

The construction of the PG Transition Module is an adventurous endeavor. I, as the Module Leader, have led the team to venture into the unknown and we have embraced risk-taking. Yet there was no guarantee that it could be an instant success despite of the achievements made. In order for it to generate an enjoyable and productive experience for all the parties in this multi-lateral collaboration, there is still some distance to go and more challenges to overcome. But in the foreseeable future, I am confident that this module will have far-reaching significance for the changes made in students' mindset in problem-solving and their approaches to lifelong learning.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Appendix

Projects in the PG Transition Module

XJTLU AI-empowered PBL innovation for primary schools
Exploring AI general education courses at Wenjing School
Little craftsman of science and innovation: “Big Hands Holding Small Hands” Tool Workshop
Children's creative laboratory: Action plan for the development of the science and innovation toolbox
Student clubs and the transition from primary to lower secondary school
Student mental health empowerment resources and navigation
Optimization of Drama & Music Curriculum in Primary Schools of Foreign Language
How to optimize the bilingual reading atmosphere in integrated classes
Intangible cultural heritage literacy from the perspective of family-school-community collaboration: Building a practical model
Constructing industry-education integration communities in the Suzhou classical garden architecture sector
Applying artificial intelligence technology in educational evaluation in vocational education
Optimizing APP adaptation for digital learning resources in adult education
Student mental health empowerment resources and navigation
How to foster university students' ethical awareness and promote their character development via PBL?
How to promote Social-Emotional Learning (SEL) in diverse classrooms through contextualized and culturally responsive practices?
How can we improve the research-oriented competency of basic education students via an organized activity?
How can Social-Emotional Learning (SEL) be systematically implemented in XJTLU Alliance Schools？
Collaborative Online International Learning (COIL): Incorporating Disaster Risk Reduction (DRR) Competencies into Educational Curricular
How to optimize campus tours to provide clients with a customized, immersive exploration space?
How to optimize the workshop sessions in teaching-related training programmes to enhance interaction and communication among participants and improve learning achievements?
How can we know if faculty development is effective in changing teaching practice?
How can actors from the digital education industry and programme better meet one another at an event centred on research projects?

How does the integration of research-led PBL and AI impact students' learning experience and academic achievement?

Engaging Minds and Enhancing Speech Through Motivational Activities for EFL Learners

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Abstract

It can hardly be denied that speaking is a vital yet challenging skill for learners. It is a productive skill that involves interaction, as well as aural comprehension. Needless to say that other factors such as student motivation and classroom environment can also have their impact on oral production. One can often hear complaints that it is easier to read, listen and understand than get involved in a short dialogue in the target language, in this case – English. The responsibility seems to be more on one stakeholder – the teacher, who has to actually teach her students to use the language and be able to express ideas in that language. A simple solution to face all these challenges is through creative tasks. A number of studies come to advocate that promoting creativity can lead to improvements in speaking skills in various educational contexts. By synthesizing creativity with practical speaking activities, the teacher can help students develop their speaking skills in engaging, enjoyable and efficient ways. This article gives a brief overview of speaking as a skill that combines a number of abilities, and offers an insight into contextual and interactional factors. A discussion on the need for communicative approach through creative activities will follow, flavored with suggestions of several classroom tasks, including rap songs, storytelling and argumentation/persuasion exercises. Hence, by incorporating these ideas and activities, the teacher can create a dynamic learning environment that boosts EFL speaking skills in students, assisting them in gaining confidence and fluency in real-life communication.

Keywords: speaking skills, creative activities, communicative approach, EFL learners

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Introduction

No secret will be revealed if stated that the productive skill of speaking is quite challenging since it combines aural comprehension with oral output thus creating a process which, in its turn, promotes marriage between contextual and interactional factors. To put it simply, speaking is a process during which a constant decoding and encoding of information is taking place. If in writing, another productive skill, the writer has time to think about how they can best perform the skill, speaking does not give the speaker the luxury of thinking long. In the classroom, the fear of making mistakes can simply shut down any incentive of speaking. That is why, in order to make the classroom a dynamic environment where learners would feel safe and confident, the teacher needs to understand what problems students have and how these challenges could be addressed.

We often speak about engaging learners in enjoyable and efficient activities. But the simple truth is there is no recipe that would make an activity engaging for everyone. So, what is engagement, first of all? In educational research, student engagement is described as action, energy, active participation, effort, and emotional responsiveness (e.g., Christenson et al., 2012; Reeve, 2012; Skinner et al., 2009). According to Fredricks et al. (2004), the core dimensions of engagement are behavioral (action), cognitive (thinking), and emotional or affective (feeling). This means that knowledge of these dimensions and how they interact with one another can help teachers to design activities specifically for their groups. It also means that students learn better if they are involved in meaningful activities that require thinking and analyzing. In addition, a positive impact on learning is observed if an emotional connection can be built between the learner and the target activity. For example, students can read information in a banner that announces details of an upcoming concert of their beloved band, and discuss how and when they are going to obtain tickets, online or from a box office. In this simple activity, all the dimensions of engagement mentioned above are present.

In addition, a concept that is quite new, task engagement, has emerged. In task performance, behavioral engagement is defined in terms of active participation or time spent on task (Philip & Duchesne, 2016). Gladwell (2011), in his book Outliers: the story of success, claims that the time one spends on a task plays a crucial role in success, and he promotes his 10,000 hour-rule. Bonwell and Eisen (1991), define active learning as something that involves students in both doing things and thinking about their actions. As it can be seen, active learning does not merely mean being visibly active. It means doing something and, most importantly, reflecting on it. It is a reciprocal process where cognition and demonstration combine to reinforce key learning points. Eventually, active learning fosters learner engagement, interaction, and deeper understanding.

This article aims to discuss several activities (namely, developing creativity through rap songs, debate-oriented activities and storytelling) that help materialize the concepts briefly addressed above, and come to prove that high results in language learning can be achieved if teachers promote collaborative and interactive learning and employ behavioral, cognitive, and emotional dimensions in active learning to reach engagement.

How to Bridge Engagement and Communicative Activities

One of the activities that seems to echo the requirements of engagement is rap songs. In his Flow: the psychology of optimal experience, Csikszentmihalyi (1990) mentions that when the level of the challenge and the level of the skill of the student are similar, then flow can emerge.

He describes flow as an optimal experience which gives a person "a sense that one's skills are adequate to cope with the challenges at hand, in a goal-directed, rule-bound action system that provides clear clues as to how well one is performing" (p. 71). In such cases, people do not think about anything else that may be irrelevant to the task at hand. Instead, they find that experience gratifying, just doing it for its own sake. The rap song activity can certainly claim its place among such experiences.

In this activity, each student gets a slip of paper with three unrelated words. They are given only a few seconds to think and create a rap song using all the three words. For example, a student gets a slip of paper with the following words: elephant, purse, ice-cream. They have only 10–15 seconds to think and come up with a rhythmic verse. The choice of the words depends on the level of a given group.

> For Example:
> An elephant stole, it stole my mother's purse.
> My mother's purse was gone.
> And the ice cream dream was gone.

Many scholars, such as Chesley (2011), Fink (2017), or Lestari (2020) believe that this activity can serve as a good vocabulary revision task. It can also be used to help learners develop their pronunciation, as well as their writing and listening skills.

Building on the engaging, communicative and cognitive benefits discussed above, the approach outlined below places particular emphasis on developing persuasive skills. Activities such as "Kick or Keep It" or "Debate Corner" enhance meaningful language application via the implementation of speaking, listening and discourse skills with high-level cognitive processes, namely collaborative argumentation, decision making and critical thinking. Research in communicative and task-based language teaching suggests that discussion- and debate-oriented activities provide learners with opportunities for purposeful language use, since students need to articulate positions, express viewpoints and respond to alternative perspectives through sustained communication (Ellis, 2003; Nunan, 2004). From a sociocultural angle, such dialogic interaction encourages building shared knowledge as well as cultivating linguistic competence and cognitive skills (Mercer, 2000; Swain, 2005). More than that, the analytical and persuasive nature of debate tasks promotes emotional engagement by inviting learners to present their perspectives and contribute to the outcome of interaction, thus fostering motivation and involvement.

For the "Keep It or Kick It" activity, students are divided into groups of three to four. Each group is provided with a set of cards featuring modern trends and habits (e.g. fast fashion shopping, using AI tools for homework, influencer culture and so on), along with two labeled boxes – "Keep It" or "Kick It". Each student selects one card and is given approximately two minutes to prepare a brief justification for their decision whether to retain or to discard the trend. They are encouraged to use expressions showing agreement/disagreement, strong adjectives and intensifiers. Depending on the purpose of the lesson, the student level and interests, the teacher may provide helpful language in advance. Students take turns reading their statement aloud, placing it in the corresponding box and expressing their opinion. While they express themselves verbally, the other classmates listen carefully. They can agree, disagree, ask follow up questions and vote on the most compelling arguments, thus enhancing active involvement/participation and critical analysis. Students then proceed to the next round

of the activity, and repeat the process for as long as the teacher and students consider it beneficial to the learning process.

Optionally, the teacher can organize it as a series of mini debates. She divides the whole class into two parties: one party argues for keeping the trend, the other side advocates for kicking it. The duration of the activity and the number of trends to discuss may be adjusted in accordance with the lesson's objectives, instructional structure and the level of student engagement. When the two parties present their viewpoints, the group votes on the most convincing argument. Some samples of contemporary trends and habits to include on the cards can be found below (Teacher-created prompts, 2026):

- Wearing only designer/ branded clothing: style and confidence boost or unnecessary pressure to look expensive?
- Digital detox weekends: does taking a break from screens actually make life better?
- Fast fashion shopping: cheap and trendy or harmful and wasteful?
- Using AI tools for homework: smart support or lazy shortcut?
- Sustainable lifestyle (recycling, reusing, thrifting): saving the planet or just a trend?
- Influencer culture: inspiring creativity or boosting unrealistic lifestyle?
- Reading books on tablets instead of print: eco-friendly convenience or losing the magic of paper?
- Extreme multitasking: productivity boost or brain overload?
- Minimalist lifestyle: living with less happiness or simply fewer possessions?

Leaning on the discussion of persuasive skills, another activity known as "Debate Corner" can be implemented to reinforce these competences. The teacher prepares a set of debatable statements and labels four corners of the room as "strongly agree", "agree", "disagree" and "strongly disagree". She then reads a statement (e.g. "Smartphones should be banned at school") and students move to a corner that represents their position of agreement. While standing in the corner, students are expected to explain their choice by providing sound argumentation and using persuasive language.

Both activities discussed above serve as powerful active-learning tools that contribute to sustainable practice, enhance meaningful engagement across multiple dimensions, and foster communicative competence, thoughtful reflection and effective persuasion.

Following persuasion-based activities, a storytelling task is introduced to shift students from argumentative discourse to narrative meaning-making. Storytelling has long played a vital role in human communication and learning, thus serving as a powerful tool with the help of which knowledge, values, beliefs and language are transmitted from one generation to another. In educational context, storytelling is broadly acknowledged as a productive pedagogical means that enhances cognitive engagement, linguistic development and student motivation. Bruner (1986) claims that narrative is a central mode of cognitive process through which a person organizes and forms meaning, making stories an effective tool for learning. In language pedagogy, narratives offer students authentic and varied input contextualized in familiar and affectively appealing contexts (Krashen, 1985).

From early childhood, exposure to fairy tales is instrumental for the development of listening skills, narrative awareness and creative thinking. As students mature, their interests seamlessly extend to popular children's literature, young readers' books and young adult fiction which offer linguistically accessible and thought-provoking content. Cameron (2001) highlights that stories create a natural bridge between comprehension and production, allowing learners to

acquire language, while remaining focused on meaning rather than just form. Analogously, Wright (1995) argues that storytelling promotes students' engagement, stimulating prediction, interpretation and emotional engagement.

Leaning on this basis, encouraging learners to re-envision a narrative by modifying its plot, character or resolution can serve as an impactful way to apply storytelling in language learning. Through these activities, learners convey receptive involvement to productive language application, promoting creativity, critical thinking and meaning formation. According to Ellis and Brewster (2014), narrative-oriented writing activities foster more profound language acquisition, as they invite students to experiment with narrative form along with presenting their perspectives. Thus, experimenting with well-known narratives can improve learners' language accuracy as well as cultivate their discourse competence and confidence in writing.

One way of introducing storytelling into the language classroom setting is with the help of 'Plot Twist Challenge' activity. For this activity, the teacher selects familiar narratives, and divides students into groups of three to four. Each group receives a well-known fairy tale, reads the short summary of the original story and together they create a brand new and unexpected ending – creative, funny, sad, failing or surprising. Afterwards, students read their resolutions in class and vote for the best ending. Depending on the purpose and the audience, the implementation of the following narratives could be considered:

- Fairy tales and classic stories: Cinderella, Snow White and the Seven Dwarfs, Beauty and the Beast, Little Red Riding Hood, Sleeping Beauty, The Frog Prince
- Popular Children's/Young Readers' Books: Harry Potter, Alice in Wonderland, The Chronicles of Narnia, Winnie-the-Pooh, Charlie and the Chocolate Factory, Matilde, The Wizard of Oz
- Young Adult/Modern Favorites: The Hunger Games, The Fault in Our Stars, Twilight, The Book Thief

"A Walk through the forest" (New English File Teacher Book, 2008) is another story-building activity that can be efficiently implemented in the language classroom, as it builds on learners' imaginative engagement and collaborative meaning-making. In this activity, students are divided into pairs and are given a worksheet with prepared scenarios and sets of questions. They actively contribute to the ongoing development of the narrative, events, characters, perspectives in a structured sequence. Participants imagine walking through a forest and describe what they see and feel at each stage. Students need to describe each step below focusing on different descriptive features in detail. For example:

- Forest – sensory impressions and emotions
- House – details of a home and its atmosphere
- Bear – emotional reactions and decisions
- Garden – personal space and symbolism
- Wall – boundaries and the unknown

After completing all the stages, students' descriptions are interpreted symbolically (life, self-image, challenges, personal space, the unknown). The task finishes with reflection and discussion. Sharing personal responses is optional and voluntary. Interpretations are exploratory, not diagnostic, as the aim is insight, not judgement.

Each of these activities enhances creative language application, interaction, negotiation of meaning and building narrative cohesion. Hence, engaging with the story-building offers

meaningful opportunities to exercise linguistic forms in context as well as cultivate discourse-level competence and narrative awareness.

Conclusion

The brief discussion of the communicative activities above supports a simple truth that creativity and engagement can contribute to the development of speaking skills in various educational contexts. By combining creativity with practical speaking activities, the teacher can help students enhance their speaking skills in engaging, enjoyable and effective ways.

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Exploring the Impact of Cultural Context in Management Education: A Pre- and Post-course Assessment

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Abstract

In today's interconnected world, cultural agility is essential for effective cross-border collaboration. This study explores the role of experiential learning in developing cultural agility through the X-Culture Global Collaboration Project, which was run as a credited course for MBA participants. Participants engaged in global virtual teams to solve business challenges, promoting intercultural cooperation and enhancing key competencies. A pre- and post-project survey was conducted among over 100 participants to measure changes in cultural agility across dimensions such as tolerance for ambiguity, cultural curiosity, perspective-taking, and relationship-building. Findings indicate a significant improvement in overall cultural agility, with notable growth in cultural curiosity, perspective-taking, resilience, relationship-building, and communication styles (direct/indirect and task/relationship orientation). Additionally, participants demonstrated a shift towards collectivist tendencies and a more adaptable approach to time perception, reflecting increased flexibility in cross-cultural settings. However, aspects such as egalitarianism and cultural humility remained relatively unchanged. This study highlights the impact of immersive, team-based global projects in strengthening cultural agility, particularly in enhancing adaptability, diverse perspective-taking, and relationship-driven collaboration. It contributes to the discourse on experiential learning and global business education, offering insights into how structured international teamwork fosters essential cross-cultural competencies. Future research could examine the long-term effects of such interventions and compare outcomes across diverse participant groups.

Keywords: cultural agility, global virtual teams, experiential learning

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Introduction

Globalization has fundamentally transformed the nature of work, requiring professionals to collaborate across cultural, geographic, and institutional boundaries with increasing frequency. As organizations expand their international footprints and adopt globally distributed work structures, the ability to function effectively across diverse cultural contexts has become a core managerial competency. Cultural agility—defined as the capacity to adapt behavior, communication, and decision-making to different cultural environments—has therefore gained prominence in both academic research and management practice (Caligiuri, 2012).

For management graduates in particular, cultural agility is no longer an optional or peripheral skill. Managers are expected to navigate cultural differences related to communication styles, power distance, time orientation, and relationship norms while maintaining productivity and trust. Traditional classroom-based instruction, however, often struggles to convey the complexity and lived experience of cross-cultural interaction. As a result, business schools and executive education programs have increasingly turned to experiential learning approaches to bridge the gap between theory and practice (Johnson et al., 2020).

This study examines the impact of experiential learning on the development of cultural agility through participation in global virtual teams (GVTs), facilitated by the X-Culture Business Project. By placing students in diverse, international teams and tasking them with solving authentic business problems, the project creates a setting in which cultural differences are not merely discussed but actively encountered and managed. The central objective of this research is to assess whether such an intervention leads to measurable changes in key dimensions of cultural agility, as captured through a pre- and post-course assessment design.

Literature Review

Cultural Agility and Its Importance

Cultural agility refers to an individual's ability to work effectively, respectfully, and productively across cultural boundaries. It encompasses a set of cognitive, behavioral, and emotional capabilities, including openness to difference, adaptability, and sensitivity to cultural norms and values (Bird et al., 2010). Individuals with high cultural agility are better equipped to interpret ambiguous situations, adjust their communication styles, and build trust with culturally diverse counterparts.

Prior research has consistently linked cultural agility and related constructs—such as cultural intelligence—to improved leadership effectiveness and performance in international contexts (Ng et al., 2012). Exposure to diverse cultures, whether through international assignments or structured learning experiences, has been shown to enhance individuals' awareness of their own cultural assumptions while increasing their ability to adopt alternative perspectives. These findings underscore the importance of intentionally designing educational interventions that promote sustained and meaningful intercultural engagement.

Experiential Learning in Global Business Education

Experiential learning theory, as articulated by Kolb (1984), emphasizes learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. Within the context of global business education, experiential learning

methods enable participants to engage directly with complex, uncertain, and socially embedded problems. Rather than passively absorbing knowledge, learners actively construct understanding through interaction and reflection.

Research suggests that experiential approaches—such as international projects, simulations, and cross-border collaborations—are particularly effective in fostering intercultural competence (Rehg et al., 2012). These methods allow participants to confront real tensions arising from cultural differences, including misaligned expectations, communication breakdowns, and conflicting work norms. Importantly, such challenges serve as catalysts for learning when supported by appropriate structure and feedback. Virtual team collaborations have been particularly effective in developing cultural competencies (Taras et al., 2021).

Global Virtual Teams (GVTs) and Cross-Cultural Collaboration

Global virtual teams consist of members from different countries and cultural backgrounds who collaborate primarily through digital communication technologies. While GVTs offer flexibility and access to diverse talent, they also present unique challenges related to coordination, trust-building, and communication (Hajro, 2020). Differences in language proficiency, time zones, and cultural norms can complicate collaboration, particularly in the absence of face-to-face interaction.

Despite these challenges, GVTs provide rich opportunities for developing cross-cultural competencies. Prior studies indicate that participation in virtual international teams enhances skills such as perspective-taking, intercultural communication, and relationship-building (Gibson & Gibbs, 2014). As such, GVT-based projects represent a promising pedagogical tool for preparing students to operate in contemporary global work environments.

Methods

Participants

The study involved over 100 participants enrolled in a management course that integrated the X-Culture Business Project as a core component. Participants were drawn from multiple universities across different countries and were assigned to culturally diverse global virtual teams. Each team collaborated over an eight-week period to address a comprehensive business challenge.

Data Collection

To assess changes in cultural agility, a structured survey instrument was administered at two points in time: prior to the commencement of the project and upon its completion. The survey included 14 items designed to capture multiple dimensions of cultural agility, including cultural curiosity, tolerance for ambiguity, perspective-taking, resilience, relationship orientation, and communication style preferences.

Data Analysis

Paired sample t-tests were conducted to compare pre- and post-course mean scores across each cultural agility dimension. Statistical significance was evaluated using conventional thresholds

($p < 0.05$). This approach allowed for the identification of dimensions in which meaningful changes occurred following participation in the experiential learning intervention.

Data Analysis

The results indicate statistically significant improvements in multiple dimensions of cultural agility. Key findings include:

- **Overall Cultural Agility**: Mean increased from 6.88 (pre) to 7.69 (post), $p < 0.001$.
- **Cultural Curiosity**: Increased from 5.22 to 7.32, $p < 0.001$.
- **Perspective-Taking**: Increased from 6.46 to 8.14, $p < 0.001$.
- **Resilience**: Increased from 6.35 to 7.09, $p < 0.01$.
- **Relationship-Building**: Increased from 6.36 to 7.36, $p < 0.001$.
- **Communication Styles**: Improvements were observed in indirect-direct communication ($p < 0.01$) and task-relationship orientation ($p < 0.01$). These findings confirm that experiential learning in GVTs significantly enhances cultural agility.

Discussion

Implications for Business Education

The findings reinforce the pedagogical value of experiential learning in management education. By embedding students in authentic global collaboration contexts, educators can facilitate the development of cultural competencies that are difficult to cultivate through traditional lecture-based methods alone. Integrating GVT projects into curricula may therefore better prepare students for the realities of globalized work environments.

Challenges and Considerations

While the X-Culture Business Project offers a structured platform for intercultural learning, it also presents challenges. Time zone differences, digital communication constraints, and cultural misunderstandings can create friction within teams. Addressing these challenges through facilitation, reflection exercises, and instructional support may further enhance learning outcomes.

Conclusion

This study demonstrates that experiential learning through global virtual teams can significantly enhance cultural agility among management students. By providing empirical evidence of measurable changes in key cultural competencies, the research supports the integration of cross-cultural virtual projects in business education. Future research could explore the long-term persistence of these effects and examine variations across different participant populations and instructional designs.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Chat-GPT tool was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Chat-GPT, no other AI or AI-assisted technologies have been used to generate content in

writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Becoming a Chemistry Teacher in the Age of AI: Pedagogical Encounters From School-Based Teaching Practice

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Abstract

The integration of artificial intelligence (AI) in pre-service teacher education is increasingly relevant in response to the growing complexity of technology-based learning environments. Understanding student perceptions is crucial for determining how AI can be meaningfully adopted in school learning practices, particularly regarding its usefulness, ease of use, and level of trust in the technology. However, empirical studies examining pre-service teachers' experiences with AI during school-based teaching practice remain limited. This study investigated the experiences of pre-service chemistry teacher students in using AI as part of their learning preparation in the school settings. A mixed-methods design was employed, involving final-semester students from the Chemistry Education Study Program at the University of Lambung Mangkurat, Indonesia (N = 50), who were participating in a teaching practice program at school. Quantitative data were collected through a Technology Acceptance Model (TAM)-based questionnaire supplemented by in-depth interviews. The results indicated that students view AI as a helpful tool for accessing learning resources, developing teaching materials, and generating creative ideas for learning. At the same time, some students remained cautious about trusting the accuracy and scientific reliability of AI-generated information, leading them to rely on verification processes and pedagogical guidance. Furthermore, the majority of students strongly recommended the need for structured training or workshops to support more optimal use of AI in learning. These findings indicated a tension between independent use of AI and the need for pedagogical and institutional support, underscoring the importance of targeted, ethical, and pedagogically grounded integration of AI into the curriculum.

Keywords: artificial intelligence, pre-service chemistry teachers, higher education, teachers' identities

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Introduction

AI in higher education has the potential to provide personalized and tailored learning experiences tailored to student needs, providing real-time feedback, and increasing student engagement (Abbasi et al., 2025; González Campos et al., 2024; Kuka et al., 2022; Orr et al., 2025; Singh & Hiran, 2022). Intelligent tutoring systems and adaptive learning platforms are representative examples of AI that adapt to students' educational content, learning style, and pace (Mupaikwa, 2025; Ratul et al., 2025). In the context of teaching efficiency, teachers can use AI-based assessments to automate various tasks, administration, especially the student assignment grading process, so that lecturers can focus more on supporting students' academic development (González Campos et al., 2024; Gurumayum et al., 2024; Ratul et al., 2025; Téllez et al., 2024). Furthermore, research processes can be conducted more efficiently, such as data collection, analysis, and presentation, as well as writing, editing, and summarizing literature (Dockens & Shelton, 2025; Orr et al., 2025). Therefore, AI development must be based on ethical principles as a form of protection and security to prepare a generation that is sensitive to the digital world (including AI) (Andocilla-Oleas et al., 2025; Wang, 2021).

In chemistry education, AI is significantly transforming the teaching and learning experience. Studies have shown that AI-based adaptive learning systems can help students understand complex chemical concepts more reflectively, including feedback and tailored content (Pullanikkattil et al., 2025; Tanveer et al., 2024). In a virtual context, AI integration can provide a safe and accessible environment for students to conduct experiments and explore chemical reactions without the risks of a physical lab (Pullanikkattil et al., 2025; Tanveer et al., 2024). It is essential, given that the laboratory aspect serves as a hands-on learning experience, allowing students to interact with various levels of representation, such as macroscopic, submicroscopic, and symbolic (Barke et al., 2012; Schwedler & Kaldewey, 2020; Tanveer et al., 2024).

Several studies have also described a variety of innovations that can improve students' skills in AI applications, such as workshops on retrosynthesis and protein structure prediction (Berber et al., 2025), intelligent tutors (Pullanikkattil et al., 2025), Gemini/BERT in assessment processes (Yamtinah et al., 2025), and detectors in exams (Sorenson & Hanson, 2024), as well as helping to design more effective and engaging chemistry lessons (Kadioğlu & Oskay, 2024; Leitea, 2023; Tanveer et al., 2024). Previous studies have identified several limitations regarding students' perceptions of AI in education. Many studies have not adequately examined the long-term impacts of AI use in education, including technical barriers and issues with the quality of the resulting content (Esfijani et al., 2025). This point emphasizes the need for in-depth studies regarding the alignment of AI integration with educational goals and its practical use (Christou, 2024; Esfijani et al., 2025), including ethical considerations of AI integration in education (Dobrovská et al., 2024; Isop, 2024; Lamanauskas & Makarskaitė-Petkevičienė, 2025; Nunez Lemoz et al., 2025).

While numerous studies have explored the potential and impact of AI in education, prior research has focused on students in general in higher education settings. Unlike previous studies, this study involves prospective science teacher students undergoing teaching practice in schools. In addition to the authentic teaching practice context, this study also emphasizes the local educational context in Banjarmasin City, South Kalimantan. This situation provides a more genuine perspective for understanding how AI is perceived in real-life teaching, particularly the alignment of local values, learning culture, and ways of thinking that characterize prospective teachers in this region. Through the field experience program in schools, students use AI technology not only as a learning tool but also to design lessons,

manage student interactions, and assess the effectiveness of AI use in pedagogical and ethical contexts. Therefore, this study offers a unique perspective on how prospective chemistry teachers' AI literacy, pedagogical readiness, and moral awareness are formed through authentic field experiences grounded in local values and culture.

Theoretical Framework

In this study, the Technology Acceptance Model (TAM) served as the primary theoretical foundation for exploring students' perceptions of the use of artificial intelligence (AI) in education. TAM contains two essential factors: “perceived usefulness (PU)” and “perceived ease of use (PEU)” (Davis & Granić, 2024). PU describes the extent to which students believe that the use of AI can improve the effectiveness and efficiency of learning. PEU reflects how easily students feel they can use AI technology without encountering significant obstacles. Research by Musa et al. (2024) found that using the TAM model helps in understanding market responses to digital products. The application of TAM was also used by Phuong Dung et al. (2023) to determine a person's acceptance of the digital world, which influences their intention to start something. PU and PEU are the main elements of TAM and have been consistently shown to influence students' attitudes and behavioral intentions towards technology (Bantoto et al., 2024; Chen et al., 2025; Karan & Chakma, 2025; Runge et al., 2025; Selevičienė & Koloda, 2025; Supriyanto et al., 2024; Zhao et al., 2024).

In a higher education setting, Fan (2023) used TAM to determine how students use social media in their learning. TAM effectively explained student acceptance of AI tools, such as ChatGPT and humanoid robots. Factors such as self-efficacy and perceived enjoyment further strengthened the model's predictive power (Chen et al., 2025; Karan & Chakma, 2025; Selevičienė & Koloda, 2025; Supriyanto et al., 2024; Ursavaş et al., 2025). Studies have found that TAM can guide the integration of AI into the curriculum, ensuring that tools are user-friendly and aligned with student needs and expectations (Bantoto et al., 2024; Selevičienė & Koloda, 2025; Supriyanto et al., 2024). The TAM, which encompasses individual characteristics (novelty-seeking and self-efficacy), provides deeper insights into student acceptance of AI, particularly in terms of perceived usefulness and ease of use (Chen et al., 2025; Ursavaş et al., 2025). Combinations of other models also strengthen and enrich the understanding of AI acceptance by adding factors such as discomfort, insecurity, and perceived behavioral control, including the Technology Readiness Index (TRI) and the Theory of Planned Behavior (TPB) (Zhao et al., 2024).

The TAM helps explore how individuals, including students, perceive and value technology, and how these perceptions and values affect students' attitudes, particularly regarding AI in learning. The diversity of perceptions and acceptance of technology can serve as a strong foundation for teaching, such as integrating AI into assessments, assignments, and references in learning design. By using the TAM, educators and policymakers can design and implement AI tools that meet students' needs and improve academic performance, given that technological literacy is a crucial element for today's generation.

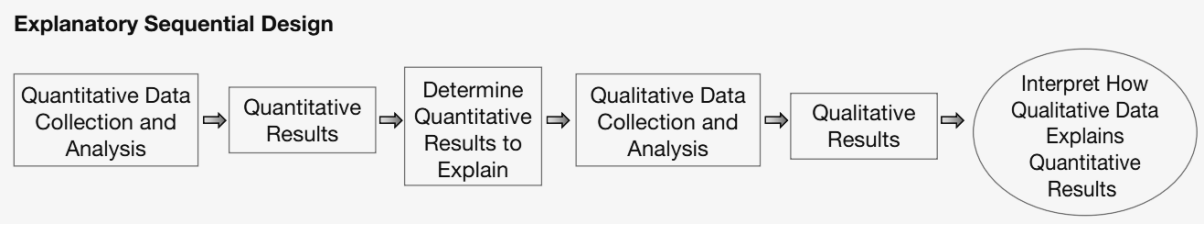
Methodology

Design

This study employed a mixed-methods design to gain a comprehensive understanding of students' perceptions of AI (Creswell & Clark, 2018). Participants were final-semester students

in the Department of Chemistry Education at the University of Lambung Mangkurat, Indonesia, who were undergoing a teaching practicum program at a school. Purposive sampling was used to ensure respondents had direct experience with chemistry content and technology-based courses.

Figure 1
Research Implementation Design (Creswell & Clark, 2018)



Instruments

Data were collected using a questionnaire and semi-structured interviews. The questionnaire consisted of 15 items structured based on the Technology Acceptance Model (TAM) framework, with two main factors: Perceived Usefulness (PU) and Perceived Ease of Use (PEU) (Davis & Granić 2024). In addition, a review of previous research on integration in education was conducted to strengthen the development of relevant indicators, such as alignment of AI with curriculum objectives, teacher readiness, assessment strategies, access challenges, adaptability, ethical challenges, and various concerns in using AI (Abidine et al., 2025; Almasri 2024; Guha et al., 2025; Kasat et al., 2025; Kohnke & Green-Eneix, 2025; Ramesh, 2025). The results of this review were then elaborated into several additional operational indicators that support the adopted definition of the TAM concept, particularly the perception component. PU was described as understanding complex chemical concepts with the help of AI, supporting learning motivation, and encouraging creativity in the design of learning experiences. At the same time, PEU included readiness to use AI, trust in the accuracy of sources, and the need for additional training.

The elaboration was then formulated as questionnaire items using a Likert scale. The questionnaire was then consulted and discussed with experts in educational psychology, chemistry education, and educational research and evaluation. The expert input was used to refine the instrument before use in data collection. The questionnaire underwent content validation by experts in chemistry education, educational research and evaluation, and Indonesian language and literature education to ensure clarity, relevance, and alignment with the study's objectives. Content validation included format, language, content, and sustainability values. Interviews were conducted using open-ended questions to explore students' opinions and experiences in greater depth, thereby strengthening the data obtained.

Data Collection and Analysis Procedures

Several stages were carried out in the study: (1) formulating the study objectives, (2) developing a Likert-based questionnaire, (3) developing an interview guide, (4) validating the questionnaire, and (5) distributing the instrument and collecting data. Quantitative data were analyzed using descriptive statistics, expressed as percentages, to provide an overview of student perceptions. Qualitative data from interviews were analyzed using thematic analysis to identify key themes related to the benefits, challenges, and recommendations for using AI.

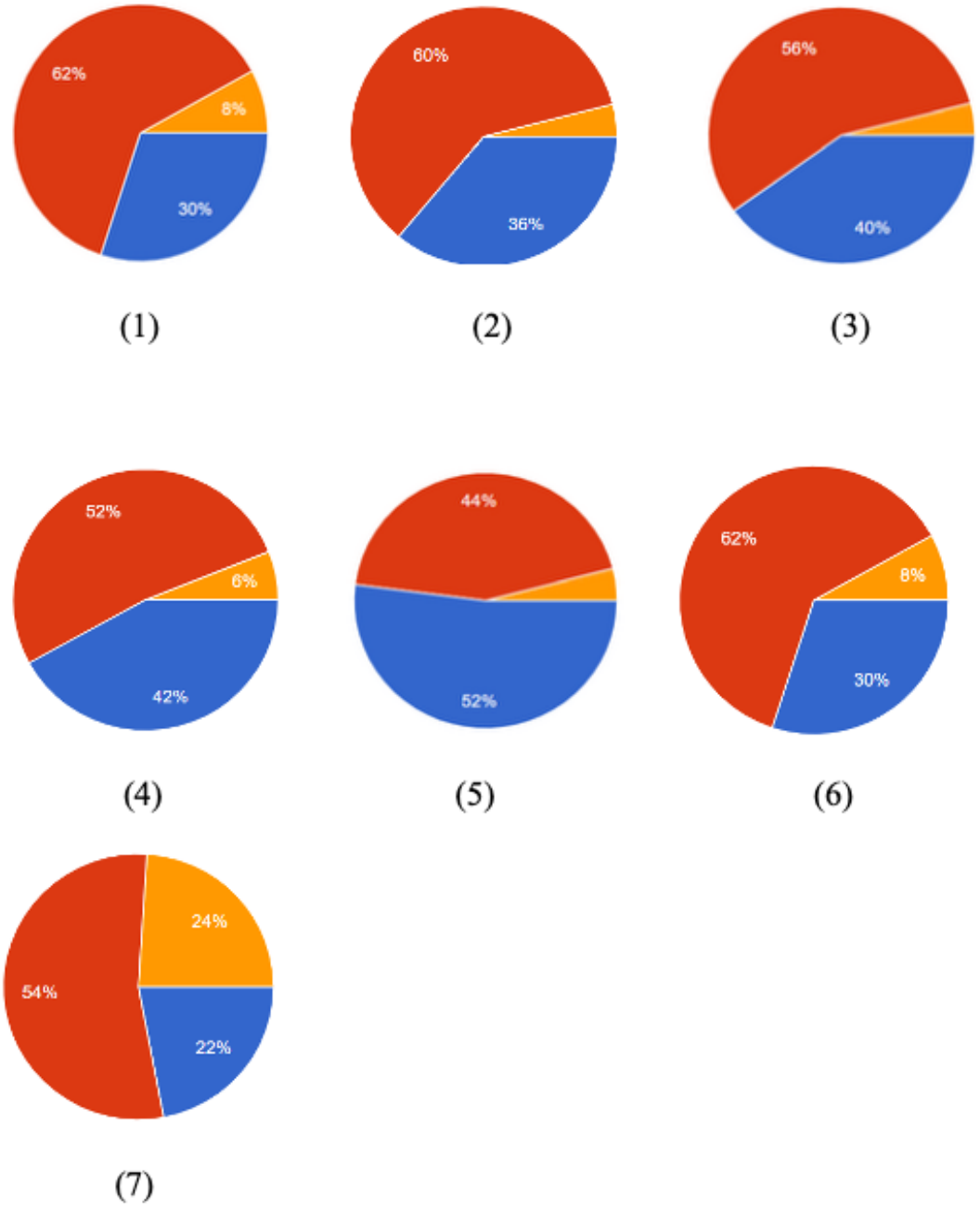
Triangulation between quantitative and qualitative data was conducted to strengthen the validity of the study's findings.

Research validity was assessed using the Content Validity Index (CVI) (Yusoff, 2019). Lynn (1986) recommended a minimum of three experts, with a neutral 4-point ordinal scale. In the assessment, scores 3 and 4 are coded as "1," while scores 1–2 are coded as "0" (Ozair et al., 2017). Items are considered valid if all validity indices are > 0.80, especially I-CVI (item-level content validity index = agreed item/number of experts), S-CVI/Ave (scale-level content validity index based on the average method), and S-CVI/UA (scale-level content validity index based on the universal agreement method) (Lau et al., 2018; Ozair et al., 2017; Yusoff, 2019).

Results

Before interpreting the study's findings, the instrument's quality must be confirmed for accuracy or validity. The content validity of the Technology Acceptance Model (TAM)-based instrument was determined through expert judgment with a Content Validity Index (CVI) involving experts. The results showed that most items had an I-CVI ≥ 0.75, with an S–CVI/Ave of 0.98 and an S-CVI/UA of 0.95. These data indicate a very high level of expert agreement on the relevance and clarity of the instrument items. This finding confirms that the instrument has adequately represented the construct being measured. Furthermore, the reliability test used Cronbach's Alpha, yielding a value of 0.874, indicating high internal consistency. Thus, the instrument is declared valid and reliable, making it suitable as a basis for interpreting students' perceptions of Perceived Usefulness and Perceived Ease of Use within the TAM framework.

Figure 2
Analysis Results for the "Perceived Usefulness (PU)" Factor for Items 1 – 6. Color Information: Blue (Strongly Agree), Red (Agree), Orange (Less Agree), and Green (Disagree)*



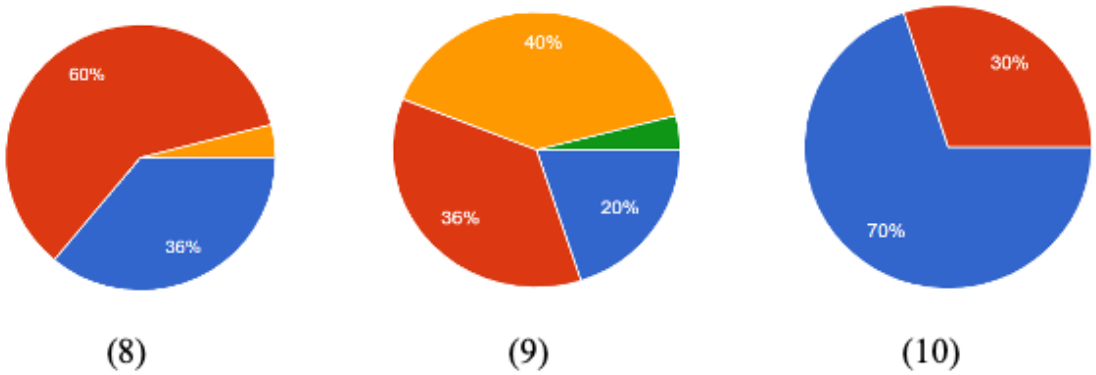
The items:

1. The use of AI technology helps me understand complex chemical concepts
2. I feel helped in preparing chemistry learning activities using AI technology
3. Using AI technology is part of a learning strategy to obtain interesting learning presentation references
4. AI technology can increase my motivation to study chemistry material as a prospective teacher

5. AI technology helps me design more creative learning experiences for students in the future
6. I feel that AI technology helps me develop problem-solving skills and digital literacy needed in the 21st century
7. I can learn chemistry independently and exploratively by using only AI technology

Figure 3

Analysis Results for the "Perceived Ease of Use (PEU)" Factor, for Items 8 – 10. Color Information: Blue (Strongly Agree), Red (Agree), Orange (Less Agree), and Green (Disagree).*



The items:

8. I am very ready as a prospective teacher to use AI technology in chemistry learning
9. I believe that the information provided by AI technology is accurate, scientific, and reliable
10. There is a need for more training and workshops on the use of AI technology to optimize its application in learning.

Table 1

Results of Student Interviews Regarding Their Perceptions of the Use of AI

Themes	Respondents' Statements	Participants
Benefits of using AI	AI technology is invaluable in the learning process/designing learning activities.	Participant-8
	AI Technology indeed makes it easier for users to find learning resources	Participant-9
	Utilize AI for creative projects and train teachers to use it in teaching	Participant-10
	AI helps teachers and students understand lessons more easily, for example, by assisting them in finding references.	Participant-12
Accuracy of Information	The AI often used is still inaccurate when searching for references, requiring repeated attempts.	Participant-1
	Not all results generated by AI can be trusted 100%, especially in science teaching.	Participant-5
	AI can be a learning resource, but it needs to be supported by other reliable sources.	Participant-3
	AI technology is invaluable, but its drawbacks are inaccuracy and being subscription-based	Participant-4

Need for development	I recommend AI to provide interactive simulations for virtual experiments	Participant-11
	Seminars or training on using AI in chemistry learning are needed	Participant-13
	AI for 3D visualization or augmented reality helps students better understand abstract concepts.	Participant-14
	The integration of AI into courses and workshops on its use in chemistry learning is essential.	Participant-15
Limitations of AI	Although AI is helpful, its output still needs to be filtered further	Participant-2
	There is one thing AI lacks: the human sense of reasoning, feeling, and empathy.	Participant-6
	It is hoped that AI has restrictions to prevent misuse by students	Participant-7

Discussion

The findings indicate a strong consensus that prospective chemistry teacher students consider AI to be invaluable in the academic process and teaching practice, from understanding complex chemical concepts, designing lessons, enriching references and creativity, and sparking learning motivation (a prominent dimension of Perceived Usefulness (PU). However, on the Perceived Ease of Use (PEU) dimension, trust in the accuracy and scientific nature of AI information remains fragile, so practical use is almost always accompanied by verification and guidance from lecturers. The results also found that although students feel ready and are already actively using AI, they also highly recommend training/workshops related to AI or AI integration. It indicates a gap between attitudinal readiness and pedagogically verifiable competencies, as reflected in the widespread demand for AI training in higher education. Thus, students position AI not simply as a substitute for teachers but as a pedagogical collaborator that requires verification protocols, ethical literacy, and institutional support, so that perceived benefits are directly proportional to the reliability of classroom practice. Beneath this consensus, a subtle gap emerges between the benefits and accuracy of AI output.

Confidence-Competence Gap: I Can Use It, but I Need Structural Instructions

The “can already” but “requires teaching” finding is a fascinating finding from the analysis. Students appear adept at operating AI in practical teaching tasks, yet they simultaneously highly recommend AI-related training/workshops. This phenomenon is not a contradiction but rather a sign of a “confidence-competence gap,” namely, the gap between declarative readiness and pedagogically verifiable skills. In the analysis, item 8 shows that approximately 60% of students stated they were ready to use AI in chemistry lesson design, indicating high confidence. However, this result contradicts the interview findings, in which students emphasized the need for seminars or specific training on AI integration (student 13), and around 50% of students stated they truly believed the information provided by AI was accurate, scientific, and reliable (item 9).

From the Technology Acceptance Model (TAM) perspective. High perceived usefulness (PU) (clear benefits) helps students prepare for learning, enhance creativity, and understand complex chemistry concepts through AI. However, perceived ease of use (PEU) is hampered by trust (still doubts) regarding the accuracy of AI information and how to moderate content for pedagogical validity. It indicates that students' skills remain technical-operational, such as the

ability to execute basic commands and generate AI output, but have not yet fully addressed the critical, verification, and pedagogical aspects required for teaching.

This picture was reinforced in interviews, where student 8 emphasized that AI was very helpful in designing learning activities, but student 6 reminded them that "AI is not human," and therefore lacks intuition, empathy, or contextual judgment. In other words, even though students can operate it well, they still require expert validation and guidance to ensure its valid use in the context of chemistry learning. In this context, what students are looking for is no longer how to turn on AI, but rather how to use it appropriately. The appropriate use of AI can not only boost student confidence but also strengthen the pedagogical competencies essential for future teachers. This confidence, coupled with competence, is necessary for students to become not only AI users but also educators who can use AI effectively and integrate it into chemistry learning.

Therefore, training is perceived as a "bridge" to transform operational skills into valid scientific-pedagogical skills or validated AI-based teaching competencies. For example, training materials can cover chemistry-domain prompting techniques, scientific verification (data sources, calculations, and conceptual coherence), academic ethics, the type of AI technology used, and formats for designing learning, including assessments. Therefore, students desire standardized, clear, and structured AI practices to produce outputs free of conceptual bias or blind dependence. Standardized AI integration has the potential to provide a safe environment for exploration in learning (Pullanikkattil et al., 2025; Tanveer et al., 2024). Appropriate exploration can yield insights that support the construction of scientific structures and mental models for prospective chemistry teachers, particularly understanding at various levels of representation (Barke et al., 2012; Schwedler & Kaldewey, 2020; Tanveer et al., 2024; van Berkel et al., 2009).

These findings reinforce the results of previous studies that emphasized the development of an "ethical framework" to guide the integration of AI in education (Dobrovská et al., 2024; Isop, 2024; Lamanauskas & Makarskaitė-Petkevičienė, 2025; Nunez Lemoz et al., 2025). Furthermore, other studies have highlighted that limited resources and a lack of teacher training are key barriers that must be addressed immediately for more effective AI utilization (Reyes-Villalba et al., 2024). The absence of a detailed ethical framework can lead students to use AI haphazardly, resulting in a lack of confidence that is not balanced by critical competency. In the context of chemistry education, this situation is crucial, given that even minor errors in concept verification can lead to representational bias at various levels (macroscopic, submicroscopic, and symbolic).

Agency vs Dependency

"Agency" is evident when students position AI as a pedagogical partner that strengthens creativity and independent learning. Approximately 96% of respondents stated that AI can help design more creative learning and stimulate accelerated work in searching for references, completing assignments, and developing learning strategies (item 5). In item 6, AI is considered to support 21st-century problem-solving and digital literacy skills (approximately 92%). Interviews corroborated these findings, with students 8 and 9 emphasizing the role of AI in designing learning scenarios and facilitating the search for learning resources, while students 10 and 15 considered AI relevant in developing various creative projects and recommending training courses. Students 11 and 14 even emphasized the need to develop interactive simulations and 3D visualizations powered by AI to better understand chemistry concepts. It

demonstrates that many students are not simply passive users of AI but are using it reflectively and innovatively to strengthen their pedagogical identity.

Conversely, students' tendency to be passive and to rely heavily on AI-generated output without a critical approach gives rise to “dependency.” Approximately 54% of respondents (item 7) agreed that they could learn chemistry using AI, indicating a high potential for dependence on AI as a primary learning resource. Furthermore, although only 20% of students (item 9) agreed that AI provides accurate information, interviews revealed that students still rely on AI results despite doubting their reliability. Students 1 and 5 stated that AI-generated information is often inaccurate and requires repeated verification. Students 3 and 4 considered AI a viable primary reference, though not always optimal and usually limited to premium features. Student 6 even acknowledged the lack of human sense, suggesting that AI lacks the elements of reason, feeling, and heart that characterize the human race. Therefore, guidance and direction are still needed to ensure its relevance and ethical use. These findings demonstrate an ambivalent stance among students: AI is invaluable for technical and creative tasks, but its presence creates a sense of dependency because of its limitations in conveying the human dimension.

This dialectic can be further understood within the Technology Acceptance Model (TAM). High perceived usefulness (PU) indicates student agency in using AI for learning, but a less-than-fully achieved perceived ease of use (PEU) suggests a sense of dependency due to concerns about accuracy, ethics, and security. In other words, while AI offers numerous pedagogical benefits, it also poses serious challenges, such as potential job replacement, ethical issues, data privacy, and security concerns (Salgado-Reyes et al., 2024; Shafik, 2024). These findings also support studies that argue that AI should be developed with ethical principles to protect and secure, preparing a generation of teachers who are sensitive to digitalization and equipped with skills that are adaptive to the times and sustainable (Andocilla-Oleas et al., 2025; Wang, 2021).

Thus, agency and dependency go hand in hand in student experiences using AI. Students demonstrate agency by using AI to support their creative learning design and develop problem-solving skills. This situation also reflects the dependence on AI, despite lingering doubts about its accuracy. This dialectic emphasizes that AI is not a substitute for teachers but rather a pedagogical collaborator that requires training, mentoring, guidance, and ethical development for optimal implementation in chemistry education.

Chemical Representation and the Need for Visualization and Simulation

In the Perceived Usefulness (PU) dimension, the majority of students agreed with items 4–6, with each item scoring above 90% (strongly agree and agree combined). These items demonstrate strong support for the need for interactive media to address chemical abstraction during the learning process. Conversely, with item 7, the percentage of students who disagreed was < 25%. This item demonstrates students' limitations when AI lacks adequate simulation- or visualization-based learning tools. Furthermore, item 10 (part of the PEU) showed 100% support for the need for training/workshops. It strongly indicates the urgent need for technical training in AI use across various learning needs, including visualization.

These findings confirm that students themselves proposed the need to integrate AI with various simulation-based features, demonstrating their awareness that using AI is not limited to text or automated answers, but must be grounded in evidence-based pedagogy through virtual experiments. In chemistry education, implementing various representation-based solutions

(macroscopic, submicroscopic, and symbolic) is a significant challenge. In fact, representation-based understanding is a key element that students need to internalize to easily build scientific structures and mental models, especially at the submicroscopic level (Barke et al., 2012; Cheng & Gilbert, 2009; Gkitzia et al., 2020; Wisudawati et al., 2022). Therefore, virtual lab simulations, reaction mechanism animations, or 3D or Augmented Reality (AR) visualizations are highly relevant as bridges to understanding.

Although perceived ease of use (PEU) is still limited to trust and accuracy, especially in the context of using AI without visual evidence or lab simulations (low support for item 7 and doubt for item 9), students' perceptions are considered to view AI as highly supportive of various components in designing chemistry learning, including the implementation of multi-representation in chemistry learning (seen from the high perceived usefulness in items 4-6). This finding is in line with previous studies related to innovations that can improve students' skills in using AI applications, such as intelligent tutors (Pullanikkattil et al., 2025), assessment processes (Yamtinah et al., 2025), detectors in exams (Sorenson & Hanson, 2024), and chemistry learning design (Kadioğlu & Oskay, 2024; Leitea, 2023; Tanveer et al., 2024). By integrating AI through visualization or interactive simulations, students can engage in meaningful learning while improving their mental models. Thus, students' learning needs for simulation visualization indicate that AI in chemistry education is most effective when positioned as representational scaffolding, an evidence-based tool that bridges the complexities of chemical abstraction while remaining evidence-based.

Structural Barriers

A relatively high score for perceived usefulness (PU) was obtained for items 4–6, with support > 90%. However, barriers to premium access and the absence of institutional guidelines can weaken the Perceived Ease of Use (PEU) dimension. In other words, the reluctance of some students in item 9 indicates that “trust” in AI's accuracy has not yet been fully achieved. This finding is relevant to previous studies that emphasize the need for regulation and institutional support in the integration of AI in higher education (Dobrovská et al., 2024; Isop, 2024; Lamanauskas & Makarskaitė-Petkevičienė, 2025; Nunez Lemoz et al., 2025). Without institutional intervention, the potential for inequality in AI utilization could arise, namely, for technically sound but ethically vulnerable and unsustainable uses. A standardized institutional framework can prevent over-reliance on AI, which can negatively impact students' cognitive development (Christou, 2024; Del Mundo et al., 2024; Esfijani et al., 2025; Vieriu & Petrea, 2025). This intervention is also highly beneficial for students in preparing for the workforce, given the significant gap between industry and higher education: only 3% of employers rate higher education as capable of preparing graduates for the AI era (AI in the Workplace 2025, 2025).

Student 4 stated that AI can only be optimally utilized through paid subscription AI. Paid AI has more comprehensive features. These factors explain why some students rated the use of AI technology in the “less agree” or “disagree” category (as seen in item 9, where only 4% of students disagreed). The gap in access between the free and premium versions widens the “trust” gap, as many students feel the information generated by premium AI is more accurate, scientific, and reliable than that of free AI. On the other hand, some lecturers allow the use of AI, but only as a “tool” or learning aid without clear boundaries for its use. This tolerance is not accompanied by institutional support in the form of a premium AI platform license and explicit ethical guidelines for use, leaving students in an ambiguous position between permissibility, limited access, and the absence of clear ethical guidelines. Studies indicate that

around 71% of students want to be involved in decision-making regarding AI integration, especially in determining what kind of AI should be used in their educational process (The Digital Education Council Global AI Student Survey, 2024).

These barriers are not only technical and economic, but also stem from inadequate policy structures. Students view the importance of institutional support, such as providing campus licenses (premium access to AI tools), AI ethics policies in the classroom (guidelines for AI use in the school, limits on plagiarism, scientific verification, and human oversight as ethical standards), curricular integration of AI (incorporating digital literacy and AI ethics across courses), and regular training/workshops, as essential prerequisites for more accurate, ethical, and sustainable AI practices. This perspective highlights the importance of institutional scaffolding that can offset individual limitations, supporting students not only in AI's operational capabilities but also in a supportive educational ecosystem. This finding aligns with a survey that found that approximately 72% of students expect universities to offer numerous courses on AI literacy, training, and the potential for errors (inherent bias/AI hallucinations) resulting from AI use (The Digital Education Council Global AI Student Survey, 2024).

Limitations

Despite numerous findings in the field, several limitations must be considered. First, the sample was limited to chemistry education students at one university, so these findings cannot be generalized to other contexts, including all study programs at the same institution or other universities. Second, the questionnaire was developed using the TAM framework and validated through expert justification, but the items have not been further tested using factor analysis. Third, the interviews did not cover the entire sample, so the diversity of experiences was not fully explored. Fourth, the context of AI use remains predominantly text-based, while the unique needs of chemistry have not been studied in depth, such as virtual labs and visualizations at various levels of representation. This limitation is compounded by the availability of free and premium AI access, which has led to varying perceptions of the accuracy and reliability of AI-generated information.

Recommendations

Given these limitations, a larger sample from multiple universities and across disciplines is highly recommended to obtain a more comprehensive picture of perceptions. Furthermore, it is necessary to add additional factors to the instrument and to the factor analysis to capture a more comprehensive picture of technology acceptance. From a practical perspective, institutions need to provide premium AI access for students, develop ethical guidelines for AI use in chemistry classes, and integrate AI literacy and ethics into curriculum development or ongoing curricula, particularly practice-based courses. Furthermore, organizing workshops or training sessions is a crucial recommendation, particularly those emphasizing verification skills, pedagogical integration, and the use of AI for multi-representational visualization in chemistry. It can build students' confidence and competence in using AI effectively and ethically.

Although this study used the Technology Acceptance Model (TAM) as the primary theoretical framework to understand students' perceptions through the PU and PEU dimensions, the qualitative analysis revealed additional dynamics beyond the TAM's core variables. Findings such as agency, dependency, trust fragility, the confidence-competence gap, structural barriers, and representational needs in chemistry learning demonstrate that students' experiences with

AI are far more complex than the TAM model predicts. Thus, while the TAM serves as a preliminary structure, these emergent findings enrich understanding and provide new theoretical contributions in explaining how students actually interact with AI in pedagogical contexts.

Conclusion

This study shows that the process of "becoming a chemistry teacher" in the era of artificial intelligence (AI) is characterized by diverse pedagogical encounters among students during their teaching practices in school settings. This process positions AI as a collaborative partner that enriches learning, not a substitute for teachers. Using the technology acceptance model (TAM) framework, students rated AI as having high perceived usefulness (PU) because it helped them understand complex chemistry concepts, stimulated creativity, and increased learning motivation. However, the perceived ease of use (PEU) dimension still faces challenges, including doubts about information accuracy, limited premium access, and the absence of institutional ethical regulations. This situation creates a "confidence-competence gap," where students are confident in operating AI technically but still require expert guidance, training, and institutional support for pedagogically valid use. Thus, students' experiences teaching in schools using AI not only expand their technical skills but also shape their pedagogical readiness to integrate technology into chemistry learning in ways that are critical, ethical, and sustainable.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author used artificial intelligence (AI)-assisted technology, such as ChatGPT, in the writing process to assist with language editing, sentence context clarity, and grammar correction. The use of AI was limited to writing and did not generate research data. The substantial content, data analysis, results description, and conclusions were entirely handled by the author.

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Assessment of the Conflict and Conflict Resolution Attitude and Styles: The Case of High School Student Leaders in Angeles City

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Abstract

Conflict resolution techniques used by young people are important for several reasons. The ability to settle conflicts with others, particularly between peers, is one of the most crucial components of a child's or young person's social skills as they grow and progress through the adolescent stage. This descriptive quantitative study assessed the conflict and conflict resolution attitudes and styles of 363 high school student leaders enrolled across nine (9) junior high schools currently enrolled in the Department of Education in Angeles City. Results showed that the respondents, who are mostly female, class officers and grade 10 students believed that there are better ways to solve problems than fighting or physical aggression; they displayed self-control and cooperation. In terms of conflict handling styles, data suggests that respondents utilized all styles, however, problem solving style is significantly preferred. These findings collectively imply that respondents are dedicated to creating a calm, encouraging atmosphere where conflicts are resolved non-violently. Recommendations for further research, to improve conflict resolution programs for young people are discussed.

Keywords: conflict, conflict handling styles, conflict resolution, conflict resolution skills and attitude

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Introduction

In every social setting, conflict inevitably arises. One of the most important aspects of a child's and young person's social skills as they develop and go through the adolescent stage is the ability to resolve interpersonal conflicts, especially confrontations with peers (Daunic et al., 2000; Humphries, 1999; McLaughlin et al., 2013). Contrary to children and young people who employ unconstructive or aggressive techniques of conflict resolution, those who adopt and put into practice constructive ways of resolving problems are more favorably received by their peers (Johnson & Johnson, 1996; Türnüklü et al., 2009).

Children and young people's conflict resolution strategies are crucial for several reasons. In addition to having an impact on peer connections, it also has an impact on how much happiness and satisfaction are felt. Contrary to non-structural conflict resolution, which heightens feelings of discontent and raises the chance of rejection by peers, constructive conflict resolution lowers the intensity of negative emotions and promotes the growth of social and communication skills (Peuraca & Vejmelka, 2015; Stevahn et al., 2002). Additionally, using violent behavior to resolve disagreements has several unfavorable effects, therefore it's critical to promote young people's employment of positive conflict resolution strategies and to prevent the rise of violent behavior in all confrontations (Mason, 2014; Shahmohammadi, 2014).

Conflict in school settings is a major problem for educators and administrators. Arguments, fights, rumors and partner conflicts are the most common conflicts between friends. Schools face the difficult task of helping students resolve conflict nonviolently. The procedure is time-consuming because those who are involved in it may spend a lot of time on it. Teachers' and guidance counselors' engagement frequently required extra time processing the conflict that could have been employed for other academic tasks (Jorbozeh et al., 2014).

This concern brought up the need for improvement in constructive conflict resolution (Adiguzel, 2015; Smith et al., 2002). Today, when conflict resolution skills are crucial for successful communication, evaluating solutions to issues, and coexisting with others with whom one may have disputes, conflict resolution programs teach young adults. Teachers and administrators experience up to a 97% reduction in disciplinary incidences as students take responsibility for their own conflicts and arrive at agreements the majority of which are upheld months later (Thomas, 2008).

The COVID pandemic has also brought attention to the need of giving student mental health and wellbeing more consideration. In the Philippines, the existing inadequate number of guidance counselors especially in public schools may make it difficult to concentrate more on the situations when their time should be used and provided (Chi, 2023; Mangaluz, 2023). Cases involving students that can be considered serious and need careful supervision and guidance may be unintentionally neglected in the desire to cater to all concerns of the students that demand mediation. This situation may cause a silent battle among students who are really in need of help and guidance. The attention of teachers and guidance counselors may take a toll in responding positively in the student situation that calls for serious help. The need for adequate guidance counselors gave teachers extra work as they served as alternative guidance counselors in providing psychosocial support to students (Chi, 2023). This additional function of the teachers adds to their duties and responsibilities that may already drag them down, and as a result the quality of the instructors' academic performance may be compromised.

Solutions to address the growing concern and need of schools who are lacking guidance counselors and teachers who are already burdened with workload have been put in place by the Department of Education (DEPED) like partnering with different organizations, teacher training for counseling students and putting up hotlines in an online platform (Magsambol & Chi, 2020). One of the responses in view of the realization of the need to call for conflict resolution programs (e.g., peer mediation program) in different schools is the need to train student leaders who will serve as other alternative mediators where conflicts within their capacity and training can be resolved. Peer mediation enables students to resolve minor conflicts without adult support (McLean, 2020; Rita et al., 2007). This will also strengthen the essential life-skills of the students in being able to communicate effectively (Avivar-Caceres et al., 2022; Johnson & Johnson, 2005). The fundamental role of peer mediation programs is to teach students peaceful communication and non-violent conflict resolution methods. The success of the peer mediation program will lead to non-violent resolution and a healthy learning environment among students.

Conflict resolution and peace education in schools now face additional challenges because of the COVID pandemic (Reyes-Guerra et al., 2021). Empirical evidence has underscored the importance of student leadership in fostering a culture of peace within school settings (Alomair, 2016; Eke, 2022; Felice & Wisler, 2007; Ozcelik et al., 2021). Engaging student leaders could eventually influence a school's culture and result in a positive school climate (Galloway, 2023). Student leaders may be very helpful in advancing the peace promotion program because they are an integral part of the school community. In addition to setting an example for peaceful conflict resolution, they can serve as role models for the values of empathy, inclusion, and critical thinking. Also, they can support initiatives for peace education throughout the entire school and help to foster a positive school climate (Eke, 2022).

Additionally, this study can provide suggestions on how school counselors and teachers might evaluate training programs incorporating conflict resolution skills and provide more useful tools for dealing with young adolescents on nonviolent conflict resolution.

Method

Descriptive quantitative research design was employed since the study aims to identify and describe the respondents' profile, conflict knowledge, attitude towards conflict, and conflict resolution skills. The study was conducted among the 363 Junior High School leaders from the nine (9) public secondary schools in the DEPEd Division of Angeles City, Pampanga with four survey instruments – instrument developed by Lam in 1989 (Dahlberg et al., 2005) for assessing attitude towards conflict, questionnaire for the Conflict Resolution-Protective Individual Profile and on conflict resolution developed by Philips and Springer (1992) and a checklist for conflict resolution developed by The Dutch Test for Conflict Handling (DUTCH).

Data collection activities were administered face to face during the respondents' vacant time inside the school premises. The data were scored and tallied accordingly before being entered into the Microsoft Excel program. An expert in the use of the Statistical Package for the Social Sciences (SPSS) application software was sought to process the collected data. The mean and standard deviation, which are required to display the descriptive statistics of the respondents' attitude, and skills on conflict and conflict resolution, were derived using the software.

Results

Based on the 363 respondents, there are 255 or 70.25% female student leaders and 107 or 29.50% male student leaders while one (1) or .27% did not respond. As per their grade level, 140 or 38.57% are Grades 10, 86 or 23.69% are Grades 8, 79 or 21.76% are Grade 9 and 58 or 15.98% are Grade 7. Most of the respondents are class officers with 233 or 68.83%, 49 or 13.50% are both class and club officers and 19 or 5.20% are club officers; 17 or 4.70% are student council/supreme officers; 16 or 4.4% are class and student council/supreme officers; 10 or 2.8% are class and club officers & student council/supreme officers and the remaining 19 or 5.20% are either class and club Officer & student council/supreme officers & others. Two (2) or .60% of the respondents did not answer the question.

Table 1 describes the respondents' attitudes to conflict. It is reflected on the table that respondents strongly agreed on the following statements: *There are better ways to solve problems than fighting* (m = 3.84); *I try to talk out a problem instead of fighting* (m = 3.64), *When my friends fight, I try to get them to stop* (m = 3.58) and *Even if other kids would think I'm weird I would try to stop a fight* (m = 3.28). The respondents' response to the abovementioned statements clearly reflects their attitude to conflict and that conflict can be resolved by talking about problems and stopping a fight.

They strongly disagreed with the following statements: *It's O.K. for me to hit someone to get them to do what I want* (m = 1.25) and *If people do something to make me mad, they deserve to be beaten up* (m = 1.35). Their disagreement with the use of violence is evident in their responses to the two (2) statements.

Table 1
Respondents' Attitudes on Conflict

	Mean	Verbal Description	SD
1. If I'm mad at someone, I just ignore them.	2.61	Somewhat Agree	0.899
2. Even if other kids would think I'm weird I would try to stop a fight.	3.28	Strongly Agree	0.768
3. It's O.K. for me to hit someone to get them to do what I want.	1.25	Strongly Disagree	0.533
4. Sometimes a person doesn't have any choice but to fight.	2.26	Somewhat Disagree	0.945
5. When my friends fight, I try to get them to stop.	3.58	Strongly Agree	0.673
6. There are better ways to solve problems than fighting.	3.84	Strongly Agree	0.533
7. I try to talk out a problem instead of fighting.	3.64	Strongly Agree	0.652

8. If people do something to make me mad, they deserve to be beaten up.	1.35	Strongly Disagree	0.619
Mean Average	**2.72**	**Somewhat Agree**	**0.70275**
N = 363			

On the respondents' resolution skills on self-control, they strongly disagree on the following statements: *If I feel like it, I hit people* (m = 1.34); *Sometimes you have to physically fight to get what you want* (m = 1.38) and *Sometimes I break things on purpose* (m = 1.54) while they disagree on the following statements: *When I am mad, I yell at people* (m = 2.07); *I do whatever I feel like doing* (m = 2.28) and *I get mad easily* (m = 2.51).

The respondents' strong disagreement with the statements implies their strong self-control in using violence while their disagreement on the last three (3) statements implies that they can put their emotions under control.

With regards to cooperation skills, respondents strongly agreed on all the six (6) items with a mean range from 3.49 to 3.73 (Table 2). This only means that the respondents believe that it is important to participate in any activities that will promote harmonious relationships with others and cooperation promotes peace and teamwork.

Table 2
Respondents' Conflict Resolution Skills

A. Self-Control	Mean	Verbal Description	SD
1. Sometimes you must physically fight to get what you want.	1.38	Strongly Disagree	0.603
2. I get mad easily.	2.51	Disagree	0.795
3. I do whatever I feel like doing.	2.28	Disagree	0.733
4. When I am mad, I yell at people.	2.07	Disagree	0.843
5. Sometimes I break things on purpose.	1.54	Strongly Disagree	0.733
6. If I feel like it, I hit people.	1.34	Strongly Disagree	0.634
Mean Average	**1.85**	**Disagree**	**0.623**
B. Cooperation			
1. I like to help around the house.	3.49	Strongly Agree	0.596
2. Being part of a team is fun.	3.6	Strongly Agree	0.597
3. Helping others makes me feel good.	3.73	Strongly Agree	0.47

4. I always like to do my part.	3.6	Strongly Agree	0.597
5. It is important to do your part in helping at home.	3.7	Strongly Agree	0.498
6. Helping others is very satisfying.	3.71	Strongly Agree	0.55
Mean Average	**3.63**	**Strongly Agree**	**0.551**
N = 363			

The respondents' conflict handling resolution styles are reflected in Table 3. The respondents display medium in all the styles in handling conflicts with the following scores: problem solving (a = 16.82), compromising (a = 14.49), forcing (a = 12.6), yielding (a = 12.16) and avoiding (a = 11.39). The respondents' conflict handling styles of being problem solvers confirm their attitude towards conflict and their resolution styles of having self-control and being cooperative. Being in the medium level in all the resolution styles, the respondents likely to utilize appropriate conflict handling resolution styles depending on the situations at hand. They may use problem solving style in one situation; compromising on the other, and vice versa.

Table 3
Conflict Handling Styles of Respondents

	Score	Interpretation
Yielding	12.16	Medium
Compromising	14.49	Medium
Forcing	12.6	Medium
Problem Solving	16.82	Medium
Avoiding	11.39	Medium

Discussion

This study seeks to provide a quantitative assessment of the conflict and conflict resolution styles of junior high school student leaders. The study was conducted in view of the lack of local empirical studies that would contribute to the effectiveness of conflict resolution programs in schools in Angeles City. In this study, respondents' attitudes on conflict have shown inclination towards a more cooperative, non-violent approach to conflict resolution. In terms of conflict handling styles, data indicated that respondents do not have a highly preferred or least preferred conflict handling style.

Data shows that most of the respondents in this study are female. This may suggest a growing willingness among females to assume leadership tasks. Women are frequently socialized to develop strong interpersonal skills, like empathy and teamwork (Lim & Kim, 2011). In leadership positions, these qualities are highly regarded, particularly in educational environments where understanding and cooperation are essential (Chapman, 2025; Singh et al., 2023). But these important qualities may not be enough for females to assume leadership as in

the findings of a large-scale study among children and adolescents in Turkey where the proportion of leadership willingness among females dropped because of decline of self-confidence (Alan et al., 2020).

With regards to grade level and leadership roles, the student leaders are mostly grade 10 and mostly class officers. This may be attributed to the fact that younger student leaders, such as those in grades 7, 8 and 9, may still be developing their conflict resolution skills. They might rely more on authority figures and exhibit more avoidance or accommodation styles due to less experience and confidence while high school or college student leaders typically have more developed social and emotional skills. They are more likely to adopt collaborative or compromising styles, showing a greater ability to negotiate and find mutually beneficial solutions (Ayub, 2024). Student leaders, such as class representatives/officers or club presidents, often develop advanced conflict resolution skills. They tend to use collaborative and integrative approaches to manage conflicts, aiming to maintain group cohesion and productivity (Feirsen & Weitzman, 2023; Rashid, 2005).

Majority of respondents do not agree that responding to conflict through physical altercation. Respondents strongly agreed that there are better ways to solve problems than fighting; they try to talk about a problem instead of fighting. It implies several positive attributes. These student leaders likely have a strong sense of respect for others and understand the importance of treating people with dignity. They prefer non-violent methods for resolving conflicts and influencing others, which is crucial for maintaining a peaceful and cooperative environment. This attitude could also reflect ethical leadership qualities, as they recognize that using force or violence is not an acceptable way to achieve goals. These leaders can serve as positive role models, promoting values of empathy, respect, and constructive problem-solving among their peers.

Not only do the respondents disagree with physical altercation, but data also suggests that respondents look for ways to stop when conflict escalates. This further implies several positive qualities. These student leaders likely possess strong peacemaking skills and are proactive in resolving conflicts among their peers. They show empathy and care for their friends, wanting to maintain harmony and prevent further escalation of conflicts (Pye et al, 2022). This attitude reflects a sense of responsibility and leadership, as they take it upon themselves to intervene and help their friends find peaceful solutions. This lends support to a qualitative study conducted by Kumar (2024) using youth participatory approach which revealed that young people's visions of peace inspire them to consider how they might live as peaceful beings who coexist peacefully with the environment, with one another, and within themselves.

On the respondents' resolution skills, they display strong self-control. Students who learned how to manage anger and emotions can enhance their interpersonal relationships and improve their academic and social environments (Pollack, 2025). This finding is supported by Johnson and Johnson (2005) where students who can control and manage their emotions in conflict situations guarantee that they take positive action may have a developmental advantage over people who cannot control their emotions.

With regards to cooperation skills, respondents strongly agreed on all the six (6) items which mean that respondents are willing to cooperate to promote harmony. Having these skills are important for working well with others and achieving a common goal. It also means building relationships with your team, resolving conflicts, and creating a work environment where everyone feels included and respected (Moseley, 2025). Moreover, when students collaborate,

they do not only engage in active dialogue, but also exchange ideas, and offer constructive feedback to one another. but also promotes critical thinking and problem-solving skills. By working together, students can tackle complex problems from multiple angles, leading to more comprehensive solutions (Kamepalli, 2024).

Respondents utilized all conflict handling styles. This may suggest a balanced approach, where respondents may use this style in some situations but not others. Just like the findings in the study of conflict management styles among students at Bahir Dar University in Ethiopia which identified all conflict management styles (Bazezew & Neka, 2017). It is noteworthy, though, that among the conflict handling styles, the problem-solving style figured the highest in the results. This may indicate that respondents equate conflict resolution with problem solving. Conflict resolution and problem solving are related but not the same. Conflict resolution can be seen as a specialized form of problem solving that focuses on interpersonal or group dynamics (Ay et al., 2019; Turk, 2017).

More so, the respondents' preferred conflict handling style is contrary to findings from other countries. In Tatarstan, Russia, 13–15 adolescents' conflict handling strategies were investigated and compromising conflict strategy was a choice of the majority while cooperation strategy is least preferred (Parfilova & Karimova, 2019). In Estonia, among 14-year-old adolescents studied, negotiation was the most frequently suggested strategy. In the same study, it was found out that in every conflict situation, girls are said to have more disagreements and are advised to negotiate more than boys (Tamm et al., 2018). Research among high school and college students in Bosnia and Herzegovina indicated a very low awareness and participation in education for peace that is responsible for promoting a non-conflict resolution. The paper highlighted the critical need for the implementation of a program that will foster a culture of peace and tolerance in a multicultural society (Mulalić, 2023). Given the cultural differences, it underscores the need for localization and contextualization of peace education and promotion of non-conflict resolution serves as a building block in promoting social skills that are pertinent in carrying out non-conflict resolution.

Comparing the conflict resolution styles of Filipinos to other nationalities, Filipinos prefer collaborating, and their alternatives are either accommodating or compromising (Jamora et al., 2020). The competing style is more favored by members of American cultures; Australians show a preference for collaborative and compromising styles. The members of Asian countries show an opposite pattern to Americans. In India the most preferred style to resolve the conflict is accommodating followed by Avoiding. Koreans resolve their conflicts mostly by Compromising and avoiding style. Chinese prefer compromising and avoiding again. Japanese prefer Avoiding and Accommodating styles in comparison to Malaysian who prefer integrating and compromising styles. No extensive study was found on conflict resolution on a variety of cultures at one platform (Asia, America and Australia), though fragmented source of information exists on different countries (Saravanakumar & Shandru, 2023).

Conclusion

Based on the results, the respondents are mostly female, class officers and belong to Grade 10. The respondents prefer non-violent solutions in resolving conflicts such as talking out problems and intervening in fights. They have strong self-control and adhere to cooperation to promote peace, and they utilize all conflict handling styles- problem solving, compromising, yielding, forcing and avoiding.

Recommendations

Given that the respondents are mostly female, class officers, and in Grade 10, schools can develop leadership and peer mediation programs. These programs can empower students to take active roles in conflict resolution and promote a culture of peace.

Since respondents prefer non-violent solutions, schools should encourage open communication through workshops and activities that teach effective communication skills. This can help students feel more confident in talking about problems and intervening in conflicts.

To build on respondents' strong self-control and cooperative attitudes, schools can implement activities that focus on emotional regulation and teamwork. This can include mindfulness exercises, cooperative games, and group projects that require collaboration.

Since respondents utilize various conflict handling styles, it would be beneficial to provide training on when and how to use each style effectively. Workshops on problem-solving, compromising, yielding, forcing, and avoiding can help students understand the appropriate contexts for each approach.

Schools should create a supportive environment where students feel safe to express their feelings and seek help when needed. This can include establishing a peer support system, having accessible counselors, and promoting a zero-tolerance policy for bullying and violence.

Many of the findings here also merit further investigation that should delve into the daily experiences of the students' leaders; thus, a qualitative study is recommended. Not only will this provide program organizers of conflict resolution a more nuanced understanding, but further qualitative studies will also allow cross checking of the quantitative results for triangulation.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Appendix

Questionnaire

PART I: STUDENT LEADERS' PROFILE
NAME OF SCHOOL: _____
YEAR LEVEL: _____ SEX: _____
INSTRUCTION: Check all which are applicable to you. What is your leadership position in your school?
____ Class Officer (President, Vice-President, Secretary, Auditor, etc.)
____ Club Officer (President, Vice-President, Secretary, Auditor, etc.)
____ Student Council/ Supreme Officer ((President, Vice-President, Secretary, Auditor, etc.)
____ Others. Please Specify _____

PART II. Attitude Toward Conflict
Instruction: Encircle the number that best describes how you feel about each statement.
Strongly Agree (4) *Somewhat Agree (3)*
Somewhat Disagree (2) *Strongly disagree agree (1)*

1. If I'm mad at someone I just ignore them.	4	3	2	1
2. Even if other kids would think I'm weird I would try to stop a fight.	4	3	2	1
3. It's O.K. for me to hit someone to get them to do what I want.	4	3	2	1
4. Sometimes a person doesn't have any choice but to fight.	4	3	2	1
5. When my friends fight, I try to get them to stop.	4	3	2	1
6. There are better ways to solve problems than fighting.	4	3	2	1
7. I try to talk out a problem instead of fighting.	4	3	2	1
8. If people do something to make me mad, they deserve to be beaten up.	4	3	2	1

PART III. Conflict Resolution Skills Instruction: Put a check (√) to indicate how closely several statements match your feelings.
4- Strongly Agree *2-Disagree*
3- Agree *1-Strongly disagree*

A. Self-Control	4	3	2	1
1. Sometimes you have to physically fight to get what you want.				
2. I get mad easily.				
3. I do whatever I feel like doing.				
4. When I am mad, I yell at people.				
5. Sometimes I break things on purpose.				
6. If I feel like it, I hit people.				
B. Cooperation				
1. I like to help around the house.				
2. Being part of a team is fun.				
3. Helping others makes me feel good.				
4. I always like to do my part.				

5. It is important to do your part in helping at home.				
6. Helping others is very satisfying.				

Part IV. Self-Assessment: Dutch Test for Conflict Handling
Purpose: This self-assessment is designed to help you identify your preferred conflict-management style.
Instructions: Read each of the statements below and circle the response that you believe best reflects your position regarding each statement.

When I have a conflict at work or school, I do the following:		Not at all	Seldom	Sometimes	Often	Almost Always
1.	*I give in to the wishes of the other party.*	1	2	3	4	5
2.	*I try to realize a middle-of-the-road solution.*	1	2	3	4	5
3.	*I push my own point of view.*	1	2	3	4	5
4.	*I examine issues until I find a solution that really satisfies me and the other party.*	1	2	3	4	5
5.	*I avoid confrontation about our differences.*	1	2	3	4	5
6.	*I concur with the other party.*	1	2	3	4	5
7.	*I emphasize that we have to find a compromise solution.*	1	2	3	4	5
8.	*I search for gains.*	1	2	3	4	5
9.	*I stand for my own and other's goals and interests.*	1	2	3	4	5
10.	*I avoid differences of opinion as much as possible.*	1	2	3	4	5
11.	*I try to accommodate the other party.*	1	2	3	4	5
12.	*I insist that we both give in a little.*	1	2	3	4	5
13.	*I fight for a good outcome for myself.*	1	2	3	4	5
14.	*I examine ideas from both sides to find a mutually optimal solution.*	1	2	3	4	5
15.	*I try to make differences seem less severe.*	1	2	3	4	5
16.	*I adapt to the parties' goals and interests.*	1	2	3	4	5

17.	*I strive whenever possible toward a 50-50 compromise.*	1	2	3	4	5
18.	*I do everything to win.*	1	2	3	4	5
19.	*I work out a solution that serves my own and the other's interests as well as possible.*	1	2	3	4	5
20.	*I try to avoid a confrontation with the other.*	1	2	3	4	5

Academic Experiences of Teachers as Graduate Students: Basis for a Proposed Graduate School Development Plan

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Abstract

This study identified the academic experiences of graduate students who are also full-time teachers. The phenomenological research design was used in this study to fully understand their experiences and interpret the themes that arose from the qualitative data that were gathered through individual interviews and focus group discussions. Using purposive sampling, participants were selected from the different programs in the graduate school of a Higher Education Institution (HEI) in the Philippines, both Master's and Doctorate degrees with a total of forty-two (42) participants across programs. Based on the findings, plans for the enhancement of the Graduate School Development Program were proposed. The findings of this study are important to inform and guide the HEIs and the education department on future innovations and further studies toward policy recommendations.

Keywords: graduate students, teachers, graduate school development program, academic experiences, challenges

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Introduction

At present, a rapid change in our world is taking place with the issues left by the pandemic and its effect on industries, countries' economies, and the lives of individuals. Among all the disrupted activities of humankind, one of the sectors hit the most was the education sector (Tria, 2020), wherein educational establishments encountered stagnation, employee turnover, and a worldwide quarantine (Kaufman & Stedman, 2022; Sage & Matteucci, 2022). Given the various situations brought about by the crisis, this study looked at the academic experiences of graduate students who are also full-time teachers, even beyond the effects of the pandemic.

In this context, one of the resolutions of the Philippines' Department of Education's Basic Education Learning Continuity Plan in the Time of COVID-19 (2020) is to strengthen teacher training and development through professional development programs, scholarships, and workshops to further enhance teacher quality and teaching quality in the country.

Provided with the changes in education brought about by the crisis of the pandemic, this study magnified and elaborated details on the academic experiences of graduate students enrolled in a higher education institution (HEI) in the country, which could reveal gaps in the existing graduate school program of the university. Moreover, this study aimed to contribute to the enhancement of the university's graduate program to continuously deliver quality teacher education and training for teachers.

Literature Review

Teachers as graduate students have had different contexts, backgrounds, and experiences in their respective fields or disciplines, and in the professional development area they pursue through a graduate program. Needless to say, they have undergone various challenges in their professional journey.

Given the effects of the COVID-19 pandemic, changes occurred at the national level and in the personal lives of people. One of which that have experienced issues is the education sector, where students and educators struggled with their engagement in a face-to-face teaching and learning setup (Guiamalon et al., 2021). Studies show that teaching is one of the professions that improve the condition of society (Ulla et al., 2017; Vásquez, 2017). Providing capacity-building sessions and available graduate programs for educators addresses the need to attain the required skills of teachers on the demands of the world at present, and should be recognized as important as nation-building (Gepila, 2020).

One of the professional development programs that educators pursue is through a graduate program, which provides an opportunity for teachers to gain an understanding of the significance of quality research as a contributory factor for handlers of knowledge and doers of developmental support in society (Moulding & Hadley, 2010). The graduate program helps teachers to be more trained in preparing and guiding the learners in the classroom to be holistically ready for the future. This also helps them use their passion for teaching as an instructional tool and as a professional motivation for teachers and motivator for learners (Palmer, 2017; Ruiz-Alfonso & León, 2016); to gain professional competence level as contribution and support to the field of education (Vural & Basaran, 2021); and to achieve satisfaction in job promotion, raised pay, and privilege of supervision or management (Tanwar & Gard, 2020). Moreover, graduate school is progressing towards altruism and is addressing global problems (Kaufman et al., 2023; Kaufman & Stedman, 2022).

Government policies and guidelines in the Philippines were crafted to continuously support the needs and progression of teachers pursuing professional development opportunities, particularly graduate studies (CMO No. 15, s. 2019; CMO No. 53, s. 2007). According to the Philippines' Commission on Higher Education (CHED) Memorandum Order (CMO) No. 53, s. 2007 titled "Policies and Standards for Graduate Programs in Education for Teachers and Other Education Professionals", discusses that graduate school in teacher education is a way of expanding the capacities of professional educators who seek to contribute to the progress of education processes, specifically in teaching and in the management of educational programs. In support of this policy, CMO No. 15, s. 2019 titled "Policies, Standards, and Guidelines for Graduate Programs Policy", explains the role of urging and sustaining competencies for educators, like creative and effective ways of learning and teaching, scientific and technological advancement, and leadership and innovation as education leaders during the pandemic.

However, despite interventions, teachers still experience challenges being concurrent graduate students. Some of these challenges are their responsibilities in their roles as a family member (Bhamani et al., 2020; Nodine et al., 2021; Weaver & Swank, 2021), their digital capability and technological issues experienced (Aboagye et al., 2020; Viola et al., 2019), the demands in their graduate school and in their workstations (Housel, 2020), their physical and mental health concerns (Blatchford, 2020; Collo, 2021; Nixon et al., 2011), and their financial limitations (Adle, 2020; Asgari et al., 2021).

Using these factors from the literature, the study focused on the academic experiences of the graduate students and developed recommendations for the graduate school programs and interventions of HEIs in the Philippines, and maybe to an extent, to the other nations.

Theoretical Underpinnings

In this study, Andragogical Theory served as the framework for understanding and interpreting the lived experiences of teachers who are simultaneously pursuing graduate studies. Knowles' assumptions about adult learners—self-direction, readiness to learn, prior experience, relevance of learning, and internal motivation—align closely with the participants' circumstances as practicing teachers enrolled in graduate programs.

By foregrounding these principles, the study recognized that teachers bring substantial professional experience, which shapes how they engage with coursework, manage academic demands, and assess the relevance of graduate-level learning to their teaching practice. Their reflections, challenges, and coping strategies are viewed not merely as isolated experiences but as expressions of adult learning processes. This theoretical lens enabled the research to capture:

- how their prior knowledge influences their learning preferences,
- how their dual roles affect their readiness and motivation to study, and
- how they perceive the applicability of graduate education to their professional growth.

In essence, the use of Andragogical Theory allowed the study to translate adult learners' experiences into policy-oriented insights, ensuring that the resulting proposed plans are not only evidence-based but also aligned with the fundamental characteristics of adult learning.

Research Aims and Statement of the Problem

This study examined the lived academic experiences of teachers who are simultaneously pursuing graduate studies, using their insights as the foundation for recommending enhancements to the Graduate School Development Program, i.e., their academic and research support plan to the students. Specifically, it sought to:

1. Describe the academic experiences of teachers as graduate students, and
2. Use these findings to recommend enhancements to graduate programs' academic and research support plan.

Methodology

Research Design

Using a phenomenological approach, the researchers sought to understand the participants' "lifeworld", or their everyday academic experiences (Creswell, 2013). The research design brought out meaning and interpretation from the stories of each participant (Leavy, 2017).

Selection Criteria and Participants

The research was conducted in a graduate school in the Philippines. Participants were purposively selected based on their active enrollment in a master's or doctoral program and their progress toward completing academic or thesis requirements. Out of 197 invited students, 42 met the criteria and participated. 41 out of 42 chose online interviews and FGDs for convenience, while only 1 chose a face-to-face interview.

Data Collection

Ethical approval from the HEI in the Philippines was secured by the researchers. Participants were also provided with detailed informed consent (see Appendix) and were asked to choose their preferred schedule and interview modality. The invitation to the participants includes (1) the extent of participation, (2) question flow, (3) the truthfulness of their responses, and (4) the confidentiality clause.

On the day of the FGD/ interview, the researcher discussed the informed consent form and emphasized that all interviews and FGDs would be recorded through note-taking and/or audio and video recording. This helped the researcher in transcribing and analyzing the data that was collected. Moreover, the discussion of the confidentiality agreement was also conducted before the start of the interview. Interview sessions took thirty to sixty minutes for each participant (Fox, 2009), while FGDs were conducted for one to two hours (Morgan, 1996).

During the interview day, participants were recognized for taking part and making time to participate in the study. Before the researcher started the recording, the participants who were interviewed online were asked to turn on their microphones, and, if they were comfortable, their videos as well. For those who were interviewed face-to-face, the researcher asked permission to use and start the audio recording.

Data Analysis

The researchers used thematic analysis following the framework of Braun and Clarke (2006). Transcripts and recordings were repeatedly reviewed, coded, and organized using NVivo and manual coding. Codes were then grouped into subthemes and overarching themes that directly answered the research questions.

Through this process, the study surfaced meaningful insights into the academic experiences, challenges, and support needs of teacher-graduate students. These findings informed proposed enhancements to the Graduate School Development Program, particularly in strengthening academic and research support for working professionals.

Results and Discussions

Results of this study highlighted two (2) main themes. First is "Teachers' Academic Experiences as Graduate Students", with 2 subthemes: (a) lived-academic experiences, and (b) challenges and support needs; and the second main theme is "Recommendations for the Strengthening Academic and Research Support in Graduate Programs".

Teachers' Academic Experiences As Graduate Students

Lived-Academic Experiences

Participants shared that their most meaningful experiences came from engagements outside the four walls of the classroom. They were invited as speakers, facilitators, validators, and participants in various trainings and workshops. These opportunities allowed them to apply theories in real-life settings, broaden their perspectives, and deepen their understanding of their field. Many described these engagements as enriching, fulfilling, and central to their growth as educators.

Second is that they were able to build networks and professional connections. They also emphasized the value of collaborating with peers from different programs, institutions, and disciplines. Learning alongside teachers from both public and private schools, and from basic and higher education, gave them wider insights into diverse educational contexts. These networks led to new partnerships, extension activities, and professional linkages that strengthened their practice.

They also talked about their personal and professional development. Participants noted that graduate school also shaped their character. They spoke about developing humility, self-awareness, courage, and perseverance, especially when facing moments of exhaustion or discouragement. Despite challenges, they remained committed to completing their programs, viewing graduate studies as essential to their professional growth.

Lastly, they were able to translate their learning into practice. The participants described how their graduate school learning directly influenced their teaching and leadership roles. Many applied theories in their classrooms, mentored colleagues in research, and took on leadership responsibilities in their schools and communities. Their growing competence in research and leadership allowed them to contribute to policy conversations, school improvements, and educational innovations.

Establishing networks with other programs and other institutions is also considered important for the teachers, as they share their differences with others. Being able to learn other perspectives and to immerse themselves in various communities gives them a wider grasp of education in disparate contexts. According to Burbank and Hunter (2022), building connections and collaboration to facilitate intellectual discussions opens pathways leading to an active society. They added that through the initiatives of stakeholders and other partners from the local level to national and international organizations, a common goal among communities can be developed.

Personal realizations and their challenges are part of their educational and academic development, where many participants claimed that they have worthwhile experiences that pushed them to do more for education and taught them to develop their character as human beings. As mentioned in the study of Riby and Rees (2024), personal development is defined as one's contemplation of the different components of self, which include cognitive, social, psychological, moral, and inner being. This could enhance their overall academic experience and foster a positive learning environment in their graduate school community and their workstations. Darling-Hammond et al. (2017) stated that an outstanding advancement in one's profession opens doorways for educators to discuss propositions and work together in the individual contexts in their workstations, i.e., effective teaching approaches in their classrooms and beyond. Based on their stories, their academic experience being a teacher and a graduate student at the same time is not an easy path, but a worthwhile one. Different factors made them sacrifice and prioritize things that needed to be done, hence their full-circle experiences.

In terms of the HEI's research and development functions, one of the qualities that graduate students have to manifest is being a research scholar, where students' learning experience has to be translated to "innovations in teaching and learning processes and other forms of education practice" (Philippine Normal University, 2015). Similar to this context are the findings in the study of Sevim and Akın (2021), wherein learning in the graduate school has added expertise to the students' competencies and mastery in their discipline. Consequently, the most significant components students gain are critical thinking and analytical expertise, which graduate students can use in teaching their learners and in developing their future research works. The graduate students being engaged in research development, handling research-related courses or subjects, and taking the initiative to write their academic papers show their interest in translating theories into practical actions that contribute to policy recommendations in their workstations, their communities, and the University, among others.

Challenges and Support Needs

The next subtheme is on the challenges and needed support of the teachers. First, based on their narratives, they experienced the strain of multiple roles. Participants consistently described the difficulty of balancing their responsibilities as full-time teachers, graduate students, and family members. Their work obligations often conflicted with graduate school schedules, forcing them to miss classes or rush academic requirements. Many shared that despite their desire to focus on their studies, workplace expectations always came first. The volume of overlapping tasks, constant deadlines, and lack of institutional support, such as limited access to study permits or deloading, resulted in stress, sleep deprivation, and health issues. This struggle to manage time and competing priorities deeply affected both their well-being and academic performance.

A second major challenge involved their interactions with professors and the learning environment in graduate school. Participants recounted experiences of unclear instructions,

unread emails, inconsistent class schedules, and faculty members who were frequently unavailable due to other commitments. Some felt intimidated or unsupported, and several noted that core and specialization courses were equally heavy in workload, leading to frustration and discouragement. Miscommunication, such as late feedback, sudden changes, or faculty who failed to read submissions, added to their anxiety. These experiences weakened their motivation and affected their confidence in the program.

The third subtopic centered on administrative concerns within the HEI. Participants struggled with limited online services, slow email responses, errors in the student portal, and inconvenient onsite processes—especially for those living outside Metro Manila. Issues such as dissolved classes, limited class offerings, unclear program standards, and irregular examination schedules caused delays in their academic timelines. Many also cited the difficulty of accessing library resources and research materials. These administrative barriers contributed to additional stress, financial challenges, and doubts about continuing in the program.

Found in the study of Amida et al. (2020), it is valuable that students learn to organize their priorities to enhance proficiency and be more adept at fulfilling the expectations of their multiple roles. However, due to the many deliverables and academic obligations of the teachers, most of them somehow failed to perform in their jobs and in their graduate studies. As stated in the study of Prendergast et al. (2023), these academic obligations were described as laborious and most difficult in completing the program, such as participation in classes, browsing of academic journals, fulfilling managerial roles, completing the research paper, organizing activities/ programs, and training material production.

The claims of Nicklin et al. (2020) said that the dispute among factors in career, education, and experiences is notably linked to anxiety, while education and personal experiences are the most significantly linked with anxiety. This was also stated in the study of Solon et al. (2024), which says that inadequate self-care is one of the crucial factors that a working graduate student can experience, given the urgent work responsibilities and academic course requirements. Relatively, not having enough sleep is mostly the teachers' issue in not attending to their well-being. They honestly said that the suffering they experience in their physical health is also because they fall short of managing their time well. However, this aspect is also because of the numerous tasks expected of them, which results in losing sight of taking care of their health. Literature presented that insufficient time to finish, or even to begin many tasks, due to time constraints, affects graduate students' welfare and efficiency (Giurge et al., 2020; Prendergast et al., 2023; Whillans & West, 2022).

In the study of Albalawi and Nadeem (2020), they stated that a successful imparting of message or "communication" among learners and teachers creates a pleasing learning environment, yet sometimes, teachers fall short of doing so. In the study of Omar et al. (2021), they also discussed that one of the components of successful learning is the planning of an enriching experience for graduate students. They must receive enough support from the community they can grow to be able to continue with their journey in their career and graduate school. Furthermore, the advisers must be thoughtful in terms of recognizing the circumstances their advisees experience, particularly those who have been in the graduate school for a long time, those who exceeded the allowed years of residency period (Rungduin & Miranda, 2018).

The inefficient processes shared by the participants lead to frustrations among students, missed deadlines, alternative conceptions, and wastage of time, money, and other resources. Alternative conceptions, as defined by works of literature in the most simple way, are incorrect

interpretations of established scientific facts and proven knowledge (Adebayo et al., 2021; Horton et al., 2007; Stojanovska et al., 2015). As a result, this could lead to setbacks and failures for the graduate students.

Additionally, participants also experienced challenges with the availability of academic courses and other issues in the academic-related programs of the institution, specifically on the enrollment process and academic terms, program offerings, tutorial classes, comprehensive examinations, shortage of teachers, and writing term defense. In a similar context, in the study of Iqbal et al. (2021) and Tworek (2018), they found that there could be issues with the reliability of online resources from different web directories as a result of unrelated or unreliable sources. Thus, the participants' experiences in terms of the administrative processes were composed of many narratives. Provided with works of literature, these processes play a vital role in the academic success of the students, not only to help them finish the degree but also to make their academic experience remarkable.

Recommendations for Strengthening Academic and Research Support in Graduate Programs

In addressing the challenges faced by teachers pursuing graduate studies, the participants proposed several recommendations shown in the second theme.

The participants emphasized the need for flexible academic scheduling and program adjustments. Recommendations included properly planning onsite and online classes to avoid costly and frequent travel, offering research courses in regular academic terms rather than short-term schedules, and aligning the institutions' calendars with the Department of Education (DepEd) in the country. Based on their narratives, this will help minimize conflicts with teaching responsibilities. They also proposed a pre-research course for students without a prior research background and the use of individual academic plans to guide course enrollment and deadlines. Additionally, financial support such as tuition discounts and scholarships was suggested to reduce stress and encourage continuous academic engagement.

Participants also highlighted the importance of mentoring and peer support systems. They recommended strengthened orientations, providing primers to clarify academic expectations, and implementing a buddy or peer system for discussion, peer teaching, and exam preparation. Mentorship programs, including a sustainable "Mentorship Exchange Program", were also proposed to monitor progress and ensure no student is left behind. Another key recommendation was integrating applied learning to link theoretical knowledge with classroom practice, fostering collaboration between faculty and students, and enhancing practical outcomes in teaching.

They also suggested improving administrative efficiency and support infrastructure. This includes enhancing online transactions and communication channels, creating physical spaces like graduate student hubs or thesis labs for collaborative work, and decentralizing some classes for students outside Metro Manila. They also proposed strengthening partnerships with DepEd offices, other HEIs, and international institutions to expand research opportunities and showcase student work. Finally, participants also emphasized the need to regularly review program statistics, course offerings, and institutional systems to prevent dissolved courses, improve program marketing, and inform evidence-based innovations in graduate education.

According to the study by Walter and Stouck (2020), it was found that there is a pressing need for those students who do not have a strong and in-depth background in research development as they begin their programs in graduate school. Alternatively, those students with prior background in research could have better knowledge, be more skilled, and be more driven in doing research work (Miller et al., 2021). Whereof, the participants mentioned that based on personal observations and experiences, offering pre-research courses for those graduate students who did not encounter a research course in their previous schools shall be designed to address the difficulty in developing a research paper.

Studies by Blanchard and Haccoun (2020) and Lorusso et al. (2020) claimed that there is a battle being a graduate student. For the teachers, as much as they would like to fully focus on their studies, they need to prioritize their jobs as teachers, considering that it is their primary source of income. Further, there is an arena of synchronizing life, work, and the rest of the demands of their other roles, hence the proposal to be more lenient in the academic course requirements. Rungduin and Miranda (2018) discussed in their study that teachers who are also graduate students need to simultaneously work on their academic course outputs alongside the work deliverables expected from them. Their responsibilities go beyond their roles as teachers and graduate students, but also as family members, a church worker, and other extra-curricular assignments as professionals. Henceforth, the participants opened the possibility of considering the alignment of the HEI's calendar with DepEd and/or with other educational institutions.

Studies also show that planning and goal setting have a beneficial impact on the improvement of students' academic performance and lessening academic anxiety (Adams & Blair, 2019; Varadarajan et al., 2021). This planning will not only help the program advisers in tracking the students' academic status and engagement but will also train the teachers in monitoring their progress and aligning their goals accordingly.

Further, HEIs could provide more financial grants and support to graduate students to help and encourage them to finish their degrees. Studies show that granting financial aid to graduate students can enhance their academic achievement. It was found that this consequently leads to high student involvement and continuity in taking up professional studies (Facchini et al., 2020; Herbaut & Geven, 2020).

As found in the study by Walter and Stouck (2020), the most popular component that graduate students need is mutual support with their peers. It was presented that this will help the students in building their community, self-development, and cultivation of academic knowledge and intellectual practices among peers. The study by Omar et al. (2021) also claims that the success of students' learning is with the company of their peers. It says that through that kind of community, graduate students stay and continue the program, and feel safe being themselves and meeting the same people with the same experiences as them. They also added that this develops logical inquiry among themselves. In different studies, the involvement of peer mentors will help the students, especially those new enrollees to be more familiar with the university's processes and other expectations in the graduate school, which will consequently result in sustaining the education progress of the students (Byers et al., 2014; Chester et al., 2013; Lorenzetti et al., 2023; Murdock et al., 2013; Outhred & Chester, 2013). Therefore, the need to strengthen the designs and implementation plans of the support mechanisms for the students' well-being is important.

Provided with these narratives, the graduate students have varying proposals, yet all are considered essential to fully support them in their academic success. As found in the study of

Collier and Blanchard (2023), professors have to be familiar with the various needs of their learners based on their status, background, and culture. It was also mentioned that there should be continuous professional advancement for faculty members to embody their vital role in teaching teachers, training trainers, and leading educational leaders. Therefore, the need to study the data of the graduate students is important to be able to understand and design appropriate activities and interventions for them.

Conclusion

The findings of the study reveal that pursuing graduate studies profoundly enhances teachers' professional competence and personal development. Through advanced learning, research engagement, and reflective practice, teachers expand their pedagogical knowledge and critical thinking skills, which in turn enrich their instructional effectiveness and leadership potential. Graduate education thus serves as a transformative process that cultivates both intellectual and personal growth among educators.

However, this study also exposes the complex realities of balancing professional responsibilities with academic demands. Teachers who are concurrently employed and enrolled in graduate programs often encounter overlapping challenges such as time constraints, workload pressures, and limited institutional support. These difficulties can compromise not only their academic performance but also their overall well-being, underscoring the need for more responsive and flexible graduate school systems.

Moreover, the study highlights that faculty competence, mentoring quality, and academic guidance play pivotal roles in shaping graduate students' learning experiences. Supportive mentorship, relevant instruction, and constructive feedback contribute significantly to student motivation and persistence. In contrast, inconsistent faculty engagement and lack of structured support systems may hinder academic progress and research productivity.

Administrative issues further compound these challenges. Inefficiencies in communication, scheduling, and policy implementation often delay academic transactions, frustrate students, and impede timely completion of program requirements. These systemic concerns point to a need for institutional review and reform to ensure that graduate programs operate with transparency, efficiency, and academic rigor.

In light of these findings, the study underscores the importance of designing strengthened, flexible, and evidence-based development plans for graduate schools. Such plans should integrate the voices and lived experiences of teacher-graduates, align with contemporary educational demands, and promote equitable access to professional growth opportunities. A strategic student-centered framework will not only improve academic processes but also sustain the transformative potential of graduate education in advancing the teaching profession.

Recommendations

Based on the findings and conclusions of this study, here are the proposed recommendations to enhance the quality and responsiveness of graduate education for teachers. Foremost, graduate schools should implement flexible and teacher-responsive academic scheduling and pacing. Flexibility in course delivery and program pacing can help alleviate scheduling conflicts and promote sustained engagement.

Graduate institutions should also strengthen their mentoring, advising, and faculty development systems. Establishing structured mentorship and peer-support networks will encourage collaboration, confidence, and scholarly growth among students. Simultaneously, providing continuous training for faculty on research supervision, inclusive pedagogy, and standardized instructional practices will ensure consistency and quality in graduate instruction. Strengthened academic relationships between faculty and students create more meaningful and productive learning experiences.

Finally, the improvement of administrative systems and the expansion of research-oriented partnerships are vital for institutional advancement. Streamlined processes, responsive student services, and effective communication mechanisms will minimize bureaucratic delays and enhance academic progression. Likewise, developing partnerships with local schools, communities, and research institutions can broaden opportunities for applied learning and professional relevance. Together, these measures will support a comprehensive and evidence-based graduate school development plan that promotes both institutional excellence and teacher empowerment.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that AI-assisted technologies were used solely to support the writing process of this manuscript. The usage of these tools was limited to refining words, improving grammar, and enhancing clarity. All ideas, interpretations, analyses, and conclusions presented in this paper remain the sole responsibility of the authors. The authors reviewed and verified all content generated with the assistance of AI tools to ensure accuracy and integrity.

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Appendix

Informed Consent

This form details the purpose and significance of this study, a description of the involvement required, and your rights as a participant.

Purpose and Significance of the Study

This study aims to look into the academic experiences of graduate students and how these experiences can be used as a basis for a proposed Graduate School Development Plan of the Philippine Normal University. The results of this study are significant contributions to HEIs and the Philippine education department to enhance its graduate school program/s for graduate students, and for future innovations and further studies toward policy recommendations.

Number of Participants

A total of forty-two (42) participants across course programs of a state university in Manila, Philippines, will be invited to this study and will be asked to participate during the Focus Group Discussion and interview schedules.

Procedure for Study

Interview sessions would take thirty to sixty minutes (30–60 min.) for each participant, while FGDs usually take one to two hours (2 hrs.). A day before the schedule of the interview or the FGD, the researcher shall send a copy of the interview questions and a reminder via email on the scheduled session, while the participants shall send a confirmation of their attendance through email.

All interviews and FGDs shall be recorded through note-taking and/or audio and video recording. Various platforms, such as Zoom, Google Meet application, or face-to-face will be used in the data gathering.

Participants are given the flexibility to choose their preferred interview schedule and venue, to ensure their availability and convenience. To do this, they will be asked to complete a Google form upon signing the consent form, indicating their preferred schedule and venue.

Risks and Inconveniences

Emotional risks or discomforts may arise during the interview and FGD sessions given that the research questions require answers on the participant's experiences; however, the researcher will respect the participant’s decision in disclosing details the respondent is comfortable sharing.

Safeguards

Despite the identified risks and inconveniences, the interview and FGD sessions will be a safe space between the researcher and the participant. All data shall be secured, and the identities of the participants will not be disclosed and be kept confidential.

Confidentiality

All data must be stored on a personal computer and only the researcher/s will have access to such. Identities and other information of the participants, and actual names mentioned during interviews shall be kept confidential throughout the entire conduct of the study.

THE RESULTS WILL BE KEPT CONFIDENTIAL AND ONLY BE REVEALED IF REQUESTED BY THE PARTICIPANT.

Voluntary Participation
Participation in this study is voluntary. Should you decide to take part in this study, you will be asked to sign this consent form. After you sign the consent form, you are still free to withdraw at any time upon prior notice to the researcher. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

If you have any questions or concerns, please contact the researcher through the following platforms:

- Email: lumahan.hgr@pnu.edu.ph
- Mobile, Viber, and Telegram Number: 09xx xxx xxxx

By signing below, I acknowledge that I have read and understood the above information. I am aware that I can discontinue my participation in the study at any time.

Participants' signature over printed name: _____
Date: _____

I certify that I have explained the purpose of the research to the participant and consider that s/he understands what is involved and consents to participate.

Researcher's signature over printed name: Hannah Grace R. Lumahan (sgd.)
Date: _____

Educational Innovation in Science Communication: Enhancing Public Understanding of Environmentally Friendly Nuclear Technology in Indonesia

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Abstract

This study investigates educational innovations in science communication aimed at enhancing public understanding and acceptance of environmentally friendly nuclear technology in Indonesia. As global energy transitions increasingly highlight the importance of low-carbon alternatives, nuclear power has re-emerged as a viable option. However, public skepticism and limited scientific literacy pose significant challenges to its acceptance. This research focuses on how nuclear power plants are represented within educational and public discourse, emphasizing the role of nuclear scientists not only as technical experts but also as educators and communicators. The Indonesian Nuclear Society Association (Himpunan Masyarakat Nuklir Indonesia/HIMNI) is examined as a case study, representing a professional community actively involved in public education and outreach. Through activities such as webinars, workshops, media campaigns, and informal learning events, HIMNI seeks to build trust and foster informed dialogue on nuclear issues. Anchored in a constructivist paradigm and utilizing a qualitative case study approach, data were collected through interviews, observations, and document analysis, applying triangulation to ensure credibility. The findings reveal that the use of innovative communication tools—including interactive digital technologies, infographics, animation, and social media platforms—plays a vital role in enhancing nuclear science literacy and increasing community engagement. Moreover, integrating artistic and visual elements into educational content contributes to making complex nuclear concepts more accessible and relatable. The study concludes by emphasizing the importance of rethinking science communication as a form of public education and calls for interdisciplinary strategies merging scientific content with effective pedagogical and media practices in the context of nuclear energy development.

Keywords: educational innovations, science communication, public understanding, nuclear technology, scientific literacy, HIMNI, public education, community engagement

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Introduction

In essence, science is not only knowledge but also a way of thinking. Science, in this case, must be applied effectively in society, as it is not solely the preserve of scientific groups like scientists, but also belongs to the wider public. In this regard, members of the public who are unfamiliar with science cannot understand explanations by scientists using scientific, rigid, and seemingly complex language. This can lead to the public not achieving the results they expect from science itself. Therefore, such conditions can lead to a loss of trust in science (and the emergence of anti-science) if they consistently occur, due to the failure to meet the public's high expectations for science. This situation can also be exacerbated by the rapid spread of fake news (hoaxes) due to the lack of a comprehensive understanding of science among the majority of the public. Science communication, in this regard, is crucial for the scientific community, as scientists act as science communicators and negotiators in informing and educating the public about research results and various scientific issues, as well as for policymakers to gain a more comprehensive understanding.

In today's digital era, science communication plays a crucial role in maintaining the public's ability to think intelligently and distrust fake news (hoaxes). It is crucial for the public to receive information from reliable and trusted sources, including credible and accountable scientists. This aligns with the interconnected communication between scientists, the public, and the government. Scientists, with their expertise, are expected to be able to explain their research findings related to scientific issues to the public and provide important recommendations to the government. Furthermore, the success of science communication can also be influenced by the cultural context of society, including how they understand science. This understanding of science, in this context, also includes scientific literacy, where scientists make a significant contribution to economically competitive development (Stilgoe et al., 2014). Therefore, scientists, as practitioners and communicators of science, must be equipped with the skills to engage with the public and convey findings and innovations to the public. Furthermore, the adoption of technology and aesthetic values, such as popular science or fiction, is also necessary (Gregory & Miller, 1998).

Science communication is the science of communicating scientific topics in a popular style from scientists to scientists and the public. Practically, this is often done through journalistic media (blogs, social media, and television), exhibitions, and public policy mapping with science as a primary element. From the perspective of governments and scientists, science communication is crucial for determining the effectiveness of science communication to the public on environmental science issues, specifically regarding environmentally friendly nuclear technology, through public media. Science communication to the public can be conducted through three media groups: mainstream media (such as magazines, television, and radio), face-to-face events, and online interactions (Bultitude, 2011). However, in the modern era of advances in communication technology, we are faced with the proliferation of social media platforms, making social media science communication a complementary tool.

The concept of science communication in English is a modified form of the terms science and communication. The history of science communication can be traced back to ancient times, but its development became more structured and focused in the 19th century and flourished in the 20th century (Nielsen, 2022; Schneider & Heinecke, 2019). The history of science communication reflects a gradual evolution from elite intellectual exchange to broad public engagement. It began during the Age of Enlightenment (17th–18th centuries), when thinkers such as Galileo, Newton, and Descartes promoted rational inquiry and the scientific method.

By the early 19th century, science gained recognition as an independent discipline through the rise of scientific magazines and newspapers. Advances in printing and illustration expanded public access to complex scientific ideas, while the establishment of museums and exhibitions in the 19th century made scientific knowledge more tangible and publicly accessible (Bauer & Bucchi, 2008; Bucchi, 2013; Nielsen, 2022).

The popularization of science continued into the 20th century, exemplified by figures like Carl Sagan, whose media presence bridged science and public imagination. The emergence of mass media—radio, television, and later the internet—transformed science communication into a global phenomenon. Educational institutions and scientific organizations such as the American Association for the Advancement of Science (AAAS) and the British Science Association (BSA) strengthened the field through publications, conferences, and outreach programs. Finally, the digital and social media revolution in the late 20th and early 21st centuries enabled scientists to directly engage with audiences worldwide, marking a new era of participatory and democratized science communication. This development demonstrates that science communication is the result of a variety of interrelated factors, including the development of science itself, the development of communication technology, and the efforts of individuals and organizations dedicated to disseminating scientific knowledge to the public (Bucchi & Trench, 2014).

Several influential figures have contributed to defining and shaping the concept of science communication. Carl Sagan viewed science not merely as a body of knowledge but as a *way of thinking*, emphasizing the transmission of scientific reasoning to the wider public (Davidson, 2000). Alan Alda highlighted the relational dimension of science communication, stressing the need to bridge understanding between scientists and lay audiences through clear and empathetic interaction (Weiss, 2011). Neil deGrasse Tyson advocated that science must be accessible to everyone, underscoring the importance of explaining scientific concepts in a simple and engaging manner (Elshahed & Tyson, 2020; Tyson, 2020). Meanwhile, Sandra Knapp emphasized the role of science communication in raising public awareness of biodiversity and environmental conservation (Wheeler et al., 2012).

It is important to remember that the definition of science communication can vary between individuals and can depend on the context. Each individual might highlight specific aspects of science communication based on their experience and understanding of the relationship between science and society. In its developmental context, science communication has evolved rapidly along with technological advancements and changes in access to information.

Contemporary science communication is shaped by several key developments. Social media platforms such as X (formerly Twitter), Facebook, Instagram, and YouTube enable scientists to share research findings and interact directly with the public. Podcasts and videos make complex topics more accessible, while infographics and data visualization enhance public understanding through visual clarity. The growth of scientific blogs and websites allows researchers to reach wider audiences, supported by stronger collaboration with science journalists to ensure accuracy and accessibility. Public education programs—including workshops, exhibitions, and museum initiatives—foster direct engagement, while online communities facilitate discussion and knowledge exchange. Increasing scientist participation in media and public events strengthens outreach, and amateur science initiatives contribute valuable data, particularly in fields like astronomy and ecology. These developments collectively create an environment in which science communication can reach a wider audience

and ensure that scientific information is more openly and easily understood by the general public.

From a Science Communication perspective, science communication can be grouped into several contexts that encompass the dimensions of communication and interaction between scientists, research institutions, and the public. Science communication can be broadly categorized into interrelated domains that together form a comprehensive framework for understanding how scientific knowledge is created, shared, and received (Kappel & Holmen, 2019; Mulder et al., 2008). The first domain is public scientific communication that includes both formal and informal channels. Formal communication refers to the dissemination of research findings through scholarly journals, academic conferences, and professional presentations, while informal dissemination focuses on sharing scientific information with the general public via traditional media outlets, press releases, and public events. The second domain is communication in science education that encompasses pedagogical and outreach-oriented interactions. Within formal education, scientific learning takes place in classrooms and laboratories, emphasizing the structured transmission of scientific concepts. Beyond formal settings, public education initiatives—such as workshops, training programs, and community-based learning activities—extend the reach of science to broader audiences, promoting lifelong engagement with scientific ideas.

The third domain involves mass media and science journalism, which play an essential role in translating complex scientific developments into accessible narratives for public consumption. This area also emphasizes the importance of collaboration between scientists and journalists to ensure that scientific reporting remains accurate, engaging, and socially relevant. Another critical aspect is risk communication and scientific ethics, which focus on how information about environmental, technological, and health-related risks is conveyed to the public. This dimension also highlights the ethical responsibilities of scientists in communicating research processes and implications transparently and responsibly.

Furthermore, communication in collaborative research addresses internal communication among researchers, including teamwork, coordination, and interdisciplinary dialogue across different scientific domains. Effective communication within and between research teams fosters innovation and strengthens the integrity of collaborative inquiry. In addition, social media and online scientific communities have transformed the contemporary landscape of science communication. Through digital platforms, scientists, students, and the public can now engage directly, share information, and participate in ongoing discussions, creating new forms of interaction that transcend traditional institutional boundaries. Finally, scientific marketing activities—including research promotion and scientific branding—have become increasingly significant. These activities help communicate the societal value of research outputs, enhance institutional visibility, and establish a recognizable identity for individual scientists, research teams, or scientific organizations.

Taken together, these interconnected categories illustrate that science communication today is not merely a linear process of information transfer, but a multidimensional and participatory practice that bridges scientific communities, educators, media, and the wider public. By grouping science communication within the framework of Science Communication, it is easier to understand the various aspects of scientific communication that involve various parties and contexts.

Science communication uses a multidisciplinary approach reflecting the understanding that science and communication are interconnected, and that combining approaches from various disciplines can enhance the effectiveness and impact of scientific communication. Science communication is inherently multidisciplinary, drawing insights and methods from a wide range of academic fields. From the natural sciences, it adopts principles of scientific communication and cognitive psychology to understand how individuals process and interpret complex scientific information. Within the field of communication studies, theories of communication, media, and journalism provide frameworks for effectively transmitting scientific messages and engaging the public through mass media channels (Mulder et al., 2008; Wood, 2023).

The domain of education contributes through instructional design and health education, emphasizing the creation of accessible learning materials and the integration of science into everyday contexts. Anthropology and sociology offer perspectives on cultural values, social behavior, and group dynamics, helping communicators understand how societal factors shape the reception and acceptance of scientific knowledge. Meanwhile, information technology and graphic design enhance science communication through the use of visualizations, infographics, and interactive digital platforms that promote participation and engagement. The arts and humanities add creative and narrative dimensions—using visual art, storytelling, and literary techniques to make scientific ideas more relatable and emotionally resonant (Scrimshaw, 2019; Tuveri et al., 2024; Zallio, 2021).

Ethical and legal considerations emerge from the fields of law and ethics, which emphasize responsible communication, respect for scientific integrity, and awareness of policy frameworks influencing public discourse (Medvecky & Leach, 2019; Priest et al., 2019). Lastly, economics and marketing contribute strategies for promoting scientific initiatives, analyzing the efficiency and impact of communication efforts, and ensuring that resources are allocated effectively. Together, these disciplines form an integrated foundation for science communication, positioning it as both a scientific and cultural endeavor that bridges knowledge production and public understanding. A multidisciplinary approach enables science communication to be more holistic and adaptive to various challenges and contexts. By combining diverse perspectives and skills, science communication practitioners can reach a wider audience and optimize the impact of scientific information (Davies, 2022; Stengler, 2020).

Science topics are often raised through various media platforms within the four groups mentioned above. Currently, one hot topic is environmentally friendly nuclear technology. Based on the application of environmentally friendly nuclear technology, we recognize two sectors: the energy sector (Nuclear Power Plants/NPP) and the non-energy sector (agriculture, animal husbandry, health, industry, etc.) (Murakami & Anbumozhi, 2020). At least the government must fulfill three important things for the smooth development of nuclear power plants in Indonesia: (1) There is a strong commitment from the President regarding the realization of nuclear power plants; (2) The realization of this Presidential commitment by the House of Representatives (DPR) together with the National Energy Council (DEN) through changes to the National Energy Policy (KEN) to make nuclear energy a top priority energy and no longer a last alternative; (3) Public campaigns by the government to increase the level of public acceptance (public acceptance rate) towards the use of nuclear power plants (Hariyadi, 2017). This third point is a crucial point in shaping mindsets and educating the public.

In the Outline of A Theory Practice, it is stated that habitus is related to knowledge resources (Bourdieux, 1977). This is correlated in the form of inhibiting factors for scientists in the context of science communication, namely: language problems (translating the complexity of science from scientific language into semi-popular language that is easily understood by the public), perception problems (tendencies towards various theoretical scientific data and focus on accuracy rather than readability), and value problems (the media's assumption that science does not have enough news value). According to the government's energy roadmap through the Indonesian Ministry of Energy and Mineral Resources (ESDM), it is known that the target for new nuclear needs will begin in 2040, where the demands for the government's seriousness in building a nuclear power plant are very high. In addition, the government will form a Nuclear Energy Regulatory Agency that is directly responsible to the president.

Globally, the development of nuclear power plants for Indonesia as the largest archipelagic country is very much in line with the energy transition in order to achieve the target of zero carbon emissions by 2060, because nuclear is one of the clean energy sources. However, economically, nuclear power plants are considered expensive to maintain, and Indonesia's limited nuclear scientists' ability to produce uranium as fuel is also questionable. These political and economic factors have led to a lack of media coverage of nuclear issues, leading the Indonesian public to become less informed and perceive nuclear issues not only as uninteresting but also as frightening (Massagony et al., 2025; Rahmanta et al., 2023; Santosa et al., 2023).

With regard to the application of environmentally friendly nuclear technology, this study focuses on the energy sector in environmentally friendly nuclear technology through the representation of nuclear power plants (NPP). Furthermore, one key point reinforces the role and urgency of science communication in educating the public about environmentally friendly nuclear technology, which correlates with the government's crucial commitment to ensuring the smooth development of nuclear power plants in Indonesia. This is the urgency of public campaigns by the government to increase public acceptance of nuclear power plants.

This study is to explore the practice of communicating environmentally friendly nuclear technology, particularly through the representation of Nuclear Power Plants (NPP) to the public by nuclear scientists enabling educational innovation in science communication that can foster more effective public engagement in Indonesia’s transition toward clean energy. Hence, this study answers one main question: how do nuclear scientists communicate nuclear power plants (NPP) in Indonesia to the public as the innovation of science communication, which in turn forms public understanding and acceptance?

With the constructivist paradigm and the qualitative approach, this study has some significances as the effective communication strategy for the government in educating the public related to nuclear issues, and the support of policy-making strategy by the government and actors in the issue of NPP development in Indonesia.

The Diffusion of Innovations Theory

In science communication, gaps and innovations reflect the dynamics of developments in conveying scientific information to the public. Therefore, this study utilizes the diffusion of innovation theory, developed by Everett Rogers. This theory is a conceptual framework that explains how, why, and how quickly innovations or new ideas are accepted and spread in society (Rogers et al., 2014).

Rogers's diffusion of innovations theory discusses the process of innovation diffusion from initial discovery to widespread acceptance, using several key concepts:

1. Innovation: Refers to ideas, practices, and objects perceived as new by a particular individual or group. Innovations can be technologies, products, services, or other ideas.
2. Communication: The process of conveying information about innovations. Communication plays a crucial role in shaping individual perceptions of innovations.
3. Communication Channels: The pathways used to convey information about innovations to individuals or groups. These channels can include mass media, interpersonal communication, or even live presentations.
4. Time: The theory of innovation diffusion identifies five categories for measuring diffusion time: innovators, early adopters, early majority, late majority, and lagging majority. Each group has a different level of openness to innovation.
5. Social System: Refers to the social group within which the innovation diffusion process occurs. Social systems can involve smaller groups, such as family or friends, to larger groups, such as communities or organizations.
6. Adoption Decision: The process by which an individual or group decides to accept or reject an innovation. This decision is influenced by various factors, including the characteristics of the innovation and the characteristics of the recipient.
7. Factors Influencing Diffusion: Rogers identified several factors that influence the speed and extent of diffusion, such as the perceived benefits to the recipient, the complexity of the innovation, compatibility with existing values, demonstrability, and limited trials that can be conducted before full adoption.

In this regard, this theory can provide important insights for researchers in understanding how an innovation can be successfully implemented and spread in society, where gaps and innovations in science communication reflect the dynamics of developments in conveying scientific information to the public.

Methodology

This study used a case study method studying a particular phenomenon in a real context—usually complex and multidimensional, particularly a single case with the classification of scientists as the main actors delivering messages within the Indonesian Nuclear Society Association (HIMNI), especially affiliated with the National Research and Innovation Agency (BRIN) as the home to government nuclear scientists—previously, the home for Indonesia nuclear research was the National Nuclear Energy Agency (BATAN). For collecting data, this study applied a triangulation encompassing interview, observation, and document analysis:

1. Interview with nuclear scientists from HIMNI inside and outside BRIN;
2. Participatory observation through the HIMNI webinar series as a form of communication activity;
3. Document analysis related to communication materials in practice carried out by HIMNI as well as BRIN and BATAN as the former entity of nuclear research before BRIN.

Findings and Conclusion

The results of this study can be described as follows:

1. Interview with Nuclear Scientists. The researcher interviewed two nuclear scientists:
    a. Dr. Geni Rina Sunaryo, the nuclear scientist of HIMNI affiliated with BRIN. She is one of female nuclear scientists from BRIN, formerly BATAN. She has

only written in certain media: Detik, Media Indonesia, Senayan Post, Nawacita Study Institute, Istana Rakyat Magazine.
   b. Mr. Harun Ardiansyah, the freelancer as well as the PhD degree holder from the University of Illinois at Urbana-Champaign, USA. He wrote in scientifically certain media like The Conversation.
2. Observation: the researcher participated HIMNI webinar series as a form of communication activity organed regularly by HIMNI at least once a week.
3. Document Analysis: the researcher analyzed some documents related to communication materials in practice:
   a. Carried out by HIMNI through its official website (https://himni.org/), specifically displayed on "Berita" menu of the website (https://himni.org/category/berita/).
   b. Carried out by the National Research and Innovation Agency (BRIN) as the home to government nuclear scientists as displayed on its website, specifically at the Nuclear Energy Research Organization (https://www.brin.go.id/page/profil-pejabat).
   c. Popular nuclear media in BATAN era before merging into BRIN namely NUTECH (http://www.batan.go.id/index.php/id/publikasi-pdk).

Based on the collected data, the researcher found that HIMNI is still limited in innovation and use of digital technology as one form of digital transformation in the current era. Nuclear scientists in this regard have not been used to writing in various popular as well as online media. NUTECH was the pride of BATAN as a media for communicating nuclear science to the public, yet it is no longer published in BRIN era. In addition, the official website of BRIN as the home of nuclear research is lacking in nuclear-related educative content. BRIN displays minimum of specific content related to public campaigns about nuclear or dissemination of nuclear information to the public.

HIMNI is actually expected to play a strategic role in bridging the gap between nuclear scientists and the general public. Through its educational, collaborative, and open approach, HIMNI aims to establish a strong foundation for enhancing public understanding and acceptance of nuclear power plants (NPP) in Indonesia. This effort follows a structured communication strategy that emphasizes education and public literacy as the core pathways toward building trust. By involving experts directly in outreach and leveraging social media platforms as effective communication tools, HIMNI is hopefully capable of strengthening engagement and transparency. Ultimately, these integrated efforts are designed to foster greater public confidence and acceptance of environmentally friendly nuclear technology in Indonesia.

As the definition of science communication in this study as the science of communicating scientific topics in a popular style from scientists to scientists and the public. Practically, this is done through journalistic media (blogs, social media, and television), exhibitions, and public policy mapping with science as a primary element. Therefore, researchers can explore gaps that represent novelty in their research. Gaps and innovations in science communication reflect the dynamic developments in conveying scientific information to the public.

The following are some of the gaps observed in the context science communication in this study:

1. Language gap (scientific-public): the technical and complex language used in scientific publications can be a barrier to public understanding.

2. Demographic gap: ranges from limited access since not all groups in society have equal access to scientific information to generational gap since different generations may have different communication preferences that require diverse approaches.
3. Ethics and integrity challenges: how to respond to scientific uncertainty and how to communicate risks without causing panic or misunderstanding.
4. Issues of the politicization of science: political polarization in which science can be a source of political conflict, and scientific communication can be affected by this polarization.

In this study, various innovations in science communication are needed to address the gaps, and are designed to ensure that scientific information is more effectively accessed, understood, and appreciated by the general public. Here are the recommended innovations:

1. Interactive technology: using interactive technology to present scientific information in a more engaging way.
2. Social media and podcasts: using social media and podcasts as channels to share scientific information and interact directly with audiences.
3. Better data visualization (dynamic infographics and animations): using more dynamic and interactive data visualizations to explain scientific concepts.
4. Use of narrative (scientific stories): using narrative and story elements to make scientific information more engaging and easier to digest.
5. Scientist participation on social media (scientist's presence on social media platforms): scientists who are active on social media can directly interact with the public and disseminate scientific information in a way that is easy to understand.
6. Community engagement programs: programs that directly involve the public in the research or data collection process.
7. Collaboration with artists (arts and sciences): collaboration between scientists and artists to combine elements of art in the presentation of scientific information.
8. Increasing scientific literacy (public education): initiatives to increase scientific literacy among the public to be better able to access, understand, and evaluate scientific information.
9. Use of AI in content personalization: utilizing AI to create content that can be personalized according to the needs and level of understanding of individuals.

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Bridging the Gap: Developing Lexical and Syntactic Complexity Through CLIL After Study Abroad Programmes

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Abstract

This study investigates the development of lexical and syntactic complexity in English as a Foreign Language (EFL) learners after returning from a five-month study abroad programme. While previous research suggests that immersion in English-speaking environments enhances fluency and general communicative competence, questions remain regarding its long-term impact on academic writing proficiency once returned to their home countries. Drawing on Content and Language Integrated Learning (CLIL) as a post-study abroad teaching strategy, this research explores whether CLIL instruction can foster continued growth in advanced academic lexis and syntactic structures. Analysing weekly written samples from six Japanese university students collected over one academic year, this paper aimed at observing changes in linguistic complexity. Through quantitative measures, findings revealed no statistically significant or consistent improvements in lexical nor syntactic complexity despite maintaining overall motivation and engagement of students since returning to their home country. These results suggest that while CLIL can provide a meaningful and content-rich context for EFL language use, it may not in itself be sufficient to stretch learning to observe measurable development in academic writing proficiency. The study highlights the need for more explicit instruction, targeted scaffolding and feedback on complex language use within CLIL frameworks, especially for learners transitioning from immersive environments back to domestic academic contexts. It also raises important pedagogical considerations for supporting sustained linguistic development in post-study abroad programmes.

Keywords: CLIL (Content and Language Integrated Learning), lexical complexity, syntactic complexity, academic writing, study abroad

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Introduction

Study abroad programmes have always been seen as a feasible option for enhancing second language (L2) proficiency among university students. While these immersive experiences often lead to notable gains in confidence as well as spoken fluency, it remains unclear whether they also equip learners with the linguistic tools required for academic writing in English. Upon returning from study abroad, students may still struggle to bridge the gap between conversational proficiency and the demands of academic discourse.

A key concern in EFL language education is the absence of authentic learning, i.e. activities that mirror real-world scenarios and equip learners with meaningful, transferable knowledge that is applicable in practical contexts (Gilmore, 2007). The attractiveness of foreign exchange programme is that communicative activities can be integrated with authentic learning tasks. This has been shown to enhance learner motivation, provide culturally rich L2 (second language) input, and align second language instruction with real-life communicative contexts (Garcia-Pinar, 2019; Jacobs et al., 2022; Ozverir et al., 2017; Purnawarman & Dajarati, 2020; Vellanki & Bandu, 2021). Such authenticity would seem to be effective as it takes into account the learners' identities, the nature of the learning tasks, and the discourse in which the language is used to effectively communicate in a foreign coiuntry (Ahmadi, 2019). When studying abroad, such authenticity is likely to be embedded in instructional design, leading students to increase thei engagement, improved spoken L2 production, and enhanced knowledge transfer (Gilmore, 2007; Larsen et al., 2017; Perkins & Salomon, 2012; Wang et al., 2012). However, when returning back to their home countries, it is questionable that students can continue to maintain this momentum and develop further their academic skills.

To address this possible stagnation after returning from abroad post-study abroad English programme, a *Content and Language Integrated Learning* (CLIL) approach was implemented into the classroom as a pedagogical approach to integrate EAP subject content while also offering a potential pathway for continued language growth through authentic learning.

Literature Review

Study Abroad

Recent research continues to affirm the benefits of study abroad experiences for L2 development, particularly in enhancing oral fluency, pragmatic awareness, and vocabulary breadth (Friginal & Polat, 2022; Reynolds, 2020). Immersion in an L2 environment exposes learners to authentic communicative contexts and varied input, which can significantly improve their confidence and spontaneous language production. These gains are especially notable in functional spoken language and sociolinguistic competence (Bown & Dewey, 2020) as well as gains in fluency, pragmatic competence, and vocabulary breadth (Freed, 1995; Kinginger, 2009).

However, these benefits are not uniformly observed across all linguistic domains. While spoken interaction often improves, gains in academic language proficiency, particularly in academic writing and research, are less consistent (Pérez-Vidal & Barquin, 2014). This is due to study abroad programs catering in developing confidence, emphasising informal communication, and encouraging cultural engagement. These programmes, however, offer limited opportunities for students to engage with academic genres, advanced syntactic structures, or discipline-specific lexis (Lee & Curdt, 2021) as these students are rarely included

in truly academic and authentic enviuronments with native English speakers. As a consequence, students may return with strong conversational fluency but remain underprepared for the true linguistic demands of academic writing in the L2 (Taguchi & Greer, 2019).

Recently, there has been a small but growing body of research that would seem to suggest the necessity in providing post-return support. This should be an essential component for consolidating and hopefully extending the language gains made during study abroad. It would be beneficial for Japanese university students who have returned from their short-term programs abroad, showing improvements in fluency and lexical diversity in speech, but only marginal gains in written complexity (Imai & Kaneko, 2021). A study by Lasagabaster also observed a similar situation with Taiwanese students who studied abroad in English-speaking countries. While they significantly improved in interactive oral skills, they still required academic writing courses to develop their syntactic range and academic vocabulary further (Lasagabaster, 2021). It is evident that without explicit instruction in academic literacy, students may struggle to transfer their communicative gains to contexts that require higher-order cognitive and linguistic skills (Strobl & Baten, 2021). For instance, students' writing complexity, organisation, and vocabulary depth could continue to remain underdeveloped after studying abroad unless structured writing support is provided (Marijuan & Sanz, 2020; Strobl & Baten, 2021). Post-return programs that incorporate academic writing and critical thinking could, therefore, play a crucial role in helping learners internalise and transfer their linguistic gains into formal educational or professional contexts (Crossley & Kyle, 2021). As a result, while study abroad can offer rich, authentic input within immersive experiences to naturally enable L2 development, its impact on academic literacy remains limited without supplementary pedagogical support.

Content and Language Integrated Learning

Although often referred to as methodology, CLIL is not a method in the traditional pedagogical sense. It lacks a fixed set of teaching procedures or a universally agreed-upon implementation model. Rather, CLIL is a flexible educational approach that emerged in Europe in the 1990s, referring to programs in which a second or foreign language is used to teach subject content to learners who are still developing proficiency in that language (Coyle et al., 2010). CLIL is an increasingly influential approach in multilingual education that integrates the learning of academic subject matter with the simultaneous development of a second or foreign language (Coyle et al., 2010; Mehisto et l., 2019). In CLIL contexts, students learn curricular content, such as history, science, or the arts, through a language they are still acquiring.

This dual focus enables learners to use language for meaningful communication while also developing conceptual knowledge. CLIL operates as a dual-focused approach that integrates both content and language learning. While the emphasis may shift between content and language, the two are always interwoven. However, it is important to add that while content-based instruction teaches language through content, CLIL is subtly nuanced in that it focuses on teaching content through language (Echevarria et al., 2017; Lopriore, 2021). In other words, CLIL address the gap by shifting away from teaching language as an isolated subject to a language tool for actual learning (Morton, 2020). Its central aim is to promote meaningful language use in cognitively engaging contexts, thereby fostering deeper learning and broader communicative competence. By integrating language and content, CLIL encourages students to acquire disciplinary knowledge while developing the linguistic tools needed to discuss, analyse, and apply that knowledge in the target language. Such an approach could also have

the potential benefit of mirroring some of the positive aspects of studying abroad and thereby naturally continuing on from where the study abroad programme left off.

Empirical studies confirm that CLIL positively influences aspects of learning felt on foreign language exchanes. These EFL linguistic skills include: receptive skills, vocabulary acquisition, morphological development, creativity, fluency, and learner motivation (Dalton-Puffer, 2008). Students can also continue develop a broader range of academic and technical vocabulary than their peers in other traditional EFL courses. However, despite these obvious benefits, CLIL also appears to have minimal impact on other important aspects of second language acquistion, namely syntax, informal writing, pronunciation, and pragmatics (Table 1). In this research, the course wil adopt CLIL to teach aspects of social studies and other mumanity subjects in English within an EAP contect. Students will hopefully continue to engage in tasks such as discussions and mini-lectures to develop critical thinking and cross-cultural understanding from both British and Japanese perspectives in this EAP setting.

Table 1
Impact of CLIL on Specific EFL Linguistic Skills

Unaffected or Indefinite	Favorably Affected
Syntax	Receptive skills
Informal/non-technical writing	Vocabulary
Pronunciation	Morphology, creativity, risk-taking, fluency
Pragmatics	Emotive/affective outcomes

Lexical and Syntactic Complexity

Lexical and syntactic complexity are widely recognised as key indicators of advanced L2 writing proficiency. These constructs have, in fact, been necessary in assessing and supporting L2 writing development (Yang et al., 2023). Lexical complexity plays a particularly important role in academic writing and is commonly considered an indicator of L2 proficiency and development (Bulté & Housen, 2021). It refers to the richness, variety, and sophistication of vocabulary use, encompassing dimensions such as lexical diversity, lexical density, and word frequency (Lu & Ai, 2015). However, despite its importance, vocabulary acquisition and productive lexical use often receive less explicit attention in Japanese EFL education, particularly in terms of supporting students' academic English development (Paquot & Granger, 2020).

Syntactic complexity, in contrast, reflects the structural variety and grammatical elaboration in writing, including the use of subordinate clauses, compound sentences, passive constructions, and nominalisations (Kyle & Crossley,2019). Syntactic complexity has long been recognised as a key indicator of L2 proficiency, particularly in the context of academic writing. It refers to the range and sophistication of grammatical structures used by a learner and is widely employed in SLA research as a robust metric for evaluating linguistic development over time (Bulté & Housen, 2021; Vyatkina, 2012). When assessing syntactic development in written discourse, especially among university-level English learners, syntactic complexity provides critical insight into learners' ability to produce structurally elaborate and hierarchically organised sentences (Tavakoli & Wright, 2020).

Both types of complexity are essential elements in academic writing competence as they contribute to coherence, precision, and clarity. For instance, more sophisticated academic

writing is characterized by a high degree of lexical and syntactic complexity. It has also become evident that improvements in lexical sophistication, such as the use of low-frequency or academic words, can lead to improvements in reading fluency and writing quality in general (Paquot & Granger, 2020). Similarly, increases in syntactic complexity are associated with higher scores in holistic writing assessments, particularly in academic or argumentative tasks (Staples & Biber, 2021a).

Research Questions

Q1. Will the level of lexical complexity improve as a direct result of the introduction of CLIL?
Q2. Will the level of syntactic complexity improve as a direct result of the introduction of CLIL?

Methodology

Participants

Participants were six third-year students from a private university in Tokyo participated in this study. Each had recently returned from a five-month study abroad programme in Australia. TOEIC scores ranged from 660 to 800 before departure (CEFR: B1-B2) and from 750 to 835 after returning (CEFR: upper B2 to lower C1). Informal interviews indicated increased confidence and motivation to improve academic English.

CLIL Lessons

Over the academic year, students attended a weekly 90-minute CLIL class focusing on topics in cultural and social studies. CLIL classrooms often prioritise content delivery over language scaffolding, so learners may find few opportunities to develop grammatical accuracy and syntactic complexity (Ibarrola & Lasagabaster, 2021). Although CLIL's success depends on careful planning and responsiveness to learners' needs, time constraints meant that, in this course, lessons mainly focused on teaching content through English with minimal language-focused intervention. As a result, there was only limited explicit attention to the mechanics of language form.

Data Collection

Writing samples were collected bi-weekly over one academic year during a CLIL-based EAP course. Students were asked to write spontaniously for a 10-minute period at the end of class their opinions on the discussions introduced. Topics related to social studies and humanities, and were selected to promote critical thinking and expression.

Measuring Lexical Complexity

To assess lexical complexity in this study, we adopted Lu's (2012) Lexical Complexity Analyzer (LCA), a widely validated tool that automatically calculates 26 lexical indices across all three dimensions (Lu, 2012). This tool was chosen for its transparency, accessibility, and alignment with prior research in L2 lexical development. Due to expediency, lexical complexity commonly followed categorised the three distinct but related dimensions: lexical diversity, lexical sophistication, and lexical density (Yang et al., 2023) (Table 2). First, lexical

diversity refers to the range of different words used in a given text, often measured using indices such as the type-token ratio (TTR), and corrected TTR (CTTR) (Malvern et al., 2020). These metrics provide insight into the breadth of vocabulary employed by the learner and are widely used in studies of L2 academic writing. Second, lexical sophistication involves the use of low-frequency, academic, or otherwise advanced words, indicating the depth of a learner's vocabulary (Crossley & Kyle, 2021). Measures such as the proportion of words from the Academic Word List (AWL) and low-frequency word ratio are commonly employed to assess lexical sophistication. These measures are particularly relevant in evaluating learners' ability to engage with academic discourse, as they capture the extent to which students employ domain-specific or context-appropriate lexis (Staples et al., 2020). This paper used lexical sophistication (LS1) and verv sophistication (VS1) to determine this aspect of lexical complexity. Finally, lexical density, in contrast, assesses the informational load of a text by calculating the proportion of content words (nouns, verbs, adjectives, adverbs) to total words (Schmitt et al., 2019). Higher lexical density is generally associated with more formal or academic registers, distinguishing it from conversational or narrative writing. As a consequence, the measure lexical density (LD) was also included in this research.

Table 2

Dimensions of Lexical Complexity, Their Common Measures and Their Academic Relvance

Category	Definition	Typical Measures	Academic Relevance
Lexical Diversity	Range of different words used in a text. Reflects vocabulary breadth.	- Type-Token Ratio (TTR) - Corrected TTR (CTTR)	Indicates vocabulary range and learner variability; commonly used to assess productive vocabulary size. (Yang et al., 2023)
Lexical Sophist-ication	Use of low-frequency, academic, or advanced vocabulary items.	- Proportion of Academic Word List (AWL) words - Low-frequency word ratio such as Lexical Sophistication I (LS1); Verb Sophistication I (VS1)	Reflects lexical depth and learner ability to use domain-specific or contextually appropriate vocabulary. (Crossley & Kyle, 2021)
Lexical Density	Ratio of content words (nouns, verbs, adjectives, adverbs) to all words in the text.	- Lexical Density (LD) (Content Words / Total Words)	Indicates information load and formality; distinguishes academic from conversational writing. (Schmitt et al., 2019)

Measuring Syntactic Complexity

This study adopted Lu's L2 Syntactic Complexity Analyzer (L2SCA) to evaluate syntactic complexity across 14 established indices (Lu, 2010). Its reliability, accessibility, and consistency with corpus-based norms have made it one of the most widely used tools in academic writing research (Lu & Ai, 2015). This study focuses on nine syntactic measures that recent research has consistently found to be both developmentally sensitive and pedagogically relevant in academic contexts (Table 3). These measures are grouped into three primary categories: First are the length-based measures: Mean Length of Sentence (MLS); Mean Length of T-unit (MLT); Mean Length of Clause (MLC). These indices represent overall

grammatical elaboration and have shown significant correlation with writing proficiency in L2 learners, especially in argumentative and expository tasks (Knoch & Elder, 2017; Kyle & Crossley, 2019). The second group of measures are the subordination-based measures: Clauses per Sentence (C/S); Dependent Clauses per Clause (DC/C); Complex T-units per T-unit (CT/T). Subordination reflects learners' ability to build complex syntactic hierarchies, a characteristic of advanced academic writing. These measures are particularly effective in distinguishing between intermediate and advanced levels of syntactic development (Crossley & Kyle, 2020). The final measures concentrates on phrasal complexity: Complex Nominals per Clause (CN/C); Complex Nominals per T-unit (CN/T); Verb Phrases per T-unit (VP/T). These indices measure nominal and verbal elaboration, which are increasingly seen as indicators of mature academic style, especially in scientific and technical writing. Phrasal complexity has recently been recognised as a key developmental feature in academic writing that complements traditional clause-based complexity (Parkinson & Musgrave, 2014). Overall, this selection aligns with validated frameworks for assessing syntactic complexity in academic L2 writing (Staples & Biber, 2021b).

Table 3
Dimensions of Syntactic Complexity, Their Common Measures and Their Academic Relevance

Category	Measure	Definition	Academic Relevance
Length-Based	Mean Length of Sentence (MLS)	Average number of words per sentence.	Indicates overall grammatical elaboration; associated with advanced writing proficiency. (Kyle & Crossley, 2019)
	Mean Length of T-unit (MLT)	Average number of words per T-unit (an independent clause with any subordinate clauses).	Strongly correlated with writing fluency and syntactic maturity in academic genres. (Kyle & Crossley, 2019)
	Mean Length of Clause (MLC)	Average number of words per clause.	Reflects how learners elaborate on ideas within sentence-level grammar.(Kyle & Crossley, 2019)
Subordination-Based	Clauses per Sentence(C/S)	Average number of clauses per Sentence.	Captures sentence complexity through subordinate clause use. (Crossley & Kyle, 2020)
	Dependent Clauses per Clause (DC/C)	Ratio of dependent to total clauses.	Measures hierarchical sentence structure, signalling higher writing proficiency. (Crossley & Kyle, 2020)
	Complex T-units per T-unit (CT/T)	Proportion of T-units containing more than one clause.	Useful in identifying syntactic sophistication in expository and argumentative writing.(Crossley & Kyle, 2020)
Phrasal Complexity	Complex Nominals per Clause (CN/C)	Number of noun phrases with modifiers per clause.	Reflects nominal elaboration typical of academic writing style. (Parkinson & Musgrave, 2014)

	Complex Nominals per T-unit (CN/T)	Number of complex noun phrases per T-unit.	Associated with increased density and formality in academic prose. (Parkinson & Musgrave, 2020)
	Verb Phrases per T-unit (VP/T)	Number of verb phrases per T-unit.	Captures verbal complexity and helps identify developmental differences in syntactic use. (Parkinson & Musgrave, 2020)

Results

Lexical

Lexical Diversity

The mean TTR across the term was 0.63 (SD = 0.06), indicating a moderate range of lexical variety in student writing. A repeated-measures ANOVA revealed a significant difference across the 14 time points, $F(13, 182) = 230.43$, $p < .001$, $\eta^2 = 0.943$, suggesting that nearly 94% of the variation in TTR was linked to changes over time. However, a correlation analysis showed a non-significant downward trend ($r = –0.396$, $p = 0.161$), implying that while variation occurred, lexical diversity did not steadily increase.

Similarly, CTTR, which adjusts for text length, averaged 4.56 (SD = 0.39) over the 14 weeks. This measure also demonstrated significant differences over time, $F(13, 182) = 132.81$, $p < .001$, $\eta^2 = 0.905$, with a very large effect size. Yet again, correlation analysis revealed a non-significant decline ($r = ç0.282$, $p = 0.329$), suggesting that although CTTR values fluctuated, no consistent upward trajectory was observed.

Table 4

Lexical Diversity: Type-Token Ratio (TTR) and Corrected Type-Token Ratio (CTTR)

TTR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean	**0.63**	**0.66**	**0.60**	**0.62**	**0.61**	**0.69**	**0.69**	**0.67**	**0.63**	**0.59**	**0.60**	**0.63**	**0.63**	**0.55**
SD	0.10	0.06	0.04	0.06	0.06	0.06	0.05	0.05	0.06	0.07	0.09	0.07	0.06	0.07
Max	0.77	0.71	0.66	0.71	0.70	0.76	0.72	0.74	0.71	0.70	0.72	0.73	0.68	0.64
Min	0.52	0.57	0.56	0.55	0.54	0.60	0.61	0.60	0.55	0.52	0.49	0.54	0.56	0.46
CTTR														
Mean	**4.63**	**4.59**	**4.56**	**4.58**	**4.41**	**4.83**	**4.54**	**4.47**	**4.73**	**4.56**	**4.49**	**4.74**	**4.50**	**4.27**
SD	0.34	0.62	0.31	0.16	0.07	0.19	0.54	0.38	0.55	0.65	0.45	0.31	0.53	0.31
Max	5.01	5.22	4.97	4.79	4.51	5.07	5.03	5.10	5.62	5.54	4.99	5.10	4.92	4.61
Min	4.10	3.83	4.24	4.36	4.35	4.53	3.79	3.97	4.25	4.03	3.97	4.27	3.67	3.84

Taken together, the results indicate that while both TTR and CTTR varied significantly across time, neither measure showed sustained improvement. This may reflect the cognitive and linguistic demands of CLIL content, where students prioritised content comprehension and grammatical accuracy over increasing lexical variety.

Lexical Sophistication

Table 5

Lexical Sophistication: Lexical Sophistication I (LS1) and Verb Sophistication I (VS1)

LS1	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean	**0.172**	**0.303**	**0.188**	**0.205**	**0.162**	**0.365**	**0.243**	**0.215**	**0.318**	**0.354**	**0.134**	**0.175**	**0.330**	**0.318**
SD	0.066	0.031	0.038	0.062	0.041	0.114	0.117	0.048	0.053	0.061	0.025	0.038	0.048	0.059
Max	0.244	0.343	0.222	0.258	0.225	0.473	0.354	0.278	0.357	0.438	0.176	0.217	0.404	0.386
Min	0.081	0.265	0.145	0.098	0.118	0.196	0.091	0.147	0.226	0.293	0.115	0.118	0.288	0.235
VS1														
Mean	**0.047**	**0.036**	**0.025**	**0.092**	**0.071**	**0.067**	**0.066**	**0.080**	**0.047**	**0.052**	**0.092**	**0.075**	**0.108**	**0.029**
SD	0.044	0.065	0.034	0.094	0.041	0.042	0.052	0.074	0.044	0.050	0.041	0.060	0.050	0.030
Max	0.087	0.150	0.062	0.250	0.100	0.105	0.111	0.174	0.087	0.105	0.133	0.148	0.174	0.071
Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.000	0.053	0.000

The average LS1 score was 0.25 (SD = 0.06), representing the proportion of low-frequency or academic vocabulary used in student writing. A repeated-measures ANOVA showed a highly significant difference across time, $F(13, 182) = 962.69$, $p < .001$, $\eta^2 = 0.986$, indicating nearly all variance in LS1 was accounted for by time. A correlation analysis revealed a non-significant positive trend ($r = 0.276$, $p = 0.340$), suggesting some upward movement in lexical sophistication, but without statistical confirmation of consistent growth.

VS1, representing verb-related lexical sophistication, had a mean of 0.06 (SD = 0.05). ANOVA results again indicated significant variation across time, $F(13, 182) = 109.76$, $p < .001$, $\eta^2 = 0.887$. Correlation analysis showed a non-significant positive trend ($r = 0.315$, $p = 0.272$), implying that students gradually increased their use of advanced or less frequent verbs, though not at a statistically significant rate.

In summary, both LS1 and VS1 demonstrated significant fluctuations across time, with very large effect sizes, yet neither showed a steady linear improvement. These results indicate that while CLIL instruction may encourage more sophisticated lexical choices, especially in verb use, gains may be topic-dependent or uneven in progression.

Lexical Density

Table 6

Lexical Density

LD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean	**0.571**	**0.600**	**0.600**	**0.585**	**0.589**	**0.597**	**0.599**	**0.550**	**0.581**	**0.618**	**0.544**	**0.578**	**0.579**	**0.597**
SD	0.049	0.030	0.024	0.064	0.047	0.043	0.040	0.086	0.017	0.017	0.037	0.060	0.045	0.041
Max	0.625	0.642	0.638	0.673	0.639	0.667	0.629	0.653	0.600	0.644	0.593	0.659	0.626	0.663
Min	0.516	0.571	0.579	0.500	0.514	0.560	0.541	0.447	0.559	0.595	0.500	0.510	0.509	0.566

The data showed no significant consistent improvements in lexical or syntactic complexity at the group level. However, individual differences were observed, suggesting that learners responded differently to the instructional context. The most notable finding was a strong negative correlation between lexical sophistication (LS1) and verb phrases per T-unit (VPT), $r = –0.628$, $p < .001$. Moderate negative correlations were also observed between LS1 and DCT ($r = ç0.450$) and LS1 and MLT ($r = –0.295$).

These patterns further support the idea that increased lexical complexity may coincide with reduced syntactic elaboration, likely due to cognitive constraints in managing both dimensions simultaneously. These findings align with the Limited Attentional Capacity Model (Skehan, 2009), which posits that learners may prioritise either lexical sophistication or syntactic complexity depending on task demands and available cognitive resources.

Syntax

Length-Based

Table 7

Length-Based Measures: Mean Length of Sentence (MLS), Mean Length of T-unit (MLT), Mean Length of Clause (MLC)

MLS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean	**15.89**	**15.45**	**17.55**	**14.88**	**15.12**	**15.06**	**18.14**	**16.31**	**15.45**	**16.79**	**18.80**	**16.99**	**15.60**	**12.48**
SD	4.44	3.38	4.21	3.34	1.83	2.20	7.58	1.67	1.70	0.82	6.93	2.58	3.17	1.48
Max	21.00	21.00	21.25	19.86	17.25	18.00	28.33	19.33	18.14	17.50	29.00	20.00	18.83	15.10
Min	9.91	12.14	11.00	11.89	13.14	12.13	11.25	14.80	14.00	15.63	12.14	13.67	11.11	11.50
MLT														
Mean	**14.04**	**13.33**	**15.73**	**13.31**	**13.42**	**12.23**	**13.23**	**13.97**	**13.63**	**13.76**	**16.76**	**15.17**	**11.85**	**10.93**
SD	4.27	1.53	2.97	2.60	1.94	2.00	5.36	2.04	0.60	0.77	7.21	2.23	2.40	1.32
Max	21.00	15.75	18.14	16.57	15.43	15.17	21.25	16.57	14.20	15.00	29.00	18.75	15.29	12.58
Min	9.91	12.00	11.00	10.38	11.50	9.80	10.00	10.67	12.73	13.00	10.83	13.00	9.09	9.00
MLC														
Mean	**8.57**	**8.65**	**8.51**	**8.48**	**7.34**	**8.83**	**6.96**	**8.06**	**11.38**	**10.50**	**9.70**	**7.90**	**8.19**	**8.47**
SD	1.12	2.17	2.19	0.30	0.92	1.27	0.88	1.60	1.76	1.70	3.09	0.72	0.61	1.08
Max	9.69	11.14	12.14	8.91	8.36	10.18	7.73	10.57	13.71	13.00	14.50	9.11	9.11	10.22
Min	6.81	6.30	6.50	8.23	6.57	7.00	6.00	6.17	9.57	8.75	6.55	7.32	7.53	7.31

This study investigated syntactic development in L2 writing following a study abroad experience, using three measures of complexity: Mean Length of Sentence (MLS), Mean Length of T-unit (MLT), and Mean Length of Clause (MLC). Data were collected over 14 CLIL-based instructional sessions, and changes across time were analysed using repeated-measures ANOVA, linear regression, and correlation analysis.

The analysis of MLS revealed an average sentence length of 16.04 words (SD = 3.24). A repeated-measures ANOVA showed that the variation in sentence length across time was statistically significant, $F(13, 182) = 36.09$, $p < .001$, with a large effect size ($\eta^2 = 0.720$). This indicates that sentence complexity fluctuated meaningfully over the course. However, a linear regression showed only a slight upward trend, and the correlation between MLS and time was not statistically significant ($r = –0.073$, $p = 0.805$). While sentence length varied across the 14 sessions, there was no consistent linear increase in complexity.

For MLT, the average T-unit length was 13.67 words (SD = 2.66). ANOVA results indicated significant changes across the time points, $F(13, 182) = 2.37 \times 10^{29}$, $p < .001$, with an extremely large effect size ($\eta^2 = 1.000$). Despite this, the linear regression suggested a slight downward trend, and correlation analysis confirmed no significant relationship with time ($r = –0.189$, $p = 0.519$). These findings suggest that while structural changes occurred in T-unit length, they did

not reflect a steady increase in syntactic elaboration; rather, students may have opted for more concise structuring over time.

In contrast, MLC showed more promising indicators of development. The average clause length was 8.68 words (SD = 1.39), and this measure exhibited the lowest variability of the three, suggesting relative stability in clause construction. Repeated-measures ANOVA confirmed a significant difference across time, $F(13, 182) = 98.53$, $p < .001$, with a very large effect size ($\eta^2 = 0.876$). A linear regression showed a gentle upward trend in clause length, and while the correlation with time was not statistically significant ($r = 0.166$, $p = 0.571$), the direction of the trend points to a gradual increase in clause-level syntactic complexity.

In summary, while all three measures (MLS, MLT, and MLC) demonstrated statistically significant variation over the course of the programme, only MLC showed a clear and sustained trend toward greater complexity. This suggests that CLIL-based instruction may be particularly effective in supporting internal clause development, even if broader sentence- or T-unit-level complexity does not progress in a strictly linear fashion.

Subordination-Based

Table 8

Subordination-Based Measures: Clauses per Sentence (C/S), Dependent Clauses per Clause (DC/C), Complex T-units per T-unit (CT/T)

C/S	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean	**1.83**	**1.94**	**2.10**	**1.75**	**2.10**	**1.74**	**2.55**	**2.08**	**1.37**	**1.64**	**2.01**	**2.18**	**1.93**	**1.49**
SD	0.33	0.87	0.48	0.38	0.43	0.37	0.81	0.39	0.15	0.32	0.77	0.43	0.49	0.25
Max	2.17	3.33	2.83	2.29	2.63	2.20	3.67	2.40	1.56	2.00	3.33	2.50	2.50	1.80
Min	1.46	1.14	1.69	1.38	1.57	1.25	1.75	1.40	1.17	1.25	1.43	1.50	1.33	1.13
DC/C														
Mean	**0.37**	**0.32**	**0.45**	**0.34**	**0.44**	**0.27**	**0.39**	**0.42**	**0.17**	**0.23**	**0.39**	**0.43**	**0.24**	**0.24**
SD	0.12	0.18	0.13	0.12	0.11	0.13	0.07	0.11	0.12	0.16	0.17	0.10	0.14	0.09
Max	0.54	0.50	0.59	0.50	0.57	0.40	0.46	0.58	0.29	0.42	0.60	0.60	0.40	0.33
Min	0.23	0.13	0.29	0.20	0.27	0.09	0.30	0.29	0.00	0.00	0.20	0.33	0.08	0.11
CT/T														
Mean	**0.61**	**0.35**	**0.63**	**0.46**	**0.62**	**0.38**	**0.62**	**0.58**	**0.16**	**0.24**	**0.55**	**0.57**	**0.38**	**0.24**
SD	0.28	0.20	0.28	0.20	0.28	0.25	0.30	0.22	0.11	0.18	0.28	0.13	0.25	0.11
Max	1.00	0.58	1.00	0.78	0.86	0.60	1.00	1.00	0.30	0.43	0.88	0.75	0.71	0.33
Min	0.30	0.14	0.40	0.25	0.25	0.10	0.33	0.40	0.00	0.00	0.25	0.43	0.09	0.06

To examine development in subordinate clause usage, three measures were analysed over the 14-week CLIL-based course: Clauses per Sentence (C/S), Dependent Clauses per Clause (DC/C), and Complex T-units per T-unit (CT/T).

The mean number of clauses per sentence (C/S) was 1.91 (SD = 0.30), indicating moderately complex sentence constructions. A repeated-measures ANOVA revealed a statistically significant difference across the 14 time points, $F(13, 182) = 167.98$, $p < .001$, $\eta^2 = 0.923$, suggesting that over 92% of the variance in clause use per sentence was attributable to instructional time. Linear regression analysis showed a noticeable upward trend, indicating that students increasingly produced multi-clause sentences as the term progressed.

The proportion of dependent clauses per clause (DC/C) averaged 0.34 (SD = 0.13). ANOVA results confirmed significant variation across time, $F(13, 182) = 55.14$, $p < .001$, $\eta^2 = 0.798$. Although the regression trend was subtler than that of C/S, it was still upward, suggesting a gradual increase in learners' use of subordination strategies over time.

The ratio of complex T-units per T-unit (CT/T) was 0.46 on average (SD = 0.22), reflecting learners' integration of subordinate structures into complete thought units. ANOVA again revealed significant changes over time, $F(13, 182) = 38.76$, $p < .001$, $\eta^2 = 0.735$, with a moderate upward regression trend. These results indicate increasing syntactic maturity in how students structured and extended their ideas.

Taken together, all three subordination-based measures demonstrated statistically significant variation across time and positive developmental trends. These findings suggest that CLIL instruction following study abroad may support learners in advancing their use of embedded and hierarchical sentence structures—an essential aspect of academic writing fluency.

Phrasal Complexity

Table 9

Phrasal Complexity: Complex Nominals per Clause (CN/C); Complex Nominals per T-unit (CN/T); Verb Phrases per T-unit (VP/T)

CN/C	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean	**0.75**	**1.03**	**1.09**	**0.72**	**0.62**	**0.69**	**0.81**	**0.68**	**1.13**	**1.23**	**0.70**	**0.80**	**1.05**	**0.93**
SD	0.13	0.34	0.43	0.17	0.24	0.13	0.22	0.27	0.36	0.14	0.28	0.49	0.28	0.36
Max	0.89	1.57	1.71	0.94	1.00	0.90	1.09	1.14	1.57	1.36	1.13	1.67	1.56	1.33
Min	0.62	0.75	0.68	0.55	0.42	0.57	0.63	0.42	0.79	1.08	0.50	0.50	0.87	0.62
CN/T														
Mean	**1.24**	**1.62**	**2.01**	**1.13**	**1.13**	**0.98**	**1.60**	**1.15**	**1.37**	**1.65**	**1.29**	**1.46**	**1.52**	**1.18**
SD	0.39	0.44	0.71	0.34	0.38	0.34	0.94	0.32	0.43	0.38	0.82	0.63	0.43	0.40
Max	1.67	2.00	3.00	1.67	1.67	1.50	3.00	1.60	2.00	2.29	2.25	2.50	2.00	1.69
Min	0.80	0.86	1.15	0.75	0.83	0.70	1.00	0.71	0.89	1.30	0.67	0.86	1.00	0.75
VP/T														
Mean	**2.43**	**1.91**	**2.87**	**2.35**	**2.57**	**1.81**	**2.03**	**2.21**	**1.78**	**1.49**	**2.73**	**2.49**	**1.73**	**1.51**
SD	0.47	0.48	0.59	0.67	0.30	0.21	0.66	0.41	0.33	0.14	0.59	0.46	0.52	0.25
Max	3.17	2.50	3.86	3.11	2.86	2.00	3.00	2.86	2.10	1.71	3.50	3.13	2.43	1.75
Min	2.00	1.29	2.44	1.63	2.13	1.50	1.57	1.67	1.29	1.33	2.00	1.83	1.27	1.13

This section reports the development of phrasal complexity over 14 CLIL-based sessions, using three key measures: Complex Nominals per Clause (CN/C), Complex Nominals per T-unit (CN/T), and Verb Phrases per T-unit (VP/T).

The mean value of complex nominals per clause (CN/C) was 0.70 (SD = 0.17), reflecting a moderate density of noun phrase elaboration at the clause level. A repeated-measures ANOVA revealed a statistically significant difference across time points, $F(13, 182) = 23.02$, $p < .001$, $\eta^2 = 0.622$, indicating that nearly two-thirds of the variance was attributable to instructional changes. However, correlation analysis showed no significant trend across time ($r = 0.089$, $p = 0.763$), suggesting that while variability occurred, it did not consistently increase or decrease.

The complexity of noun phrases at the T-unit level (CN/T) averaged 1.25 (SD = 0.28), indicating frequent use of extended noun constructions. The ANOVA results showed significant differences across the term, $F(13, 182) = 15.94$, $p < .001$, $\eta^2 = 0.533$, with a medium-to-large effect size. The Pearson correlation showed a weak negative trend ($r = –0.271$, $p = 0.345$), indicating that although T-units were often complex, their elaboration did not increase over time and may have slightly decreased.

Verb phrase density, measured by verb phrases per T-unit (VP/T), yielded an average of 1.79 (SD = 0.25). The ANOVA showed significant differences across the 14 time points, $F(13, 182) = 8.97$, $p < .001$, $\eta^2 = 0.391$, suggesting moderate variability. However, the trend analysis showed a weak, non-significant positive trend ($r = 0.142$, $p = 0.631$), implying that learners may have incrementally increased their use of verb phrases, though not in a statistically meaningful way.

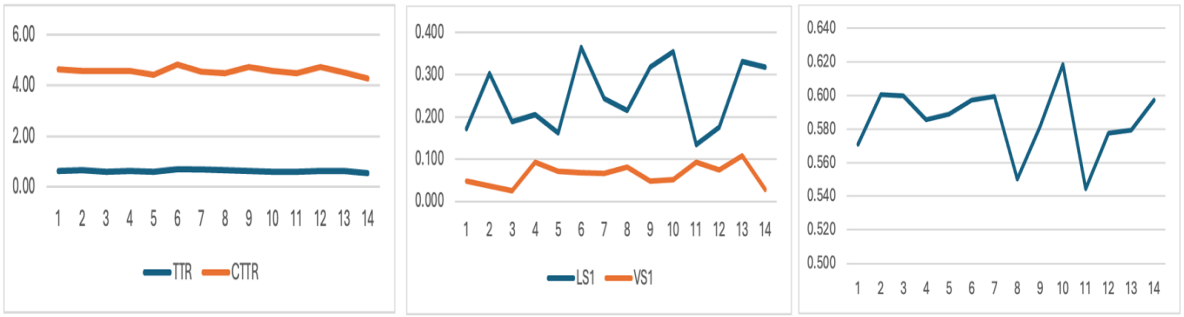
In summary, while all three phrasal complexity measures showed statistically significant changes across time, none displayed a consistent linear trend. These findings indicate that although CLIL instruction may foster structural variation and phrasal elaboration, such development does not necessarily progress in a steady or upward direction.

Discussion

Q1. Will the level of lexical complexity improve as a direct result of the introduction of CLIL?

Graphs 1–3

Lexical: 1. Diversity (left), 2. Sophistication (centre), 3. Density (right)



The results revealed statistically significant variation over time in all measured aspects of lexical complexity. Lexical diversity (TTR, CTTR) (Graph 1), lexical sophistication (LS1, VS1) (Graph 2), and lexical density (LD) (Graph 3) show no consistent upward trend. For example, while LS1 and VS1 showed positive correlations with time, these trends were not statistically significant. Similarly, TTR and CTTR showed slight downward trends, and LD remained relatively flat. These findings suggest that CLIL alone does not lead to sustained improvements in lexical complexity.

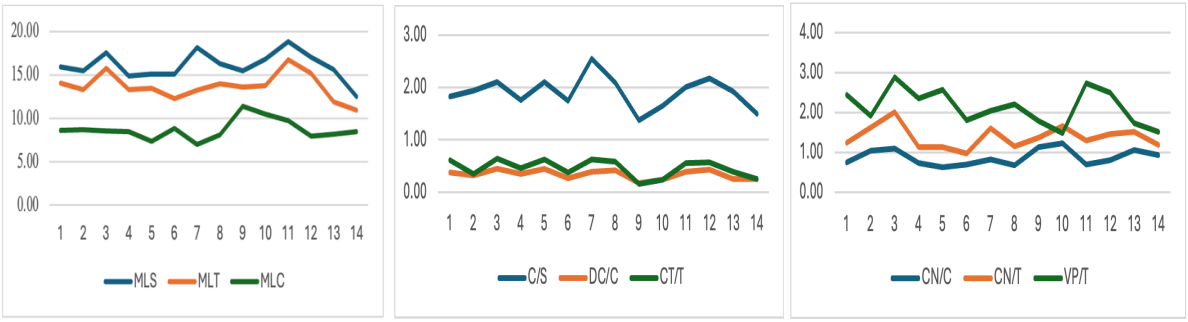
These outcomes suggest that while CLIL may foster variability and topic-related fluctuations in lexical usage, it does not in itself ensure steady gains in academic lexical development. This may be due to the cognitively demanding nature of CLIL tasks, which place pressure on learners' processing capacity. Learners may simplify vocabulary in favour of maintaining content coherence, illustrating the often-cited lexico-syntactic trade-off (Révész et al., 2020). Furthermore, although CLIL encourages exposure to domain-relevant texts, it often lacks

explicit focus on academic vocabulary development (Paquot & Granger, 2020), and students may struggle to internalise and actively produce advanced lexis without scaffolded vocabulary tasks. These findings align with previous studies suggesting that post-return academic language instruction must be explicitly targeted, particularly if lexical development is to be fostered (Crossley & Kyle, 2021; Lasagabaster, 2021).

Q2. Will the level of syntactic complexity improve as a direct result of the introduction of CLIL?

Graphs 4–6

Syntactic: 4. Length-Based (Left), 5. Subordination-Based (Centre), 6. Phrasal Complexity (Right)



The introduction of CLIL did not result in overall improvement across all aspects of syntactic complexity. Focusing on Length-Based Measures (Graph 4) , Mean Length of Sentence (MLS), T-unit (MLT), and Clause (MLC) indicated no consistent upward trend. In fact, by the end of the academic year, MLS and MLT values became slightly lower than at the beginning of the course. Subordination-Based Measures (Graph 5) also indicated no progress. Measures like Clauses per Sentence (C/S) and Dependent Clauses per Clause (DC/C) showed inconsistent results, with fluctuations but no overall imporvement. This suggests that learners did not systematically improve in producing subordinated structures. Phrasal Complexity (Graph 6) was the only aspect of syntactic complexity where an upward trend in the metrics, CN/C, CN/T, VP/T, was observed although not linearly and not significantly. It could be argued that phrasal complexity measures improved across most learners, which could indicate a possible shift toward denser, noun-based academic style, even if sentence or clause complexity remained static. These outcomes support the idea that CLIL may not systematically shift students toward more complex global syntactic constructions unless explicit instruction is included (Ibarrola & Lasagabaster, 2021).

Implications

Table 10

Summary of Significant Improvement in Lexical and Syntactic Complexity Measures and Instructional Suggestions

Domain	Measure	Significant Change	Correlation Trend	Effect Size (η^2)	Instructional Suggestion
Lexical Diversity	TTR	Yes	Non-significant ↓	0.943	Introduce targeted vocabulary tasks with range-building goals.
Lexical Diversity	CTTR	Yes	Non-significant ↓	0.905	Use longer writing prompts to naturally increase CTTR.
Lexical Sophistication	LS1	Yes	Non-significant ↑	0.986	Focus on low-frequency and academic vocabulary introduction.
Lexical Sophistication	VS1	Yes	Non-significant ↑	0.887	Support verb-focused lexical expansion using academic verbs.
Lexical Density	LD	Yes	Non-significant ↓	0.829	Encourage summarisation & explanation tasks to increase lexical density.
Sentence Complexity	MLS	Yes	Non-significant ↓	0.72	Encourage varied sentence structure but pair with cohesion training.
Sentence Complexity	MLT	Yes	Non-significant ↓	1	Support with sentence planning to prevent overly short T-units.
Sentence Complexity	MLC	Yes	Non-significant ↑	0.876	Reinforce internal clause building with practice in relative clauses.
Subordination	C/S	Yes	Significant ↑	0.923	Introduce scaffolded exercises on subordination and conjunction use.
Subordination	DC/C	Yes	Non-significant ↑	0.798	Encourage awareness of clause roles in complex ideas.
Subordination	CT/T	Yes	Non-significant ↑	0.735	Use structured sentence combination tasks to strengthen T-unit complexity.
Phrasal Complexity	CN/C	Yes	Non-significant ↑	0.622	Expose students to academic noun phrase models (e.g., nominalisation).
Phrasal Complexity	CN/T	Yes	Non-significant ↓	0.533	Provide sentence frames with embedded nominal structures.
Phrasal Complexity	VP/T	Yes	Non-significant ↑	0.391	Practice expanding verb phrases through tense, aspect, and modality.

As there was no significant progress evident in any of the lexical and synactic complexity over the academic year (Table 10), it would appear that there is some kind of cognitive trade-off in L2 writing (Skehan, 2009). Learners may prioritise either vocabulary or syntax depending on

task demands and cognitive resources. This finding has important pedagogical implications: without structured support, students may be unable to optimise both dimensions of complexity, limiting their academic writing development.Taken together, the findings confirm that CLIL serves as a valuable platform for extending fluency and discourse-level writing, but its impact on advanced academic language development, especially lexical sophistication and broader syntactic growth, requires additional pedagogical scaffolding. The data support calls in recent literature for integrating genre-based writing support and explicit linguistic objectives within CLIL instruction (Gierlinger, 2020; Matsuda, 2023).

As students return from immersive English programmes abroad, their fluency and confidence often outpace their academic writing capabilities. While it is evident that CLIL provides a valuable opportunity to reinforce language learning through meaningful content, additional support would seem to be required to ensure that students can meet the demands of academic discourse. CLIL does promote meaningful language use but it does not automatically result in increased complexity unless it is combined with explicit instruction in academic language. If participants have not been directed to develop specific lexical or syntactic features, it may explain the lack of measurable progress. Moreover, the absence of feedback on writing quality would also have further limited the opportunities for targeted improvement on specific aspects of academic writing. CLIL, by itself, may serve more as a platform to maintain and arguably build skills in L2 communication than a mechanism for developing refined academic writing skills. To develop complexity at a lexical and syntactic level, there may be the need for finely-tuned interventions and carefully scaffolded tasks to develop the mechanics in academic Language. Given the challenging transition from spoken to written academic English, returning students may benefit from scaffolding activities that target sentence structure, academic collocations, and cohesive devices. Combining CLIL with explicit writing instruction could better support learners' needs.

However, it remains unclear at what level that would not interfere with fluency and motivation. One method would be to include focused instruction on aspects such as advanced lexis, and syntactic structures. To optimise gains, instructors may consider: introducing corpus-informed vocabulary tasks that target academic collocations; providing sentence combining and expansion exercises to foster syntactic fluency; or incorporating reflective self-assessment and peer review, helping learners track development over time. Such support may involve tailored writing workshops, peer-review sessions, and exposure to model texts, all of which can guide students in transforming conversational competence into academic proficiency. Hopefully, these measures can support students in transforming the gains made during immersive language use abroad into academic literacy gains that are sustainable and transferrable to university and professional settings.

Conclusion

While the data indicated slight but not significant improvement in syntactic complexitity, except at subordination, overall there was no evidence in clear progress. However, ultimately, CLIL alone is not sufficiently effective in developing higher-level academic writing proficiency. This research would argue for the inclusion of supplementing CLIL-based instruction with focused academic writing support to assist students returning from their EFL programmes abroad. While immersion builds communicative confidence and general proficiency, academic writing development requires targeted strategies to target issues and enhance lexical and syntactic complexity. The integration of CLIL with explicit instruction would, therefore, seem to offer a promising direction for supporting learners’ transition from

general spoken English to more advanced EAP courses. Future implementations of CLIL should consider incorporating academic literacy goals into course design, including formative assessment, metacognitive reflection, and task-based writing development to assist in and stretch further each student's L2 academic endeavours.

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Digital Literacy Education for Political Communication Ethics and Culture in Digital Space: Reflections After the 2024 Indonesian Simultaneous Elections

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Abstract

The rapid development of information technology has given rise to social media as a new space for shaping public opinion, particularly in political participation and democratic practices. However, instead of strengthening democracy, digital media in Indonesia has often worsened public communication through the spread of disinformation, hate speech, and identity politicization. This became especially visible during the 2019 Indonesian Election and resurfaced in the 2024 Indonesian Simultaneous Elections, marked by sharp political polarization fueled by unchecked information flows on platforms like Facebook, X (Twitter), Instagram, and TikTok. From a communication education perspective, digital literacy involves not only technical skills to access and manage information but also critical abilities to evaluate, create knowledge, and engage ethically in digital spaces. The four pillars of digital literacy introduced by Siberkreasi of the Indonesian Ministry of Communication and Information (Kominfo), which are digital skills; digital culture; digital ethics; and digital safety form a key foundation for fostering civilized political communication. In particular, digital culture and digital ethics play vital roles in shaping national character, reinforcing *Pancasila* values, and upholding ethical standards in free expression. This study reflects on the practice of digital literacy during the 2024 Indonesia Simultaneous Elections and identifies key lessons for strengthening communication education moving forward. By making digital literacy a strategic educational agenda, Indonesia's younger generation can be better equipped to enhance democratic practices through ethical, inclusive, and knowledge-based political communication in today's dynamic digital era.

Keywords: social media, public opinion, digital media, disinformation, 2024 Indonesian simultaneous elections, digital literacy, Siberkreasi, political communication

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Introduction

The development of information technology has changed the landscape of contemporary democracy, especially through the presence of social media which has become a new space in the formation of public opinion and political participation (Kaplan & Haenlein, 2010; Smith, 2011). The media, which initially functioned as a pillar of democracy and a channel for public information, now faces serious challenges due to the rapid flow of free, fast digital information that is not always accompanied by validation and communication ethics (Bahruddin, 2019; Strömberg, 2015). In Indonesia, this phenomenon was clearly seen in the implementation of the 2019 General Election and became stronger in the 2024 Simultaneous Election, where platforms such as Facebook, X (Twitter), Instagram, and TikTok became the main means of campaigning, political communication, and the spread of disinformation, hate speech, and politicization of identity (Ramadlan, 2022; Syah et al., 2025).

Although social media has the potential to expand political participation, its ease of access and anonymity also open up space for political communication deviations, especially by users who do not understand journalistic principles and digital communication ethics (Bahruddin, 2019; Syafarani et al., 2023). In this context, Indonesia's digital democracy is still procedural, with the quality of participation not yet supported by adequate political knowledge (Hart et al., 2004; Maiello et al., 2003). This situation is exacerbated by the low level of digital literacy and the weak public awareness of the importance of ethical political communication.

To respond to these challenges, digital literacy needs to be interpreted not only as technical skills in accessing information, but also as critical and ethical abilities in sorting, assessing, and disseminating information responsibly (Setyaningsih et al., 2019; Suherdi, 2021). The Kominfo digital literacy program through the National Siberkreasi Movement emphasizes four main pillars: digital skills, digital culture, digital ethics, and digital safety (Fajri, 2022). Of the four pillars, digital culture and ethics are important foundations in shaping the nation's character and strengthening *Pancasila* values in the digital space. *Pancasila*, the philosophical foundation of the Indonesian state, consists of five core principles: belief in one supreme God, a just and civilized humanity, the unity of Indonesia, democracy guided by inner wisdom through deliberation, and social justice for all.

Thus, digital literacy rooted in ethical and cultural values is not only needed to stem the flow of hoaxes and hate speech, but is also strategic in supporting substantial democracy in Indonesia. This study aims to reflect on digital literacy practices in the context of the 2024 Simultaneous Elections and provide important implications for strengthening political communication education in the digital era. This study aims to answer the main question: how can digital literacy education strategies encourage the strengthening of ethics and culture of political communication in the 2024 Simultaneous Elections?

This study is based on a constructivist paradigm that views social reality as the result of joint construction through interaction, symbols, and communication processes (Creswell & Creswell, 2017). In this context, social media as a digital communication space not only acts as a channel for information, but also as an arena for negotiating meaning, values, and political identities. Therefore, a qualitative approach based on library research is used to examine how digital literacy education plays a role in shaping healthy political communication ethics and culture amidst the dynamics of the 2024 Simultaneous Elections.

The significance of this study lies in its contribution to filling the gap in academic discourse on the importance of digital ethics and culture in Indonesian electoral democracy. Amid the current of disinformation and hate speech that is spreading in the digital space, digital literacy education is not only a technical need, but also a normative need in realizing substantial democracy (Kominfo, 2023; Ward & Vedel, 2006). This study is expected to enrich the literature on the relationship between digital media, civic education, and strengthening democratic values in the era of technology-based political communication.

The Network Society Theory

As a figure of the Network Society Theory, Castells (2011) argues that contemporary society is increasingly structured through networks that include communication technologies, social relations, economic systems, and cultural flows. In this society, identities can change and experience resistance because it is difficult to distinguish between reality and circulating symbols. Information and knowledge become central to economic production and social organization in the concept of "informationalism", where individuals are connected locally and globally, influencing identity, social relations, and activism.

In his book "The Rise of the Network Society", Castells outlines several key concepts:

1. Networks as the primary structure of modern society that connects various aspects of life.
2. Informationalism as a new form of social and economic organization based on information.
3. Flow Space that replaces the "place space" of industrial society, emphasizing the importance of global flows of information, capital, and culture.
4. Networked Individuals, namely the broad connectivity of individuals and its impact on identity and social relations.
5. Globalization as the interconnectedness of economy, culture, and society on a global scale.

In "Communication Power" (Castells, 2009), the role of communication and media in a network society is emphasized, especially the role of information technology in shaping social, economic, and political structures; the dynamics of power in communication networks and the control of information flows; media politics as a tool of power by various actors; resistance and activism that emerges through media; and the role of globalization in communication networks.

Overall, Castells' Network Society Theory emphasizes social transformations due to technology and communication, and how power and resistance take place in a highly connected society. The book "The Rise of the Network Society" is a primary reference in understanding the relationship between technology, communication, and social change.

Methodology

This study used a systematic literature review approach as a methodological basis for understanding the dynamics of digital literacy, political communication ethics, and digital space practices in the context of the 2024 Simultaneous Elections in Indonesia. The study was conducted by tracing, evaluating, and synthesizing various relevant literature sources, both from academic and institutional realms.

The data sources reviewed include scientific articles from reputable national and international journals (Scopus, SINTA, Google Scholar), policy reports from government institutions such as Kominfo, Bawaslu, and the Ministry of Education, as well as digital literacy program documents from the National Siberkreasi Movement. In addition, reports from civil society organizations such as SAFEnet, MAFINDO, and ICT Watch were also used as important references to capture critical perspectives on digital literacy practices in the field. The literature analyzed was selected based on certain inclusion criteria: published in the 2018–2024 period, relevant to the context of Indonesian digital democracy, and explicitly discussing issues of digital literacy, communication ethics, social media, or political participation.

The data collection process was carried out through a structured search using keywords such as “digital literacy”, “political communication ethics”, “Indonesian election social media”, and “digital culture”. The main databases used include Google Scholar, DOAJ, Scopus, and repositories owned by government institutions and non-governmental organizations.

Data analysis was carried out through a thematic content analysis approach, which includes three main stages. First, a data reduction process was carried out to filter the most relevant articles and documents. Second, the content of each source was categorized based on key themes such as digital ethics, digital culture, political disinformation, and the role of social media in the electoral process. Third, findings from various literatures were synthesized to identify patterns and relationships between concepts that answer the main question of how digital literacy education strategies can encourage the strengthening of ethics and culture of political communication in the 2024 Simultaneous Elections.

To maintain the sharpness of the analysis and increase the validity of the study results, a source triangulation strategy and cross-references between literature were applied. In addition, critical reflection on possible biases contained in previous studies was carried out to maintain the objectivity of interpretation.

Findings

The results of this study can be described as follows:

Digital Literacy Gap Among Voters and Political Actors

Based on various studies (Jatmiko, 2019; Kominfo, 2024; Rianto, 2019; Yilmaz et al., 2024), digital literacy in Indonesia shows significant inequality, both in terms of age, education, and geography. Young voters in urban areas tend to be more exposed to digital literacy programs, but this is not always accompanied by an ethical understanding of the use of political information. Meanwhile, many political actors both formal and informal still use social media manipulatively that strengthen identity polarization and spread content containing disinformation and hate speech (Azizah, 2023; Danaditya et al., 2022; SAFEnet, 2024).

This phenomenon reinforces the view that technical digital literacy (digital skills) does not automatically lead to digital ethics, let alone a digital culture that reflects the values of deliberative democracy (Singer & McConnell, 2021). A study in Indonesia by Purwantiningsih et al. (2022), along with a conceptual article by Smith (2020), underscores the urgency of promoting digital politeness and ethical responsibility in social media use as an integral part of digital citizenship. Meanwhile, Sari et al. (2024) highlights that moral and legal dimensions are critical elements in shaping a civil digital culture. Furthermore, community-based research by

Wulandari & Winarno (2021) demonstrates that digital ethics can be cultivated not only through normative instruction but also through real-life social practices and collective participation at the local level.

Weak Political Communication Ethics in Digital Space

The studies by Arianto (2022), Trianto (2023), and Bawaslu (2024) show that violations of communication ethics increase during the digital campaign period, including the use of political buzzers, hoaxes containing ethnicity, religion, race and inter-group (SARA), and negative campaigns against political opponents. Low awareness of the principles of citizen journalism and the code of communication ethics has caused social media to become an arena for propaganda rather than dialogue (Felicia & Loisa, 2018).

This shows that Indonesia's digital democracy is still procedural, not substantial, because political communication is not yet rooted in public ethical values, such as honesty, respect, and responsibility (Latifah & Najicha, 2022; Lubis et al., 2022; Yulianto, 2023).

Relevance of Digital Culture in the Context of *Pancasila* Values

The digital literacy program from Kominfo and Siberkreasi which emphasizes the four pillars of digital literacy is a positive first step. However, based on an evaluation by Amaly & Armiah (2021) and Krisnawati et al. (2023), the pillars of digital ethics and digital culture are still less dominant than technical skills. In fact, *Pancasila* values such as deliberation, tolerance, and social justice are very relevant to strengthening a healthy political communication culture in cyberspace.

Digital culture, which is interpreted as the internalization of local and national values into online practices, must be a primary concern in the development of digital literacy curricula and campaigns in the future (Khoirunisa et al., 2022; Wijaya, 2023).

Implications for Strengthening Political Communication Education

Findings from the literature indicate the need for a multidisciplinary approach in digital political communication education combining technical, ethical, and cultural aspects. Educational institutions, governments, and civil society need to work together in designing political communication strategies that educate, not divide. This study recommends the integration of *Pancasila* values in digital literacy programs as an ethical and cultural foundation in building substantial digital democracy. These values are essential in shaping a digital communication culture rooted in tolerance, civic responsibility, and national integrity (Yorman & Sadam, 2025; Yusuf et al., 2024).

To strengthen the literature analysis, there is a thematic table that compiles findings from various references into main themes that are relevant to the focus of this study, namely digital literacy, communication ethics, digital culture, and digital democracy after the 2024 Simultaneous Elections:

Table 1
Literature Analysis on Digital Literacy in Political Communication

Main Themes	Sub-Theme Focus	Literature Sources	Key Findings
Digital Literacy	Definition and dimensions of digital literacy	Amaly and Armiah (2021); Kominfo (2023); Krisnawati et al. (2023)	Digital literacy includes 4 pillars: skills, culture, ethics, and digital security. Government programs are still dominant in technical aspects.
	Indonesian society's literacy level	Kominfo (2024); SAFEnet (2024)	Still low, especially in evaluative skills and digital ethics; has an impact on the high spread of hoaxes.
Political Communication Ethics	Political communication patterns on social media	Latifah and Najicha (2022); Lubis et al. (2022); Yulianto (2023); Bawaslu (2024); Yilmaz et al. (2024)	Political communication is often unethical, contains hate speech and disinformation, especially during political campaigns.
	The role of non-journalistic actors (influencers, buzzers)	Jatmiko (2019); Rianto (2019); Arianto (2022); Danaditya et al. (2022); Azizah (2023); Trianto (2023); SAFEnet (2024)	Political buzzers dominate digital narratives, blurring the lines between personal opinion and factual information.
Digital Culture	Cultural values in digital space	Smith (2020); Singer and McConnell (2021); Wulandari and Winarno (2021); Purwantiningsih et al. (2022); Sari et al. (2024); Kominfo (2024)	A healthy digital culture must uphold tolerance, rationality, and constructive participation.
	Challenges to *Pancasila* values in digital space	Felicia and Loisa (2018); Khoirunisa et al. (2022); Wijaya (2023); Kominfo (2024); SAFEnet (2024); Yusuf et al. (2024); Yorman and Sadam (2025)	Politicization of identity and intolerance often strengthen on social media; lack of awareness of national values.
Digital Democracy and Participation	Patterns of citizens' political participation on social media	Jatmiko (2019); Rianto (2019); Wulandari and Winarno (2021); Purwantiningsih et al. (2022); Sari et al. (2024); Yilmaz et al. (2024)	Social media opens up space for participation, but it is more procedural and not supported by substantial understanding.
	Challenges to the quality of democracy in the digital ecosystem	Arianto (2022); Trianto (2023)	Democratic dialogue is disrupted by polarization, digital noise, and weak public deliberation on online platforms.

Conclusion

Digital literacy based on ethics and culture is an important foundation in building the quality of digital democracy in Indonesia, especially after the 2024 Simultaneous Elections. Findings from the literature show that although social media has opened up wider political participation space, the quality of this participation is still weak due to the dominance of digital narratives by non-journalistic actors, low critical literacy of the community, and minimal understanding of political communication ethics.

Digital literacy programs that have been initiated so far, such as the National Digital Literacy Movement by the Ministry of Communication and Information, have touched on aspects of technical skills, but have not fully reached the dimensions of digital culture and ethics in depth. As a result, the digital space is still vulnerable to the spread of disinformation, hate speech, and politicization of identity, which ultimately weakens the substance of democracy. Thus, there needs to be a strengthening of the understanding that digital literacy is not merely a technological skill, but a reflective ability to use digital space ethically, critically, and responsibly.

There are several recommendations that can be given in this study:

1. Reorientation of digital literacy programs: the government, especially the Ministry of Communication and Information and its strategic partners, needs to balance the focus of digital literacy from merely technical skills to strengthening digital culture and ethics that are contextual to the conditions of Indonesian democracy.
2. Integration of political communication ethics in education: formal and non-formal education curricula need to include education in digital political communication ethics so that the younger generation is not only technically competent, but also critical and has integrity in using the media.
3. Increasing the capacity of local actors and digital communities: local communities, positive influencers, and citizen journalists need to be empowered to become literacy agents who are able to fight the flow of disinformation through fact-based narratives and *Pancasila* values.
4. Strengthening regulation and moderation of digital platforms: the government needs to encourage social media platforms to be more responsible in moderating content, especially that which has the potential to divide society during political contestation.
5. Building an inclusive digital democracy ecosystem: digital participation must be directed towards inclusive and substantive deliberation, by creating healthy public dialogue spaces, free from symbolic violence and algorithmic manipulation.

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Preservice Teachers' Perceived Effectiveness of Autonomy Support on Children With Educational Needs

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Abstract

Recently, researchers have focused on motivating students with diverse educational needs in regular classrooms. Some students find it difficult to maintain motivation. Motivational research has revealed the positive effect of teachers' autonomy support on students' motivation. The purpose of this study was to examine the characteristics of beliefs regarding autonomy support for students with educational needs among Japanese preservice teachers. Participants were 214 Japanese undergraduates enrolled in teacher training courses. They evaluated the effectiveness of autonomy support for fictional students with and without educational needs in regular classes. General linear model analyses revealed that the preservice teachers rated autonomy support as more effective for both students who experience difficulties in daily classes and those who feel bored because of a mismatch between their abilities and the class level than for a general child. A controlling teaching style was perceived as less effective for students with educational needs. Furthermore, preservice teachers with high controlled motivation perceived controlling teaching as more effective regardless of students' characteristics. These findings suggest that most preservice teachers understand the importance of autonomy-supportive teaching for diverse students at the level of educational beliefs. Teacher training programs should provide opportunities to learn concrete instructional strategies to support students with educational needs. On the other hand, informing preservice teachers with high controlled motivation regarding the evidence regarding the effects of autonomy support and control is also important.

Keywords: perceived effectiveness of autonomy support, educational needs, preservice teachers

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Introduction

Autonomy Support for Students' Motivation

Previous studies have suggested that motivation plays an important role in students' academic success (e.g., Pintrich, 2003). It has been well-documented that intrinsic motivation or autonomous motivation can lead to some aspects of academic outcomes, such as academic achievement, greater persistence, and positive attitudes to academic learning (Howard et al., 2021; Ryan & Deci, 2016). Therefore, educational researchers and practitioners have paid attention to how they can support students' motivation in classroom settings.

According to Self-Determination Theory (Ryan & Deci, 2017), autonomy support is a key component of motivational teaching. Autonomy support is a useful theoretical framework for capturing teachers' support for students' motivation. In the research literature, many factors have been found to affect individuals' motivation (Deci & Ryan, 1985). These factors were integrated within the framework of autonomy support in interpersonal interaction contexts. Deci and Ryan (1987) defined autonomy support as encouraging people to make their own choices. In more detail, as defined by Black and Deci (2000), autonomy support means that an individual in a position of authority (e.g., a teacher) takes the other's (e.g., student's) perspective, acknowledges the other's feelings, and provides the other with pertinent information and opportunities for choice, while minimizing the use of pressures and demands. Reeve et al. (2022) applied the concept of autonomy support to teachers' motivating styles in classroom settings and identified the following seven aspects: (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. In sum, autonomy support is the instructional effort supporting students' needs for autonomy, which is the need to be the origin of one's behaviors.

Control represents the opposite teaching style to autonomy support. Controlling teaching refers to the adaptation of a teacher-focused authoritarian attitude and an interpersonal tone of pressure in which the teacher prescribes what students should think, feel, and do, irrespective of what students prefer (Reeve et al., 2022). Researchers regard autonomy support and control as two opposite ends of a dimension (e.g., Deci et al., 1981; Reeve, 2009). On the other hand, some empirical studies found two orthogonal factors of autonomy support and control (e.g., Bartholomew et al., 2011; Reeve et al., 2013; Shih, 2013).

Autonomy-supportive teachers exhibit distinctive teaching strategies. In observational studies, autonomy-supportive teachers ask what students want to do, create independent work time, encourage students' voice, provide rationales, and provide informational feedback (Reeve et al., 2008). On the other hand, controlling teachers give directives, utter "should statements," tell "the right way," and ask controlling questions.

Empirical studies have shown that teachers' autonomy support increases students' intrinsic motivation. Deci et al. (1981) found that teachers' self-rated autonomy-supportive teaching was related to increases in children's intrinsic motivation in the sample of elementary school students. In addition, most studies focused on students' perceptions of teachers' autonomy support (e.g., Yu et al., 2018). Okada (2018a) revealed that students' perceptions of teachers' autonomy support were related to academic grade, intrinsic motivation, and school well-being by conducting a meta-analysis. A recent meta-analytic study including teachers' and

parents' need support verified the effects of autonomy support on students' academic success (Howard et al., 2024; Patzak & Zhang, 2025). Thus, it was verified that teachers' autonomy support plays a crucial role in students' academic success.

Teachers' Thinking of Autonomy Support

Teachers' autonomy-supportive behaviors are influenced by several factors. Among them, teachers' thinking or beliefs regarding effective teaching can have an impact on their actual teaching behaviors. Teachers hold thinking or beliefs regarding how it should be done, what methods are most effective, who is responsible for it, and so on. Teachers' beliefs are used to filter and interpret information, frame a specific problem or task, and guide immediate action (Buehl & Beck, 2015). Beliefs regarding teaching vary from teacher to teacher, and the belief can guide the classroom-level decisions of teachers (Fives et al., 2015).

As for autonomy-supportive teaching, teachers' thinking also can vary. Reeve (2009) stated that teachers who adopt controlling behavior (as opposed to autonomy-supportive teaching) hold the "maximal-operant principle" of motivation. The maximal-operant principle represents the belief that the likelihood of producing long-term interest in academic tasks is assumed to vary positively with the size of a reward. That is, some teachers interact with their students in controlling way because they believe that such teaching is effective. Reeve et al. (2014) examined the effect of teachers' beliefs on their autonomy-supportive teaching in the samples of eight different nations. The beliefs examined in the study were perceived effectiveness, normalcy, and ease of implementation regarding autonomy support. Among them, effectiveness was a strongest predictor of autonomy-supportive teaching behavior. This suggests that teachers who believe the effectiveness of autonomy support tend to behave in autonomy-supportive way actually.

Beliefs regarding the effectiveness of autonomy support vary across several factors. Okada (2017) examined teachers' perceived effectiveness of autonomy support toward motivation. Perceived effectiveness of autonomy support toward motivation was "teachers' perception that supporting students' autonomy is effective for motivating them" in the study. Perceived effectiveness of autonomy support toward motivation was higher in elementary school teachers than in high school teachers. Among high school teachers, perceived effectiveness of autonomy support toward motivation increased as yeas of teaching experience. In addition, preservice teachers think that autonomy-supportive teaching is less effective for motivating students than professional teachers (Okada, 2018b). On the other hand, preservice teachers who were themselves autonomously motivated for learning considered autonomy-supportive teaching as more effective (Okada, 2020).

Autonomy Support for Student With Special Educational Needs

In recent years, there has been growing attention to how to motivate students with diverse educational needs in regular classes. Ministry of Education, Culture, Sports, Science and Technology-Japan (2022) in Japan reported that 6.5 % of students in regular classes have significant difficulties in learning. However, methods to motivate them in regular classes have not been yet fully established.

Students with learning disabilities (LD) can have deficits in their academic motivation. Louick and Muenks (2022) stated that students with LD tend to attribute their difficulties to their own stable traits and their success to external factors other than their efforts, which can

lead to low motivation. A recent meta-analysis suggests that students with LD have lower intrinsic motivation compared to students without LD (Okada, 2024). Students who have difficulties in regular classes are likely to struggle to maintain their motivation.

Previous studies have demonstrated that teachers' autonomy support has an impact on students with LD. Deci et al. (1992) showed that perceived teachers' autonomy support was positively related to students' autonomous motivation in a sample of students with LD. The positive relations between teachers' autonomy support and intrinsic motivation has been confirmed in several studies (e.g., Loopers et al., 2024; Patrizia et al., 2018). These findings suggest that teachers' autonomy support can promote motivation of students with LD.

Another research literature examined the effects of autonomy support on students with high cognitive abilities. Gifted students have special needs in school learning. Previous studies have found that gifted students generally have high levels of intrinsic motivation (e.g., Gottfried & Gottfried, 1996; Hornstra et al., 2020). However, some gifted students have difficulty maintaining motivation in regular classes (Agaliotis & Kalyva, 2019). Despite their characteristically superior cognitive abilities, gifted students do not realize their full potential. As a result, they feel bored in classes and lose their motivation to learn. It has been suggested that gifted students are prone to feeling bored in school (e.g., Plucker & Mclntire, 1996; Preckel et al., 2010). Previous studies have suggested that teachers' autonomy support can affect the motivation of gifted students. Gifted students who perceived teachers' autonomy-supportive teaching reported higher levels of intrinsic motivation and engagement in their learning at school (Hornstra et al., 2020).

Given the recent emphasis on inclusive classroom, it is an important challenge to establish teaching methods that support the motivation of students with diverse educational needs in regular classes. In particular, preservice teachers are expected to acquire teaching methods that support diverse students' autonomy and motivate them for learning. As discussed earlier, autonomy-supportive teaching can be influenced by teachers' beliefs (Reeve et al., 2014). Therefore, this study focused on how students in teacher training courses perceive the effectiveness of autonomy-supportive teaching for school students with diverse educational needs. This would provide useful insights to support preservice teachers to acquire versatile teaching skills.

Present Research

The purpose of this study was to examine the characteristics of beliefs regarding autonomy support for students with educational needs among Japanese preservice teachers. The main research question was how preservice teachers perceive the effectiveness of autonomy support differently for students who have educational needs and those who do not. Given that a key concept of autonomy support is taking each student's perspective, we predicted that preservice teachers would perceive autonomy support to be more effective for students who struggle with learning. Furthermore, it was hypothesized that preservice teachers who have autonomous motivation would perceive autonomy-supportive teaching as more effective.

Method

Participants and Procedures

Participants were 214 Japanese university students (96 males, 117 females and 1 unspecified) enrolled in a teacher training course, with a mean age of 20.27 years (*SD* = 0.93). Approximately eighty-three percent (82.71%) of participants had not yet completed their practicum in elementary or junior high schools at the time of the study. All participants were volunteers and were informed that the outcome and participation would not affect their course grades. After the orientation, the participants were given a booklet and completed a questionnaire. Seventy-three participants were part of the sample from a previous study (Okada, 2020). This study was approved by the research ethics committee of Faculty of Education, Kagawa University (No. 2305).

Measures

Perceived Effectiveness of Autonomy Support

Participants were randomly presented either a short description of an elementary school student with some difficulties in daily classes (difficulty condition) or an elementary school student who feels bored due to a mismatch between his/her abilities and class levels (boredom condition). For the difficulty condition, participants were instructed: "Imagine a student in an elementary school math class who struggles academically and therefore has difficulty keeping up with daily lessons." For the boredom condition, participants were instructed: "Imagine a student in an elementary school math class who is good at studying and therefore finds the daily lessons too easy and boring." Following the instruction, participants were asked to rate the effectiveness of autonomy-supportive or controlling teaching behaviors to motivate the student mentioned above. Okada's (2017) seventeen items were used for autonomy-supportive or controlling teaching behaviors. Sample items are "Giving students the opportunity to make their own decisions during class" for autonomy support (ten items) and "Creating an atmosphere of 'I must study' during class" for control (seven items). Each item was rated on a 5-point Likert scale, from 1 (*not effective*) to 5 (*effective*). In addition to the two conditions, a general condition was also set up in which no description of a student was presented. For the general condition, some of the data from a previous study (Okada, 2020) was utilized. In the study, participants rated the same items without imaging a specific student. The instruction for the general condition was as follows: Imagine a student in an elementary school math class. The number of participants was eighty-three in the difficulty condition, fifty-eight in the boredom condition, and seventy-three in the control condition.

An exploratory factor analysis with the maximum likelihood method was administered to the data. Eigenvalues were 3.33, 2.37, 1.74, 1.18, 1.00, and 0.93 for each factor, and the value of BIC was the lowest for the three-factor solution; thus, a three-factor model was adopted. Four items with low factor loadings were removed. The result is presented in Table 1. Three factors were interpreted as "perceived effectiveness of control," (six items: e.g., "Showing clear deadlines for assignments and submissions"), "perceived effectiveness of autonomy support" (four items: e.g., "Adjusting lessons to suit the students' interests"), and "perceived effectiveness of catch-up support" (three items: e.g., "Providing individual support to students who are having trouble with assignments during class"). The estimated reliability coefficients (omega coefficient) were found to be .76 for control, .68 for autonomy support,

and .54 for catch-up support. Because the estimated reliability coefficient for catch-up support was slightly low, the following results regarding catch-up support should be interpreted with caution. The descriptive scores were calculated by averaging the item scores.

Table 1
Results of Factor Analysis

	F1	F2	F3
6. Showing clear deadlines for assignments and submissions	**.66**	.02	.05
5. Telling students that they will be in trouble if they don't study	**.65**	.01	.06
8. Creating an atmosphere of "I must study" during class	**.62**	−.03	−.17
14. Giving students homework and assignments to complete for each class	**.58**	.00	.00
16. Giving instructions using "do this" expression during class	**.48**	−.16	.19
12. Giving instructions to students in the form of questions, such as "Is it time to talk?"	**.47**	.00	.05
9. Adjusting lessons to suit the students' interests	−.06	**.79**	.01
10. Giving students the opportunity to make their own decisions during class	.01	**.73**	.03
15. Letting students find the ways to solve and think by themselves during class	.09	**.43**	−.15
13. Helping students realize what they are good at during class	.12	**.39**	.10
11. Providing individual support to students who are having trouble with assignments during class	.11	.00	**.65**
2. Communicating clearly what will be on the test during class	.02	.00	**.50**
3. Adjusting the lessons at the pace of the students at that time rather than staying on lesson plans	−.17	.08	**.45**
F1		.04	.19
F2			−.10

Academic Motivation

Participants' motivation was measured using Okada and Nakaya's (2006) Academic Motivation Scale. The scale was developed along the motivation constructs in self-determination theory (Ryan & Deci, 2017). There are four subscales of four items each: external regulation (e.g., "Because I'm forced to do it"), introjected regulation (e.g., "Because

I'll feel anxious if I don't"), identified regulation (e.g., "Because I think it's useful for my future"), and intrinsic motivation (e.g., "Because it's fun"). Participants were asked to rate each item on a 5-point Likert scale ranging from 1 (*not true*) to 5 (*true*).

The omega coefficients for the subscales were .80 for external regulation, .73 for introjected regulation, .81 for identified regulation, and .88 for intrinsic motivation. In previous studies, four subscales were often compounded to two motivation composites (e.g., Lens & Vansteenkiste, 2008). The present study created composite scores for autonomous and controlled motivation by averaging the subscales of intrinsic and identified and introjected and external regulation, respectively.

Analytic Procedures

First, a series of analysis of variance (ANOVA) was conducted to examine the mean difference in perceived effectiveness. Multiple comparisons were performed with the Holm test. Second, general linear model analyses were conducted using the scores of perceived effectiveness of autonomy support, control, and catch-up support as criterion variables. The predictor variables were two dummy codes representing the conditions, with the general condition as the reference group. The two motivation scores of participating students were entered as covariates. All analyses were conducted using R version 4.3.3.

Results

Descriptive Statistics in Each Condition

Descriptive statistics are presented in Table 2. ANOVA results indicated significant differences in perceived effectiveness across conditions. Perceived effectiveness of autonomy support was significantly higher in the difficulty and boredom conditions compared to the general condition (F (2,211) = 13.41, $p < .001$, $\eta^2 = 0.11$). On the other hand, perceived effectiveness of control was significantly lower in the difficulty and boredom conditions compared to the general condition (F (2,211) = 11.76, $p < .001$, $\eta^2 = 0.10$). Perceived effectiveness of catch-up support was significantly higher in the difficulty, general, and boredom conditions in order (F (2,211) = 29.03, $p < .001$, $\eta^2 = 0.22$).

Table 2
Descriptive Statistics in Each Condition

	Difficulty condition		General condition		Boredom condition		F	η^2
	M	*SD*	*M*	*SD*	*M*	*SD*		
Perceived effectiveness of autonomy support	4.52	0.47	4.23	0.51	4.63	0.36	13.41***	0.11
Perceived effectiveness of control	2.89	0.73	3.40	0.63	2.94	0.77	11.76***	0.10

Perceived effectiveness of catch-up support	4.04	0.69	3.82	0.53	3.17	0.83	29.03***	0.22

Note. *** $p < .001$.

Effects of Conditions × Academic Motivation on Perceived Effectiveness

General linear model analyses examined the effects of conditions and participants' academic motivation. Pearson correlations are presented in Table 3. A series of general linear model analyses examined the main effects of two dummy codes representing experimental conditions, two academic motivation scores, and the interaction effects between the dummy codes and the academic motivation scores. Condition 1 represents the difficulty condition, and condition 2 represents the boredom condition. The academic motivation scores were centered to avoid multicollinearity (Jaccard & Turrisi, 2003). In total, four interaction effects were created, consisting of two dummy codes and two academic motivation scores. In the first step, the main effects of two dummy codes and the two academic motivation were entered, and in the second step, the interaction effects were added. However, the increase in explained variance from step 1 to step 2 was not significant in all analyses. Therefore, a model with only the main effects of conditions and academic motivation was adopted. The results are shown in Table 4.

Table 3

Pearson Correlations Among Variables

	1	2	3	4
1. Perceived effectiveness of autonomy support				
2. Perceived effectiveness of control	−.01			
3. Perceived effectiveness of catch-up support	.09	.15*		
4. Autonomous motivation	.14*	.08	−.05	
5. Controlled motivation	.02	.20**	.13	−.13

Note. * $p < .05$, ** $p < .01$.

For perceived effectiveness of autonomy support, both condition 1 ($B = 0.30$, $p < .001$, 95%CI [0.15, 0.44]) and condition 2 ($B = 0.38$, $p < .001$, 95%CI [0.22, 0.54]) showed significant effects. The effects of participants' academic motivation were not significant. For perceived effectiveness of control, both condition 1 ($B = −0.50$, $p < .001$, 95%CI [−0.71, −0.28]) and condition 2 ($B = −0.45$, $p < .001$, 95%CI [−0.70, −0.21]) showed significant effects. The effect of participants' controlled motivation was also significant ($B = 0.09$, $p = .004$, 95%CI [0.03, 0.15]). For perceived effectiveness of catch-up support, both condition 1 ($B = 0.24$, $p = .03$, 95%CI [0.02, 0.45]) and condition 2 ($B = −0.64$, $p < .001$, 95%CI [−0.88, −0.40]) showed significant effects. The effects of participants' academic motivation were not significant.

Table 4
Results of General Linear Model Analyses

	Perceived effectiveness of autonomy support		Perceived effectiveness of control		Perceived effectiveness of catch-up support	
	B	*p*	*B*	*p*	*B*	*p*
Intercept	4.23^{***} [4.13, 4.34]	< .001	3.39^{***} [3.23, 3.55]	< .001	3.81^{***} [3.65, 3.97]	< .001
Condition 1	0.30^{***} [0.15, 0.44]	< .001	-0.50^{***} [−0.71, −0.28]	< .001	0.24^{*} [0.02, 0.45]	.03
Condition 2	0.38^{***} [0.22, 0.54]	< .001	-0.45^{***} [−0.70, −0.21]	< .001	-0.64^{***} [−0.88, −0.40]	< .001
Autonomous motivation	0.04 [−0.00, 0.08]	.06	0.05 [−0.01, 0.11]	.09	0.02 [−0.04, 0.07]	.58
Controlled motivation	0.02 [−0.02, 0.06]	.31	0.09^{**} [0.03, 0.15]	.004	0.05 [−0.01, 0.11]	.10
R^2	0.13	< .001	0.14	< .001	0.23	< .001

Note. Condition1: difficulty condition = 1, other conditions = 0, Condition2: boredom condition = 1, other conditions = 0. Numbers in square brackets indicate 95% confidence intervals. * $p < .05$, ** $p < .01$, *** $p < .01$.

Discussion

Present Findings

The purpose of this study was to examine the characteristics of beliefs regarding autonomy support for students with educational needs among Japanese preservice teachers. Previous studies have found that teachers' autonomy support affects students' grades, motivation, and school well-being (Howard et al., 2024; Okada, 2018a; Patzak & Zhang, 2025). The positive effects of teachers' autonomy support have also been verified in samples of students with some educational needs (Deci et al., 1992; Hornstra et al., 2020; Loopers et al., 2024). Furthermore, the practice of autonomy-supportive teaching is influenced by teachers' beliefs (Reeve et al., 2014). Preservice teachers are expected to acquire teaching methods that support the autonomy of diverse students and motivate them for learning. Therefore, this study focused on how preservice teachers perceive the effectiveness of autonomy support for students with educational needs.

First, the perceived effectiveness of autonomy support was higher in the conditions involving students with educational needs than in the condition involving a general student. This suggests that preservice teachers believe that autonomy-supportive teaching can motivate students with special educational needs. Consistent with this, they perceived the effectiveness of controlling teaching for students with some educational needs to be lower. Interestingly, they thought that autonomy support could motivate both students who have some difficulties in daily lessons and students who feel bored with daily lessons due to a mismatch between their abilities and the class level. What they have in common is that the students have their unique needs regarding interests and decisions. Both students with difficulties and students with very high cognitive abilities tend to struggle to maintain their motivation in the regular classes (e.g., Agaliotis & Kalyva, 2019; Louick & Muenks, 2022). Autonomy-supportive

teaching can help them keep their motivation for learning. Preservice teachers have beliefs regarding motivational strategies that are consistent with empirical findings (Howard et al., 2024; Okada, 2018a; Patzak & Zhang, 2025).

On the other hand, catch-up support was only perceived as effective for students with difficulties in learning. Rather, for students who feel bored with daily lessons because of their high ability, preservice teachers perceived that catch-up support was less effective. Catch-up support consisted of items showing teaching that compensate students' understanding of lessons and completing assignments. Students with difficulties in learning have a need to individualize the learning processes to ensure their understanding, and preservice teachers seem to recognize this need.

In addition to the characteristics of the students, the preservice teachers' own academic motivation was associated with their perceived effectiveness of support. Preservice teachers who have high controlled motivation perceived controlling teaching as more effective, regardless of the characteristics of students. Richardson (2003) suggested that the most important source of teachers' beliefs is experience with schooling and instruction. Also, Reeve (2009) assumed that teachers' own control-oriented personality dispositions promotes controlling teaching style. Preservice teachers have long experiences as school students before entering the teacher training courses, which form their beliefs regarding teaching and learning. Preservice teachers who tend to learn through controlled motivation may believe that such controlling motivational techniques are effective. However, empirical studies have suggested that controlling teaching can have detrimental effects on students' motivation (Haerens et al., 2016). Teacher training programs should focus not only on evidence regarding the evidence regarding the effects of autonomy support and control, but also on preservice teachers' own motivation styles.

We can draw a practical implication from present findings. Most preservice teachers believe that autonomy support is more effective for students with some educational needs in regular classes. They appear to recognize the importance of autonomy-supportive teaching for diverse students at the level of educational beliefs. Therefore, teacher training programs should provide opportunities to learn concrete instructional strategies to support students with educational needs. Additionally, preservice teachers with high controlled motivation should be informed regarding evidence on the effects of autonomy support and control.

Limitations

This study has three main limitations. First, most participants had not yet completed practicum in elementary or junior high schools at the time of the survey. In that sense, the preservice teachers in this study were in the early stages of their teaching careers. Levin (2015) suggested that preservice teachers' pedagogical beliefs can be influenced by their experiences observing and practicing in classroom during their teacher education program. Preservice teachers' perceptions of the effectiveness of autonomy support are expected to change as they learn teaching methods and gain experience. In particular, practicum may affect their perceptions of the effectiveness of autonomy support. Future studies should examine how their perceptions of the effectiveness of autonomy support change during teacher training programs.

Second, the vignettes did not provide detailed descriptions of students' difficulties. This study assumed two types of educational needs for students in regular classes: a student who has

some difficulty with daily lessons and a student who feels bored with daily lessons due to a mismatch between his/her abilities and the class level. Although the students with educational needs described in this study seem to be common in Japanese elementary schools, the students' actual needs may be diverse in terms of their backgrounds, symptoms, relationships with classmates and teachers, etc. Depending on the situation in which the student is placed, preservice teachers may perceive the effectiveness of various teaching methods differently. The findings of this study should be considered in more detailed case studies of students with educational needs.

Third, this study focused solely on preservice teachers' perceptions. Previous study has shown that thinking and perceptions of autonomy support affect actual teaching behaviors (Reeve et al., 1999; Reeve et al., 2014). In addition, teachers' beliefs may be a target of intervention in educational programs (Reeve & Cheon, 2014). Therefore, it is reasonable to focus on preservice teachers' perceptions of the effectiveness of autonomy support. However, the correlation between perceptions and behaviors regarding autonomy-supportive teaching is not perfect, and there may be a discrepancy between the two. Considering that it is the teacher's behaviors that directly affect students, in addition to the perceptions of the effectiveness of autonomy support, it is also necessary to focus on preservice teachers' autonomy supportive teaching behaviors.

Conclusions

This study addressed how preservice teachers perceived the effectiveness of autonomy support for students with and without educational needs. They perceived that autonomy support was more effective for students with some educational needs. Teacher training programs should provide opportunities to learn concrete instructional strategies to support students with diverse educational needs. Providing preservice teachers with autonomy-supportive teaching strategies for students with educational needs may be effective. This approach could foster classrooms where diverse students maintain their motivation to learn.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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The Potential of Sketchfab in Visualizing Technical Processes in the Educational Environment

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Abstract

This study analyzes the educational affordances of Sketchfab as a digital platform for representing technological processes through interactive 3D models, emphasizing its relevance for STEM and technology education. The paper considers how the use of three-dimensional visualization contributes to improved academic performance by enabling learners to interpret complex technological phenomena more effectively and by supporting the development of advanced spatial reasoning. The research is framed within the ongoing shift toward the digitalization of learning environments and the increased incorporation of immersive technologies into pedagogical practice. To investigate these aspects, a mixed-methods methodology was applied, integrating statistical evaluation of user activity with qualitative data gathered from educator and student interviews and survey responses. Results demonstrate a substantial increase in the adoption of Sketchfab among both educators and learners between 2023 and 2024, with teacher utilization increasing by 40% and student engagement rising by 37.5%. The platform is predominantly employed for the visualization of 3D models, the facilitation of project-based learning, and the enhancement of laboratory-based activities. Students reported a high level of satisfaction: 85% agreed that Sketchfab improved their comprehension of complex disciplinary content, while 90% indicated that it contributed to the development of their spatial reasoning skills. The findings indicate that Sketchfab provides significant pedagogical value, particularly within technical and STEM-oriented educational contexts. The integration of Sketchfab into instructional design not only enriches multimodal content delivery but also promotes learner autonomy and collaboration.

Keywords: Sketchfab, 3D visualization, STEM education, spatial reasoning, project-based learning

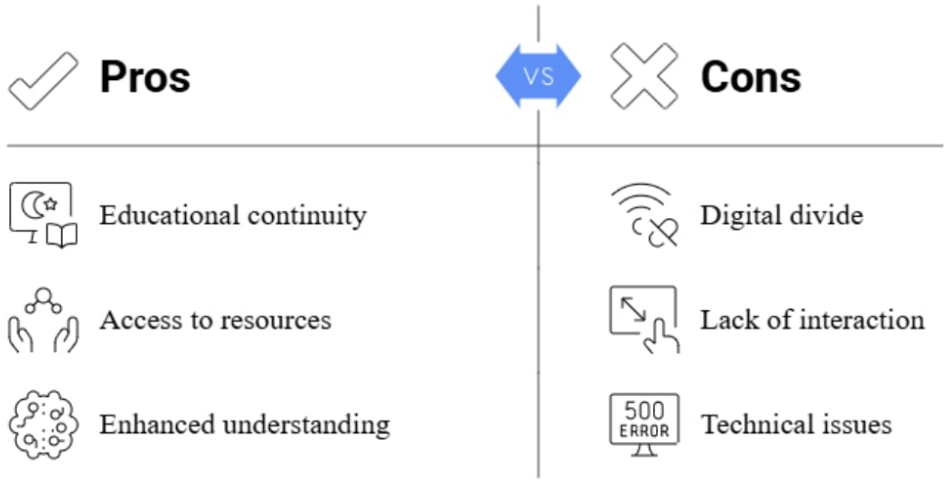
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Introduction

In the contemporary educational landscape, increased emphasis is placed on the integration of advanced digital technologies-particularly virtual 3D modeling tools-to enhance the quality and effectiveness of the learning process. One such innovative resource is Sketchfab, an online platform for creating, displaying, and interacting with 3D models, which possesses the potential to transform approaches to the visualization of technical processes within educational institutions (Areshonkov, 2020). The affordances of Sketchfab contribute to more immersive, interactive, and learner-centered instruction, which is especially important in the context of technical and engineering education.

In the conditions of martial law in Ukraine, the educational system has encountered significant challenges that necessitate the adoption of flexible and resilient instructional solutions. As illustrated in Figure 1, "Virtual Education in Ukraine," virtual learning technologies have gained particular relevance, ensuring pedagogical continuity by providing access to high-quality digital learning resources despite restrictions on physical presence and limited infrastructural capacity (Rani, 2025). Within this context, Sketchfab emerges as a powerful pedagogical instrument for teaching technical disciplines, as the platform enables precise modeling and visualization of complex technological processes. This, in turn, supports the development of deeper conceptual understanding and facilitates the integration of theoretical knowledge with practical application in a safe, accessible, and digitally enriched learning environment.

Figure 1
Virtual Education in Ukraine



The relevance of this study is determined by the urgent need to adapt the educational process to contemporary realities, particularly under conditions in which traditional instructional approaches are disrupted by constraints associated with military operations (Efimov, 2020).

To advance the modernization of engineering education in Ukraine, it is essential not only to conduct theoretical investigations but also to implement practice-oriented research that fosters independent, creative, and innovation-driven thinking among future engineers. The integration of advanced digital technologies into the instructional process-particularly 3D modeling tools-contributes to the expansion of students' professional worldview, strengthens their cognitive engagement, and promotes the development of transversal and domain-specific scientific competencies.

Integrating advanced digital tools for the visualization of technical processes also enhances learning effectiveness, supports multimodal cognition, and sustains high educational standards even in exceptional or crisis-driven contexts, including the current conditions of martial law in Ukraine. Within this framework, the Sketchfab platform serves as an immersive visualization environment that enables engineering students to explore object modeling and create interactive 3D representations across various stages of professional preparation.

Despite these advantages, there remains a significant need to improve the instructional and methodological support that ensures the pedagogically sound integration of such tools into the educational process. Therefore, the purpose of this article is to examine the pedagogical potential of using Sketchfab as an immersive visualization platform for representing technical processes within the educational environment and to identify existing challenges along with possible solutions that can ensure high-quality professional training in Ukraine's contemporary educational ecosystem.

Materials and Methods

To solve the problem, the following set of methods was used: theoretical analysis, diagnostic, teaching methods, primary statistical processing, and generalization of the obtained data.

Results and Discussion

The study examined the role and significance of visualization technologies in contemporary educational practice, highlighting their potential in the development of technical competencies within engineering education. Particular emphasis was placed on the application of 3D modeling tools, specifically the Sketchfab platform, for the visualization of technical processes in an educational environment, with consideration of the constraints imposed by the state of martial law in Ukraine.

This research is grounded in a comprehensive analysis of current trends in digital education and their transformative impact on the teaching and learning process. The focus was placed on enhancing technical competence among engineering students under conditions of limited resources and a complex security context, emphasizing the need for resilient and adaptable educational strategies.

To achieve these objectives, an extensive review of scientific literature on the integration of 3D modeling and virtual reality in technical education was conducted. Special attention was given to studies exploring the adaptation of instructional design and pedagogical strategies during periods of military conflict and instability.

The study also incorporated the practical implementation of virtual 3D models developed on the Sketchfab platform within technical discipline classes for both secondary school and engineering students. These models illustrated technical processes, mechanisms, and technological applications, thereby facilitating the translation of theoretical knowledge into practical understanding and supporting experiential learning in constrained educational settings.

A comprehensive content analysis of materials available on the Sketchfab platform was conducted to evaluate their educational potential within the Ukrainian context, particularly considering the adaptations required under martial law conditions. This analysis focused on

multiple dimensions, including the technical quality of 3D models, the availability of step-by-step instructional guidance, interactivity features, accessibility under limited technological resources, and the alignment of digital resources with specific educational objectives and expected learning outcomes.

The study revealed that Sketchfab models vary in complexity, from basic visualizations suitable for introductory lessons to highly detailed simulations for advanced technical training. Instructional guidance often included annotations, embedded instructions, and interactive labels, which enhanced students' ability to engage with the content independently. These features were particularly valuable in situations where classroom teaching was disrupted due to emergency conditions, as they allowed students to continue learning in a self-directed and flexible manner.

To summarize the findings, the analysis results are presented in Table 1, highlighting key aspects of Sketchfab materials and their alignment with Ukrainian educational standards under martial law conditions.

Furthermore, a comparative evaluation was conducted between conventional teaching methods for technical processes and the use of digital 3D models. The analysis highlighted that 3D visualizations significantly improve spatial reasoning, engagement, and comprehension of complex systems, while traditional methods often require more physical resources and direct teacher supervision.

Overall, these research methods provide a comprehensive understanding of Sketchfab's potential as a pedagogical tool for visualizing complex technical processes, supporting active learning, and ensuring continuity of education in emergency and resource-limited conditions.

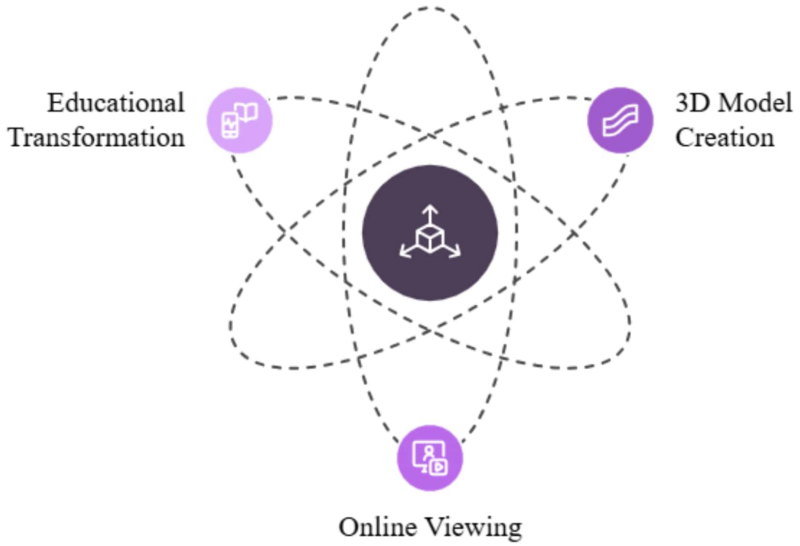
The figure illustrates how Sketchfab 3D models facilitate interactive learning, support curriculum alignment, and enhance student engagement, particularly under conditions of emergency education Figure 2.

Table 1

Content Analysis of Sketchfab Educational Materials

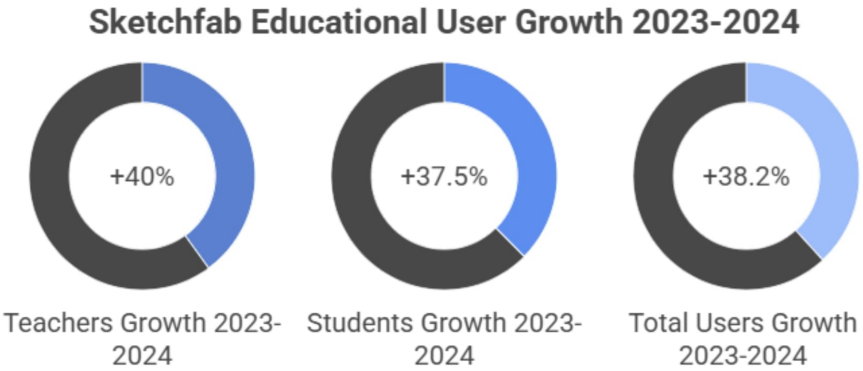
Dimension	Observed Characteristics	Educational Relevance
Technical Quality	High-resolution 3D models, some low-poly models	Facilitates accurate visualization of technical processes
Instructional Guidance	Step-by-step instructions, annotations, interactive labels	Supports self-directed learning and independent practice
Alignment with Learning Outcomes	Models mapped to curriculum objectives	Ensures relevance for technical, STEM, and vocational education
Accessibility	Requires internet access and moderate device specifications	May limit usability under constrained resources
Interactivity	Rotation, zoom, embedded animations, measurement	Enhances spatial understanding and cognitive engagement
Adaptability	Models adaptable to emergency teaching contexts	Maintains continuity of education under martial law and resource constraints

Figure 2
Sketchfab's Impact on Education



The first graph illustrates the growth dynamics of Sketchfab users in the educational sector from 2023 to 2024, categorized into teachers, students, and the total number of users (Figure 3). The data indicate a significant increase in adoption, with the number of teachers using Sketchfab rising from 320 in 2023 to 450 in 2024, representing a 40% growth. Similarly, student engagement has increased from 1,200 to 1,650 users, reflecting a 37.5% rise. Overall, the total number of users has grown from 1,520 to 2,100, marking an increase of 38.2%.

Figure 3
Number of Sketchfab Users Among Teachers and Students



The observed upward trend reflects an increasing recognition of Sketchfab's pedagogical affordances in promoting digital literacy, facilitating immersive learning experiences, and supporting interdisciplinary educational approaches. The growing adoption of the platform by educators underscores its integration into instructional design, particularly within STEM education, where three-dimensional visualization contributes to cognitive load management, spatial reasoning development, and conceptual understanding.

A notable increase in student engagement suggests a paradigm shift toward interactive and constructivist learning environments. In such contexts, learners actively explore, manipulate, and analyze 3D content, constructing knowledge through experiential and inquiry-based

approaches. This aligns with contemporary pedagogical frameworks that emphasize multimodal representations of information, active learning strategies, and student-centered methodologies.

The expansion of Sketchfab usage can also be linked to the broader digitalization of education, the demand for remote and blended learning solutions, and the growing interest in immersive educational technologies. These trends highlight the necessity for systematic research on the effects of 3D visualization tools on learning outcomes and the development of evidence-based strategies for their effective pedagogical implementation.

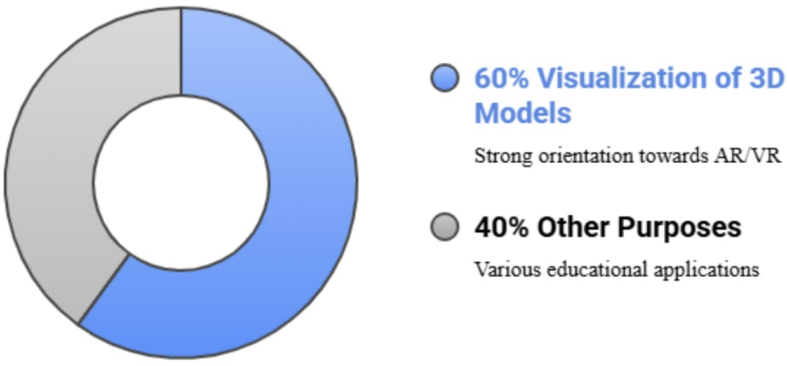
Analysis of the collected data indicates that Sketchfab is widely utilized in educational settings, primarily due to its potential to enhance visualization of learning materials and to support project-based and collaborative learning experiences. Its adoption represents a meaningful step toward integrating advanced digital tools to enrich the teaching and learning process.

The analysis of the collected data demonstrates that the predominant objective for integrating Sketchfab into the educational process is the visualization of 3D models, with 60% of educators emphasizing this purpose (see Figure 4). This finding underscores a pronounced orientation of contemporary teaching practices toward immersive technologies, including augmented reality (AR) and virtual reality (VR), which are increasingly recognized as transformative tools in modern pedagogy.

The integration of 3D and virtual models into instruction plays a significant role in fostering both domain-specific and interdisciplinary competencies. By providing a tangible representation of abstract and complex phenomena, these digital tools enhance conceptual understanding and support the cognitive processes involved in learning technical and scientific content.

Furthermore, the employment of virtual visualization strategies contributes to the development of higher-order thinking skills, such as spatial reasoning, problem-solving, and analytical thinking. This approach aligns with contemporary educational paradigms that prioritize experiential and constructivist learning, enabling students to interact dynamically with subject matter in ways that traditional methods cannot replicate.

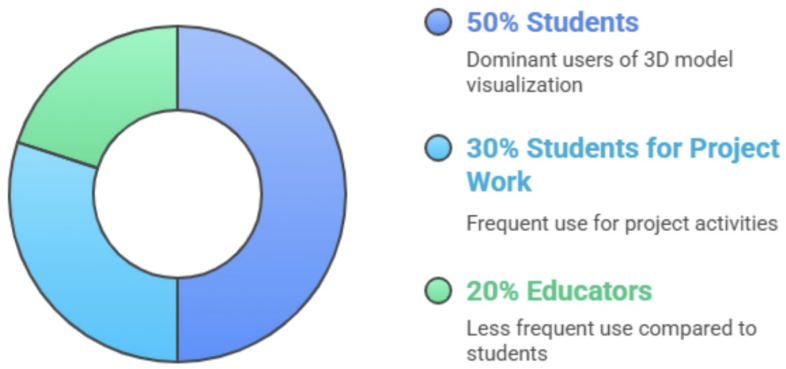
Figure 4
Pedagogical Priorities of Using Sketchfab in Education



Among students, 3D model visualization also dominates (50%), yet they use the platform more frequently for project work (30%) compared to educators (20%). This trend aligns with modern

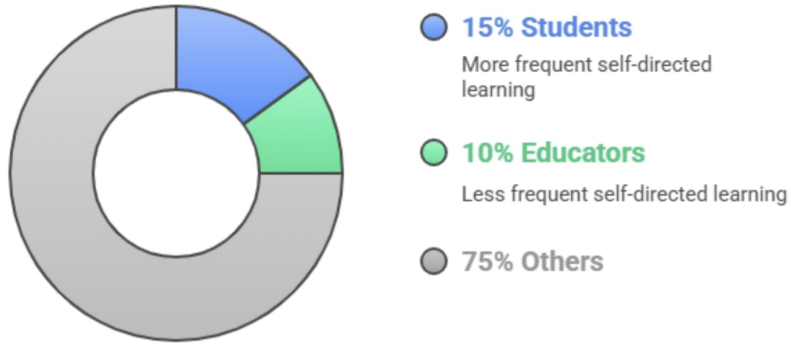
requirements for developing project-based competencies and implementing inquiry-based learning methodologies (Figure 5).

Figure 5
Distribution of 3D Model Visualization Usage



Interestingly, students utilize Sketchfab for self-directed learning (15%) more often than educators (10%) (Figure 6). This underscores the growing importance of self-regulated learning environments and reinforces the relevance of blended learning and flipped classroom methodologies.

Figure 6
Sketchfab Usage for Self-Directed Learning



The utilization of Sketchfab for laboratory activities appears to be minimal, with only 5% of students and 10% of educators reporting its use. This suggests that the integration of 3D models into laboratory settings may necessitate additional pedagogical scaffolding, as well as access to specialized technical infrastructure. Incorporating such resources effectively requires careful instructional design to ensure meaningful engagement and learning outcomes.

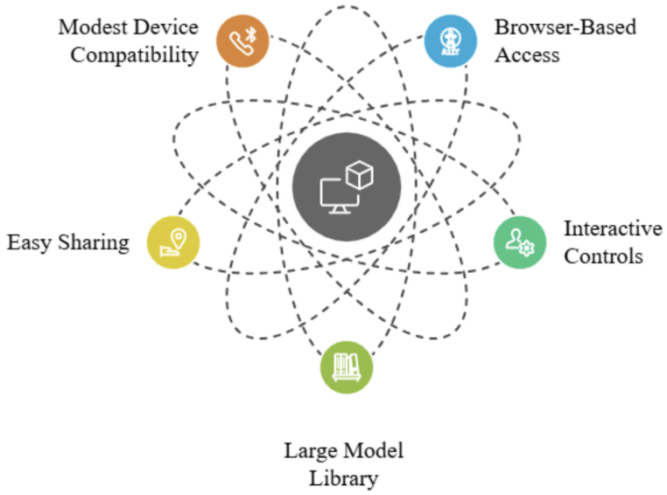
Overall, the analyzed findings substantiate that the incorporation of digital tools, specifically Sketchfab, contributes significantly to the development of digital literacy, facilitates the practical implementation of STEM education frameworks, and enhances cognitive engagement through interactive and immersive learning experiences.

Optimizing instructional strategies through virtual and 3D technologies can markedly increase the effectiveness of the educational process, aligning pedagogical practices with the evolving

requirements of the contemporary educational landscape. As illustrated in Figure 7. Enhancing Education with 3D Models, the model demonstrates how interactive 3D visualization can serve as a catalyst for deeper conceptual understanding, foster experiential learning, and provide learners with a dynamic platform for exploration and experimentation.

Research evidence demonstrates the active utilization of the Sketchfab platform by both educators and learners. Instructors engage with the platform for an average of 3.5 hours per week, indicating its integration into instructional practices, particularly for the visualization and creation of 3D models that support cross-disciplinary applications. This practice aligns with contemporary constructivist approaches, emphasizing experiential and visual learning strategies.

Figure 7
Enhancing Education With 3D Model



Students, in turn, devote more time to Sketchfab, averaging 5.2 hours per week, reflecting heightened motivation, engagement, and learner-centered participation in educational activities. Such intensive interaction with digital 3D tools highlights the platform's potential to enhance cognitive and metacognitive skills, including spatial reasoning, imaginative thinking, and autonomous learning. The overall mean usage of 4.3 hours per week illustrates a broader trend toward interactive, technology-enhanced pedagogies that foster active and personalized learning experiences.

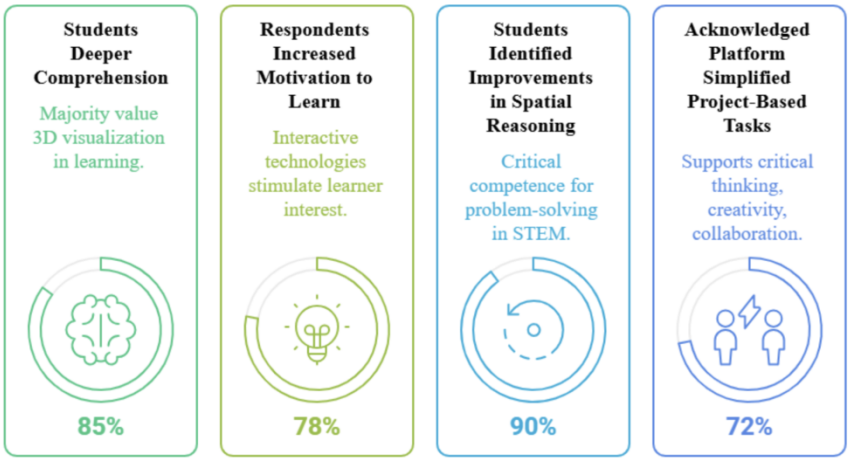
Survey results presented in Table 2 further underscore the pedagogical efficacy of Sketchfab. A substantial majority of students (85%) indicated that the platform facilitates deeper comprehension of learning materials, demonstrating the value of 3D visualization in promoting conceptual understanding and knowledge acquisition in complex academic domains. Additionally, 78% of respondents reported increased motivation to learn, highlighting the role of interactive and visually mediated technologies in stimulating learner interest and sustained engagement.

Table 2
Impact of Using Sketchfab on Learning Outcomes (Survey of Students)

Learning outcome	% of Students agreeing
Better understanding of the material	85%
Increased motivation	78%
Development of spatial thinking	90%
Facilitation of project work	72%

Moreover, 90% of students identified improvements in spatial reasoning, a critical competence for problem-solving in STEM disciplines, while 72% acknowledged that the platform simplified project-based tasks, thereby supporting the development of critical thinking, creativity, and collaborative skills (Figure 8). Collectively, these findings emphasize the transformative potential of digital 3D modeling tools in fostering higher-order cognitive skills and enhancing the overall quality of contemporary learning experiences.

Figure 8
Students Perception of Sketchfab Impact



Conclusions

The analysis of Sketchfab usage in the educational environment demonstrates a steady increase in adoption among both teachers and students, highlighting the growing role of 3D visualization technologies in contemporary pedagogical practices. The observed rise in the number of users underscores the platform's relevance in facilitating immersive, interactive, and student-centered learning experiences.

The integration of Sketchfab into the instructional process serves multiple pedagogical functions, including enhancing spatial cognition, supporting interdisciplinary project-based learning, and fostering digital literacy. The data reveal that educators primarily utilize the platform for the visualization of complex three-dimensional models, which contributes to cognitive load reduction and improved conceptual understanding, particularly in STEM

disciplines. Simultaneously, students engage with Sketchfab not only for academic purposes but also for self-directed learning and creative exploration, reflecting the shift towards constructivist and inquiry-based learning paradigms.

The increase in weekly usage hours among students compared to teachers suggests a higher degree of learner autonomy and motivation in interacting with 3D content. This trend aligns with contemporary educational frameworks emphasizing active learning, digital fluency, and the development of metacognitive skills. Furthermore, survey results indicate that students perceive Sketchfab as a valuable tool for improving learning outcomes, particularly in terms of knowledge retention, problem-solving abilities, and overall academic engagement.

From a methodological perspective, the findings suggest that the effective integration of 3D visualization tools into curricula requires well-structured pedagogical strategies that align with competency-based education and differentiated instruction principles. Educators should be equipped with adequate training and methodological guidelines to maximize the didactic potential of such technologies. Additionally, institutional support in terms of technological infrastructure and curriculum adaptation is essential to ensure the sustainability of digital learning innovations.

Given the accelerating digital transformation in education, further research should explore the long-term impact of immersive visualization tools on cognitive development, knowledge acquisition, and student motivation. Future studies should also examine best practices for implementing 3D technologies in hybrid and distance learning settings to enhance accessibility and inclusivity in education.

Acknowledgements

The author expresses sincere gratitude to colleagues and educators who have contributed to the conceptual development of this study by sharing their insights into the integration of immersive technologies in education. Special appreciation is extended to researchers in the field of educational technology whose prior work has provided a solid theoretical foundation for analyzing the pedagogical affordances of Sketchfab in fostering digital literacy, spatial reasoning, and constructivist learning experiences. Furthermore, we acknowledge the academic community's contributions in developing of interdisciplinary methodologies that enhance student engagement and cognitive development through innovative digital tools. The increasing adoption of 3D visualization platforms in education underscores the relevance of ongoing research in the field, and the author acknowledges the invaluable contributions of those advancing the discourse on interactive and multimodal learning environments. Deep appreciation is expressed to all educators and students who participated in the study, providing empirical insights into the pedagogical applications of Sketchfab. Their engagement and feedback have been instrumental in shaping the analysis and reinforcing the significance of immersive technologies in contemporary educational paradigms.

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Accreditation, Internationalization and World University Rankings: Basis for Quality Assurance (QA) in Higher Education Institutions (HEIs) in the Philippines

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Abstract

Accreditation, Internationalization, and World University Rankings (WUR) have increasingly shaped the higher education landscape over the last decade. Whilst these three dimensions have been previously examined in isolation, studies have suggested that there is a strong interplay among them. Applying qualitative content analysis using NVivo and QCAmap software, the study identified eight themes and 23 sub-themes related to accreditation across five international standards of the Asean University Network (AUN, ASEAN), Commission on Academic Accreditation (CAA, UAE), Oman Academic Accreditation Authority (OAAA, Oman), Quality Assurance Agency for Higher Education (QAA, Europe), and Southern Association of Colleges and Schools Commission of Colleges (SACSCOC,USA); seven WUR themes across the Times Higher Education (THE), Quacquarelli Symonds (QS), and Academic Ranking of World Universities (ARWU); and seven internationalization themes based on Transnational Higher Education (TNHE) Philippine Republic Act 11448 and common internationalization definitions. The Philippine accreditation standards revealed no connections in the sub-themes of Documentation, Performance, and Funding and Financial Support within the Accreditation themes. Similarly, in the Internationalization themes, there were no connections found in the Strategy and Communication, Facilities and Infrastructure for Internationalization, and Faculty and Staff Development for Internationalization. In the Ranking themes, there were also no connections in Faculty/Staff Quality, Global Outlook and Diversity, Student Success and Graduation, Global Influence, and Income and Investments. To address these identified gaps, the study extracted indicators from the five international standards and proposed a quality assurance framework aimed at enhancing the outcomes of Accreditation, Internationalization, and World University Rankings for Philippine HEIs.

Keywords: accreditation, internationalization, transnational higher education, quality assurance

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Introduction and Literature Review

Accreditation, Internationalization, and World University Rankings (WUR) are three pivotal elements shaping the strategies and outcomes of Higher Education Institutions (HEIs). Though traditionally examined as separate entities, recent studies suggest a dynamic interplay among them, where each factor influences and reinforces the others, collectively steering institutional development.

Quality Assurance and Accreditation

Accreditation serves as a quality assurance mechanism, ensuring that educational institutions or programs meet necessary standards set by external evaluators. Accreditation is the process involves evaluating services and operations to determine compliance with applicable standards. Institutions meeting these benchmarks are granted accreditation by the relevant body (ABET, 2021). Similarly, the Council for the Accreditation of Educator Preparation (ACPE, 2021) views accreditation as a process ensuring that educator preparation providers equip future teachers with essential skills and knowledge. CAEP emphasizes areas like content knowledge, clinical partnerships, program impact, equity, and diversity. Several benefits of accreditation for institutions, including: (1) providing reliable information about institutional quality; (2) ensuring fairness and accountability in student services, graduate achievements, and program delivery; (3) supporting voluntary quality improvement efforts; (4) enhancing students' confidence in institutions; (5) facilitating student transfers between institutions; (6) offering feedback to employers on graduate quality; and (7) unlocking financial support opportunities for students (Cura & Alani, 2018).

World University Rankings

University rankings reflect the global competitiveness of institutions and their relative standing in terms of quality, status, and success (Hou & Jacob, 2017). Prominent world university rankings include:

Academic Ranking of World Universities (ARWU)

Established in 2003 in China, ARWU uses six indicators, including the number of Nobel Prize winners among alumni and faculty, highly cited researchers, scholarly publications, and institutional per capita performance. Data sources include Thomson Reuters' Web of Science and national agency resources. ARWU Focuses on citations, publications, and prizes, emphasizing research output and academic recognition.

Quacquarelli Symonds (QS)

Launched in 2004 in the UK, QS evaluates universities using six indicators, such as academic reputation, employer reputation, faculty-student ratio, international faculty and student ratios, and citations per faculty. Data is sourced from Scopus databases and university portfolio surveys. QS balances academic and employer reputation, faculty-student ratios, and internationalization metrics.

Times Higher Education (THE)

Founded in 2004 in the UK, THE uses 13 indicators, including teaching reputation, research productivity, citation impact, international outreach, and industry income. These rankings rely on data from Thomson Reuters' Web of Science and institutional surveys. THE evaluates teaching, research, internationalization, and industry income, offering a holistic view of institutional performance.

Internationalization

Internationalization refers to the inbound or outbound mobility of faculty and students as a result of any of the 3: (1) individual mobility – where an individual chooses to study/teach abroad or someone from another country chooses to study/teach in the Philippines; (2) academic program mobility – where an academic program has been accepted to be taught in another country; and (3) institutional mobility – where an institution has been licensed to setup a branch in another country (i.e. a Philippine HEI has been granted a permit/license to open a branch campus in another country or a foreign HEI has been granted a permit/license to open a branch campus in the Philippines).

In a study by Buckner & Stein (2020) involving 1,439 higher education institutions across 137 countries, finding that administrators in knowledge-rich countries like the USA and Anglophone Canada see internationalization to enhance students' global awareness, with some also highlighting revenue generation as a benefit. However, Tight (2022) argued against the notion that internationalization in higher education is merely a transient trend driven by Western nations through international recruitment and the creation of overseas campuses. In the Philippines, research conducted by Ferrer (2019) with 87 private and state universities and colleges from 16 regions, revealing that the main perceived benefits of internationalization were: (1) boosted international cooperation and capacity building; (2) improved international performance via adopting global best practices; and (3) networking opportunities for faculty. Conversely, the risks associated with internationalization included limited access for students lacking financial resources and unequal benefit distribution among partners. In this study, 94.25% of respondents incorporated internationalization into their strategic planning. It is worth noting that internationalization is one of the key components of the world university rankings.

The above literature shows that accreditation, internationalization and world university rankings serve as complementary forces in higher education. Accreditation ensures quality assurance through external and internal mechanisms, rankings highlight institutional competitiveness on a global scale, while internationalization boosts global competitiveness. Together, they play a vital role in shaping the strategies, outcomes, and reputation of higher education institutions worldwide.

Research Gap

Although existing research confirms that accreditation systems are vital for improving the quality of higher education and significantly support internationalization and global rankings, there is limited exploration of why these outcomes remain underdeveloped in the Philippine higher education sector. Despite having an established accreditation system, the country exhibits poor levels of internationalization and low standing in world university rankings compared to neighboring countries like Singapore, Japan, and China. This gap underscores the

necessity to examine how the design, implementation, and alignment of accreditation practices in the Philippines compare to those in countries with higher-ranking HEIs, especially concerning their effectiveness in promoting global competitiveness and international collaboration.

Statement of Purpose

This study aims to explore the role of accreditation in advancing the internationalization and global competitiveness of Philippine higher education institutions (HEIs). Through a comparative analysis of accreditation practices in countries with high-ranking universities, the research seeks to identify effective strategies and quality assurance mechanisms that can be adapted to the Philippine context. By aligning local accreditation standards with internationally recognized benchmarks, the study intends to contribute to the development of stronger accreditation frameworks that enhance internationalization outcomes and improve performance in global university rankings. Ultimately, this research aims to support policy reforms and institutional practices that elevate the quality and global reputation of Philippine higher education.

Purpose 1: To compare Philippine accreditation standards and criteria with those of the countries which rank high in the world university rankings.

Purpose 2: To introduce institutional standards extracted from the AUN, CAA, OAAA, QAA and SACSCOC to align the Philippine accreditation system with international standards.

Methodology

The study by Aspers & Corte (2019), a qualitative research design was employed, incorporating an iterative process that involved both deduction and induction to identify and analyze various categories. Qualitative Content Analysis (QCA) was utilized as the primary method. QCA is a technique for the subjective interpretation of textual data through systematic coding and the identification of themes or patterns (Prasad, 2019). It is defined as any effort to reduce qualitative data and extract meaning by identifying core consistencies within a large volume of material. Because Accreditation, Internationalization, and Ranking are distinct variables that cannot be directly mapped onto each other, themes enabled the exploration of possible connections and relationships among them.

Developing the Themes Using QCAMap Software

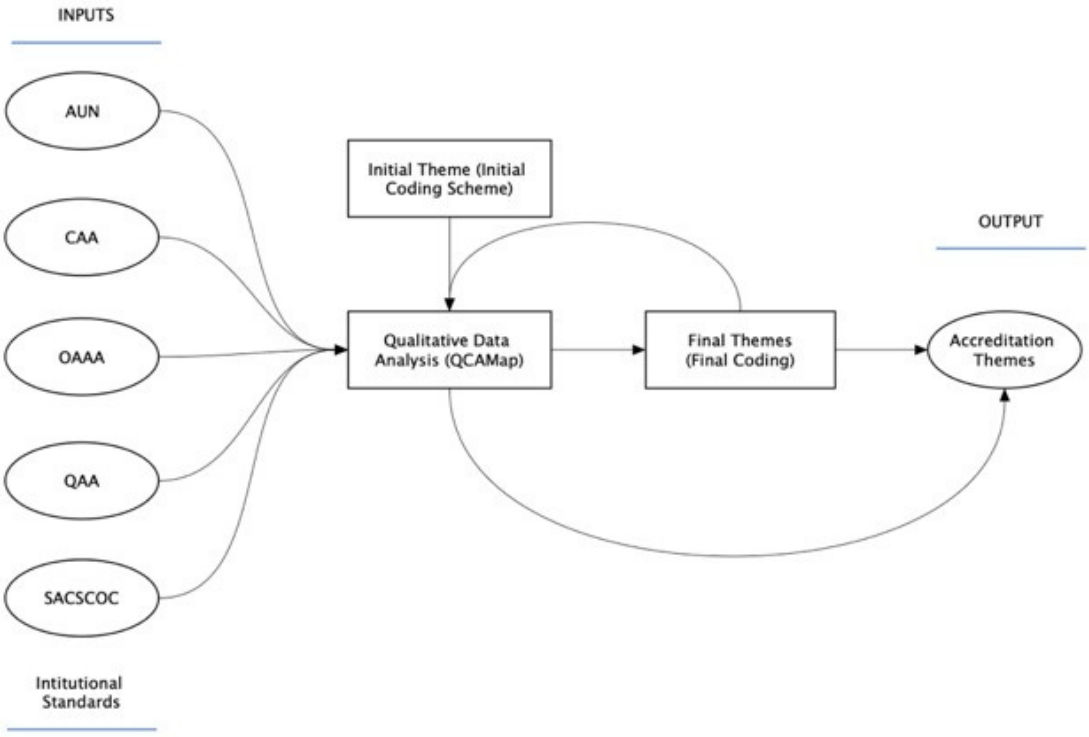
For the Accreditation theme, the study examined practices from international accreditation bodies of the AUN, CAA, QAA, OAAA, and SACSCOC to better understand the core concepts of accreditation. These standards are available online in the organization's respective websites. In exploring the Internationalization theme, the study analyzed common definitions and the provisions of the Transnational Higher Education Act, or Republic Act No. 11448 (2019) of the Philippines. For the Ranking theme, the focus was on the indicators used by the three major global university rankings: ARWU, QS, and THE. The development of these themes involved the following steps:

Accreditation Themes

To develop the Accreditation Themes, the Institutional Standards of the AUN, CAA, OAAA, QAA and SACSCOC were used as inputs in the QCAMap. There were 10 initial coding

schemes used for 29% of the data as required by the software to group common attributes, elements, concepts, or ideas of the five institutional standards. Using deductive and inductive reasoning, eight final coding schemes which generated and served as the final accreditation themes. These final accreditation themes were used to group the remaining 71% of data. Figure 1 presents the process.

Figure 1
Developing the Accreditation Themes



Internationalization Themes

Using the same procedure presented in Figure 1, the Internationalization Themes were developed using the provisions of the Transnational Higher Education Act (TNHE) on August 28, 2019, through Republic Act 11448, and common definitions of internationalization, as input to the QCAMap.

World University Rankings Themes

Likewise, using the same procedure presented in Figure 1, the Ranking Themes were developed using the indicators of the ARWU, QS, and THE, as input to the QCAMap.

Finding the Number of Connections Using NVivo Software

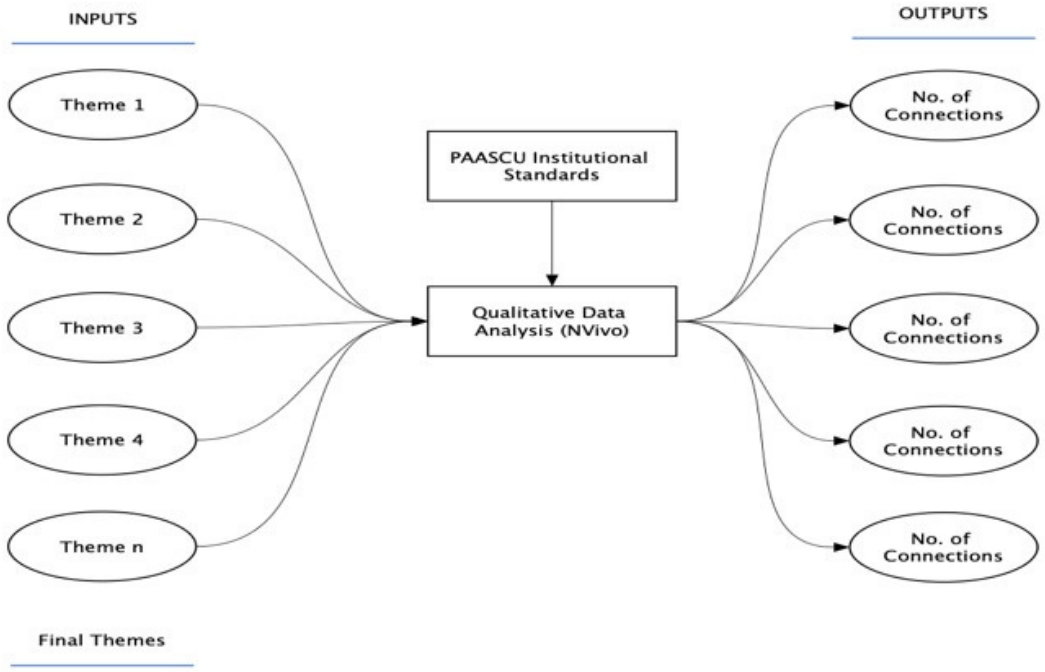
After completing the QCAmap, the NVivo software was used to finalize the Accreditation, Internationalization, and Ranking Themes which involved the following steps:

1. Preparing the Institutional Standards for importing to NVivo
2. Using the final themes generated from the QCAMap as input
3. Finding the number of connections from the institutional standards for each theme

Finding Connections of the Philippine Institutional Standards With the Accreditation, Internationalization, and Ranking Themes

At the time of the study, only the Philippine Accrediting Association of Schools, Colleges and Universities (PAASCU) Institutional Standards was available as basis for the study. PAASCU is a private, voluntary non-profit, non-stock corporation that accredits academic programs in the Philippines. Using the final themes, the PAASCU (23) Institutional Standards were inputted to the NVivo to find the number of connections for each of the Accreditation, Internationalization, and Ranking Themes. The number of connections shows the strength of relationship of each institutional standards to the final accreditation themes.

Figure 2
Finding the Number of Connections for Each Themes



Developing the Proposed Institutional Standards

A summary of the data from the QCAMap showing each institutional standard from the AUN, CAA,OAAA, QAA, and SACSCOC that falls under each theme was used as basis for proposing a list of institutional standards that can be used to augment the Philippine institutional standards.

Results and Discussion

To find answers for the Statement of Purpose 1, the study compared Philippine accreditation standards and criteria with those of the countries which rank high in the world university rankings such as USA, Europe, UAE, ASEAN Countries, and the Sultanate of Oman. To do this, Accreditation Themes were developed from the 5 Institutional Standards, and the Philippine Institutional Standards were mapped to find the number of connections.

The PAASCU Institutional Standards has 23 indicators and criteria which when mapped against the accreditation themes showed no connection with *Documentation*, *Performance*, and *Funding and Financial* Support. The findings suggests that while the Philippine accreditation standards exhibit similar characteristics with the international accreditation bodies, it lacks crucial components which are important in elevating the Philippine accreditation standards. Well-documented processes and measurable outcomes are critical for fostering transparency and accountability among stakeholders, including faculty, staff, students, regulatory bodies, and the broader community. This transparency is a cornerstone of institutional credibility, which is essential for meeting accreditation standards, gaining international recognition, and improving global rankings. Transparent practices not only build trust but also promote collaboration across all levels of the institution.

Presented in Table 1 are the Accreditation Themes and the number of connections that the PAASCU Institutional Standards have.

Table 1

Results of Mapping the Philippine Institutional Standards With Accreditation Themes

Accreditation Themes	Number of Connections
Continuous Improvement and Enhancement	**8**
Documentation	0
Improvement	1
Review and Monitoring	2
Systems and Processes	5
Governance and Management	**9**
Leadership	1
Mission, Vision, and Values	6
Planning	1
Policies and Procedures	1
Resource Management	**4**
Fiscal Resources and Budgeting	2
Resource Allocation and Management	2
Student Support and Services	**5**
Academic Support Services	2
General Support Services	3
Community Engagement and Services	**7**
Community and Stakeholder Relationship	4
Community and Stakeholder Services	3
Teaching, Learning and Curriculum Design	**7**
Assessment and Moderation	1
Curriculum	1
Graduate Attributes and Learning Outcomes	3
Teaching and Learning Activities	2
Human Resource Management	**2**
Performance	0
Qualifications	1
Training and Development	1
Research and Scholarly Activities	**2**
Funding and Financial Support	0
Performance and Outputs	2

Clear goal setting and alignment (Aguinis, 2019)—particularly between individual and institutional objectives—enhance performance management and institutional coherence. Aligning personal goals with institutional targets ensures that every member of the organization understands their role in achieving shared outcomes, a key factor in demonstrating quality assurance during accreditation reviews.

Furthermore, strategic financial investment in research and scholarly activities—such as innovation, commercialization, and start-up development—amplifies the institution's academic reputation and research productivity. These outputs not only contribute to institutional rankings but also align with internationalization goals by attracting global partnerships and talent. Importantly, such initiatives extend the institution's impact beyond academia, contributing to national development and economic growth.

Presented in Table 2 are the Internationalization Themes and the number of connections that the PAASCU Institutional Standards have.

Table 2
Results of Mapping the Philippine Institutional Standards With Internationalization Themes

Internationalization Themes	Number of Connections
Internationalization Strategy and Communication	0
Global Engagement and Collaboration	1
Facility and Infrastructure for Internationalization	0
International Standards	23
Faculty and Staff Development for Internationalization	0
Research and Scholarly Activities with Global Impact	2
Student Mobility	1

The PAASCU Institutional Standards has 23 indicators and criteria which when mapped against the internationalization themes showed no connection with *Internationalization Strategy and Communication*, *Facility and Infrastructure for Internationalization*, and *Faculty and Staff Development for Internationalization*.

The above findings suggests that while the Philippine accreditation standards exhibit similar characteristics with the international accreditation bodies, it lacks crucial components which are important in elevating internationalization outcomes. Internationalization when embedded into the strategic pillar provides the necessary direction for planning, decision-making, and implementation - shaping the long-term direction of the HEI and reinforces its global engagement goals. This strategic orientation must be clearly communicated to both internal and external audiences to gain broad support and recognition.

High-quality infrastructure and facilities are vital enablers of successful internationalization. Institutions must invest in efficient academic and administrative systems to support international recruitment, admissions, and student services. This includes streamlined processes for visa support, housing, orientation, and academic guidance for international students. On the other hand, Faculty and staff development must evolve beyond traditional professional training to encompass the skills and competencies required in a globalized education environment. Additionally, internationalization-focused development equips educators and administrators with tools for inclusive teaching, cross-cultural communication, and global citizenship.

Presented in Table 3 are the Internationalization Themes and the number of connections that the PAASCU institutional standards have.

Table 3
Results of Mapping the Philippine Institutional Standards With Ranking Themes

Ranking Themes	Number of Connections
Innovation and Knowledge Transfer	2
Faculty/Staff Quality	0
Global Outlook and Diversity	0
Academic and Employer Reputation	1
Student Success and Graduation	0
Global Influence	0
Income and Investments	0

The PAASCU Institutional Standards has 23 indicators and criteria which when mapped against the accreditation themes showed no connection with *Faculty/Staff Quality*, *Global Outlook and Diversity*, *Student Success and Graduation*, *Global Influence*, and *Income and Investments*. The above findings suggests that while the Philippine accreditation standards exhibit similar characteristics with the international accreditation bodies, it lacks crucial components which are important in elevating ranking outcomes.

The quality of faculty and staff is a critical determinant of an institution's standing in global university rankings (WUR). HEIs achieves excellence in teaching, research, institutional performance, and student outcomes. Faculty members play a central role in engaging students, cultivating critical thinking, and fostering academic environments where learners can excel. Their contributions to research and scholarly work are vital in driving innovation and enhancing the institution's academic reputation.

Global Outlook and Diversity refer to cultivating an institutional environment that embraces international perspectives, values cultural diversity, and actively engages with global educational issues. It enriches the academic and social experience by promoting cultural awareness and inclusion across all levels of the institution. This commitment includes advancing equity and representation, ensuring that women, ethnic minorities, and marginalized groups have a voice in leadership and decision-making processes. It fosters a culture of mutual respect, inclusion, and co-existence—core values in building a globally responsive institution.

Student Success and Graduation lie at the heart of higher education. They encompass students' academic achievement, personal growth, and readiness for professional careers—outcomes developed and nurtured throughout their educational journey. Key indicators of student success include retention, academic progression, and on-time graduation.

To find answers to Statement of Purpose 2, presented in Table 4 are the extracted Institutional Standards using QCAMap from the AUN, CAA, OAAA, QAA and SACSCOC to align the Philippine accreditation system with international standards.

Table 4

Institutional Standards From the AUN, CAA, OAAA, QAA, and SACSCOC

THEME 1: CONTINUOUS IMPROVEMENT AND ENHANCEMENT	
Documentation	
1	There is an established document classification policy to safeguard privacy and confidentiality, ensure that the information remain current and appropriate.
2	The institution has a document classification policy which provides guidelines to protect institutional as well as individual data from unauthorized access.
3	The published information is clear, accurate, objective and readily accessible to stakeholders.
4	The Institution has comprehensive, consistent, and accurate published (print or electronics) Policies and Procedures Manual.
5	The Institution has comprehensive, consistent, and accurate published (print or electronics) Health and Safety Manual.
6	The Institution has comprehensive, consistent, and accurate published (print or electronics) Employee Handbook.
7	The Institution has comprehensive, consistent, and accurate published (print or electronics) Program Specification (Program Catalog).
8	The Institution has comprehensive, consistent, and accurate published (print or electronics) Student Handbook.
9	The Institution has a comprehensive and integrated Academic Handbook (covering all phases of teaching and learning).
10	The institution provides Enrolment and Student Records.
11	The institution maintains a record of all employees.
Improvement	
1	Results on the achievement of the course learning outcomes are used to form basis for course improvement.
2	Results of the program evaluation are used as basis for improving the program.
3	Performance is periodically monitored and results are released to relevant stakeholders in a timely manner for improvement.
Review and Monitoring	
1	The performance of the governance and management teams are periodically evaluated.
2	The planning process and the accomplishments against plans are periodically reviewed to form basis for improvement.
3	There are key performance indicators and targets that are established to measure performance at the institutional, department and individual units. The performance indicators are benchmarked to reflect international best practices.
4	The institution has a system to oversee, direct, implement, monitor and review research activities, resources, and outputs.
5	The institution has a mechanism to solicit information on Student Satisfaction on all services and actions taken to address their concerns are communicated in a timely manner.
6	The institution collects, analyze and use relevant information on the effective management of the programs including feedback from alumni, student population, student progression, success and drop-out rates, student satisfaction with programs and services, employment graduation rates, and employer satisfaction.
Systems and Processes	
1	The Institution has a Quality Management System/Quality Assurance.

2	The institution has a quality assurance system or continuous quality enhancement system which covers the review and monitoring of all entities and activities that includes the collection of institutional data and statistics as basis for decision-making.
3	The Institution has a clearly established and communicated Policy Management System which governs the policy implementation, review, approval, communication and archiving.
4	The quality assurance system is a cyclical approach wherein the progress made on the last review is taken into consideration when preparing the next plan for continuous improvement.
5	The institution has a system for collection, management and control of documents which include guidelines for archiving and disposal.
6	The institution has a mechanism for monitoring and reporting health and safety incidents.
7	The institution complies with the national requirements on health and safety.
8	The institution has a health and safety guidelines that are communicated to the students, faculty, staff, visitors and other stakeholders.
9	The institution ensures that health and safety guidelines are provided in the use of equipment and that fire drills, earthquake drills, terrorist attacks and the likes are conducted for faculty, staff and students on periodic basis.
THEME 2: GOVERNANCE AND MANAGEMENT	
Leadership	
1	The Institution applies the Principle of Integrity in all matters of its operation and adheres to the highest ethical standards in teaching, professional development and service.
2	The Institution has a clearly defined governance and management structure.
3	The governance and management structure has a clearly defined authority, responsibility and accountability matrix.
4	The governance team exercises full responsibility for setting the strategic direction of the institution.
5	There are clear communication channel and reporting lines.
Mission, Vision, and Values	
1	The Mission, Vision and Value Statements have been developed in consultation with the stakeholders and are communicated through difference channels such as publications, websites, catalog, etc.
2	The Mission, Vision and Value Statements are cascaded and form the cornerstone for the development of the Institution’s Strategic Plan.
Planning	
1	The Institution has a comprehensive and integrated Strategic plan.
2	The Institution has a comprehensive and integrated Operational Plan.
3	The Institution has a comprehensive and integrated Risk Management Plan.
4	The Institution has Risk Registers and Mitigation Strategies.
5	The Institution has a comprehensive and integrated Financial Management Plan.
6	The Institution has a comprehensive and integrated Human Resource Management Plan.
7	The Institution has a comprehensive and integrated Physical Resources/Infrastructure Management Plan.
8	The Institution has a comprehensive and integrated Community and Industry Engagement Plan.

Policies and Procedures	
1	The Institution has a comprehensive and integrated Community and Industry Engagement Policies and Procedures.
2	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Program Planning and Development.
3	The Institution has a comprehensive and integrated Planning for Changes.
4	The plans are mission driven, includes goals, objectives and performance indicators
5	The institution has well-established policies and procedures related to succession, re-deployment, and severance that are appropriately communicated to stakeholders and consistently implemented.
6	The institution has policies and procedures for budgetary planning and control, auditing, risk management, insurance and indemnity coverage, and internal auditing.
7	Educational Policies and Procedures (covering all phases of student "life cycle" from admission to graduation).
8	There are student grievance policy and procedure for academic related matters that is readily accessible, effectively communicated to staff and student.
9	The Institution has a comprehensive and integrated Research and Scholarly Activities.
10	The institution has policies and procedures to protect and manage intellectual property such as inventions, patents, copyrights and research results.
11	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Budgeting for the Program.
12	The institution has a well-established policies and procedures for appeals, grievances and disciplinary actions that are consistently implemented.
13	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Grading System.
THEME 3: RECOURCE MANAGEMNET	
Fiscal Resources and Budgeting	
1	The Institution has an annual budget that is formally approved, effectively managed and the financial statement is externally audited.
2	The Institution has appropriate funding for learning and teaching activities that ensure adequate and appropriate learning and support resources including funds for teach-out in the event of institutional or program closure.
3	The Institutional Budget are linked to the institutional plans.
4	Where the institution has associated entities, there is mechanism to ensure that the Institution is protected against financial, legal and reputational liabilities from the entity it controls/owns.
Resource Allocation and Management	
1	The institutions provide the necessary tools, facilities and equipment to faculty and staff to allow them to dispatch their duty.
2	The institution provides recreational facilities and activities to foster camaraderie and collegiality.

3	The institution maintains appropriate number of academic, non-academic and support staff to support its the mission and goals.
THEME 4: STUDENT SERVICE AND SUPPORT	
Academic Support Services	
1	The institution supports the timely completion of degree though appropriate Academic Advising.
2	The institution recognizes and supports the different needs of International Students.
3	The institution provides Learning Resource Center/Library.
4	The institution provides Electronic and Non-Electronic Collections.
5	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Recognition of Prior Learning.
6	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Student Entry Standards.
7	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to General Education Courses.
8	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Student Recruitment and Admission.
9	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Transfer Credits and Advanced Standing.
10	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Student Retention and Progression.
11	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Definition of Academic Freedom.
12	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Credit Hours.
13	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information, and policies and procedures related to Degree Audit.
General Support Services	
1	The student grievance policy and procedure is consistently used to resolve student grievances in a manner that is fair, impartial and transparent.

2	There is a mechanism for students to air for redress of grievances on non-academic related matters. The procedures is accessible and effectively communicated to students and staff.
3	Students are provided with avenues to represent themselves in decisions that affect their learning experience (i.e. Student Council).
4	The institution provides Residence Halls.
5	The institution provides Catering/Canteen.
6	The institution provides Transportation.
7	The institution provides Sports and Recreational Activities.
8	The institution takes into consideration Student with special needs in the design of the curriculum and facilities management (i.e. special parking, elevators, ramps, PWD toilets. etc).
9	The institution provides ongoing Career and Employment Services and support students employability through various activities.
10	The institution provides various scholarship and financial support for deserving students.
11	The institution provides Student Publication and Clubs.
12	The institution provides Student Rights and Code of Conduct.
13	The institution provides Medical and Counseling Services.
14	The institution provides General Support Services.
15	The institution provides Information Technology services.
16	The institution provides Teaching and Learning Resources.
THEME 5: COMMUNITY ENGAGEMENT AND SERVICE	
Community and Stakeholder Involvement	
1	The institution has relationship with industry and employers to provide feedback toward program improvement.
2	The institution monitors alumni employment and maintains relationship with alumni to draw on their experience for improving the program.
3	The institution maintains external relations and networks which include business, industry, professional bodies and non-government organizations.
Community and Stakeholder Services	
1	The institution enters MOU with other educational providers for benchmarking of best practices.
2	The institution has a well-established MoUs with various organizations for On-the-Job Placement of students. OJT students are monitored to ensure that the intended learning outcomes are achieved.
THEME 6: TEACHING, LEARNING AND CURRICULUM DESIGN	
Assessment and Moderation	
1	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Assessment and moderation of exams.
2	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Marking Schemes and Rubrics.

3	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Grade Release and Grade Appeal.
4	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Examinations Regulations, Handling Results and Records.
5	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Academic Security and Invigilation.
6	The institution maintains a record of all students including exam scripts and communications.
Curriculum	
1	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Curriculum Development, Review and Approval.
2	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Alignment of the Program with the appropriate Qualifications Framework.
Graduate Attributes and Program Learning Outcomes	
1	The evaluation of the programs includes direct measures (i.e. student output) and indirect measures (i.e. feedback from employer, OJT supervisors, etc).
2	The institution has a mechanism for the periodic evaluation to determine the achievement of the course learning outcomes, program learning outcomes and graduate attributes.
3	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Graduate Attributes.
4	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Program Learning Outcomes.
Teaching and Learning Activities	
1	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Course Delivery and Program Evaluation.
2	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Remedial of Courses.

3	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Graduation Requirements.
4	The Institution offering degrees by coursework, by research, by correspondence, or by distance learning; at undergraduate or graduate levels, should each have well-established and published information and policies and procedures related to: Student study mode and load.
THEME 7: HUMAN RESOURCE MANAGEMENT	
Performance	
1	The Institution periodically evaluated faculty and staff performance and provides timely feedback including coaching and mentoring.
2	Results of performance evaluation are communicated to the stakeholders and form basis for rewards, recognitions, incentives, coaching and/or mentoring.
Qualifications	
1	Faculty qualifications are aligned with the courses that he/she teaches, and in accordance with the national guidance.
2	There is a fair and transparent recruitment and selection process that is consistently applied to both part-time and full-time faculty and staff.
3	There is proper induction provided to all faculty and staff at relevant levels within the institutions where faculty and staff are informed regarding their terms of employment and expectations in terms of roles, teaching, research, and community engagements.
Professional Development	
1	There are opportunities for faculty and staff professional development, training, use of innovation and use of new technologies.
2	There are opportunities for promotion, awards and recognition for faculty and staff.
3	The institution provides support for professional development in research, scholarships and other development programs for staff.
4	The institution clearly provides roles and expectations, code of conduct. key performance indicators and targets to faculty and staff for performance management.
THEME 8: RESEARCH AND SCHOLARLY ACTIVITIES	
Funding and Financial Support	
1	The institution has a budget allocated to research and scholarly activities.
2	The institution has a research funding scheme which include conference participation and research publications.
Performance and Outputs	
1	The institution defines the expectations for research and scholarly activities which are in line with its mission and adheres to ethics and bio-safety standards.
2	The institution has research collaboration and partnerships.
3	The institution supports research, innovation, collaboration and research excellence.
4	The Institution has a comprehensive and integrated Research and Scholarly Activities.
5	The institution has a well-established guideline for research commercialization, student involvement in research, and research-teaching nexus.

Conclusion

Accreditation bodies establish defined standards and criteria that higher education institutions (HEIs) must meet to attain and maintain accredited status. These benchmarks are typically outlined in a document referred to as Institutional Standards, which covers key areas such as governance and management, teaching and learning, program quality, qualifications, and institutional effectiveness**.** The study identified common themes and sub-themes across the institutional standards of international accreditation bodies such as AUN, CAA, OAAA, QAA, and SACSCOC, highlighting benchmark criteria that collectively define institutional quality assurance. Furthermore, the analysis revealed opportunities for enhancement within the Philippine accreditation system. By integrating relevant criteria and indicators from these international frameworks, the Philippine system can be strengthened—potentially leading to improved outcomes in accreditation, internationalization, and global rankings.

Recommendation

In light of the findings, the following are the recommendations:

Benchmark Accreditation Practices Against International Standards: Conduct a systematic benchmarking of the Philippine accreditation system with international accreditation bodies such as AUN, CAA, OAAA, QAA, and SACSCOC to identify specific areas for enhancement. This process aims to elevate the quality of higher education by aligning local accreditation practices with globally recognized standards.

Validate Standards and Criteria Through Broader Stakeholder Engagement: Strengthen the validation process of the proposed standards and criteria—derived from leading international frameworks. Broader participation will help identify additional areas for improvement and provide a more comprehensive understanding of how Philippine HEIs align with international benchmarks.

Continue Benchmarking to Drive Continuous Improvement**:** The development of standards and criteria should be viewed as an evolving process. Ongoing benchmarking with international accreditation bodies should go beyond mere comparison and aim for continuous improvement and institutional maturity, fostering a culture of excellence and global competitiveness in higher education.

Promote Further Research in Quality Assurance and Accreditation: Encourage more in-depth studies on quality assurance and accreditation practices across HEIs. This should be complemented by sharing of best practices and promoting open data access to support collaboration, transparency, and informed decision-making within the higher education sector.

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Beyond Coding: Reframing Vocational Education Through South Korea's ICT Education Policy and the Varieties of Capitalism Framework

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Abstract

In 2018, South Korea implemented mandatory coding education in primary and lower secondary schools as part of a national education reform. While this policy is often celebrated as a forward-thinking strategy aligned with SDG 4.4, which aims to increase access to technical and vocational skills, it also reflects the country's unique industrial and economic structure, heavily shaped by export-driven conglomerates and a coordinated market economy model. Using a qualitative method, this study draws on policy documents, national curriculum guidelines, government reports, and economic development strategies to examine how South Korea's coding education policy reflects the structural characteristics of its coordinated market economy. Through document analysis interpreted within the Varieties of Capitalism framework, the research explores the institutional logic behind vocational education policy formation and its implications for the realization of SDG 4.4. By adopting Varieties of Capitalism (VoC) as a framework for analyzing education policy, this study contributes to a more structurally grounded understanding of skills development, strengthening the case for aligning educational reforms with broader socio-economic systems. It further contributes to global education discourse by questioning the uncritical adoption of high-tech vocational models and encouraging more context-specific strategies that reflect each state's economic and institutional configurations toward achieving the shared goal of SDG 4.4.

Keywords: Korean education policy, vocational education policy, ICT education, education and development, SDG 4.4

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Introduction

Over the past decade, South Korea has actively integrated Information and Communication Technology (ICT) into its national education reform. In 2018, the government implemented mandatory coding education in primary and lower secondary schools. This initiative was promoted as a forward-thinking strategy that prepares youth for a digital economy and supports the global commitment to Sustainable Development Goal (SDG) 4.4. SDG 4.4 aims to substantially increase the number of youth and adults with relevant technical and vocational skills for employment, decent work, and entrepreneurship by 2030 (United Nations, 2015). While coding education appears to support this goal, the policy also reflects deeper structural characteristics specific to South Korea's political economy.

South Korea's approach to vocational education policy has been shaped by its position as a coordinated market economy. This model emphasizes long-term collaboration between the state and industry, strong linkages between public and private actors, and a focus on export competitiveness (Hall & Soskice, 2001). Educational strategies are not developed in isolation. They are tied to broader industrial goals and institutionalized mechanisms of labor-market coordination. Chaebols are large conglomerates that dominate the Korean economy. They have historically shaped the types of skills the state promotes through its schooling system (Kim & Kim, 2021). These dynamics raise the question of whether coding education in Korea functions simply as a neutral tool for digital literacy or whether it also reproduces institutional logics embedded within the coordinated market model.

Existing research on ICT-based education in Asia often focuses on access, infrastructure, or innovation. However, fewer studies have interrogated how vocational education policy reflects and reproduces national economic structures. This gap becomes more salient as global education agendas increasingly endorse high-tech vocational programs without attending to structural differences among countries. As more governments pursue digital education policies under SDG 4.4, it becomes important to understand the political and economic context that shapes policy design and implementation.

This study critically examines South Korea's mandatory coding education policy as a case of vocational education reform. It adopts the Varieties of Capitalism (VoC) framework to explore how the state's industrial logic is embedded within education planning. The study draws on curriculum guidelines, policy documents, national development strategies, and government reports. These materials are analyzed through a qualitative document analysis method that focuses on institutional features and their alignment with the coordinated market economy model.

Rather than treating ICT education as an isolated innovation, this paper situates coding education within South Korea's long-term strategy to maintain competitiveness in global technology markets. By doing so, the study provides a structurally grounded understanding of how educational reforms intersect with national economic systems. It also offers implications for other countries seeking to implement vocational and ICT education under the banner of sustainable development.

Methodology

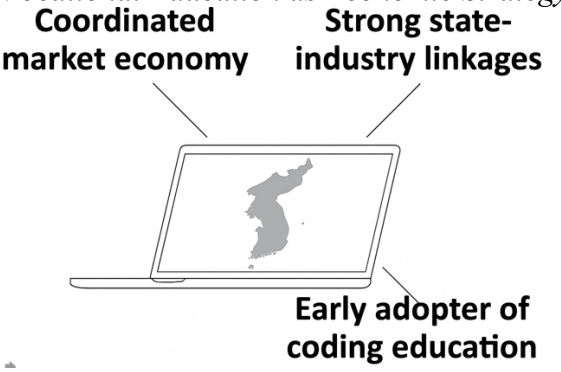
This study adopts a qualitative research design that treats education policy as a window into the broader political economy of South Korea. The analysis does not approach coding

education as a neutral or stand-alone digital literacy initiative. It conceptualizes the 2018 decision to introduce mandatory coding education in primary and lower secondary schools as a policy that is embedded in a coordinated market economy and in a long history of state-led industrialization. Within this perspective, vocational and ICT-related reforms are interpreted as instruments that support long-term strategies for technological upgrading rather than as isolated pedagogical innovations.

The research uses a document-based approach. The primary materials include national education policy documents, curriculum guidelines, government white papers, long-term human resource development plans, and strategy reports on the digital economy produced between 2010 and 2025. These documents cover the period in which coding education was first debated, piloted, and then integrated into the national curriculum. Additional sources include statistical yearbooks, OECD education indicators, and reports by international organizations that describe South Korea's ICT development and skills strategy (e.g., OECD, 2021; UNESCO, 2019). The selection of documents follows a purposeful strategy. The analysis focuses on texts that explicitly connect education reform with industrial policy, digital transformation, or human capital formation.

Figure 1

Vocational Education as Economic Strategy



South Korea is treated as a single-nation case that allows an in-depth examination of how one coordinated market economy translates economic priorities into education policy. The country represents an early adopter of mandatory coding education in basic schooling and has a strong record of export-oriented growth, large business groups, and dense ties between the state, firms, and education providers. This configuration makes South Korea a suitable case for applying the Varieties of Capitalism framework, which emphasizes institutional complementarities between production regimes, labor markets, and skill formation systems (Hall & Soskice, 2001). The case is not chosen as a statistical example. It is selected because it offers a theoretically rich instance through which the structural logic of ICT-oriented vocational reform can be explored.

Data analysis proceeds in two stages. First, the documents are read with open coding to identify recurrent references to skills, competitiveness, future industries, and digital transformation. Particular attention is paid to how coding, software education, and computational thinking are framed in relation to export industries, innovation policy, and the fourth industrial revolution. Second, these coded patterns are interpreted through the Varieties of Capitalism lens. The analysis asks how the texts express features that are associated with coordinated market economies, such as strategic coordination between the state and business, firm-specific skills,

and institutional support for long-term investment in human capital. This step links specific curricular decisions to broader mechanisms of economic governance.

The study also examines how policy actors are described and positioned within the documents. Ministries, local education offices, major conglomerates, and public agencies are analyzed as part of a network of institutions that co-produce vocational pathways. References to industry–university cooperation, public–private partnerships, and talent pipelines for strategic sectors are treated as evidence of this coordination. By tracing these linkages across multiple documents, the research reconstructs a policy narrative in which coding education functions as one node in a larger system that connects schooling to industrial upgrading.

The methodology has several limitations that shape the scope of the findings. The research does not include interviews with policymakers, teachers, or students, and it does not analyze classroom practices or learning outcomes. The focus remains on how the state and related institutions narrate and justify coding education at the level of policy texts. As a result, the study cannot evaluate the effectiveness of the reform in terms of student skills. Instead, it clarifies the institutional logic that underpins the reform and shows how that logic aligns with South Korea's coordinated market economy. This design is appropriate for the aim of the paper, which is to provide a structurally grounded interpretation of vocational ICT policy and to extend the application of the Varieties of Capitalism framework to a non-Western education system.

Results and Findings

The analysis of South Korea's coding education reform produced three main findings. First, the policy is closely embedded in the logic of a coordinated market economy rather than framed solely as a response to global digital literacy agendas. Second, the design and implementation of coding education reflect strong state and industry coordination that channels skills formation toward specific sectors of the economy. Third, the Varieties of Capitalism framework helps to explain why the reform appears ambitious in form yet conservative in its underlying institutional orientation.

The first finding concerns how the state framed mandatory coding education in high level policy documents. Government white papers and strategy reports link coding education directly to national competitiveness, innovation capacity, and the fourth industrial revolution (Ministry of Education, 2018; Ministry of Science and ICT, 2019). Policy texts repeatedly describe students as future human resources for artificial intelligence industries, advanced manufacturing, and digital exports. The official rationale rarely stops at individual empowerment or generic digital literacy. Instead, coding is described as a tool to secure national advantage in global value chains and in export markets. This pattern supports the interpretation that the reform operates as an economic upgrading strategy that is consistent with the expectations of a coordinated market economy (Hall & Soskice, 2001).

The second finding relates to institutional coordination between the state, large firms, and educational actors. Policy documents emphasize public private partnerships, cooperation councils, and joint curriculum development with major ICT and manufacturing companies. References to internships, industry linked contest programs, and company supported teacher training appear frequently in government reports. These initiatives position large firms as central partners in the design of the coding curriculum and in the provision of learning opportunities beyond the classroom. Such arrangements echo the role of employer associations

and large firms in classic coordinated market economies, where firms play an active role in vocational training and long-term skill formation (Hall & Soskice, 2001). In the Korean case, conglomerates function as key nodes that connect school-based learning with future employment pathways in the digital and manufacturing sectors.

The third finding concerns how the structure of the coding curriculum reflects vocational and economic priorities. Curriculum guidelines locate coding within technology and practical arts rather than as a separate humanities or enrichment subject. Learning objectives stress problem solving for real world applications, system thinking, and project-based tasks that resemble simplified versions of software development and automation processes. Advanced modules in some local implementations are connected to career exploration in software engineering, data analysis, and digital content production. The documents also show alignment between coding lessons in general schools and more specialized programs in Meister high schools and vocational tracks. This pattern suggests that coding education functions as an early layer in a broader pipeline of technical skill formation that runs through secondary and post-secondary vocational institutions.

Figure 2
Varieties of Capitalism



Applying the Varieties of Capitalism framework to these materials clarifies that the reform represents institutional continuity more than radical change. On the surface, mandatory coding education appears similar to reforms in liberal market economies that stress individual digital literacy and flexible skills. However, the Korean policy remains anchored in coordinated mechanisms. The state sets clear strategic goals, large firms participate in implementation, and schools integrate coding into structured pathways that support specific industries. The VoC lens shows that the reform deepens existing complementarities between education, industrial policy, and employment relations rather than dismantling them. Coding education becomes another instrument through which the state and major firms coordinate long term skill needs.

The findings also reveal a selective borrowing of global policy language. Government documents cite international agendas such as SDG 4.4 and global discourses about twenty-first century skills and computational thinking (United Nations, 2015). Yet these ideas are translated into a national context where export driven growth and industrial upgrading remain central. Digital skills are promoted, but they are framed as means to sustain the competitiveness of core

sectors rather than as neutral or universally defined competencies. This selective adaptation supports the argument that education policy mirrors deeper economic structures and coordination logics.

Finally, the findings point to specific implications for discussions of SDG 4.4. In the Korean case, coding education does appear to expand access to technical and vocational skills for young people. At the same time, the reform channels many of those skills toward a particular model of development that relies on large firms and coordinated industrial policy. The case suggests that policies which look similar on the surface may function very differently depending on the underlying economic institutions. Vocational education that uses ICT can support SDG 4.4, but its effects will depend on how it is embedded in each country's system of coordination between the state, firms, and educational institutions.

These findings gain additional meaning when they are read against the historical and structural context of South Korea. After the Korean War the state adopted a developmental model in which rapid industrialization depended on close coordination between government agencies and a small group of large firms (Amsden, 1989). Policies in the 1970s promoted heavy and chemical industries and linked access to credit and protection in domestic markets to export performance. This pattern created a strong expectation that education and training systems would supply the technical workforce needed for industrial upgrading rather than only provide general academic skills (Kim, 1997).

The state has continued to act as a central planner in the field of skills and education. Government strategies describe human resources as the main driver of growth because South Korea has limited natural resources. Long term plans for science, technology, and information industries place education at the center of economic policy and treat curriculum reform as a direct instrument of competitiveness policy (Ministry of Education, 2018; Ministry of Science and ICT, 2019). Coding education fits into this tradition because it is framed as a way to prepare future workers for specific sectors such as semiconductors, software, and artificial intelligence. The reform is therefore consistent with the coordinated market economy pattern in which the state steers skill formation in line with industrial priorities rather than leaving it solely to individual choice or market signals (Hall & Soskice, 2001).

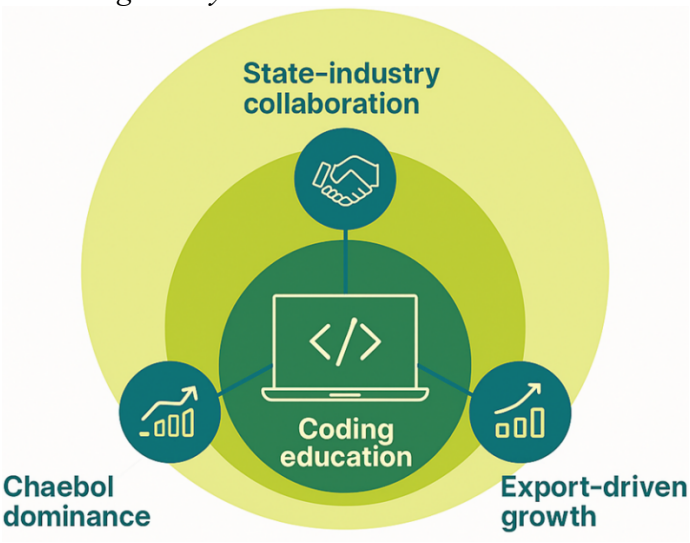
Large business groups have also played a decisive role in the way skills are produced and used. Conglomerates such as Samsung and Hyundai have long operated internal research centers and training institutes and have offered structured career ladders for engineers and technicians (Chang, 1993). Public reports on coding education refer to partnerships with these firms for curriculum development, teacher training, and student contests. These links indicate that the school based coding curriculum is expected to feed into existing channels of firm based training and recruitment. The result is a multi layered system in which basic coding skills in compulsory education connect with more specialized vocational programs and then move into firm specific training within major companies.

This structural context helps to explain why coding education in South Korea appears ambitious while still reinforcing existing institutional arrangements. The state uses the language of global digital literacy and SDG 4.4, but it embeds the reform in a long standing pattern of export driven growth and firm centered skill formation. The Varieties of Capitalism framework clarifies that the Korean case is not only a story about innovation in pedagogy. It is a case in which a new curriculum reflects and reproduces a coordinated system of economic governance. For debates on SDG 4.4 this suggests that digital and vocational reforms need to

be interpreted through each country's political economic structure. Similar policies may lead to different outcomes when they are placed in different configurations of state capacity, industrial organization, and education systems.

In this light, coding education functions as a mirror of Korea's institutional arrangements rather than a stand alone pedagogical experiment. The policy links classroom content to national goals of export upgrading and digital transformation. Curriculum documents describe coding as a core competence for work in semiconductors, software, and artificial intelligence rather than only as a general digital literacy skill. This supports the view that vocational education in South Korea operates as an economic strategy that serves coordinated growth and industrial upgrading.

Figure 3
CME-Aligned Hybrid Model

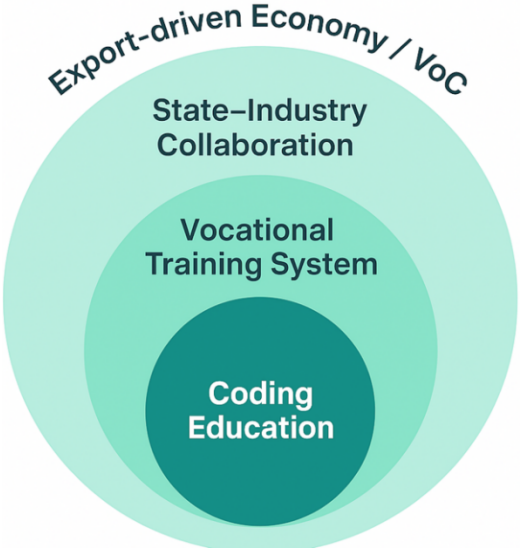


The application of the Varieties of Capitalism framework clarifies Korea's position as a coordinated market economy with hybrid features. Policy texts and white papers frequently highlight cooperation among ministries, business federations, and universities in the design and implementation of coding education. These patterns match the logic of coordinated systems that rely on strategic collaboration instead of pure market competition in the fields of training, innovation, and wage setting (Hall & Soskice, 2001). At the same time, the strong role of export competition and global value chains shows that Korea does not reproduce European coordinated models in a simple way. The case therefore extends VoC debates to an Asian context and illustrates how coordination can operate under conditions of high external competitiveness.

The findings also show that education policy can be read through the same institutional lens that comparative political economy research has usually applied to labor markets and welfare regimes. Coding education in Korea reflects long term patterns of state led steering, firm centered skill formation, and export driven industrial strategy. It is not only a response to global discourses on digital literacy and SDG 4.4. It is also an adaptation of those discourses to an existing system of coordination between the state, large firms, and educational institutions. This result suggests that future research on vocational and ICT based reforms in other countries should examine how similar policies are filtered through different institutional configurations rather than assuming uniform effects across contexts.

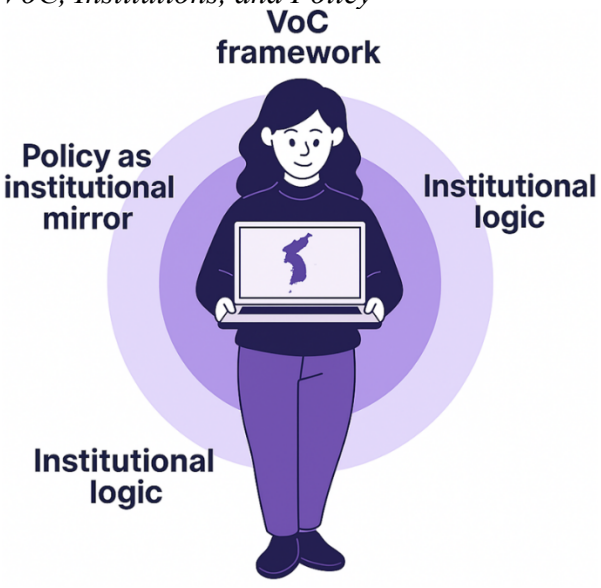
In this structural context the emergence of coding education in South Korea can be better understood through the Varieties of Capitalism framework, which explains how national models of coordination shape reform trajectories in different policy domains (Hall & Soskice, 2001). Coding education sits within a wider vocational training system that has long been organized through dense ties between the state, large firms, and education providers.

Figure 4
Coding Education in Korea's Skills System



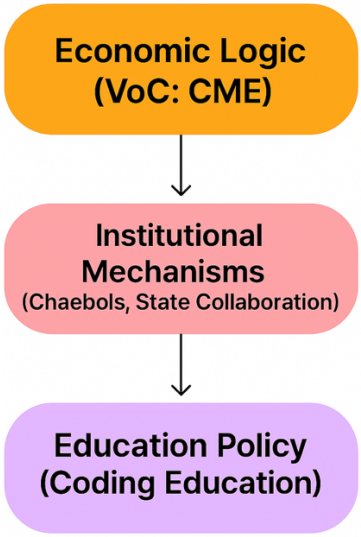
The policy therefore reflects an existing logic of strategic coordination in which the government designs skill formation not only for individual learning but also for industrial competitiveness. When viewed in this way coding education appears as one element in a sequence that links economic strategy, institutional arrangements, and sectoral policy. This reading supports the argument that policy often functions as a mirror of underlying institutions rather than as an independent or purely technocratic choice.

Figure 5
VoC, Institutions, and Policy



The content, timing, and framing of coding education in Korea reveal the priorities of a coordinated market economy that relies on highly skilled labor, firm specific training, and export oriented upgrading. Coding education is not simply a reaction to global enthusiasm for digital literacy. It is embedded in Korea's particular system of economic coordination in which state led planning, firm based innovation, and education policy are closely connected.

Figure 6
From Economic Logic to Coding Policy



Understanding coding education as an embedded reform clarifies why Korea moved relatively early to mandate coding in schools and why this reform is likely to reinforce existing patterns of vocational skill formation rather than replace them.

Implications & Conclusion

The analysis of South Korea's coding education policy shows that vocational education that uses ICT functions as part of a broader economic strategy rather than as a simple classroom innovation. Coding education supports export oriented growth and digital industrial upgrading because it channels young people into skills that match the needs of large firms and technology intensive sectors. This finding is consistent with the logic of coordinated market economies in the Varieties of Capitalism framework, where skill formation and firm strategies are closely linked to long term national development paths (Hall & Soskice, 2001).

These results have several implications for the implementation of SDG 4.4. International debates often present digital skills and coding education as universal solutions that every country should adopt in a similar way. The Korean case suggests that such policies work most effectively when they are aligned with existing patterns of coordination between the state, firms, and educational institutions. SDG 4.4 calls for an increase in the number of youth and adults with relevant technical and vocational skills (United Nations, 2015). The Korean experience shows that relevance is not only a question of curriculum content. It is also a question of how skills are linked to concrete employment pathways within a particular political economy.

The findings also highlight the limits of simple policy transfer. Coding education in South Korea is anchored in strong state industry collaboration, dense links between universities and large firms, and a history of export oriented industrial policy. Countries with liberal market

economies that rely more on competitive markets and weaker forms of coordination are likely to experience different outcomes even if they adopt similar ICT based curricula. Developing countries with large informal sectors or limited state capacity may face even greater mismatches if they import high tech vocational models without the supporting institutional infrastructure. The Korean model can offer ideas for how to connect vocational education with growth strategies, but it cannot serve as a ready made blueprint.

At the same time, the study does not suggest that countries should avoid ICT based vocational reforms. Instead, it argues that such reforms should be designed with careful attention to institutional complementarities. Policymakers need to ask how new digital curricula will interact with existing labor market institutions, firm level training practices, and state development strategies. The Korean case illustrates that vocational education can reinforce a particular growth model when these elements are aligned. It also suggests that misalignment may produce weaker results or even deepen inequalities if only some groups gain access to employment that uses new skills.

The study makes a theoretical contribution by extending the use of the Varieties of Capitalism framework into the field of education policy. Previous VoC research has focused mainly on production regimes and labor markets in Europe and North America (Hall & Soskice, 2001). By applying VoC to a non-Western case and to the domain of schooling and vocational education, the analysis supports the claim that education policy can be read as a mirror of institutional structures. Coding education in South Korea reflects long standing patterns of coordination between the state and large firms. It also reflects a national preference for strategies that link human capital formation with export competitiveness. This perspective invites further work that treats education ministries, school systems, and curricula as part of the institutional architecture of coordinated or liberal market economies.

There are also important methodological and empirical limits to this study. The analysis is based on document review rather than interviews with policymakers, teachers, or students. It therefore reconstructs institutional logic and policy intentions but does not directly measure classroom level practice or labor market outcomes. Future research could combine this structural perspective with qualitative fieldwork in schools and firms or with quantitative analyses of student trajectories in vocational and ICT related tracks. Comparative work that examines other Asian economies with different configurations of state capacity and industrial organization would also deepen the argument. Such studies could test how far the Korean pattern travels and where it breaks down.

Despite these limits, the findings offer a set of cautious implications for global education debates. Efforts to achieve SDG 4.4 will benefit from promotion of digital skills, but they will be more effective when reforms are grounded in each country’s political economic structure. The Korean case shows that coding education can support inclusive and future oriented skill formation when it is embedded in a coherent system of coordination across the state, firms, and education providers. It also warns against the uncritical diffusion of high tech vocational models that ignore institutional context. A more realistic approach to SDG 4.4 will recognize that there are many possible paths to building relevant skills and that each path must reflect national histories of development, governance, and industrial organization.

In conclusion, this study has interpreted South Korea’s mandatory coding education policy as a structural feature of its coordinated market economy rather than as a purely pedagogical reform. Viewing the policy through the Varieties of Capitalism framework clarifies how

vocational education can function as an economic strategy that supports export oriented upgrading. The case therefore contributes to both educational research and political economy by linking debates on ICT based learning to deeper questions about institutional design and development.

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Autoethnography as Story: The Realities and Dynamics of Transnational Children's Education on the Indonesia-Malaysia Border

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Abstract

This study examines the dynamics of transnational children's education on the Indonesia-Malaysia border, specifically in the Dayak Bidayuh community between Kampung Sontas (Indonesia) and Entubuh (Malaysia). The main issue is how citizenship status, limited mobility, and state policies affect children's access and educational experiences in cross-border kinship networks. The study aims to uncover the complex realities of these children's education from the perspective of actors directly involved in border life. Using an autoethnographic method implemented over five years (2019–2024), researchers immersed themselves in the lives of border communities, conducting participant observation, in-depth interviews, and documenting personal experiences as the main narrative. The results of the study show that transnational children face administrative limitations, gaps in educational facilities, and pressures of national and ethnic identity. Nevertheless, families and local communities play a central role in maintaining educational values through adaptive strategies and kinship solidarity. The implications of this study indicate the importance of inclusive and cross-border education policies and the need for state recognition of the complexity of identity and mobility of border communities. Autoethnography as an approach can bridge personal experiences with the structural dynamics that influence the lives of transnational children.

Keywords: autoethnography, transnational children, border education, Indonesia–Malaysia border, Dayak Bidayuh community, cross-border mobility, citizenship and identity

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Introduction

Various studies on education in border regions often place children as statistical figures: school participation rates, school dropout rates, or literacy achievements. However, behind these data there are complex life experiences, especially for children who grow up in transnational social spaces, where national borders are administrative but do not completely cut off social relations, kinship and cultural identity. This article departs from this anxiety, by focusing on the realities of transnational children's education on the Indonesia–Malaysia border, especially in the Bidayuh Dayak communities who inhabit Sontas Village (Indonesia) and Entubuh (Malaysia) (Dewantara et al., 2020).

The Sontas-Entubuh border region is not simply a geopolitical line separating two countries, but rather a shared living space that existed long before modern state borders were established. The Dayak Bidayuh communities in both regions share strong kinship ties, shared historical origins, and intertwined socio-cultural practices. In this context, children grow up with relatively fluid cross-border mobility, often hampered administratively. Education, as a state institution heavily dependent on citizenship status and formal bureaucratic systems, becomes an arena where the tension between transnational life and the logic of the state is most palpable. (Dewantara et al., 2025).

Transnational children across the Indonesia-Malaysia border face a paradoxical situation. On the one hand, they live within transnational family networks that allow alternative access to schools, educational resources, and diverse learning experiences. On the other hand, they face limited legal documentation, differences in national curricula, disparities in educational facilities, and state policies that tend to view cross-border mobility as an anomaly or even a threat. These conditions impact not only their access to formal education but also their daily learning experiences, sense of security, and the formation of national and ethnic identities. (Dewantara et al., 2023).

Most previous research on border education still uses a structural or public policy approach, focusing on the state as the primary actor. This approach is important, but it often fails to capture the subjective experiences of the children and families living within it. Yet, for border communities like the Dayak Bidayuh, education is not solely understood as an institutional process within schools, but rather as part of a survival strategy, the transmission of values, and the negotiation of identity amidst pressures from the nation-state. Therefore, an approach that bridges personal experiences with broader structural dynamics is needed.

This article uses autoethnography as the primary methodological approach to understand this reality. Autoethnography allows researchers to position themselves not only as observers but also as part of the social world being studied. Through direct engagement and reflection on personal experiences over five years (2019–2024) of living, working, and interacting with the Sontas–Entubuh border community, this research seeks to present stories from within about the education of transnational children. This approach rejects claims of objectivity separate from experience, instead emphasizing the importance of narrative, emotion, memory, and social relations in the production of knowledge.

Autoethnography as story serves as the primary conceptual framework in this article. Stories are not understood simply as data illustrations, but as an analytical medium that reveals power relations, structural inequalities, and community adaptive strategies. Through everyday stories—about children attending school across borders, parents negotiating with authorities,

teachers facing limited facilities, and families relying on kinship solidarity this article shows how education is experienced, negotiated, and interpreted in a border context (Widoyoko, 2016).

The education of transnational children in the Dayak Bidayuh community is inextricably linked to issues of identity. These children grow up with a dual awareness of belonging to the same ethnic community, yet simultaneously interpellated by two countries with differing national narratives. Schools become crucial spaces where national identity is introduced, negotiated, and even questioned. In certain situations, children must learn to adapt to rigid national demands while maintaining local identities and cross-border kinship ties (Aditya Dewantara et al., 2025).

By positioning personal experiences as the entry point for analysis, this article aims to reveal the dynamics of transnational children's education in a more holistic and humane way. The primary focus is not only on what they lack documents, access, or facilities but also on what they build: the adaptive strategies of families, the role of local communities, and practices of solidarity that enable education to continue despite limitations. Through an autoethnographic approach, this research contributes to the discourse on border education, transnational studies, and qualitative methodology by demonstrating that personal stories can be a powerful analytical tool for understanding complex social structures.

Ultimately, this article emphasizes that understanding children's education in border regions is not sufficient only through policies and statistics. It requires methodological courage to listen to stories, feel tensions, and reflect on the researcher's position within them. Autoethnography offers this space, while also opening up the possibility for formulating education policies that are more inclusive, contextual, and sensitive to the lived realities of border communities.

Method

This research uses a qualitative approach with an autoethnographic method, positioned not only as a data collection technique but also as an epistemological framework for understanding the educational realities of transnational children in the Indonesia-Malaysia border region. Autoethnography was chosen because it can bridge the researcher's personal experiences with the broader social, cultural, and political context, particularly in border situations fraught with negotiations of identity, mobility, and state power (Dewantara & Budimansyah, 2024).

Autoethnographic Approach

Autoethnography in this research is understood as “autoethnography as story,” an approach that places the researcher's lived narrative as both the primary data source and the analytical tool. The researcher does not position herself as a neutral external observer, but rather as an actor directly involved in the social life of the Dayak Bidayuh communities in Kampung Sontas (Indonesia) and Entubuh (Malaysia). This position allows the researcher to capture the dynamics of transnational children's education from within, including emotions, ethical dilemmas, and daily practices that are often overlooked by survey approaches or policy studies. (Miles et al., 2014).

Autoethnography was chosen because the research context the education of children across borders within kinship networks is difficult to fully understand without long-term engagement and in-depth social relations. This method allows for critical reflection on the researcher's

personal experiences as part of the social structure being studied, while also opening up space to examine the relationships between the micro (individual and family experiences) and the macro (state policies, citizenship regimes, and national education systems).

Location and Duration of Research

The research was conducted in the Sontas-Entubuh border region for five years (2019–2024). Sontas and Entubuh villages were chosen because both are Dayak Bidayuh communities with cross-border kinship ties, high social mobility, and child education practices that involve two different state systems. The long research period allowed the researchers to conduct repeated observations, build trust with the community, and capture changes and continuity in transnational child education practices.

Data Collection Techniques

Data were collected through several complementary techniques:

Participant Observation

The researcher was directly involved in the daily life of the community, including participating in family activities, school activities, children's interactions, and community meetings. Participant observation was conducted reflectively, noting not only the events observed, but also the researcher's position, feelings, and responses to the situation.

In-Depth Interviews

Interviews were conducted informally and in-depth with transnational children, parents, teachers, traditional leaders, and local officials. The interviews were flexible and narrative, allowing informants to share their educational experiences without being constrained by a rigid question structure.

Reflective Notes and Personal Narratives

The researcher compiled ongoing reflective field notes, which included personal experiences, dialogues, significant events, and critical reflections on the researcher's position within power relations and research ethics. These notes served as the primary source for constructing the autoethnographic narrative.

Contextual Documentation

Supporting documents such as education policies, population administration documents, and local archives are used to enrich the analysis and link personal experiences to the broader structural framework.

Data Analysis

Data analysis was conducted narratively and thematically. Rather than conducting formal coding separate from the narrative, researchers interpreted the data through the construction of narratives encompassing key themes, such as administrative limitations, cross-border mobility, disparities in educational facilities, and negotiations of national and ethnic identity. The

analysis process was iterative, in which personal reflections, interview data, and field observations were mutually tested and deepened (Blasco & Wardle, 2007).

Research Validity and Ethics

Research validity is maintained through reflexivity, long-term engagement, and triangulation of data sources. In the context of autoethnography, reflexivity is a key aspect of validity, as the researcher explicitly discloses their positionality, involvement, and potential biases. Ethical considerations include maintaining the anonymity of informants, obtaining informed consent, and ensuring that the narratives presented do not harm individuals or communities.

Through this method, the research seeks to provide an in-depth, contextualized, and lived-experienced understanding of the dynamics of transnational children's education in border regions.

Result and Discussion

Education in the Space Between: Administration, Mobility, and the Uncertainty of Transnational Children

The education of transnational children in the Sontas–Entubuh border region takes place in what can be called an in-between space—a social space at the intersection of transnational kinship and the rigid administrative system of the nation-state. This space is neither entirely within the logic of Indonesia, nor entirely subordinate to Malaysia. Over five years of fieldwork, this in-between space emerged as a key context shaping the access, experience, and meaning of education for Dayak Bidayuh children. One of the most striking findings of this research is that administrative uncertainty is a persistent structural condition in the educational lives of transnational children, not simply a momentary obstacle. Many children in Sontas Village have a history of long-standing cross-border mobility: born in Entubuh, raised in Sontas, returning to Malaysia for school, and then returning to Indonesia to follow their parents or relatives. This mobility is socially considered normal and legitimate within the Dayak Bidayuh kinship framework, but it does not always align with the logic of state population administration.

In formal education, uncertainty about citizenship and documentation is a major source of vulnerability. Children who lack Indonesian birth certificates, child identity cards, or valid cross-border documents are often admitted to school through informal mechanisms. Teachers and principals, particularly in border areas, often take a pragmatic stance, prioritizing children's rights to learn over rigid administrative compliance. However, this acceptance is always temporary and dependent on broader political-administrative circumstances. From the children's perspective, this creates an ambiguous school experience. School is not only a space for learning, but also a space of uncertainty. Children grow up with an implicit awareness that their presence at school could be questioned at any time. They understand that there are certain things that should not be asked or explained too much—for example, about birthplace, parental status, or reasons for changing schools. This awareness shapes a cautious attitude and a strategy of silence that develops from an early age.

Cross-border mobility is another dimension that deepens the educational experience in the in-between space. In autoethnographic accounts, researchers observe how children habitually move residences following family dynamics: living with their parents in Sontas, then spending

some time with their uncles or grandparents in Entubuh for school, and then returning again. These moves are not always accompanied by smooth transitions within the education system. Differences in curriculum, language of instruction, learning rhythms, and school culture mean that children must constantly adapt.

This socially fluid mobility clashes with state expectations of residential stability and identity. National education systems, in both Indonesia and Malaysia, are primarily designed for individuals who are settled, documented, and have clear citizenship status. Transnational children, with their fluid mobility and identities, fall outside this normative imagination. As a result, they are often positioned as “special cases” to be addressed ad hoc, rather than as part of a systemic education policy design.

The disparity in educational facilities between Sontas and Entubuh also influences families' educational choices. Schools in Entubuh have relatively better infrastructure, a more ideal teacher-student ratio, and more consistent state support. These conditions encourage families in Sontas to view education in Malaysia as an opportunity, despite the accompanying administrative risks. This decision is rarely based on ideological preferences for a particular country, but rather on practical considerations regarding their children's future. However, attending school in Malaysia does not necessarily solve problems. Children who attend Entubuh face complex identity challenges. At school, they are socialized into the Malaysian national narrative through the curriculum, state symbols, and disciplinary practices. At home and in the community, they continue to live within the Dayak Bidayuh culture, which transcends borders and is not fully tied to any one country. This tension creates a layered and sometimes contradictory identity experience.

In their autoethnographic experiences, researchers noted how children often navigated situational shifts in identity. In the school classroom, they conformed to prevailing national expectations; at home, they reverted to ethnic and kinship identities. Education, in this context, not only transmitted academic knowledge but also trained children to become flexible, adaptive subjects, able to navigate contexts of power.

For parents, the transnational education of children was a decision-making process fraught with moral and emotional dilemmas. Parents had to balance compliance with state regulations with the responsibility to ensure their children received a proper education. In many cases, they relied on cross-border kinship networks to overcome administrative limitations—for example, by entrusting their children to relatives with more complete documents or better access to certain schools. The state was present in family life not as a single, clear entity, but as a series of changing rules, apparatuses, and procedures. This uncertainty forced families and children to continually adapt their educational strategies. Education became an ongoing practice of negotiation, rather than the stable, linear process envisioned in national policies.

This subsection demonstrates that the education of transnational children on the border is not simply a matter of access to or quality of schooling, but a lived experience shaped by administrative uncertainty, cross-border mobility, and structural inequalities between countries. Children not only learn to read, write, and count, but also learn to understand national borders, bureaucratic loopholes, and survival strategies within a system that does not fully accommodate their existence. Through an autoethnographic approach, these experiences are not reduced to abstract data but are understood as living narratives that reflect the power relations between the state and border communities. Uncertainty, in this context, is not an anomaly, but a normal

condition that shapes the subjectivity and educational experiences of transnational Dayak Bidayuh children in Sontas–Entubuh.

Nurturing Education Amidst Disadvantages: The Role of the Family, Kinship Solidarity, and the Negotiation of Transnational Children's Identities

Amid administrative uncertainty, cross-border mobility, and limited state policy, the education of transnational children on the Sontas–Entubuh border is not entirely dependent on formal institutions. This research finding indicates that families and cross-border kinship networks play a central role as the main pillars of the educational sustainability of Dayak Bidayuh children. Education, in this context, is treated as a collective social practice that transcends school spaces and state logic.

Dayak Bidayuh families in Sontas and Entubuh view children's education not solely as the responsibility of the immediate parents, but as a shared responsibility within the extended kinship circle. When access to formal education is hampered by paperwork, distance, or limited facilities, solutions are often found through cross-border family solidarity. Children are entrusted to uncles, aunts, grandparents, or cousins who live closer to a particular school or have more stable administrative status. This practice is not seen as a form of "transfer of responsibility," but rather as a collective strategy to ensure the child's future. In autoethnographic experiences, researchers witnessed how educational decisions are often made through family deliberations. Considerations arise not only regarding school quality but also regarding the child's safety, residential stability, and the family's ability to cope with administrative risks. Education is understood as a long-term process that requires flexibility, patience, and the ability to adapt to changing border situations.

This kinship solidarity also serves as an emotional protection mechanism for children. Children who must change schools or residences do not feel completely uprooted because they remain within the same extended family circle, culturally and emotionally. Dayak Bidayuh ethnic ties serve as a crucial foundation for maintaining a sense of continuity of identity for children amidst cross-border migration. Thus, despite changes in school and state systems, a sense of "home" remains through kinship ties.

In addition to families, local communities also play a crucial role in supporting the education of transnational children. Traditional leaders, teachers, and villagers often mediate between children's needs and state regulations. In many cases, schools in border areas demonstrate a high degree of flexibility in accepting children from unclear administrative backgrounds. This flexibility is not without risk, but is seen as a form of moral responsibility for the future of the community's younger generation. However, the role of families and communities is not only practical but also symbolic. The education of transnational children becomes an arena where values of kinship, ethics of sharing, and collective responsibility are reproduced. Parents and relatives actively instill in children that education is a path to community strengthening, not merely a means of individual social mobility. This narrative is crucial to understanding why, despite facing various limitations, families continue to strive to maintain the continuity of their children's education.

On the other hand, education also serves as a crucial space for transnational children to negotiate their national and ethnic identities. Dayak Bidayuh children grow up in a world that simultaneously cultivates cross-border ethnic identities and distinct national identities. Schools, as state institutions, play a significant role in this process. Through their curriculum,

flag ceremonies, national symbols, and language of instruction, schools transmit narratives of nationality that are often exclusive.

Children attending school in Malaysia, for example, are exposed to a national narrative that emphasizes loyalty to the Malaysian state, while their ethnic identities are not always given adequate space for expression. Conversely, children attending school in Indonesia also experience a process of national socialization that positions national borders as a clear marker of identity. In both contexts, Dayak Bidayuh identity, as a cross-border identity, is often marginalized. However, the findings of this study indicate that children do not simply passively accept this national narrative. Through cross-border life experiences, they develop contextual and situational identity negotiation skills. At school, they learn to project an expected national identity; at home and in the community, they return to an inclusive and cross-border ethnic identity. This ability is not the result of formal learning, but rather the result of everyday life experiences that constantly demand adaptation.

In autoethnographic accounts, researchers reflect on how children are often more flexible than adults in interpreting identity. For them, being “Indonesian,” “Malaysian,” and “Bidayuh” are not always understood as mutually exclusive identities, but rather as layers of identity that can be activated according to context. Education, in this case, serves as a social training space for managing these complex identities.

However, this flexibility also carries an emotional burden. Children sometimes experience confusion, especially when the national narrative in school contradicts their lived experiences at home and in the community. When the state is presented as the sole legitimate source of identity, children's cross-border experiences become invisible or even questioned. In these situations, the role of the family again becomes crucial as a safe space to discuss experiences, explain differences, and affirm ethnic identity.

This subsection emphasizes that the education of transnational children at the border cannot be separated from the social care work carried out by families and communities. When the state's presence is limited and often insensitive to the realities of the border, families and kinship networks take over the role of guardians of the continuity of children's education and identity. Education is maintained not only through school, but also through daily practices that instill the values of adaptation, solidarity, and resilience. Through an autoethnographic approach, these findings demonstrate that the educational success of transnational children is not solely determined by state policy, but by the ability of border communities to nurture education as a collective practice. Identity negotiation, in this context, is not a sign of crisis, but rather a form of social intelligence that enables children to survive and thrive in the space between two countries.

Education in Border Spaces as an Arena for Negotiation Between State, Kinship, and Identity

The findings of this study demonstrate that the education of transnational Dayak Bidayuh children on the Sontas-Entubuh border cannot be understood solely as an institutional process under state control, but rather as an arena of complex social negotiation. Schools and everyday educational practices become spaces where the logic of the nation-state, cross-border kinship ties, and the formation of children's identities interact, compete, and compromise. In this context, education functions not only as a means of transmitting knowledge, but also as a

mechanism for social regulation and the production of citizenship subjects (Arpannudin & Dewantara, 2025).

From the state's perspective, education is positioned as a crucial instrument for instilling national identity and ensuring citizen loyalty. The curriculum, national symbols, language of instruction, and disciplinary practices in schools reflect the state's efforts to normalize territorial boundaries and shape subjects consistent with a stable civic imagination. However, research findings suggest that this logic does not fully align with the realities of children's lives in border regions (Dewantara, 2024). Dayak Bidayuh children grow up in a social context that transcends national borders, where kinship relations, mobility, and ethnic identity are cross-territorial (Olendo et al., 2022).

In this situation, education becomes a space where the tension between these two logics is practically negotiated. Children and families do not outright reject the state, but neither do they completely submit to administrative demands and rigid national identities. Instead, they develop adaptive strategies that enable education to continue. These strategies include leveraging cross-border kinship networks, flexibility in school choice, and the children's ability to adapt to differing identity expectations across social spaces (Sulistyarini et al., 2021).

These negotiations also demonstrate the limitations of a territorial and exclusive approach to education policy. When education is designed only for clearly documented citizens, transnational children are left vulnerable and not fully accommodated (Jailani et al., 2021). These findings strengthen the argument that education in border regions requires a policy framework that recognizes mobility and multiple identities as social realities, not deviations. In other words, education needs to be understood as a contextual social practice, not simply the implementation of national regulations (Dewantara, 2025).

Furthermore, this subchapter highlights the role of kinship as an alternative social structure that balances state dominance in educational settings. The extended family and Dayak Bidayuh community serve as a social safety net, ensuring the continuity of children's education when the state's presence is limited or inconsistent. This role demonstrates that education in border areas is supported not only by formal institutions but also by informal social mechanisms rooted in the values of solidarity and collective responsibility (Fatmawati & Dewantara, 2022).

In the context of identity formation, education in borderlands produces children with reflective and contextual abilities in interpreting nationality and ethnicity. Children do not view national and ethnic identities as mutually exclusive categories, but rather as layers of identity that can be negotiated according to the situation. This ability challenges the assumption that national education always produces a single, homogeneous identity (Budimansyah & Dewantara, 2025). In contrast, education on the border demonstrates how identity is fluid and situational.

Thus, education in border regions can be understood as an arena where state, kinship, and identity interact in an unequal relationship. The autoethnographic approach used in this research allows for a deeper understanding of these dynamics, as it positions lived experience as a legitimate source of knowledge. This sub-chapter emphasizes that to fully understand the education of transnational children, a perspective that transcends the nation-state framework and allows for the experiences, stories, and social practices of border communities is necessary.

Conclusions

This research demonstrates that the education of transnational children on the Indonesia-Malaysia border, particularly within the Dayak Bidayuh communities of Sontas and Entubuh, is a social process that takes place in an in-between space characterized by administrative uncertainty, cross-border mobility, and ongoing identity negotiations. Education cannot be understood solely as a technocratic state service, but rather as a lived practice continuously negotiated by children, families, communities, and formal institutions within the border context. Using an autoethnographic approach, this research reveals that transnational children face various structural limitations, particularly related to citizenship status, access to documents, and disparities in educational facilities across countries. However, these limitations do not completely halt the educational process. Instead, families and cross-border kinship networks play a key role in maintaining the continuity of education through adaptive strategies, social solidarity, and flexibility in dealing with state systems that are not always responsive to the realities of the border.

The research findings also confirm that education is a crucial arena for the formation and negotiation of transnational children's identities. On the one hand, schools transmit national narratives that tend to demand a single loyalty. On the other hand, cross-border life experiences enable children to develop layered, contextual, and situational identities. This ability demonstrates that national and ethnic identities are not necessarily antagonistic but can instead be pragmatically negotiated in everyday life.

Methodologically, this research emphasizes the value of autoethnography as an approach capable of bridging personal experiences with broader structural dynamics. By employing storytelling as an analytical tool, autoethnography enables a more human and contextual understanding of education in border regions something often relegated to policy- and statistical-based analyses.

Ultimately, this research highlights the importance of more inclusive education policies that are sensitive to the mobility and complex identities of border communities. State recognition of the transnational realities of children and families in border areas is a key prerequisite for ensuring equitable and sustainable education rights. Without such recognition, the education of transnational children will continue to be precarious, relying on the resilience of families and communities rather than on systemic state protection.

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Creating an Inclusive, Accessible, and Supportive Foreign Language Learning Environment for Students With Disabilities

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Abstract

Today, most higher education institutions have a support center for students with disabilities (SWDs), but for the most part, if a teacher is not directly contacted, these support centers remain largely unknown to language teachers. To help bridge the gap between the disabilities resource center and the foreign language classroom at the university in which this research took place, an open-ended survey was given to the staff and teachers. Qualitative surveys sought to identify procedural steps from student application for reasonable accommodation to the classroom and bring attention to the various types of disabilities teachers need to accommodate. In-depth interviews with two teachers describe how they adapted their teaching approach and learning materials to accommodate specific disabilities. A framework was first created showing the step-by-step procedure from application to the classroom to help teachers understand the services and support offered. Following this, the support center and teachers provided practical advice on classroom management for various disabilities. The researcher hopes that through this paper, teachers can gain a deeper understanding of the general procedure of applying for reasonable accommodation and consider how to more effectively accommodate students of varying abilities in the second language classroom.

Keywords: reasonable accommodation, teacher professional development, English as a foreign language (EFL)

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Introduction

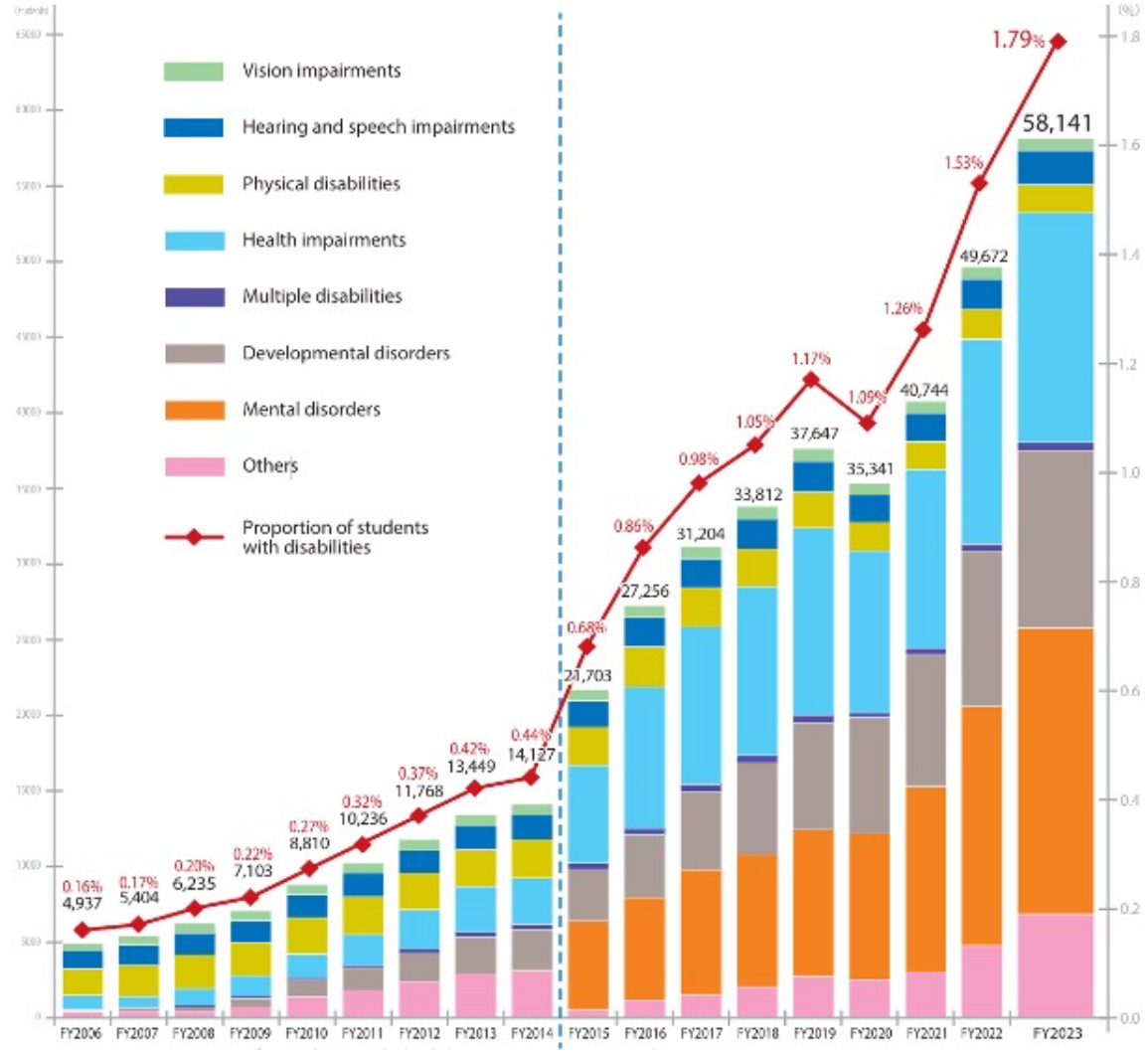
Based on the philosophy of the 2013 "Act for Eliminating Discrimination Against Persons with Disabilities" (Japanese Law Translation, Act No. 65, 2013), Japanese universities are encouraged to provide "reasonable accommodation" (support) to students with special needs by eliminating barriers for all students to exercise the right to study and experience university life, ensuring an equal opportunity environment regardless of disabilities. Kyoto University's Disability Resource Centre (DRC) deems "disability" to be an "artifact of society or the environment (social barriers, etc.), rather than an aspect of the individual" (DRC, n. d.). In essence, students with disabilities (SWDs) have specific limitations in physical, sensory, cognitive, developmental, psychological, speech, or other disabilities accompanied by a physician's diagnosis. In order to participate effectively in regular classes, students must apply for reasonable accommodation after which teachers can make special provisions with teaching approaches, learning materials, and the physical classroom environment to accommodate their special needs. In 2021, the Act was amended to pertain specifically to public higher education institutions and in 2024 to private universities.

Since 2005, the Japan Student Services Organization (JASSO) has provided support for Japanese higher education institutions in creating an inclusive and equitable educational environment. They have released several national reports related to the increasing number of SWDs in the past two decades. Between 2006 to 2025, JASSO has reported a significant increase in SWDs from 0.16% in 2006, 0.42% in 2013, 1.17% in 2019, 1.26% in 2021, and the current figure of 1.79% in 2023 (JASSO, 2022, 2025). The sharp incline on the chart (Figure 1) from 2015 was due to classification categories being increased and modified, as well as the opening of more support centers across Japan and overall improvements in coordination efforts in educational institutions.

Figure 1 shows the breakdown of various disabilities from JASSO's 2025–2026 report (JASSO, 2025).

Figure 1

Increase in Percentage of Students With Disabilities and Disability Type in Higher Education Institutions FY2006–2023 (n = 58,141)



At the university in which this research took place, the number of SWDs has seen a similar increase: from 43 students in 2017 to 300 in 2024. This has resulted in several language teachers having to accommodate one or two SWDs in their courses each year. For educators who have never taught a SWD or received specific training for special education students, this situation can cause feelings of anxiety or stress. Teacher affective issues (e.g., anxiety and well-being) related to teaching special needs students is an area of EFL that is somewhat under researched as the focus tends to be on how to effectively teach SWDs. A study by Alshahrani (2018) in Saudi Arabia reported a lack of specialist support and in-service training for teaching students with special needs leading to stress and anxiety. Challenges navigated by language teachers in Kahil and Pradia's (2023) research in the Philippines were limited teaching methods, a lack of resources for specific disabilities, communication difficulties, adapting to diverse disabilities, creating special assessment methods, and making individualized learning plans. In a systematic review, over ten years, Johnson and Erasmus (2024) found several persistent challenges educators face, mainly a lack of professional development and training programs, a weak institutional culture of collaboration and communication, and institutional barriers. In Japan specifically, Young (2024) surveyed 13 EFL teachers who reported five challenges of supporting SWDs: disclosure of disability, curricular constraints, barriers to inclusion within

the institution, lack of support from the university, and a need for more targeted teacher training. These studies all show that the challenges of teaching SWDs are worldwide and feelings of anxiety are natural. However, with some guidance and understanding of how to teach special needs students, teachers would be able to cope more effectively with reasonable accommodation requests.

The aims of this qualitative study are two-fold: (a) to improve teachers' understanding of the procedures related to requesting reasonable accommodation and (b) to bring attention to various types of disabilities and how language teachers can provide reasonable accommodation.

Method

This research used a qualitative approach to collect data from office staff and English language teachers. A bilingual open-ended survey was first given to the disabilities office at the university to understand the procedural flow from applying for reasonable accommodation to enrolment in courses as well as gain knowledge of the types of disabilities that teachers are expected to accommodate. The purpose was to help build a bridge between the disabilities center and the foreign language classroom. It also sought to identify specific services and support offered to help teachers understand where to go if they required assistance with the SWD. Key questions asked were:

1. What is the role of the staff in the disabilities resource center?
2. How is "reasonable accommodation" defined by the office?
3. How many SWDs are currently enrolled at the university? How much has this number increased, decreased or remained constant over the past decade?
4. What kinds of "disabilities" does the office support?
5. What is the procedure from application to course enrolment?
6. What kind of support and services are available to help teachers if they face challenges?

In-depth interviews with two teachers described their first-hand experiences of teaching SWDs, how they reduced feelings of anxiety when teaching special needs students as well as how they adapted their teaching approach and learning materials to accommodate specific disabilities. The following two questions guided the interview.

1. Could you describe your experiences with SWDs in the language classroom?
2. Based on your experiences, could you share any suggestions or advice that would help teachers to create a more inclusive classroom?

The researcher asked follow-up questions during the interview to delve deeper into the teachers' experiences.

Results and Discussion

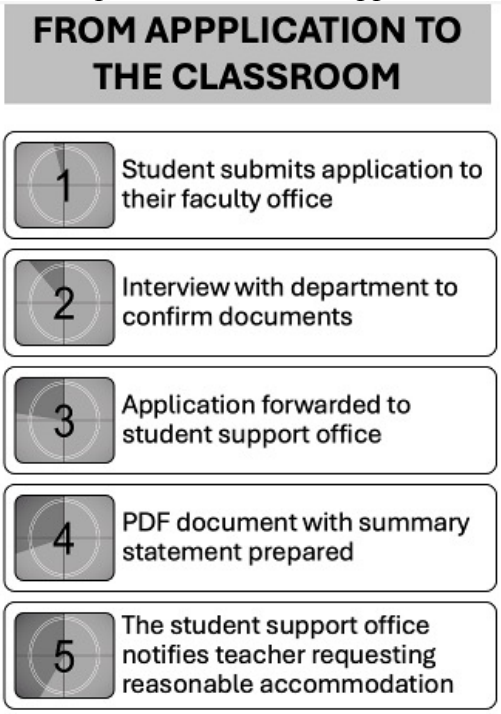
This section discusses data collected from the office staff and teachers. Practical information about procedures and types of disabilities are presented followed by first-hand accounts from teachers' interviews and suggestions about how to create an inclusive, accessible, and supportive learning space.

Data Collected From the Disabilities Office: Procedural Steps and Support

The process of applying for reasonable accommodation to enrolment in language courses is one of the areas that most teachers are unfamiliar with. Understanding the process for

disclosure can help to narrow the gap between the student disability support center and the language classroom as teachers become aware of various contact points to support their teaching and student learning. Survey data showed the procedure at the researcher's university (Figure 2):

Figure 2
Five-Step Procedure From Application to Course Enrolment



In step 1, the student applies for reasonable accommodation through the relevant office. An examination of reasonable accommodation is conducted by faculty to which the student is affiliated. Students are encouraged to apply as far in advance as possible as it becomes easier to meet any special need.

In step 2, the content of reasonable accommodation is determined through frequent communication with the student and confirmation of supporting documents (such as a disability certificate, doctor's note, or psychological findings).

In step 3, the student's faculty administrative office forwards the application to the DRC. The staff have a consultation as a team and with the student to identify how best the student can be accommodated.

In step 4, the DRC prepares a password-protected secure document explaining the type of disability and summarizing the needs of the student.

In step 5, the applying student will confirm the details and make a decision on whom to directly inform about their condition (faculty, teachers, other students, etc.). The disabilities center and faculty office will then send the document requesting reasonable accommodation to the classroom teacher.

In both teachers' experiences in this study, the students rarely contacted them directly. Instead, communication went mainly via the disabilities support office through emails, mostly for the

purpose of documentation, and if necessary, to report concerns or ask follow-up questions. It should be noted here as a possible sixth step, that if the condition or situation of disability changes, or the desired accommodation is not effective, the details are re-examined and further communication is required between the teacher and student.

Teachers are generally asked to consider four areas when accommodating students: the physical layout of the learning space, communication with the student before, during, and after lessons, use of assistive technologies, and flexibility with assessment procedures. One point that the researcher noted that was not mentioned in the documents provided by the faculty and disabilities office, is that reasonable accommodation is intended to provide *equal opportunities* and does not guarantee gaining the course credit. This is an essential piece of information that should be made clear to both teachers and students as early as possible to avoid any misunderstandings and unnecessary stress to both parties.

Disability Types

There are seven classified disabilities that language teachers were expected to accommodate at the university:

- Visual impairment (partial or full blindness)
- Hearing impairment (partial or full deafness)
- Physical disability (affecting movement or dexterity)
- Chronic illness / physical frailty (long-term illness that might not be visible)
- Developmental disability (usually mental development on a spectrum from childhood)
- Mental disorder (affecting emotions, thinking, and behavior)
- "Other" disabilities (impairments that do not fit into the above categories)

Of these disabilities, almost all students were categorized as having a developmental disability or mental disorder. The main reason for this is the modifications in the 2015 classification of disabilities (Figure 1) in which sub-categories were added to health impairment categories, mental illnesses were no longer classified as "other," and more focus began to be placed on developmental rather than physical disorders.

Support for Students

Services and other support programs for students included individual consultation with trained staff, collaboration with libraries, assistive technology to help with specific learning needs, mediation between teacher and student, and proving a barrier-free access map to help students and teachers understand the best routes to various buildings. This information, provided on the office's website for faculty and staff, is likely unknown to the teachers until they are asked to accommodate a SWD. For the researcher, the support and services offered to students and teachers was discovered only after beginning the study which is evidence of the wide gap that exists between the disabilities support center and teachers.

Data Collected From Teacher Interviews: Key Insights

Two teachers described their experiences teaching SWDs in the English language classroom. Interviews were recorded and key insights extracted from the qualitative data. Five themes emerged from interview transcripts:

1. Having to tailor instruction for each disability
2. Adapting learning materials for specific special needs

3. Being more flexible with assessment procedures
4. Understanding the importance of positive behavioral support
5. Experiencing feelings of anxiety as a result of the lack of special needs training and disconnect with the support office

The greatest challenge for both teachers was the time it took to adjust teaching methods for just one student. Having a SWD typically meant teaching a regular class and then spending extra time to make specific materials for the special needs student. This sometimes meant sending emails to the student in advance explaining what was going to happen in the next lesson and responding to questions if the student misunderstood the instructions or any part of the lesson. For teachers with large numbers of students in a class (over 30), having to spend additional time with only one student can easily lead to increased fatigue.

The second most challenging aspect of teaching SWDs was creating effective learning materials. Visually impaired students, for example, required special materials which needed to be made at least two weeks before the course began in order to be converted into braille text. If a student did not apply for reasonable accommodation before the start of the semester, it put pressure on the teacher to make special materials for the student each week. Teachers who make materials week-to-week would probably find it somewhat challenging to accommodate these students. In addition, courses with heavy visual content had to use appropriate language to describe each visual (e.g., charts, diagrams, maps, photos, power point slides, or scientific models). Explanations were written by the disabilities support office staff, but if the staff did not understand complex visuals or the course content, meetings had to be organized with the teacher in charge of the course. This led to extra time required for teaching the student. Thus, a recommendation from one of the teachers was to avoid using visuals unless absolutely necessary. A final point that teachers rarely think about when designing materials is the instruction used to explain a task. Special needs students sometimes need a learning activity to be broken down into basic steps with specific examples. Language needs to be simplified, strong models need to be included within task instruction, and clear goals need to be stated for every task, including how smaller tasks fit into the overall aim of the particular lesson. As mentioned before, this can be extremely time consuming and requires teachers to be very organized. Any changes to the learning materials during the semester must be communicated clearly.

One point that both teachers agreed on was maintaining positivity and being flexible with deadlines for assignments and exams. For teachers, it is crucial to help students build positive relationships with classmates without the stigma of being “special.” If SWDs feel that they are being treated differently, it could lead to a loss of motivation and feelings of unfairness from other students. Teachers thus need to keep an open a line of communication with all students equally to show that they are available for individual consultation if necessary. Understanding that the disabilities support center is available for possible mediation and suggestions for how to better accommodate students is crucial for both the learner and teacher. If the teacher does not speak the student’s L1, then they have to find creative ways to communicate. Due to the significant improvements in generative AI today, communication has become much easier.

Regarding feelings of anxiety, for one teacher there were times when they felt inadequate about how to accommodate the student due to lack of special training. However, the teacher felt that with the documentation provided by the university and early preparation, they could manage to adapt to the new situation without too much trouble. The other teacher had a background in special needs and found no difficulty in adjusting educational instruction and learning materials

to meet the needs of various disabilities. This shows that targeted training would be useful for all teachers, whether through an orientation video, forum, or reference guide. The researcher's plan in 2027 is to compile a list of teacher suggestions and teaching strategies when instructing SWDs into a central database for language teachers at the university. A few suggestions are presented below.

The Inclusive Classroom

One of the key suggestions from the teachers interviewed to create an inclusive classroom was adjusting teaching style to a universal method and designing learning materials to suit a wider variety of students. This means that rather than teaching for individuals with specific needs, teachers should instead design materials and approach teaching in a manner that suits all students in multiple formats (e.g., text, audio, video). Preparing materials far in advance, setting clear goals for the lesson as well as each smaller task, and including clear, simplified instructions in lesson plans and during teaching was most beneficial.

The Accessible Classroom

For both teachers, the accessible classroom was achieved both physically and in digital spheres. Ensuring that both the classroom and the teachers' office could be easily accessed, especially for visually and physically impaired students, was the most important consideration. Being aware of the classroom layout and instructing all students in the classroom to always be mindful not to create obstacles and providing special furniture where necessary contributed to creating an accessible classroom. Outside of the classroom, it is important for teachers to understand how to direct students clearly to the classroom or teacher's office (depending on the disability), as well as how to direct students to avoid various obstacles (e.g. garbage cans, or bicycles). Students with developmental challenges who struggled in face-to-face classes joined through Zoom and submitted assignments digitally. This required knowledge of various assistive technologies. The key point is to communicate with the student and office about how they can be *reasonably* accommodated and find the most convenient solution.

The Supportive Classroom

Finally, maintaining a positive attitude and keeping an open line of communication with students and the support office helps to foster trust and create a supportive atmosphere for all students. Providing clear structure but also being flexible with deadlines and/or assessments improved learning outcomes for learners who worked at a different pace. Both positivity and flexibility significantly reduced the pressure on the teacher to complete tasks in a certain time frame. A crucial point that one teacher mentioned was the possibility that inviting students to openly communicate with the teacher could lead to a significant increase in emails. With teachers already facing time constraints, having to respond to second language learners in the L2 in a comprehensible manner is challenging. Even with AI and translation tools, the teacher's communication style has to be simple but also clear so that the communication does not go back and forth several times. Constructing emails for second language learners that ensure full understanding can take a considerable amount of time. However, from the teacher's first-hand account, less than 10% of students, with or without disabilities, requested further assistance with assignments.

Conclusions

"Integration" and "inclusion" are two terms that are often confused or used interchangeably in the research literature, especially when it refers to SWDs. Whereas integration refers to being placed into an existing system and support provided accordingly, an inclusive classroom emphasizes that SWDs learn differently and should have the same access to educational resources and opportunities as other students. That is, rather than SWDs adjusting to a fixed educational structure, the educational structure is adjusted to accommodate several learning styles. As noted earlier, the DRC office at Kyoto University recognizes a "disability" as a product of the surrounding environment rather than a problem with the individual. Therefore, the intention of inclusive learning at the university is to remove barriers to allow all students in a class, with and without disabilities, to learn *equally*.

It is not possible for teachers to accommodate the diverse needs of every single student in a classroom given the time constraints, large class sizes, limited resources, lack of special training, poor IT skills, and/or fatigue. Thus, to create an inclusive, accessible, and supportive foreign language learning environment for students with disabilities, it is important to be aware of various factors, particularly how to improve learning materials, adapt teaching methods, arrange the physical layout of the classroom, and communicate openly with students and the disabilities support office.

Japan's journey toward inclusive education is ongoing and has been progressing steadily in areas such as universal design for learning (Berger, n. d.); inclusive practices in English language teaching (Young, 2024); and governmental policies and projects by Japan's Ministry of Education (MEXT, 2021) such as the "grand design for higher education toward 2040," and the "Reasonable accommodation practical case database" (NISE, 2026).

Creating an inclusive learning environment thus requires not only top-down reforms, but also teacher initiative, collaborative efforts with student disabilities centers, and most important, open communication with the SWDs themselves. For teachers, understanding various types of disabilities, being mindful about teaching practices, and helping to build a university culture where knowledge about teaching SWDs is shared could help to alleviate teacher burdens and improve educational outcomes for all students.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Social Studies Learning With Reflective Inquiry Approach as a Means of Improving Cultural Literacy

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Abstract

Cultural literacy has become an important element in education today, especially in Social Studies learning. Reflective and inquiry-based approaches provide an effective framework to help students understand and internalize diverse cultural values. By using these teaching methods, students are encouraged to think critically, reflect on their own experiences, and actively explore various aspects of culture through questioning and investigation. This research employs a literature review method based on the works of Cohen & Lawrence Manion and Keith Morrison (2018). The study highlights the importance of integrating reflective and inquiry approaches in Social Studies education to strengthen cultural understanding and build cross-cultural awareness. A learning process that emphasizes reflection allows students to connect cultural knowledge with their personal and social contexts, while inquiry facilitates the independent discovery of new knowledge. Through this approach, students not only acquire information but also develop skills in analysis, evaluation, and synthesis of complex cultural phenomena. Furthermore, this learning fosters respect and appreciation for cultural diversity, which is essential in today's global era. Therefore, Social Studies learning based on reflective and inquiry approaches is a strategic effort to enhance students' cultural literacy, which ultimately can strengthen cultural identity while opening spaces for intercultural dialogue.

Keywords: social studies learning, reflective inquiry approach, cultural literacy

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Introduction

Culture plays an important role in the development process and is also a key factor supporting the progress of a society. Every individual is born into a family and community environment that has its own language, customs, and norms, which become part of the psychological development process, such as language ability, the formation of social identity, awareness of social responsibility, and contribution to the continuity of the community (Packer & Cole, 2020). Edward Taylor defines culture as a collection of knowledge, beliefs, and rules that apply within a society (Taylor, 1871).

Culture is formed gradually through continuous social interactions. Through culture, humans build a shared life structure that regulates how they interact with one another. Nowadays, globalization has become a phenomenon that greatly influences cultural interactions worldwide (Hassi & Storti, 2012). Globalization is unavoidable and presents a challenge that all countries must face (Abu-Laban & Bakan, 2020). This process encompasses economic, social, political, and cultural aspects that have a broad impact on both individuals and societies. With technological advancements, globalization drives interaction and interdependence among countries, while also exerting a significant influence on local cultures (Demaio, 2011).

Along with the development of communication technology in the 20th century, the cultural industry emerged, enabling the massive spread of culture beyond national borders. Cultural heritage and modern culture attract tourists, which in turn drives local and regional economic development. This process of cultural exchange also strengthens cultural diversity and fosters mutual respect among nations (Qie, 2024).

However, the impact of globalization also poses the risk of losing local cultural identity due to the strong and widespread influence of foreign cultures. National borders become increasingly irrelevant in global cultural exchanges, causing local cultures to often be overshadowed by global consumerism culture (Alkharafi & Alsabah, 2025). In this context, social studies education plays a strategic role in shaping the understanding and cultural values of the younger generation through the dimensions of knowledge, skills, values, attitudes, and behavior (Sapriya & Nurdin, 2006).

Cultural literacy becomes one of the important competencies that students must master in social studies learning. This literacy refers to the ability to understand, interpret, and practice cultural values as part of national identity in daily life (Kementerian Pendidikan dan Kebudayaan, 2019; Rahmadi & Hayati, 2020). It states that cultural literacy encompasses various aspects of life, including customs, language, religion, arts, and traditional technologies such as games, dance, music, and traditional clothing. Strengthening smart character education is also part of the effort to instill the nation's noble values in accordance with the teachings of Ki Hadjar Dewantara (Kementerian Pendidikan dan Kebudayaan, 2015).

One effective approach to enhancing cultural literacy in social studies learning is through reflective inquiry. Vygotsky (1978) emphasized the importance of social interaction and cultural context in the learning process, with the concept of the zone of proximal development illustrating the learning potential through collaboration and reflection (Kozulin et al., 2003). Robert Wilkins (2011) emphasizes the need for social studies education to focus on developing critical thinking skills as a response to the dynamics of society and the current explosion of information. The reflective inquiry approach provides students with the opportunity to actively explore information, analyze culture, and engage in critical reflection on cultural values in

everyday life (Roberts et al., 2011). Based on this, this article attempts to examine how social studies learning with a reflective inquiry approach can enhance students' cultural literacy. The reflective inquiry approach is chosen in social studies education because it encourages students to actively explore, analyze, and critically evaluate social phenomena in depth. Contextual social studies learning requires methods that not only transfer knowledge but also develop students' critical and reflective thinking skills regarding the social and cultural realities around them. Through reflective inquiry, students are invited to ask questions, conduct research, and reflect on their findings, making the learning process more meaningful and capable of fostering authentic cultural awareness (Salmon & Barrera, 2021).

In addition, the reflective inquiry approach provides students with the opportunity to connect theory with their real-life experiences in everyday life (Darling-Hammond et al., 2024). The continuous reflection process helps students not only understand the learning material content but also internalize the cultural and social values present in society (Darling-Hammond et al., 2020). This is very important in the context of cultural literacy, because students not only merely know about culture but are also able to appreciate, critically evaluate, and apply cultural values in their social interactions.

This approach also facilitates the development of students' metacognitive skills, which is the ability to think about how they think and learn (Stanton et al., 2021). Through guided reflection, students can identify both correct understandings and misconceptions related to social and cultural concepts. Thus, social studies learning becomes an effective means to deepen cultural literacy, enabling students to recognize cultural diversity while considering the dynamics of globalization that influence local cultural identity. Reflective inquiry aligns with the demands of the 21st-century curriculum, which emphasizes the development of critical, creative, and communicative competencies. This approach supports student-centered learning and encourages them to become independent learners capable of adapting to socio-cultural changes (Martinez, 2022). Thus, reflective inquiry not only enhances conceptual understanding in social studies but also strengthens cultural literacy as an important asset in facing the challenges of globalization and ongoing social change. Therefore, this study aims to examine the effectiveness of the reflective inquiry approach in improving cultural literacy in social studies learning.

Research Method

This study uses a qualitative approach aimed at understanding social phenomena and student behavior in the context of social studies learning with a reflective inquiry approach. This approach provides an in-depth understanding of how individuals interpret and give meaning to their learning experiences (Moser & Korstjens, 2017). In this study, data were collected by utilizing online sources such as online databases, article collections, and relevant digital materials, which facilitated an efficient and focused information gathering process (Cohen, n.d.).

For data analysis, this study employs content analysis methods that allow for the interpretation and understanding of texts and content related to culture and learning within a social context. The purpose of this analysis is to identify main themes, patterns, and meanings from the collected data to address research questions concerning the enhancement of cultural literacy through the reflective inquiry approach (Creswell, 2018). The data used are secondary data in the form of documents, transcripts, field notes, and other media sources. The analysis process follows the stages described by Hsieh & Shannon (2005), which include data collection, coding

of relevant text units, and interpretation and analysis of the meanings of themes that emerge within the context of Social Studies learning.

In addition, a literature study was conducted to complement and strengthen the research data. By using the Publish or Perish tool with a publication date restriction from 2022 to 2024, 30 articles were found discussing cultural literacy and the development of Social Studies learning materials using various approaches, including the reflective inquiry approach. This literature review not only enhances the validity and credibility of the research but also ensures that the study is relevant and significant in the context of developing Social Studies teaching methods to improve students' cultural literacy.

Discussion

Implementation of Social Studies Learning With a Reflective Inquiry Approach

The implementation of a learning strategy that encourages students to actively participate in the process of knowledge discovery. The teacher acts as a facilitator who guides students to ask critical questions related to the Social Studies (IPS) material being studied (Isa et al., 2023). This strategy does not only focus on the transfer of information but emphasizes the development of critical and reflective thinking skills so that students can deeply understand social and cultural phenomena (Indrašienė et al., 2023).

Learning activities are carried out through systematic inquiry stages, starting with identifying problems or social phenomena relevant to the local and global cultural context. Students are encouraged to conduct observations, collect data, participate in group discussions, and engage in reflection both independently and collaboratively (Gogus, 2012). Through these activities, students are able to connect social studies theories with real-life experiences in their environment, thereby enhancing cultural literacy and social awareness. The learning media used are highly varied to support the reflective inquiry process (Warmoes et al., 2025). For example, teachers use digital learning resources such as articles, documentary videos, and interactive platforms that provide data and information related to cultural issues. The use of these media aims to facilitate access to information while stimulating students' curiosity, encouraging them to explore the topics discussed more deeply (Cabellos et al., 2023).

In the implementation of learning, the teacher's role is very strategic as a facilitator and motivator. The teacher not only delivers the material but places greater emphasis on the ability to guide students in developing questions, conducting analyses, and reflecting on their findings. (Chin & Osborne, 2008). The teacher also plays a role in creating an open and supportive classroom atmosphere, so that students feel comfortable discussing and expressing ideas without fear or hesitation (Martineau & Cyr, 2025).

Meanwhile, the role of students in reflective inquiry learning is very active and central. Students are not merely recipients of information but act as little researchers who take the initiative to ask questions, seek answers, and test their understanding through critical reflection. An active attitude and curiosity become the main assets for students in exploring knowledge and cultural values around them (Daniel et al., 2024).

During the learning process, collaboration among students is also optimized through group discussions and presentations of inquiry results. These activities encourage students to share perspectives, appreciate the diversity of opinions, and develop good social communication

skills. This collaboration not only enriches students' understanding of social studies material but also builds awareness of the importance of tolerance and respect for cultural differences (Macklin, 2014). Digital media and educational technology increasingly strengthen the effectiveness of social studies learning through the reflective inquiry approach. Teachers utilize online learning platforms and multimedia resources to provide varied and contextual learning experiences (Timotheou et al., 2023). The use of these media also facilitates monitoring of students' learning processes and provides constructive feedback in real-time.

Overall, the implementation of Social Studies learning with a reflective inquiry approach positions the teacher as a guide who directs the learning process, while the students act as the main actors engaging in exploration and reflection (Photo, 2025). The right combination of learning strategies, motivating activities, and supportive media creates a conducive learning environment for enhancing cultural literacy as well as the comprehensive development of students' social and intellectual skills. The implementation of the reflective inquiry approach in Social Studies learning to improve cultural literacy can be seen in the table below;

Table 1
Implementation of Reflective Inquiry Approach in Social Studies Learning to Enhance Cultural Literacy

No	Activity	Description
1	Start with a trigger question relevant to local culture	The teacher can start the lesson with open-ended questions that encourage students to observe and explore cultural aspects in their surroundings, such as: • What cultural traditions exist in our region? • How does globalization affect the habits and cultural values in our community?
2	Start with a trigger question relevant to local culture	The teacher can begin the lesson with open-ended questions that encourage students to observe and explore cultural aspects in their surrounding environment: • What cultural traditions exist in our region? • How does globalization affect the habits and cultural values in our society? These questions stimulate curiosity and motivate students to actively seek answers
3	Facilitate students to independently collect and analyze information	In the inquiry phase, students are encouraged to collect data from various sources, such as interviews with family members or community leaders, observation of local traditions, and

		credible online sources. Then, they process the information to identify cultural values, changes that have occurred, and the impact of globalization on culture.
4	Encourage deep reflection on the meaning of culture and social change	After data collection, students are encouraged to discuss and write personal reflections on the influence of local culture and globalization on their identity. For example, they might contemplate: - What does local culture mean to me and my community? - How can I preserve and maintain this culture amid changing times?
5	Integration of Collaborative Activities to Strengthen Cultural Understanding	Through group work, students can share their findings and reflections, compare cultural experiences with their peers, and formulate concrete steps to preserve local culture within the school and community.
6	Use of Media and Technology as Means for Cultural Exploration	Utilizing technology, such as cultural documentary videos, digital learning platforms, and social media, can help students access various cultural resources and broaden their perspectives in an interactive and engaging way.
7	Process- and Product-Based Evaluation that Assesses Cultural Understanding and Attitudes	Assessment is not limited to written tests but also includes presentations, reflective journals, creative works such as cultural posters, or cultural preservation projects. This encourages students to express their understanding and appreciation of culture in a deeper and more authentic way.

The Spectrum of Catalysts and Resistance in Inquiry-Based Education Practices

In the implementation of social studies learning with a reflective inquiry approach, there are various internal and external factors that act as both supports and obstacles (Kapici, 2025). The most dominant internal factor is student motivation. High motivation encourages students to actively participate in the learning process, especially during the exploration and reflection stages. Motivated students are more diligent in seeking information, engaging in discussions,

and connecting the material with their personal experiences, thus optimizing the inquiry process (Wijnia et al., 2024). However, if motivation is low, students tend to be passive and the learning process becomes less effective.

Teacher readiness is also an important internal factor that influences the success of the learning process. (Çemçem et al., 2024). Teachers who have a deep understanding of the reflective inquiry approach and are able to manage the classroom interactively will be able to facilitate a dynamic and meaningful learning process. Conversely, teachers who are less prepared or unfamiliar with this approach may face difficulties in stimulating critical questions and managing reflective discussions. In addition, the readiness of relevant, contextual learning materials rich in cultural elements also supports the success of this approach, as the materials serve as a bridge connecting theory and real cultural practices (Ylimaki & Brunderman, 2022).

From the external factors perspective, adequate learning facilities such as comfortable classrooms, access to libraries, and interactive learning media are key supports. Full support from the school, including teacher training, provision of learning resources, and sufficient time for reflective discussions, greatly facilitates the smooth running of the learning process (Reeves, 2012). The socio-cultural environment surrounding the school also plays an important role, especially when students have opportunities to observe and interact directly with local culture as well as global cultural phenomen (Ong & Quek, 2023). A supportive environment for local culture allows learning to become more authentic and meaningful.

However, there are also obstacles that need attention; internal barriers such as low student motivation due to lack of interest or unawareness of the importance of cultural literacy can hinder the inquiry process (Williams, 2021). In addition, limited teacher readiness to implement the reflective approach due to high workload or lack of training can become an obstacle. On the external side, limitations in facilities and learning resources, as well as minimal support from the school environment or family, can reduce the effectiveness of learning (Hardman & Sandi, 2024). A less conducive socio-cultural environment, such as a lack of attention to the preservation of local culture, also poses a distinct challenge.

To overcome these obstacles, strategies that can be implemented include increasing student motivation by providing learning contexts that are relevant and engaging, as well as connecting the material to their daily lives. Continuous training and mentoring for teachers are also important to enhance their competence and confidence in using the reflective inquiry approach. (Smith, 2022). The school needs to provide adequate facilities and learning resources, as well as create a conducive learning environment by involving all components of the school and the community (Al-Zu’bi et al., 2024). In addition, collaboration with community leaders and local cultural figures can strengthen students' connection to the surrounding culture and enrich their learning experience.

Implications of Developing the Social Studies Curriculum With a Reflective Inquiry Approach

The findings from the implementation of social studies learning using a reflective inquiry approach provide important implications for the future development of the social studies curriculum. First, this approach should be recommended for sustainable application because it significantly enhances students' cultural literacy. The social studies curriculum needs to be designed by incorporating learning elements that encourage students to actively seek, analyze, and reflect on cultural phenomena critically and deeply (Valladares, 2021). This will foster

positive attitudes and essential analytical skills in understanding the complexities of both local and global cultures (Combi, 2016).

Curriculum development should also emphasize the integration of material that is contextual and relevant to students' everyday experiences (Huizinga et al., 2019). This is important so that learning is not merely theoretical memorization, but also meaningful socially and culturally. The reflective inquiry approach creates space for students to explore culture directly through field projects, case studies, and structured critical discussions. Thus, students can internalize cultural values and develop awareness of the importance of cultural preservation in the era of globalization (Zalli, 2024).

In addition, the research findings show that the development of cultural literacy competencies must become one of the primary goals of the social studies curriculum. (Lähdesmäki et al., 2022). Cultural literacy here refers not only to knowledge about culture but also to critical and reflective abilities in interpreting culture, as well as an attitude of tolerance and appreciation for diversity (Maine & Vrikki, 2021). Therefore, strengthening this competence must be integrated into various themes of social studies learning so that students have a comprehensive and applicable understanding.

Curriculum developers and education policymakers also need to pay attention to enhancing teachers' capacity through intensive training and providing teaching materials that support the reflective inquiry approach (Kim et al., 2022). Teachers must be prepared to become facilitators who can manage the learning process that requires active student involvement, guide discussions, and facilitate reflection (Sormunen et al., 2020). In this way, social studies learning will be more meaningful and have a positive impact on the sustainable development of students' cultural literacy.

Conclusion

Culture plays a fundamental role in the development and progress of society because it forms the foundation for social identity, language abilities, as well as individual social awareness and responsibility. Culture is a collection of knowledge, beliefs, and rules formed through social interactions and serves as the basis for living together in a community. The rapid globalization in the modern era has brought significant impacts on culture, both in terms of cultural exchange and the challenges of preserving local culture. Globalization expands interactions and interdependencies among countries, but at the same time poses risks of local cultures being displaced by dominant foreign cultures.

The cultural industry and advancements in communication technology provide opportunities for massive cultural dissemination, which also supports economic development through tourism and strengthens diversity and mutual respect among nations. However, this process must be managed wisely so that local culture is not eroded by the currents of globalization. Cultural literacy is an essential competence in Social Studies education because it helps students understand, appreciate, and practice cultural values as part of national identity. Intelligent character education must be integrated with cultural literacy to instill the noble values of the nation.

The reflective inquiry approach in Social Studies learning is very effective in enhancing cultural literacy. With this method, students are actively invited to explore, analyze, and reflect critically on socio-cultural phenomena, making learning meaningful and capable of fostering

authentic cultural awareness. The learning process using reflective inquiry not only strengthens conceptual understanding but also helps students internalize cultural and social values in their daily lives. This approach also trains metacognitive skills, namely the ability to think about how to learn and think independently.

Teachers act as facilitators guiding students to ask questions, conduct research, and actively discuss in an open and supportive classroom environment, while students become the main actors who explore and test their understanding. Collaboration among students enriches understanding and builds tolerance and appreciation for cultural diversity. Overall, Social Studies learning with a reflective inquiry approach is highly relevant to the demands of the 21st-century curriculum, which emphasizes critical, creative, and communicative competencies. This approach equips students with strong cultural literacy as a capital to face the challenges of globalization and dynamic social change.

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A Community Approach: School-Wide Station Rotation Pedagogy

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Abstract

Our school observed that many teachers faced challenges in applying e-pedagogy (e-Ped) effectively. Developing digital competencies and encouraging collaborative lesson design became a key priority. However, teachers often lacked clarity on how to design meaningful e-Ped lessons and tended to work in isolation. Traditional teacher-led classrooms also limited differentiation, despite students' diverse learning needs and preferences. To address these gaps, a structured pedagogical model integrating differentiation, active learning, and meaningful technology use was introduced. This solution builds on a successful pilot of the Station Rotation (SR) pedagogy conducted by a Lead Teacher from 2021–2022. In these humanities classes, structured, student-centered rotation activities led to improved student engagement and learning outcomes. Following these results, SR was scaled up as a whole-school approach. To assess the effectiveness of the model, both qualitative and quantitative feedback surveys were conducted with students who experienced SR lessons and approximately 75% of the teachers who implemented them. These were administered after the first year of implementation and indicated positive responses regarding engagement, clarity, and lesson design. The feedback informed refinements to the model in its second year. Additional data will be collected at the end of the current cycle to further evaluate long-term impact. The SR model empowers teachers to blend e-pedagogy with personalised instruction and collaboration. It offers a flexible framework for lesson design, enabling varied, engaging activities tailored to learner needs. This approach fosters professional growth, enhances collaboration, and improves students' learning experiences through purposeful use of technology.

Keywords: station rotation, e-pedagogy, school wide, community

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Introduction

The unique context presented by our school is that our school is an all-boys school, whose ages ranges from 13–17 years old. About 20% of our students are also diagnosed with special Educational Needs. In Singapore, the Ministry of Education is also encouraging e-pedagogy as there is now a push to include technology in the teaching and learning in the classrooms. There is also a collective push by the school to go from a teacher-centred learning environment to a student-centred learning environment. We also want to meet 21st century competencies of collaboration between learners. Boys also need to have agency in what and how they learn and incorporating movement during lessons should be considered to keep boys engaged (Gurian & Stevens, 2010). With all these parameters taken into consideration, a lead teacher in our school, Mr. Marek Otreba, decided to try using a pedagogy called Station Rotation (SR) (Tucker, 2021) as this seemed to meet all our needs that were unique to our school. In a station rotation pedagogy, students would be split into three groups. This gives teachers a chance to group students using various parameters. Whether by personality, academic readiness or in a random manner, whichever suits that class or lesson. The team wanted to ensure that there would be a e-pedagogy station, or what we termed a "tech" station. This would enable both students and teachers the opportunity to use technology in a meaningful and effective way. There would also be a collaborative station. This ensures that there would be a student-centered approach to that one particular station. Lastly, there would be a teacher-led station. This ensures that there is still a teacher-centric station to provide either professional instruction or meaningful and timely feedback to the students. The key to this approach is that the students will go through all three stations and that the stations are independent of each other. That is to say, a student does not need to go to station "A" first before proceeding to station "B". So a student starting at any station will be learning content from that particular station as part of a larger lesson which contains three parts which are related, but not dependent on knowledge build-up in a linear manner.

And indeed, Marek found the pedagogy useful, his students found the lesson engaging, and he wondered whether SR could be implemented as a whole school approach, involving all the teachers and all the subjects taught in our school, since there were benefits to both teachers and students.

Implementation

In September 2023, a team (the four authors) was formed to look into how we could implement SR where all the teachers would learn, plan and implement SR in their classrooms. By December 2023, a year end staff training session was conducted using SR, giving all teachers in our school an experience of being students in a SR setting, with all the rationale explained to them. In January 2024, teacher training on SR pedagogy was provided to all teachers, through face to face briefings and through online micro-lessons, giving teachers the time and space to learn independently. From January 2024 to March 2024, senior teachers and heads of departments modelled the use of SR in their classrooms and invited teachers to walk into any of these classes to see how SR was implemented in their classrooms. Teachers were then told to try SR in their own classrooms from March 2024 to September 2024. The team in charge of SR implementation was cognizant of the fact that some teachers would need more support. Thus, the senior teachers and the team in charge of this program made themselves available to provide advice and consultation to teachers who needed more support. An online resource where SR lesson plans created by teachers who have already completed their SR lessons successfully was also made available to all teachers

who needed to reference exemplar lessons. Teachers were also encouraged to open their classrooms to their colleagues so that a spirit of community learning would be fostered.

Improvements and Focus After One Year

After the first year where all teachers tried SR, it was observed by the team in charge that the e-pedagogy and collaborative elements were lacking in impact. Many times, it was observed that the students were cooperating with each other, instead of collaborating. Thus, a collective effort was made to train the teachers how to plan a better e-pedagogy lesson and to plan better collaborative activities. A e-pedagogy framework provided by the Singapore Ministry of Education was adapted into the lesson planning template used by teachers to scaffold them in planning a e-pedagogy station in SR. Professional Learning Teams (PLT) of 4–5 teachers were also formed so that teachers worked together to collectively and collaboratively plan and execute a SR lesson with the PLTs using a modified Lesson Study methodology as a research tool to help assess the effectiveness of their SR lessons.

Methodology

We wanted to measure the effectiveness of SR in teaching and learning on both the teachers and students. Two surveys were created, one for students and one for teachers. Both quantitative and qualitative results were obtained from the survey. The table below shows the sample size.

Table 1
Sample Size of Survey Respondents

Year	2024	2025
Students	340	421
Teachers	70	65

Students were asked to complete the survey after attending an SR lesson. Teachers completed the survey at the end of term 3, by which they would have completed their SR lessons.

Below are some sample questions completed by students.

Q. I was engaged till the end of the lesson when the Station Rotation Model was used.
Q. This lesson using the Station Rotation Model enabled me to learn better.
Q. Elaborate why you agreed or disagreed that the lesson with the Station Rotation Model used, enabled you to learn better.

Findings

Figure 1

Student Enjoyment Perception Results Over Two Years

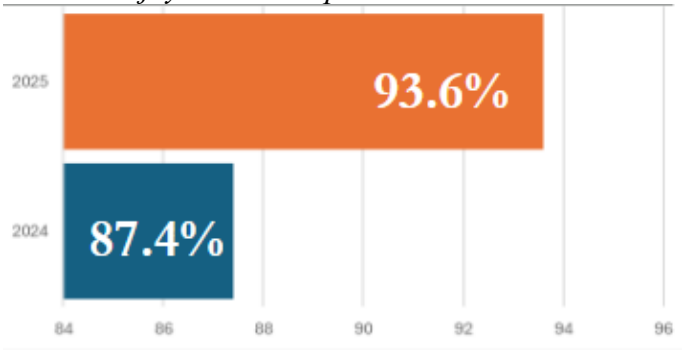


Figure 2

Student Engagement Perception Results Over Two Years

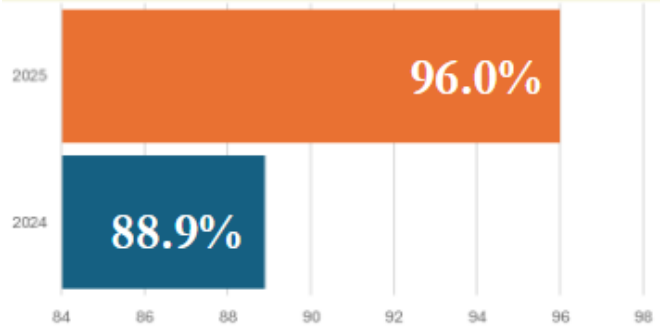


Figure 3

Student Learning Better Perception Results Over Two Years

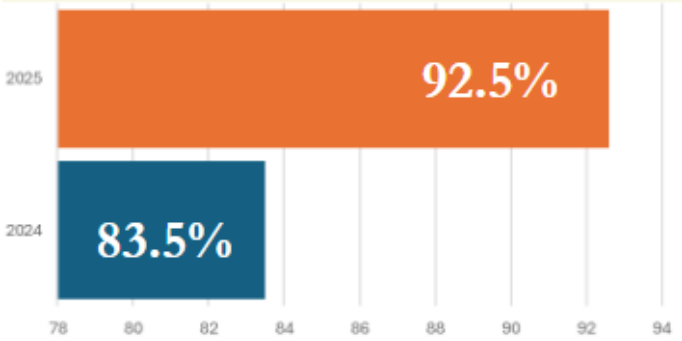


Table 2

Some Qualitative Feedback From Students (2025)

	Sample qualitative feedback by student
Student 1	It allows me to learn a lot more in the same amount of time as a regular lesson
Student 2	It teaches me teamwork
Student 3	I get to use my ipad
Student 4	I don't have to learn 1 thing at a time. Instead, I can learn 2 things in one lesson
Student 5	I could learn from others when playing with people better than me (PE lesson).
Student 6	We were able to move around and learn in smaller groups rather than as one big group.

Figure 4
Teachers' Positive Impact on Learning Perception Results Over Two Years

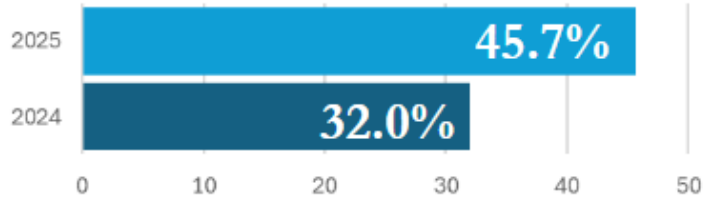


Figure 5
Teachers' Student Learning and Achievement Perception Results Over Two Years

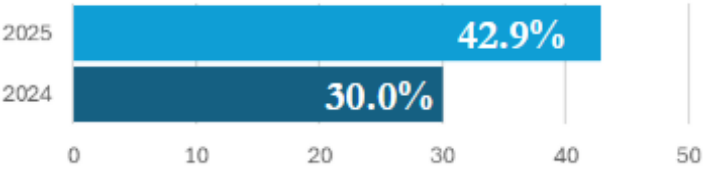
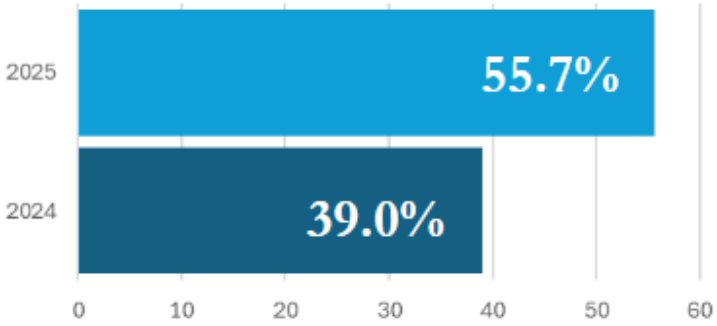


Figure 6
Teachers' Willingness to Continue Using SR



There is a difference in perception between teachers and students on the effectiveness of SR in terms of engagement, effectiveness and enjoyment. The team was not surprised with the results as teachers are humans too. And humans are usually hesitant in using something new. Teachers were asked to not just learn, but to plan and implement a new pedagogy. So the less positive results obtained by the teachers were not unexpected. What is encouraging is that the teachers perceptions have improved over the two years.

The positive results obtained by students were encouraging, give us information that students were not just engaged but enjoy learning using the SR pedagogy. The improvement in students' perception also points to teachers getting better in planning and executing their SR lessons.

Conclusion

Over two years of teachers using SR, it was shown that SR is implementable for all subjects, from Languages, Math to Physical Education. Although there is a gap in teachers' and students' perception in how effective SR is, the improvement in survey results points to positive trend. Having scaffolds built into lesson planning templates also showed an observable improvement in how e-pedagogy was carried out in the tech station.

There were certain challenges that the school faced over the two years of SR being implemented by the whole school. It was clear that it was more complex to plan for an SR lesson as the teacher needs to be aware of all activities in all the stations planned to start and end at the same time. Logistically, there were some issues faced by the teachers, such as moving the furniture to accommodate the three or two stations. A lack of teacher presence at some stations also presented some challenges to both the students and teachers, leading to unclear directions for students. It was also apparent that not all topics were suitable for SR. And SR should not be employed all the time as this will cause teachers to spend an unreasonable amount of time in planning for SR lessons.

Institutions looking to implement SR should start with a two station rotation. This provides a simpler planning and implementation strategy. Each station should also last a minimum of twenty minutes to provide sufficient time and space for impactful student learning. Each station must have clear instructions as the teacher will not be present at all the station at all times. Support and training for teachers is key to the success of SR implementation in any institution. Collaboration between teachers and knowledgeable others increases the effectiveness and chances of success of SR implementation in any institution.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Google Gemini, an AI-assisted writing software, was used in proofreading, checking for formatting compliance, and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and ensuring adherence to the specific IAFOR submission guidelines. The author further declares that, apart from Google Gemini, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from the careful and systematic conduct of the research.

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Sustainability of Indigenous Community Education Through Baduy Tribe Ethnomathematics: Integrating Local Wisdom in 21st Century Mathematics Learning

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Abstract

This study explores the ethnomathematical practices of the Baduy indigenous community and examines their potential as a foundation for developing culturally contextualized geometry teaching materials for junior high school students in Indonesia. Using a qualitative ethnographic approach, data were collected through participant observation, in-depth interviews with community elders and craftsmen, and documentation of cultural artifacts. The findings reveal that Baduy cultural practices embody rich geometric concepts, particularly through artifacts such as the *Adu Mancung* weaving motif and the *Dudukuy* headgear, which represent rhombus patterns, symmetry, circles, radial structures, and proportional reasoning. These ethnomathematical elements were mapped onto the junior high school geometry curriculum and transformed into contextual learning tasks that connect formal mathematical concepts with authentic cultural experiences. The integration of Baduy ethnomathematics into geometry instruction offers meaningful learning opportunities that enhance students' conceptual understanding, spatial reasoning, and problem-solving skills while fostering appreciation of local wisdom. This study concludes that Baduy ethnomathematics provides a strong pedagogical foundation for culturally responsive geometry education and supports the sustainability of indigenous community knowledge in the context of 21st-century mathematics learning.

Keywords: ethnomathematics, Baduy tribe, geometry education, indigenous knowledge, culturally responsive teaching

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Introduction

In the era of rapid globalization and digital transformation, students are increasingly exposed to foreign cultures through social media, entertainment platforms, and global information networks (Becker & Park, 2011; Drozdikova-Zaripova, 2020; Kadirbayeva et al., 2022; Nadarajan et al., 2023). While such exposure provides opportunities for intercultural exchange, it also contributes to the gradual marginalization of local cultures in students' daily lives. Many young learners tend to adopt global popular culture as their primary cultural reference, while indigenous traditions, values, and knowledge systems are progressively overlooked. This phenomenon has raised serious concerns regarding the sustainability of indigenous community education and the intergenerational transmission of local wisdom, which are essential for maintaining cultural identity and social cohesion (Adonis & Silinda, 2021; Dewantara, 2025; Knijnik, 2002; Sianturi et al., 2025).

Education plays a strategic role in preserving cultural heritage, particularly through the integration of local wisdom into school curricula (Adonis & Silinda, 2021; Hilaliyah et al., 2019; Sakinah et al., 2023). However, in many formal education contexts, especially in mathematics education, learning remains largely decontextualized from students' cultural environments. Mathematics is often presented as a universal and abstract body of knowledge, detached from the socio-cultural realities in which students live. As a result, students frequently perceive mathematics as irrelevant to their everyday experiences, which may reduce learning motivation and hinder conceptual understanding (Kadarisma et al., 2020). This situation is exacerbated by the limited availability of instructional materials that incorporate local cultural contexts as meaningful learning resources.

In Indonesia, most mathematics teaching materials used at the junior high school level are still dominated by standardized textbooks that emphasize procedural competence and symbolic manipulation (Hilaliyah et al., 2019; Muhtadi et al., 2021; Nuraeni et al., 2021). Although these materials are aligned with national curriculum standards, they rarely reflect the rich cultural diversity of Indonesian society. The absence of culturally responsive learning resources not only weakens students' cultural literacy but also limits opportunities to develop contextual and meaningful mathematical understanding. Consequently, there is a growing need to design mathematics learning materials that bridge formal mathematical concepts with students' cultural backgrounds.

One promising approach to addressing this challenge is ethnomathematics, which examines mathematical ideas embedded in cultural practices, artifacts, and social activities (D'Ambrosio, 1985, 1997). Ethnomathematics positions culture as a legitimate source of mathematical knowledge and recognizes that different communities develop their own ways of quantifying, measuring, designing, and organizing space. Through ethnomathematics, mathematics learning can be contextualized within students' lived experiences, thereby promoting conceptual understanding, cultural appreciation, and critical thinking (Sari et al., 2025).

The Baduy tribe is an indigenous community in Indonesia that has preserved its traditional way of life for generations. The Baduy people strictly adhere to customary laws and maintain harmonious relationships with nature, social structures, and spiritual values. Their daily activities, including house construction, weaving, farming, and spatial organization of settlements, implicitly embody a variety of mathematical concepts. For example, the architecture of traditional Baduy houses reflects geometric structures such as prisms, pyramids, and rectangular forms, while weaving patterns demonstrate symmetry, repetition, and

geometric transformations. In addition, traditional measurement systems based on body proportions and natural units reveal indigenous approaches to quantification and proportional reasoning.

These cultural practices represent a rich source of ethnomathematical knowledge that is highly relevant to school mathematics, particularly geometry. Geometry plays a central role in developing students' spatial reasoning, visualization, and problem-solving skills. However, geometry is often perceived as one of the most difficult topics by junior high school students due to its abstract nature and heavy reliance on symbolic representations (Hodiyanto & Santoso, 2019; Subekhi & Nindiasari, 2021). Integrating geometric concepts with concrete cultural contexts, such as those found in Baduy culture, may help students construct more meaningful and intuitive understandings of geometric ideas.

Several previous studies have explored ethnomathematics in the Baduy community from different perspectives (Arisetyawan & Yuda, 2019; Bukhori Muslim, 2021; Eliza & Pujiastuti, 2022; Farokhah et al., 2023; Firmansyah & Septiani, 2019a, 2019b; Megantari & Setyawan, 2020; Muhibah et al., 2023; Yulyani et al., 2023). Researchers have documented geometric concepts in traditional house architecture, analyzed patterns and symmetries in weaving crafts, and examined indigenous systems of measurement and spatial organization. These studies consistently demonstrate that Baduy culture contains abundant mathematical representations that can serve as valuable learning resources. However, most of these studies remain at the level of cultural documentation and conceptual identification. The transformation of ethnomathematical findings into structured instructional materials for formal classroom use is still limited.

Furthermore, previous research has rarely addressed the issue of sustainability in indigenous community education by linking ethnomathematics to curriculum development. While ethnomathematical studies contribute to cultural preservation, their impact on formal education practices remains marginal if they are not translated into practical teaching resources. There is a critical gap between ethnomathematical research and classroom implementation, particularly in the development of geometry teaching materials that are aligned with curriculum standards and pedagogical principles.

Therefore, this study seeks to address this gap by positioning Baduy ethnomathematics not only as an object of cultural investigation but also as a foundation for curriculum-oriented instructional design. This research aims to explore and analyze geometric concepts embedded in Baduy cultural practices and to use these findings as the basis for developing geometry teaching materials for Indonesian junior high school students. By integrating local wisdom into formal mathematics learning, this study is expected to contribute to culturally responsive education, promote meaningful learning experiences, and support the sustainability of indigenous community education in the context of 21st-century mathematics learning.

Method

This study employed a qualitative research approach with an ethnographic orientation to explore ethnomathematical practices within the Baduy indigenous community and to use these findings as the foundation for designing geometry teaching materials for junior high school students in Indonesia. The ethnographic approach was selected to capture the cultural meanings, social practices, and contextual realities in which mathematical ideas are embedded in the daily life of the indegenious Community (d'Ambrosio, 2006).

The research was conducted in the Baduy community, Banten Province, Indonesia, which is well known for its strong adherence to customary laws and preservation of traditional lifestyles. The participants included community elders, traditional leaders, craftsmen, and local residents who possess extensive knowledge of Baduy cultural practices. Participants were selected through purposive sampling to ensure that the data reflected authentic cultural representations and indigenous knowledge systems.

Data were collected through participant observation, in-depth semi-structured interviews, and documentation of cultural artifacts. Participant observation focused on daily activities such as house construction, weaving, farming, and settlement organization, with particular attention to practices that reflect geometric concepts. In-depth interviews were conducted with community leaders and craftsmen to explore indigenous perspectives on measurement, spatial organization, and traditional construction techniques. Cultural artifacts, including traditional houses, weaving products, and village layouts, were documented through photographs, sketches, and detailed field notes.

The data were analyzed using thematic analysis with an ethnomathematical perspective. The analysis process involved data reduction, coding, and categorization of mathematical concepts embedded in cultural practices. Identified concepts were then mapped onto the junior high school geometry curriculum to examine their relevance and alignment with learning objectives. This mapping process served as the basis for designing culturally contextualized geometry teaching materials.

To ensure the trustworthiness of the findings, data triangulation was applied by comparing information obtained from observations, interviews, and documentation. Member checking was also conducted by discussing preliminary interpretations with community representatives to confirm the accuracy of the cultural and mathematical interpretations.

Through this methodological framework, the study integrates ethnographic exploration with curriculum-oriented instructional design, ensuring that Baduy ethnomathematics is systematically documented and translated into meaningful geometry learning contexts for junior high school students.

Result and Discussion

This section presents the main findings of the study on ethnomathematical practices within the Baduy community and discusses their implications for junior high school geometry learning. The results highlight the geometric concepts embedded in Baduy cultural activities, artifacts, and spatial organization, and examine how these concepts can be meaningfully integrated into culturally contextualized teaching materials. Furthermore, this section discusses the role of Baduy ethnomathematics in supporting culturally responsive mathematics education and contributing to the sustainability of indigenous community education in the context of 21st-century learning.

The discussion interprets the findings through an ethnomathematical and educational perspective by relating indigenous mathematical knowledge to formal geometry concepts in the school curriculum. It also elaborates on how cultural contexts can serve as powerful learning resources that enhance students' conceptual understanding, engagement, and appreciation of local wisdom. Through this discussion, the study demonstrates that Baduy culture is not only a repository of rich mathematical ideas but also a valuable foundation for

developing meaningful and relevant geometry learning experiences for junior high school students.

One of the main ethnomathematical artifacts identified in this study is the traditional Baduy weaving motif known as *Adu Mancung*. This motif is widely found in woven fabrics used by the Baduy community, particularly among the Baduy Luar, and carries strong cultural, social, and philosophical meanings. The Adu Mancung motif is characterized by a repeated arrangement of diamond-shaped patterns formed by symmetrical geometric structures that resemble a sequence of rhombuses aligned horizontally.

From an ethnomathematical perspective, the Adu Mancung motif represents a clear manifestation of geometric concepts embedded in Baduy cultural practices. The basic structure of the motif consists of a sequence of congruent rhombuses arranged in a regular and repetitive pattern. Each rhombus is formed by four equal sides and diagonals that intersect perpendicularly, reflecting fundamental properties of plane geometry. The motif also exhibits translational symmetry, as the pattern is generated through the repetition of a single geometric unit along a linear direction. In addition, reflective symmetry can be observed in the arrangement of the shapes, indicating an intuitive understanding of geometric balance and proportion within Baduy weaving traditions.

The process of producing the Adu Mancung motif involves precise spatial reasoning, proportional thinking, and pattern recognition. Weavers determine the size, alignment, and spacing of each rhombus based on traditional rules that have been transmitted across generations. Although these rules are not formally expressed using mathematical symbols, they reflect an indigenous mathematical system that governs consistency, regularity, and aesthetic harmony in textile production. This demonstrates that the Baduy community possesses an implicit form of geometric knowledge that is deeply rooted in their cultural practices.

The Adu Mancung motif holds not only aesthetic value but also cultural and philosophical significance. In Baduy tradition, the motif symbolizes harmony, balance, and unity, reflecting the community's social values and worldview. The repetitive interlocking rhombus shapes represent togetherness and continuity, which are essential principles in Baduy social life. This cultural meaning further strengthens the relevance of the motif as a contextual learning resource, as it allows students to explore geometry while simultaneously understanding the values embedded in indigenous culture.

Based on these findings, the Adu Mancung motif can be systematically transformed into a contextual learning resource for junior high school geometry instruction. The repeated rhombus patterns provide concrete representations for introducing concepts such as quadrilaterals, properties of rhombuses, perimeter and area, symmetry, and geometric transformations. For example, students can be guided to identify the properties of rhombuses from the motif, calculate the area of each geometric unit, analyze the symmetry of the pattern, and investigate the effects of translation and reflection in the motif's arrangement.

Figure 1

Geometric Representation of the Adu Mancung Weaving Motif in Baduy Culture



Motif Adu mancung adalah salah satu motif tenun Baduy yang sederhana, berupa wajik atau separuh wajik yang disusun berurutan. Suku Baduy Luar mengadaptasi teknik songket dalam pembuatan motif pada kain tenun Adu Mancung yang memiliki nilai sakral diperuntukan bagi laki-laki Baduy Luar dan digunakan pada saat acara adat dan budaya Suku Baduy Luar. Keistimewaan tenun motif Adu Mancung adalah digunakan dalam kegiatan keagamaan karena mengandung makna filosofis suku Baduy Luar, yang menganut sistem perkawinan monogami, dan kerukunan keluarga baru pasangan Baduy Luar yang menikah



Jika kita perhatikan susunan pola motif adumancung akan menghasilkan bentuk belah ketupat seperti pada gambar disamping

The *Adu Mancung* motif is one of the traditional Baduy weaving motifs characterized by a simple design in the form of a diamond or half-diamond shape arranged sequentially. The Baduy Luar community adopts the songket weaving technique in producing the Adu Mancung woven fabric, which possesses sacred value and is specifically intended for Baduy Luar men. This fabric is used during traditional and cultural ceremonies of the Baduy Luar community. The uniqueness of the Adu Mancung woven motif lies in its use in religious activities, as it contains philosophical meanings of the Baduy Luar people, who uphold a monogamous marriage system and emphasize harmony within newly married Baduy Luar families.
If we observe the arrangement of the Adu Mancung motif pattern, it forms a rhombus shape, as illustrated in the adjacent figure.

Furthermore, the Adu Mancung motif can be incorporated into geometry learning activities through visual exploration, pattern reconstruction, and project-based tasks. Students may be asked to redesign the motif using coordinate geometry, create tessellation patterns based on the rhombus structure, or model the motif using dynamic geometry software. Such activities promote meaningful learning by connecting abstract geometric concepts with authentic cultural artifacts.

Figure 2

Contextual Geometry Problem Based on the Adu Mancung Weaving Motif

Permasalahan :

Seorang penenun ingin membuat kain dengan panjang 2 meter yang dihiasi deretan belah ketupat berukuran sama (panjang diagonal 20 cm dan 12 cm). Jika motif belah ketupat disusun berjajar horizontal tanpa celah, berapa banyak belah ketupat yang bisa dimuat dalam kain sepanjang 2 meter? Berapa luas total belah ketupat yang menghiasi kain tersebut?



A weaver wants to make a piece of fabric with a length of 2 meters that is decorated with a sequence of identical rhombus motifs (with diagonal lengths of 20 cm and 12 cm). If the rhombus motifs are arranged horizontally without any gaps, how many rhombuses can fit along the 2-meter fabric? What is the total area of the rhombuses that decorate the fabric?

The learning content presents a contextual geometry problem that connects mathematical concepts with traditional weaving activities. Students are introduced to a real-life situation in which a weaver plans to produce a two-meter-long fabric decorated with a horizontal sequence of identical rhombus motifs, each having diagonals of 20 cm and 12 cm. The motifs are

arranged side by side without gaps, and students are asked to determine how many rhombuses can fit along the length of the fabric and to calculate the total area covered by the motifs. Through this problem, students are encouraged to apply their understanding of rhombus properties, area formulas, and unit conversions in a meaningful cultural context. Such tasks help students develop problem-solving skills, spatial reasoning, and mathematical modeling abilities while simultaneously fostering an appreciation of local cultural heritage and demonstrating the relevance of mathematics in everyday life.

These results indicate that the Adu Mancung weaving motif represents a rich ethnomathematical resource that can serve as a strong foundation for developing culturally contextualized geometry teaching materials. By integrating this indigenous pattern into formal mathematics instruction, geometry learning becomes more concrete, relevant, and culturally responsive, while simultaneously contributing to the preservation and appreciation of Baduy cultural heritage (Fitri et al., 2020; Kehi et al., 2019).

The second ethnomathematical artifact identified in this study is *Dudukuy*, a traditional woven bamboo headgear used by the Baduy community. *Dudukuy* is a large circular hat specifically worn by Baduy Luar women, while Baduy men commonly use *Iket* (or Blangkon/Lomar), a triangular-shaped headcloth. In addition, the Baduy community also uses *Caping* (farmer's hat), another circular woven bamboo hat designed to protect farmers from sunlight while working in the fields. These traditional head coverings demonstrate a strong representation of geometric concepts, particularly circles and triangles, embedded in Baduy cultural practices.

From a geometric perspective, *Dudukuy* exhibits the properties of a circle, including a central point, radius, diameter, and circumference. The weaving pattern radiates outward from the center, forming concentric circular structures that reflect an intuitive understanding of radial symmetry and proportional spacing. The structural design of *Dudukuy* requires careful measurement and spatial reasoning to ensure balance, stability, and comfort when worn. Meanwhile, the Iket headcloth represents a triangular form when folded and tied, illustrating the application of triangular geometry in traditional clothing design.

The production of *Dudukuy* involves precise weaving techniques that rely on consistent spacing and uniform curvature, indicating an implicit understanding of circular geometry and symmetry. The radial weaving pattern also demonstrates repeated angular divisions around the center, which can be interpreted as a practical application of angle concepts and partitioning of a circle into equal sectors. Although these concepts are not formally expressed in mathematical notation, they reflect indigenous mathematical reasoning developed through cultural experience and craftsmanship.

Figure 3
Dudukuy as an Ethnomathematical Artifact of Circular Geometry



Masyarakat Suku Baduy menggunakan beberapa jenis penutup kepala, termasuk **Dudukuy** (atau Tudung) yang merupakan topi anyaman bambu berbentuk bundar besar yang khusus untuk wanita Baduy Luar, dan Iket (atau Blangkon/Lomar) yang merupakan kain ikat kepala berbentuk segitiga yang digunakan oleh pria, baik di Baduy Dalam maupun Baduy Luar. Selain itu, ada juga Caping (atau Tudung Petani), topi anyaman bambu berbentuk bundar besar yang fungsinya lebih untuk melindungi dari sinar matahari saat berladang.

Figure 4
Contextual Geometry Problem Based on the Baduy Dudukuy Headgear

Sebuah *dudukuy* (tutup anyaman bundar) dibuat oleh perajin Baduy. *Dudukuy* berbentuk lingkaran dengan **diameter 40 cm**. Perajin menenun dudukuy dengan menggunakan **strip bambu** (lebar strip = **2 cm**) yang ditata secara berlapis (seperti kisi sederhana: arah mendatar dan arah tegak lurus, dua orientasi), sehingga pada akhirnya ada susunan strip horizontal dan strip vertikal yang saling bertumpuk.

Asumsikan setiap strip bambu dipotong memanjang sepanjang **diameter dudukuy** (untuk perhitungan sederhana kita anggap semua strip memiliki panjang sama = diameter). Satu batang bambu utuh dapat dipotong menjadi **2 potongan panjang 1 m** yang siap dipakai (jadi setiap batang memberikan 2 meter bambu total yang bisa dipakai dalam potongan-potongan).

Hitung:

1. Luas dudukuy dalam **cm²** dan **m²**.
2. Berapa banyak **strip** (bambu) yang diperlukan pada satu orientasi (mis. arah horizontal)? Berapa total strip jika ada dua orientasi (horizontal + vertikal)?
3. Jika setiap strip panjangnya = diameter (40 cm), berapa **jumlah total panjang bambu** yang dibutuhkan (dalam meter)?
4. Berapa **batang bambu** yang diperlukan ?

A *Dudukuy* (a circular woven head covering) is made by Baduy craftsmen. The *Dudukuy* has a circular shape with a diameter of 40 cm. The craftsmen weave the *Dudukuy* using bamboo strips (each strip is 2 cm wide) that are arranged in layers, similar to a simple grid pattern with two orientations: horizontal and vertical. As a result, the final structure consists of overlapping horizontal and vertical bamboo strips.
Assume that each bamboo strip is cut with a length equal to the diameter of the *Dudukuy* (for simplicity, assume all strips have the same length as the diameter). One whole bamboo pole can be cut into two pieces of 1 meter each, meaning that each pole provides a total of 2 meters of usable bamboo.
Calculate:

1. The area of the *Dudukuy* in square centimeters (cm²) and square meters (m²).
2. The number of bamboo strips required for one orientation (e.g., horizontal). How many strips are needed in total if there are two orientations (horizontal and vertical)?
3. If each strip has a length equal to the diameter (40 cm), what is the total length of bamboo required (in meters)?
4. How many bamboo poles are needed?

The figure illustrates a contextual geometry learning task based on the traditional Baduy headgear known as *Dudukuy*. The image presents a circular woven bamboo hat with a diameter of 40 cm, constructed using layered bamboo strips arranged in horizontal and vertical orientations. The accompanying problem guides students to explore geometric concepts such as the area of a circle, unit conversion, grid arrangement, and linear measurement through the process of estimating the number of bamboo strips required and calculating the total length of bamboo used. This learning context connects formal geometry concepts with indigenous craftsmanship, enabling students to understand mathematics through authentic cultural practices.

These findings indicate that *Dudukuy* can serve as meaningful ethnomathematical resources for junior high school geometry learning. The circular structure of *Dudukuy* provides a concrete representation for introducing concepts such as radius, diameter, circumference, area of a

circle, and rotational symmetry. Similarly, the triangular form of the Iket can be used to explore properties of triangles, perimeter, area, and angle relationships. By using these cultural artifacts as learning contexts, students can visualize abstract geometric concepts through real objects that are closely connected to Indonesian cultural heritage.

Furthermore, integrating *Dudukuy* into geometry teaching materials allows students to explore mathematical ideas through observation, measurement, and reconstruction activities. For example, students can analyze the weaving pattern to estimate the number of radial divisions, calculate the circumference and area of the hat, or design their own circular weaving patterns based on geometric principles. Such activities promote meaningful learning, enhance spatial reasoning, and foster cultural awareness.

Conclusions

This study demonstrates that the Baduy indigenous community possesses rich ethnomathematical knowledge that is deeply embedded in their daily cultural practices and traditional craftsmanship. The findings reveal that cultural artifacts such as the *Adu Mancung* weaving motif and the *Dudukuy* headgear represent fundamental geometric concepts, including rhombus patterns, symmetry, circles, radial structures, and proportional reasoning. These cultural forms embody an implicit mathematical system that reflects the community's spatial reasoning, measurement practices, and pattern construction skills developed through generations of experience.

By transforming these ethnomathematical findings into contextual geometry learning tasks, this study highlights the potential of Baduy culture as a meaningful and authentic learning resource for junior high school mathematics education in Indonesia. The integration of indigenous artifacts into geometry instruction enables students to visualize abstract concepts through concrete cultural representations, thereby enhancing conceptual understanding, problem-solving skills, and spatial reasoning. Moreover, culturally contextualized learning promotes students' appreciation of local wisdom and strengthens their cultural identity in the midst of global cultural influences.

Furthermore, this study contributes to the sustainability of indigenous community education by positioning Baduy ethnomathematics not only as cultural heritage but also as an integral component of formal school curricula. Integrating local wisdom into mathematics learning supports culturally responsive pedagogy and encourages the preservation of indigenous knowledge through intergenerational transmission within educational contexts.

In conclusion, Baduy ethnomathematics provides a strong foundation for developing culturally meaningful geometry teaching materials that align with 21st-century learning principles. Future research may extend this work by implementing and evaluating these materials in classroom settings to examine their impact on students' mathematical achievement, cultural literacy, and learning motivation.

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Students' Note-Taking Patterns and Interpreting Accuracy: An Empirical Study at a University in Vietnam

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Abstract

Grounded in interpreter training research and cognitive load theory, this study examines how different note-taking patterns influence interpreting accuracy. It focuses on three types of notation including full words, abbreviations, and symbols and identifies the note-related difficulties commonly experienced by learners. Using a mixed-methods design, data were collected from 48 undergraduates at the Diplomatic Academy of Vietnam through live consecutive interpreting tasks, retrospective interviews (n = 7), and an online survey (n = 41). The findings show that full-word notation is negatively associated with accuracy, whereas abbreviations and symbols correlate positively with accuracy. Students also reported challenges linked to information overload, limited familiarity with notation systems, and inconsistently structured notes. These results underscore the pedagogical importance of cognitively informed, strategy-focused note-taking instruction and call for more systematic integration of notation training into interpreter education.

Keywords: note-taking strategies, interpreting accuracy, abbreviations and symbols, interpreter training, cognitive load theory

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Introduction

Consecutive interpreting (CI) remains a central modality of mediated communication in multilingual settings. Its prominence is particularly evident in Asian institutional and diplomatic contexts, where flexibility, confidentiality, and cost-efficiency are prioritized (Gillies, 2017). In CI, interpreters process the source speech in segments and reproduce its content immediately after each pause. Because these segments frequently exceed working-memory capacity, interpreters rely on note-taking as an external cognitive scaffold that helps manage processing load and maintain accurate recall (Gile, 1995; Pöchhacker, 2015; Seleskovitch, 1978).

Note-taking in CI is not a passive act of transcription but a selective, strategic, and cognitively demanding process. It unfolds under strict time pressure while competing with listening, analysis, memory operations, and coordination, which makes it fundamentally different from general-purpose note-taking (Gile, 1995; Gillies, 2017). Previous research shows that strategic note-taking enhances both accuracy and fluency, especially when interpreters employ reduced forms such as symbols and abbreviations to encode meaning efficiently (Rozan, 1956; Setton & Dawrant, 2016). These systems also become increasingly personalized, as interpreters combine symbols, abbreviations, and full words in ways shaped by cognitive preferences and training backgrounds (Chen, 2020).

Despite its central role in CI, empirical research that examines how specific note-taking strategies affect interpreting performance remains limited. Most existing studies focus on professional interpreters or advanced trainees, leaving early-stage learners systematically underexamined (Dai & Xu, 2007; Dam, 2021). There is still limited knowledge about how undergraduate interpreters, especially those trained in English-as-a-foreign-language (EFL) settings, construct and use their note-taking systems. Even less is known about how their use of full words, abbreviations, and symbols relates to accuracy and fluency in CI performance. This gap is particularly salient in the Vietnamese context, where interpreter training is expanding rapidly, but remains underrepresented in international scholarship.

The Diplomatic Academy of Vietnam (DAV), with its established translation and interpreting program, offers a representative EFL-based environment for examining note-taking practices among novice interpreters. Understanding how these learners deploy different note-taking forms, and identifying recurring problems in their notes, can generate insights for improving CI training and supporting the development of effective note-taking skills. Such insights are essential, as note-taking functions as a central cognitive mechanism that mediates memory processes and shapes interpreting output (Pöchhacker, 2015; Setton & Dawrant, 2016).

Guided by these considerations, the present study addresses two questions:

RQ 1. How does the use of full words, abbreviations, and symbols in students' notes influence the accuracy of their consecutive interpreting performance?

RQ 2. What types of note-taking difficulties are most commonly associated with decreased accuracy in students' consecutive interpreting?

To address these questions, the study adopts a mixed-methods design combining content analysis of students' notes, standardized performance assessment, and retrospective interviews. By examining how different note-taking strategies function as memory aids for novice interpreters, the study contributes to a more nuanced understanding of note-taking as both a

cognitive and pedagogical tool in early-stage CI training. It also offers implications for curriculum design in EFL interpreter-education contexts.

Literature Review

Theoretical Foundations of Note-Taking in Consecutive Interpretating

Historically, a number of influential studies have been conducted on the conceptualization and development of note-taking systems in consecutive interpreting. Consecutive notes serve as memory prompts, supporting rather than replacing understanding (Seleskovitch, 1978), and represent the "skeleton structure" of the original discourse rather than verbatim transcription (Gillies, 2017). Effective note-taking enables interpreters to focus on comprehension while listening and later analyze their notes to produce accurate and coherent output. Ilg and Lambert (1996) and Jones (2014) highlight the importance of visual structuring and symbolic efficiency, noting that well-structured notes aid both memory and delivery.

Notably, Gile's Effort Models (1995) provide a valuable framework for understanding how note-taking influences interpreter performance by conceptualizing consecutive interpreting as a process involving two interrelated phases. In the first phase, listening and note-taking, interpreters simultaneously engage in listening and analysis (L), note-taking (N), short-term memory management (M), and coordination of these activities (C). The second phase, target speech production, involves remembering the source content (Rem), reading and retrieving notes (Read), and producing the target speech (P). Within this framework, note-taking (N) directly competes with listening and memory for cognitive resources, such that inefficient notes increase cognitive load during both listening and production, ultimately reducing output quality. Conversely, when symbols are internalized and applied efficiently, they decrease cognitive demands in both phases by minimizing the time and effort required for note production and retrieval, thereby supporting more accurate and fluent interpretation.

Gile and Chai (2009) argue that properly recorded notes serve as a strong memory aid, making it easier to recall speech units and produce fluent interpretations. As approved by Zhou and Dong (2019), note-taking significantly enhances the accuracy and fluency of consecutive interpreters' recall of source texts, with a facilitative effect increasing as interpreting training experience accumulates. In practice, the interpreter who can use compact, meaningful symbols during listening has more mental bandwidth to allocate to short-term memory and analysis. This suggests that symbolic systems, when well-learned, enhance both processing efficiency and interpretive accuracy.

Numerous researchers have utilized the Effort Models in their work. For instance, G. Wu and Wang (2009) introduced a supplementary approach called discourse transformation to address capacity limitations, building on Gile's Effort Models. Later, C. Wang (2023) emphasizes the cognitive limitations of interpreters, highlighting that effective note-taking in consecutive interpreting must structure ideas coherently. Similarly, Kuang and Zheng (2022) examine how the effort model is reflected in the interpreters' note-taking effort, note-taking product, and note-reading effort. To enhance the pedagogical relevance of the concept, Gile (2021) redefined the Effort Models as a practical teaching tool, highlighting their role in illustrating high cognitive demands, identifying core challenges, and forecasting developments in translation and interpreting studies.

Interpreters must distill complex utterances into cognitively manageable forms while maintaining the logical structure and semantic integrity of the source speech. To achieve this, interpreters rely on a repertoire of notational elements, typically grouped into three main categories: symbols, abbreviations, and full words. “A symbol represents a concept, not a word” (Gillies, 2017); therefore, when interpreters use symbols in note-taking, the focus is on the underlying meaning of a term, not on the actual word or expression used by the speaker. Regarding abbreviations, a general rule of thumb is to shorten all words longer than four or five letters (Rozan, 1956). Writing out full words is discouraged in note-taking, as it can slow down the interpreter, except for some proper names.

Rozan’s (1956) system is based on efficiency and simplicity. He introduces 10 basic signs (such as plus, minus, brackets) and 10 additional symbols divided into three categories. This minimalist approach is language-independent and aimed at maximizing speed and comprehension (Albl-Mikasa, 2008). However, Matyssek (1989) adopts a contrasting view. While he supports Rozan’s seven principles, he advocates for the extensive use of symbols. Matyssek argues that symbols are more efficient than words or abbreviations, as they are quicker to write and easier to read. He has developed a comprehensive system of categorized symbols that interpreters can adapt to their personal style. Opinions remain divided on the use of symbols. Chen (2020) supports symbols for their speed and clarity. On the other hand, Bowen & Bowen (1984) caution that if a symbol requires more strokes than an abbreviation, it is less efficient and should not be used just for the sake of being a symbol. They emphasize practicality and suggest that note-taking systems (NTS) need not be overly systematic, since both handwriting and spoken language are inherently inconsistent.

In terms of language choice, it remains a contested issue in interpreting studies. Dam (2021) emphasized the influence of the language’s status within the interpreter’s language combination, rather than its functional role in the task. Particularly, Y. Wu (2010) observed that while taking notes in the source language (Chinese) can reduce cognitive load, students who used the target language (English) performed better, indicating enhanced comprehension and processing. Additionally, González (2012) and Zhan (2019) argued that the interpreter's expertise level plays a crucial role in determining language choice. Furthermore, Zhan (2019) expanded this view by suggesting that language choice is also shaped by practical factors such as handwriting efficiency with interpreters often relying on language-based note forms.

Empirical Studies on Note-Taking and Interpreting Quality

Empirical investigations into note-taking in consecutive interpreting (CI) have consistently sought to understand how specific note-taking practices relate to interpreting performance. Early studies, such as Her (2001), examined Chinese-English student interpreters with varying training levels and found a positive correlation between overall note quality and interpreting outcomes. This finding indicates that well-structured and meaningful notes do not merely record information but actively support cognitive processing, enabling interpreters to manage memory load and maintain accuracy during production. Chen (2021) further confirmed this association in a sample of both students and professional interpreters, demonstrating that experience and proficiency in note-taking jointly enhance CI performance. Collectively, these studies suggest that note quality, including clarity, organization, and symbolic representation, serves as a fundamental mediator between source-text comprehension and target-text production, aligning with theoretical perspectives that frame notes as external memory aids (Gile & Chai, 2009; Gillies, 2017; Seleskovitch, 1978).

Beyond overall note quality, researchers have examined the effects of specific note-taking features, such as note quantity, symbol use, abbreviations, and reliance on full words. Cardoen (2018) found that, for Dutch-Spanish interpreters, note quantity generally facilitated both accuracy and fluency, yet the impact of symbols varied according to task complexity, and overuse of abbreviations sometimes hindered fluency. J. Wang and Wu (2022) observed that the use of incomplete Chinese characters and symbols enhanced interpreting outcomes among Chinese-English students, reinforcing the notion that cognitive efficiency in encoding and retrieving information is crucial for CI performance. In contrast, Y. Liu et al. (2023) reported no significant relationships between note-taking features and interpreting quality, a result likely influenced by small sample sizes and variability in participants' training and proficiency.

These mixed results highlight several critical points. First, note-taking effects are inherently context-dependent, influenced by factors including the language pair, interpreting direction, task complexity, and the interpreter's level of expertise (González, 2012; Zhan, 2019). Second, empirical studies often focus on a narrow set of participants or on isolated features of note-taking, leaving the holistic effect of note-taking on both accuracy and fluency underexplored. Third, most prior research has concentrated on well-established language pairs and professional contexts, with little attention to emerging or understudied combinations such as English-Vietnamese CI.

This study addresses these gaps by examining how note-taking strategies – full words, abbreviations, and symbols – relate to interpreting performance among undergraduates at the Diplomatic Academy of Vietnam (DAV). As a national institution for training diplomats and multilingual communication professionals, DAV represents interpreter education within emerging EFL contexts in Southeast Asia and provides an appropriate setting for investigating note-taking under authentic cognitive and institutional demands.

Within this context, the study explores the cognitive and practical implications of note-taking features and their effects on interpreting quality, particularly accuracy. By generating context-sensitive evidence, it offers pedagogical insights for undergraduate CI training and helps bridge the gap between cognitive load theories (Gile, 1995; Ilg & Lambert, 1996) and classroom-based learning outcomes.

Methodology

Research Design

This study adopts a mixed-method design integrating quantitative and qualitative data to examine the relationship between three note-taking strategies – full words, abbreviations, and symbols and consecutive interpreting (CI) quality among undergraduate learners. Combining data types enables cross-checking and enhances validity (Turner et al., 2017).

The design is grounded in Gile's Effort Models (1995), which conceptualize CI as the coordination of Listening, Note-taking, Memory, and Production Efforts. Within this framework, full words support retrieval but increase processing time; abbreviations reduce time costs but risk ambiguity; and symbols maximize speed but require stable internal conventions. These distinctions inform the operationalization of note-taking variables and their hypothesized effects on interpreting quality.

The study is situated at the Diplomatic Academy of Vietnam (DAV), a leading institution for training diplomats, interpreters, and language professionals. As interpreter education in Vietnam is developing within a broader EFL context, DAV provides a representative setting for examining cognitive load management in CI and the effectiveness of note-taking instruction.

The study pursues two aims: (1) to examine statistical relationships between note-taking features and interpreting quality, and (2) to explore learners' note-taking difficulties. Accordingly, the research was conducted in two stages: a controlled interpreting experiment with retrospective interviews, followed by a survey of a larger student cohort.

Participants

Forty-eight students enrolled in the English Linguistics program at DAV participated in the study. All had completed introductory interpreting training and demonstrated at least IELTS 6.5 proficiency. A small subsample (n = 7) was selected for the experimental phase to generate in-depth, information-rich data on note-taking behaviours and cognitive decision-making during consecutive interpreting. In line with qualitative research guidelines, sample size was determined by data richness, research scope, and data collection methods rather than statistical considerations (Moser & Korstjens, 2018).

The remaining participants (n = 41) completed an online questionnaire to capture broader practices and perceptions of note-taking. This sample size is appropriate for exploratory survey research, which typically involves 20–150 participants (Daniel, 2012). All participants provided informed consent, and all data were anonymized to ensure confidentiality.

Data Collection Procedures

Stage 1: Interpreting Experiment and Retrospective Interviews

Seven students completed two CI tasks: Vietnamese-to-English (V-E) and English-to-Vietnamese (E-V). The recordings were selected for clarity, moderate speed, and general topics to avoid unnecessary technical load. The V-E passage (2:15, 244 wpm) discussed minimalism and electronic devices. The E-V passage (2:30, 109 wpm) described steps for filing a police report. Task order was counterbalanced.

Students took notes on paper during listening and delivered their interpretations immediately afterward. Note-taking competed with listening and memory, which made it possible to observe how note choices affected cognitive effort during CI. After the interpreting tasks, each student participated in a 20-minute retrospective interview. They explained why they chose certain forms (full words, abbreviations, symbols), discussed difficulties they experienced, and clarified unclear parts of their notes. All interviews were recorded and transcribed.

Stage 2: Online Survey

A survey was then administered to 41 additional students. It examined their note-taking strategies, challenges, and perceptions of how note-taking affects interpreting accuracy. The survey helped situate the experimental findings within a broader student context.

Data Analysis

Quantitative Analysis

Three note-taking features including full words, abbreviations, and symbols were counted for each participant's notes in both interpreting directions. Counting was performed at the unit-level of individual note items rather than lines or ideas, allowing consistent comparison across participants.

Interpreting accuracy was evaluated using an adapted version of Lee's (2008) rubric. Accuracy was defined based on the widely accepted criterion of *sense consistency* between source speech and target rendition (Gile, 1995; Kurz, 2003). Following Pöchhacker's (2015) notions of "accurate rendition" and "equivalent intended effect," accuracy was operationalized as the degree to which meaning was preserved. Errors included unjustified omissions, additions, and distortions of intended meaning.

Two trained raters independently assessed all CI recordings. Inter-rater reliability was calculated using Cohen's kappa in SPSS 27. The coefficient ($\kappa = 0.78$) indicated substantial agreement. Disagreements were resolved through discussion.

Data were analyzed in SPSS 27. Pearson correlation tested associations between note-taking patterns and accuracy. Multiple regression examined how each note-taking feature predicted accuracy while controlling for language direction and individual differences.

Qualitative Analysis

Interview transcripts and scanned notes were coded in NVivo 12. Open coding identified common problems such as incomplete information, unclear symbols, ineffective abbreviations, and disorganized note layout. Axial coding then grouped these issues into broader themes. The qualitative findings contextualized the statistical patterns, explaining why certain note-taking strategies supported or hindered accurate interpretation.

Collectively, quantitative and qualitative strands were integrated at the interpretation stage. Examining behavioural patterns (from notes and accuracy scores) alongside learners' metacognitive accounts (from interviews and surveys) provided a multidimensional understanding of how note-taking choices shape cognitive load and CI performance. This design thus aligns empirical evidence with the theoretical assumptions of Effort Models, allowing the study to draw practice-oriented implications for interpreter training in EFL contexts.

Results

Assumptions Check

Prior to analysis, data were inspected for normality and homoscedasticity. Residuals were approximately centered around zero with no systematic pattern, supporting the use of parametric tests. Minor deviations from normality were observed but deemed negligible. (see Appendix 3, Table 3.1, Figures 3.1–3.3)

Note-taking Patterns in EV and VE Tasks

Experimental Task (n = 7)

Participants' note-taking in English-Vietnamese (EV) tasks consisted mainly of full words (M = 0.54, SD = 0.10), abbreviations (M = 0.27, SD = 0.07), and symbols (M = 0.19, SD = 0.07). In Vietnamese-English (VE), full words decreased slightly (M = 0.49, SD = 0.11) and symbols increased (M = 0.28, SD = 0.13).

Table 1
Descriptive Statistics of Note-Taking Patterns (n = 7)

Strategy	EV Mean	EV SD	VE Mean	VE SD
Full words	0.54	0.10	0.49	0.11
Abbreviations	0.27	0.07	0.23	0.05
Symbols	0.19	0.07	0.28	0.13

Pearson correlations indicated a negative association between full words and accuracy (EV: r = -0.84; VE: r = -0.89) and a positive association between symbols and VE accuracy (r = 0.88). Abbreviations showed inconsistent patterns. These results are exploratory due to the small sample. (see Appendix 4, Table 4.1)

Survey Findings (n = 41)

Survey responses reflected frequent use of full words (M = 3.10, SD = 0.94), symbols (M = 2.71, SD = 0.81), and abbreviations (M = 2.27, SD = 0.84). Correlations with self-reported accuracy were negative for full words ($r = -0.42$, $p = .003$) and positive for symbols ($r = 0.59$, $p < .001$) and abbreviations ($r = 0.36$, $p = .010$). (see Appendix 4, Table 4.24.3)

Multiple regression indicated that symbols predicted accuracy most strongly ($\beta = 0.49$, $p < .001$), full words had a negative effect ($\beta = -0.30$, $p = .022$), and abbreviations contributed positively but non-significantly ($\beta = 0.10$, $p = .457$; $R^2 = 0.451$). (see full data on Appendix 5, Table 5.1–5.3)

Table 2
Linear Regression Results Predicting Interpreting Accuracy From Note-Taking Patterns

Predictor	β	t	p
Full words	−0.30	−2.39	0.022
Abbreviations	0.10	0.75	0.457
Symbols	0.49	3.71	< 0.001

Consistently across experimental and survey data, symbol use is positively associated with interpreting accuracy, whereas heavy reliance on full words is negatively associated.

Common Challenges Affecting Interpreting Quality

To investigate challenges in interpreting note-taking, a structured questionnaire based on three thematic areas was developed with seven pilot participants and administered to 41 students. Over 83% of respondents agreed that note-taking positively influences interpreting performance, 14.6% were neutral, and 2.4% disagreed, indicating a strong perceived value of note-taking and warranting further exploration of specific difficulties.

Challenges Related to Capturing Information

Nine coded interview references highlighted difficulties in efficiently capturing spoken information. Students often relied on full-word notation when uncertain about abbreviations or symbols, which increased cognitive load:

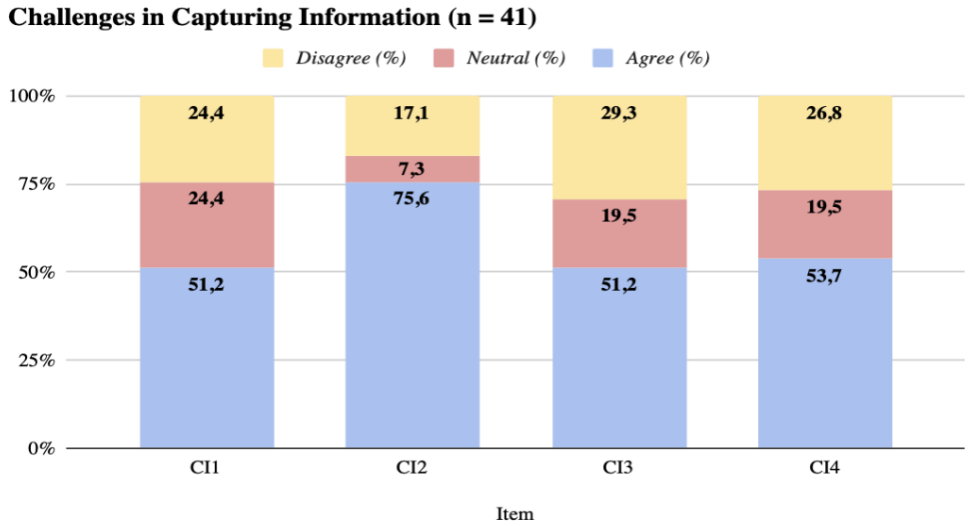
"I just focus too much on writing and miss the next part of the message." (Participant No. 6)

"One common problem I have to deal with is not being able to write fast enough, which sometimes leads to missing the next piece of information." (Participant No. 3)

Quantitative data supported these observations. The four-item scale demonstrated good internal reliability (α = .781; standardized α = .780). As shown in Table 8, 75.6% reported difficulty capturing enough information during complex content (CI2). Over half frequently missed key information (CI1, 51.2%) or struggled to record numbers, names, or units accurately (CI3, 51.2%). Additionally, 53.7% indicated their notes were often dense or overloaded (CI4). These results suggest students face consistent challenges in balancing completeness and clarity under cognitive pressure.

Figure 1

Capturing Information Problems in Interpreting Note-Taking Strategies Encountered by Students (n = 41)



Note. CI1: I often miss key information when taking notes during interpreting tasks.
CI2: When interpreting dense or complex content, I often fail to capture enough useful information in my notes.
CI3: I struggle to write down numbers, names, or units in a complete and accurate way.
CI4: My notes are often too dense or overloaded with too much information.

Unfamiliarity With Symbols and Abbreviations

Ten coded references revealed inconsistent or limited use of symbols and abbreviations. Students avoided symbolic notation due to insufficient training or lack of a personal system:

"I don't have a consistent symbol or abbreviation. So sometimes I forget what I meant or misunderstand my own notes." (Participant No. 4)

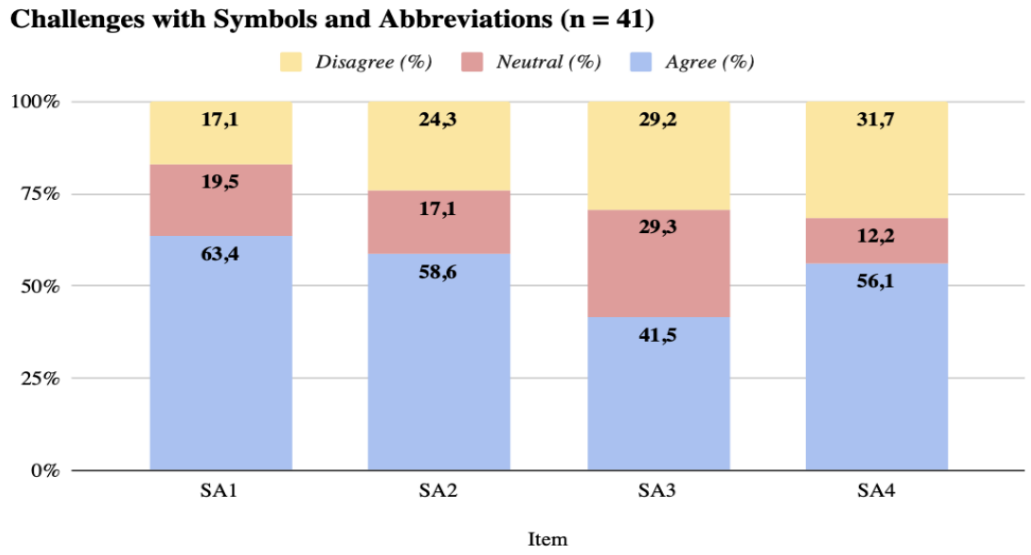
"If I use abbreviations or symbols I am not familiar with, or that just pop up in the moment, I sometimes get confused by them while interpreting." (Participant No. 1)

"I know symbols can be faster, but I don't have a system. I just use arrows or maybe some simple signs." (Participant No. 2)

The four-item scale showed acceptable reliability (α = .715; standardized α = .718). Inconsistent abbreviation use (SA1) was most common, reported by 63.4% of students. Underuse of symbols (SA2) was noted by 58.6%, while 41.5% reported occasional symbol overload (SA3). Over half (56.1%) tended to write full words instead of abbreviations (SA4). These findings indicate recognition of the efficiency benefits of symbolic notation but insufficient consistency in application.

Figure 2

Symbols and Abbreviations' Challenges in Interpreting Note-Taking Strategies Encountered by Students (n = 41)



Note. SA1: I use abbreviations inconsistently (e.g., I write the same word differently at different times).
SA2: I do not use enough symbols to make my notes more visual or efficient.
SA3: I use too many symbols in my notes, and sometimes I forget what they mean.
SA4: I tend to write full words even when abbreviations could save time.

Problems With Logical Organization and Layout

Seventeen coded references highlighted difficulties in structuring notes coherently. Students reported content-rich notes lacking logical arrangement, affecting recall during delivery:

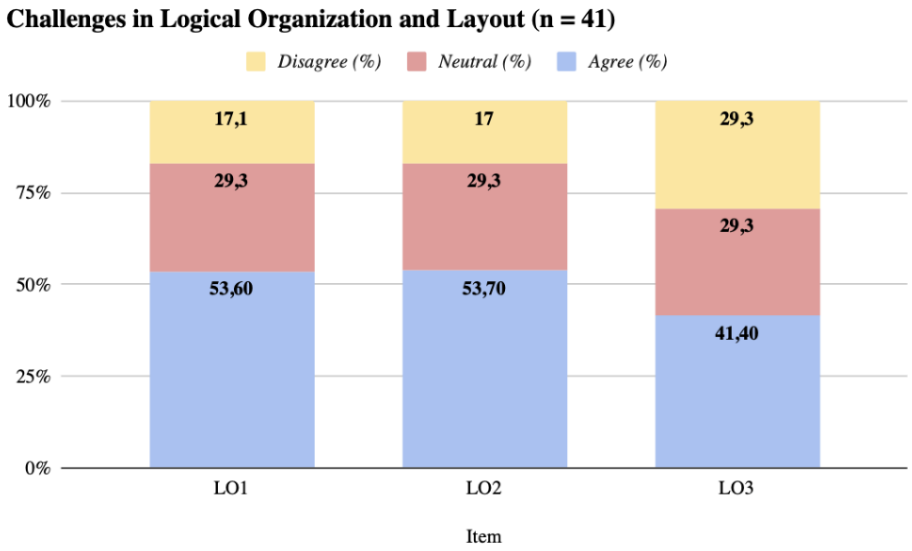
"I try to note down as much information as possible, so I forget to organize my note-taking. Even though I have a lot of information, the logic of my interpretation is not high quality." (Participant No. 7)

"I don't always organize my notes clearly. So when I look at them, it's hard for me to follow the logic." (Participant No. 6)

The three-item scale demonstrated strong reliability (α = .784; standardized α = .785). Over half of participants reported unclear note structure (LO1, 53.6%) and lack of visual hierarchy (LO2, 53.7%). Additionally, 41.4% indicated their notes did not reflect the speech's logic (LO3). These results suggest that challenges in visual and logical organization are common and may hinder accurate interpretation.

Figure 3

Logic and Layout's Challenges in Interpreting Note-Taking Strategies Encountered by Students (n = 41)



Note. LO1: The structure of my notes is sometimes unclear, making it hard to follow the speaker's ideas.
LO2: I do not organize my notes with clear layout or visual hierarchy (e.g., indentation, columns).
LO3: My notes do not reflect the logic or structure of the original speech.

Discussion

The Relationship Between Note-Taking Patterns and Interpreting Quality

The findings confirm that note-taking patterns exert a measurable influence on interpreting accuracy. Across survey and task data, full-word note-taking was consistently associated with lower accuracy, whereas abbreviations and symbols supported more efficient processing and higher-quality output, particularly in the VE direction. These results align with Rozan's (1956) principle of cognitive economy and Gillies's (2017) emphasis on compact visual cues, and are well explained by Gile's (1995) Effort Models: full-word notation increases coordination and memory effort, reducing resources available for listening and analysis.

The negative impact of full-word notes is consistent with prior research showing that transcript-like notation slows processing and disrupts attention (Aminifard and Aminifard, 2012; Chen,

2020). Their higher frequency in the EV direction reflects learners' tendency to over-write in their L1 for perceived lexical precision, often at the cost of propositional accuracy.

By contrast, symbols and abbreviations facilitate faster encoding and retrieval. The strong association between symbolic notation and VE accuracy extends earlier training-based findings (Chen, 2020) and aligns with evidence for dual-coding and compression effects.

Importantly, this study contributes context-sensitive evidence from Vietnamese undergraduate interpreter training, where formal notation instruction is limited. The robust advantage of symbols—especially in VE—suggests that their cognitive efficiency holds even outside standardized European training traditions and can partially offset increased processing demands when working into a less dominant language. Differences from M. Liu (2008) may be explained by task length and note density, which allowed symbols here to function as genuine compression devices.

Overall, abbreviations and symbols confer clear cognitive and performance benefits, while full-word notation increases load and reduces accuracy, with directionality amplifying these effects.

Common Note-Taking Problems

Three recurring problems emerged from survey responses and qualitative analysis: inconsistent abbreviation systems, limited and sometimes ineffective symbol use, and disorganized or overly dense layouts. These issues reflect deeper challenges in multitasking and prioritization that align closely with Gile's (1995) Effort Models. When excessive effort is consumed by writing or by searching for unstructured notes, listening and memory operations are compromised.

Linking these issues directly to RQ2, disorganized layouts showed the strongest association with reduced accuracy. Students whose notes lacked visual hierarchy including unclear segmentation, inconsistent indentation, or crowding tended to omit major propositions or misrepresent logical relations during delivery. Inconsistent abbreviations produced a similar effect: when students forgot what their own abbreviations meant, reconstruction became slower and less accurate. Limited symbol use, while less damaging on its own, often compounded the problem by forcing students to record more full words, thereby increasing cognitive load.

These patterns parallel findings from Chen (2020), who observed that novice interpreters often prioritize quantity over clarity. In this study, many students showed discomfort with structured notation, reflecting limited exposure to systematic training and limited metacognitive awareness of their own processing constraints. The result mirrors Rozan's (1956) caution: ineffective note-taking can impede performance as much as it is meant to support it.

Collectively, disorganization, inconsistent abbreviation use, and limited symbol use are the difficulties most associated with decreased accuracy, with structural disorganization posing the greatest risk.

Conclusion

This study demonstrates a clear relationship between note-taking strategies and interpreting performance. Consistent with cognitive load theory and established interpreter training models, students who relied on symbols and abbreviations achieved higher accuracy, whereas extensive

use of full words tended to hinder performance. Survey responses further indicated recurring challenges in managing complex information, maintaining consistent abbreviations, and organizing notes effectively. These patterns reinforce that note-taking is not merely a technical skill but a cognitive strategy shaped by task demands, language direction, and individual experience.

The difficulties documented in this study including overly detailed notes, limited or inconsistent symbolic notation, and disorganized layouts reflect broader issues of cognitive overload and insufficient strategic awareness. Addressing these problems requires training that helps learners prioritize key information, develop structured personal systems, and balance listening and writing efforts. Direction-specific effects were evident: symbols proved especially effective in Vietnamese-English interpreting, while abbreviations were more helpful in the English-Vietnamese direction. This suggests that instruction should account for asymmetries in processing load across language directions.

For practical implications, interpreter education should integrate early, structured instruction in symbolic and abbreviated note-taking, along with exercises that balance listening, processing, and writing. Such training can enhance efficiency, reduce cognitive load, and foster strategic awareness.

This study is limited by its small task-based sample, the reliance on self-reported data, and the use of moderately complex passages drawn from a restricted topical range. These factors may limit the generalizability of the results. Future research should employ larger and more diverse cohorts, track development longitudinally, and incorporate a wider range of task types and cognitive demands. Future research should examine larger and more diverse samples, include longitudinal designs to track skill development over time, and explore a broader range of task types, language pairs, and cognitive loads. Integrating corpus-based analysis with complementary cognitive measures would further clarify how note-taking strategies evolve and operate in real-time. Taken together, the findings highlight efficient note-taking as a core competency in consecutive interpreting, contributing to both theoretical understanding and the refinement of interpreter education.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

In the development and revision of this manuscript, I utilized both Grammarly and ChatGPT as AI-assisted tools to support the writing process. Grammarly was employed primarily for proofreading, including correcting grammatical and punctuation errors, enhancing clarity, improving sentence structure, and ensuring coherence across sections. ChatGPT was used to support paraphrasing, refining academic tone, and enhancing the overall clarity and flow of the text, particularly in the abstract, introduction, and literature review sections.

I affirm that the use of AI tools was strictly limited to language improvement and editorial support. No AI technologies were used for generating research ideas or questions, designing the methodology, collecting or analyzing data, interpreting findings, constructing arguments, or synthesizing literature. All intellectual contributions, including research design, data analysis, interpretation, and the formulation of conclusions, are entirely my own and reflect my original scholarly work.

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Appendix

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Enhancing Andragogy for Educators Through Knowledge Building Professional Learning Approach (KBPL Approach)

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Abstract

Knowledge Building (KB) has emerged as a transformative pedagogical approach in Singapore's secondary education landscape. However, what is less studied is the adaptive use of KB in adult learning. This practice-orientated study explores the design and implementation of the Knowledge Building Professional Learning (KBPL) Approach in a Singapore Secondary School, highlighting its constructive role in fostering effective professional learning and collaborative culture for educators. KBPL is an integrative professional learning practice-orientated methodology that maps and synthesizes the key features of andragogy, elements of Tuckman's group development model and the practices of the 4Ms framing [Micro, Meso, Macro and Mega], with KB scaffolds and principles as its overarching andragogical structure and support base. This gives rise to KBPL signature andragogical moves [Let's Hear Out! Let's Build-on! Let's Rise Above!] that applies across all collaborative scales: (i) Intra-School Idea Café [Micro-Meso] that gathers practitioners of different subjects for a time of reflective dialoguing towards collective knowledge creation and synthesis in advancing their classrooms instructional practices; (ii) Inter-School "The History Times" project [Meso-Macro] involving connecting and mentoring teachers from at least 2 schools in reframing the learning experiences for learners of History towards participatory, inquiry-driven and historiographical-orientated prospectus; and (iii) International KB Community Network [Macro-Mega] focusing on mapping the collaborative journeys, modelling successful practices, and mentoring peers across schools and countries, to refine and drive collective pedagogical growth. The overwhelmingly positive feedback from participants underscores KBPL practicality, accessibility, and potential to inspire impactful professional learning communities. As a dynamic and adaptable methodology, the KBPL Approach stands as a promising andragogical model for advancing knowledge building and professional development in diverse educational contexts, and facilitates the move towards 21st century heutagogy where adult learners' sense of autonomy, agency and maturity are maximized and realised.

Keywords: knowledge building, KBPL approach, professional learning, andragogy, Tuckman's Model, 4Ms framework, collaboration, teacher development, Singapore education

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Introduction

Knowledge Building (KB) has emerged as a transformative pedagogical approach in Singapore's secondary education landscape. As a learning theory and pedagogy, KB has been widely studied within the K-12 context (Chen & Hong, 2016). Through its twelve principles, KB facilitates towards the flourishment of students' collective epistemic agency within a collaborative learning environment (Scardamalia, 2004). Central to KB is Knowledge Forum (KF), an online platform that supports asynchronous and synchronous discussions, enabling educators and students to document, refine, and build on ideas collectively. However, what is less studied is the adaptive use of KB in adult learning. Andragogy, as represented by Knowles's (1980), relies on six principles in facilitating effective learning for adults, with its key focuses on practicality, personal autonomy and experiences, and problem-orientated learning. Similarly, Lin's study (2024) highlights the importance of KF in allowing adult learners to pursue their professional growth of collective knowledge advancement and reflective practice across space and time, within and considering their various personal commitments. This practice-orientated study aims to showcase how Knowledge Building Professional Learning (KBPL) Approach enterprises the intentional and integrative use of KB principles and practices, supported and contextualized within the adaptation of Tuckman's (1965) group development model and the 4Ms framework [Micro, Meso, Macro and Mega]. The frameworks in turn help in enhancing and advancing the andragogical learning processes, methodologies and moves for educators. At the same time, this facilitates the move towards 21st century heutagogy where adult learners' sense of autonomy, agency and maturity are maximized and realised.

Participants

The participants in this study comprised a total of 19 educators. They represented a variety of subject disciplines, reflecting a multidisciplinary background that enriched the collaborative process. All participants were engaged in at least two of the platforms explored in this paper, and they had prior knowledge of Knowledge Building (KB), which enabled them to contribute effectively to the initiatives.

KBPL Approach and Its Implementation

KBPL Approach is an integrative professional learning practice-orientated methodology that maps and synthesizes the key principles of andragogy, elements of Tuckman's group development model and the practices of the 4Ms framing, with Knowledge Building as its overarching andragogical structure for effective community advancement.

Table 1
How KB Facilitates and Initiates Accompanying Andragogical Moves

Key Principles of Andragogy	**Key Principles of KB [adapted from its 12 principles]**	**Andragogical Moves arising from KB and its key descriptions**	**KB Scaffolds in facilitating these andragogical moves**
Personal Experience Problem-orientated	Centrality of participants' voices	Let's Hear Out! Participants to share & voice out their personal stories, focusing primarily on their struggles & issues [areas that they need feedback & ideas]	My theory
Practicality Personal Experience	Culture of collective build-on	Let's Build-on! Participants to share strategies, initiate suggestions &/or engage in clarification in addressing the above struggles & issues	I need to understand I have new information This theory does not explain
Personal Autonomy Practicality	Course of Continuous Development	Let's Rise Above! Participants to generate their next individual steps & methodology for further improvement & enhancement	A Better Theory Putting Our Knowledge Together

Table 2
Integration of KB Andragogical Moves Throughout the Processes & Platforms

KB Andragogical Moves	**Tuckman's Group Development Model [adapted] & Description**	**Progressive Andragogical Platforms integrating the 4Ms framework [adapted]**
Let's Hear Out Let's Build-On Let's Rise Above	<u>Form: Form the Team</u> Participants form a team, share their stories and get familiarized with the KB andragogical moves	Intra-school [Micro-Meso] Cross-subject disciplines Inter-schools [Meso-Macro] Cross-communities of same subject disciplines (Inter)-national [Macro-Mega] Cross-subject disciplines, Cross-communities & Cross-countries
	<u>Norm: Norm the Culture</u> Participants to constantly engage in the use of KB andragogical moves throughout all their Professional Learning Sessions [ranging from pedagogical discussions to design]	
	<u>Perform: Perform the Practices</u> Participants to implement KB lessons in class [Figure 1 for the key principles] with the team members engaging as learning observers in the segment on Let's Build-on	

Intra-school Collaboration: The Idea Café

The Idea Café exemplifies the KBPL Approach as represented in Figure 1, an integrative professional learning methodology that synthesises the principles of andragogy with KB through structured moves such as "Let's Hear Out", "Let's Build-On", "Let's Rise Above". At the micro-meso level as seen in Figure 2, the Idea Café fosters a collaborative environment where teachers across disciplines collectively advance their pedagogical practices.

This intra-school collaboration aligns with Tuckman's stages of group development: forming as teachers from diverse subject backgrounds come together as they discuss challenges in KB implementation. Teachers map their pedagogical challenges and goals using real classroom scenarios and model KB practices by sharing best strategies. The ability to also mentor each other in adapting KB principles and monitor the collective progress through reflective dialogue facilitated is made available through the affordances of the Knowledge Forum.

For instance, a Music teacher exploring "Improvable Ideas" might mentor a Literature teacher in using collaborative questioning to deepen text analysis. This iterative process highlights KB as the andragogical structure, enabling teachers to navigate challenges and engage in collective knowledge creation for their classrooms.

Inter-school Collaboration: "The History Times"

The inter-school "The History Times" initiative similarly applies the KBPL Approach but at a meso-macro level to reframe history education as a participatory, inquiry-driven discipline. Guided by KB principles, this collaboration involves teachers from the two schools who engage in forming connections, brainstorming through initial curriculum redesigns.

Using the framework, teachers map the limitations of traditional history teaching, such as reliance on rote memorization, and identify opportunities for KB integration. They model innovative practices through Knowledge Forum, where ideas about historical narratives are documented, shared, and refined. Mentorship plays a pivotal role, as experienced KB practitioners support colleagues in embedding KB principles like "Epistemic Agency" and "Real Ideas, Authentic Problems" into the activities. Lastly, teachers collect feedback from students and teachers alike to iterate on project designs, ensuring continuous improvement as seen from the improvements made from the first iteration.

International Collaboration: Knowledge Building Community Network Learning (KBCNL)

Finally at the macro-mega level, Knowledge Building Community Network Learning (KBCNL) thus becomes a platform where the insights and outcomes of intra-school and inter-school collaborations converge and expand. Guided by the KB principles such as "Symmetric Knowledge Advancement" and "Idea Diversity" as well as the accompanying KBPL Approach, it enables educators to share practices from initiatives like the Idea Café and "The History Times".

KBCNL provides a space for educators to map their collaborative journeys, model successful practices, and mentor peers across schools and countries. Through shared dialogue and reflective feedback, educators monitor and refine their approaches, ensuring scalability and adaptability. This international platform fosters symmetrical knowledge advancement,

distributing expertise and driving collective growth. teachers and researchers to co-create ideas that cater to diverse educational contexts. The international dimension of KBCNL also reinforces "Community Knowledge, Collective Responsibility", as educators engage in a reciprocal process of knowledge exchange that strengthens the global KB community. This systemic processes of the KBCNL also in turn reflect themes explored by Teo et al. (2021), particularly the use of teacher networks to transform pedagogy through shared discourse and idea-centered practices.

By connecting local innovations to a global audience, the KBCNL amplifies the impact of KB practices, allowing for symmetrical advancement, sharing insights and building on one another's innovations that ultimately serves as both a culmination of localised efforts and a springboard for advancing professional learning communities worldwide.

Analysis

Table 3

A Survey on KBPL Approach for the 19 Participants

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I find our school KBPL Approach to be practical and useful in enhancing my professional growth and practices	10	9	Nil	Nil	Nil
The KB Andragogical Moves [Let's Hear Out. Let's Build-on. Let's Rise Above] and scaffolds makes the PL sessions accessible, approachable and meaningful	18	1	Nil	Nil	Nil
Engaging in at least 2 of the 3 KBPL Platforms [Inter-school + Intra-school &/or International] facilitates my professional growth in both depth and breadth	13	6	Nil	Nil	Nil
If given the chance, I will strongly recommend KBPL approach for all professional learning communities	10	8	1	Nil	Nil
On a personal note, KBPL Approach gives me ideas and insights on how to design meaningful and productive PL sessions for my colleagues and myself	9	9	1	Nil	Nil

Discussion

The survey results in Figure 3 highlight the overwhelmingly positive reception of the KBPL Approach among the 19 participants. All respondents found the KBPL Approach practical and useful in enhancing their professional growth, with 10 participants strongly agreeing and 9 agreeing. The structured andragogical moves—Let's Hear Out, Let's Build-On, Let's Rise Above—and the scaffolds supporting professional learning sessions were praised for their accessibility and meaningfulness, with 18 participants strongly agreeing.

Participants expressed high enthusiasm for recommending the KBPL Approach to other professional learning communities, with 18 out of 19 agreeing or strongly agreeing. Also exemplified by a quote from one of the participants,

> At the start, I am wondering how KBPL Approach and the various platforms will assist me in my professional growth. I had undergone many various forms of PL models…. But as I enrol myself in, I see the huge potential and affordances of this approach and its platforms. The concept of us as co-agents in the stage of continuous advancement amazes me. Many a times, PL stops once we gotten the results/outcomes. But, KBPL goes beyond that. Its processes reveal that of an authentic world where knowledge and learning always rise above, beyond what we can imagine. Outcomes are now just milestones that awaits new breakthrough; achieve through not by individual efforts but in a community setting where we are all co-agents in advancing the practices.

These results demonstrate the KBPL approach's efficacy in fostering meaningful and collaborative professional development, underscoring its potential for wider adoption.

Conclusion

The implementation of the KBPL Approach has demonstrated its effectiveness in fostering meaningful professional learning and collaboration among educators. By integrating andragogical principles, Tuckman’s group development model, and the 4Ms framework, the approach has enhanced both individual growth and collective advancement across intra-school, inter-school, and international platforms. The overwhelmingly positive feedback from participants underscores its practicality, accessibility, and potential to inspire impactful professional learning communities. As a dynamic and adaptable methodology, the KBPL Approach stands as a promising model for advancing knowledge building and professional development in diverse educational contexts.

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Coding Connections: Intercultural Competence Through Peer-Assisted Learning Among Digital Media and Technology Students

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Abstract

This study explores how peer-assisted learning with Burmese international mentors contributes to the development of intercultural competence among Thai students majoring in digital media and technology. Grounded in Byram's model of IC and Vygotsky's Sociocultural Theory, the research engaged 30 undergraduates in a 10-week PAL program at a Thai university. Using pre- and post-program questionnaires alongside English language assessments, the findings revealed strong student satisfaction with the PAL sessions—particularly in terms of collaborative project work, cross-cultural communication, and problem-solving support. Participants reported perceived growth in intercultural sensitivity, confidence when working in multicultural environments, and greater openness to diverse perspectives, skills that are increasingly vital in globally networked technology fields. However, the program did not produce measurable gains in English proficiency. Nonetheless, the study underscores PAL's potential to promote intercultural learning and global readiness in STEM-related education, reinforcing the value of Internationalization at Home. It recommends expanding PAL initiatives within digital and technological curricula to prepare students for global collaboration in the tech sector.

Keywords: peer-assisted learning, intercultural competence, Internationalization at Home

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Introduction

Background of the Study

Internationalization has become a central priority in Thai higher education, with universities increasingly seeking ways to equip students with the intercultural awareness, communication skills, and global competencies needed to thrive in diverse environments. Although study-abroad programs remain a common strategy, institutions worldwide are turning to Internationalization at Home (henceforth IaH) to expand intercultural learning opportunities for students who do not travel abroad (Bacon & Torremucha, 2025b; Feng et al., 2025). In Thailand, the number of international students has steadily increased, creating opportunities for meaningful intercultural engagement; however, language barriers, limited interaction, and social distance continue to hinder sustained cultural exchange between Thai and international students. As a result, structured, socially mediated learning environments are needed to bridge these gaps and promote deeper intercultural understanding on campus (Bacon & Maneerutt, 2024).

Peer-Assisted Learning (henceforth PAL) is one such environment. Widely implemented globally, PAL has been shown to enhance academic outcomes, student engagement, and collaborative learning skills (Asare, 2025; Bacon et al., 2021). More recently, scholars have highlighted its potential to foster intercultural dialogue, empathy, and mutual understanding, especially when local students work closely with peers from diverse cultural backgrounds (Bacon & Maneerutt, 2024; Ellison et al., 2023). Yet, despite growing interest in IaH initiatives, empirical research on how PAL supports IC, particularly among Thai university students, remains limited.

Advancing Cultural Understanding Through Peer-Assisted Learning

PAL provides structured, low-pressure spaces where students interact regularly through discussion, problem-solving tasks, and peer-supported activities (Asare, 2025; Bacon et al., 2021). Drawing on Vygotsky's sociocultural theory (henceforth SCT), learning occurs through guided social interaction, making PAL an ideal context for intercultural learning (Bacon & Torremucha, 2025b; Ellison et al., 2023; Vygotsky, 1978). Likewise, Byram's IC model emphasizes attitudes of openness, curiosity, and respect, qualities that can be developed through purposeful engagement with culturally diverse peers (Alred & Byram, 2002; Byram, 1997; Davis & Knight, 2023). When Thai students collaborate with international peer-mentors, PAL sessions can function as localized sites of cultural learning, enabling students to share perspectives, negotiate meaning, and reflect on cultural similarities and differences. Such engagement not only supports cognitive development but also promotes social integration, reduces cultural barriers, and strengthens communicative confidence.

Research Problem

Although Thai universities host growing numbers of international students, meaningful intercultural interaction between local and international peers remains inconsistent. Studies indicate that Thai students often experience limited exposure to foreign cultures, while international students face linguistic and social barriers that prevent integration (Pratama et al., 2024). Existing PAL programs at Thai universities focus primarily on academic support, with little empirical evidence documenting their role in cultural learning, personal development, or the cultivation of IC. Consequently, there is a need to examine how PAL sessions, already

embedded in the university's learning ecosystem, can serve as structured platforms for intercultural engagement and cultural understanding between Thai students and international peer-mentors.

Research Objectives

This study aims to:

1. Identify the mechanisms through which PAL sessions facilitate cultural exchange between Thai students and international peer-mentors.
2. Examine how PAL participation enhances Thai students' cultural awareness, sensitivity, and broader intercultural competence.
3. Assess the personal and academic development outcomes associated with culturally diverse PAL interactions.
4. Evaluate Thai students' satisfaction with cultural exchange opportunities in PAL sessions and gather recommendations for improvement.

Research Questions

To achieve these objectives, the study investigates the following research questions:

1. How do PAL sessions facilitate cultural exchange between Thai students and their international peer-mentors?
2. In what ways do PAL sessions influence Thai students' cultural awareness, sensitivity, and intercultural competence?
3. What personal development outcomes do Thai students experience as a result of participating in intercultural PAL sessions?
4. How satisfied are Thai students with the cultural exchange opportunities in PAL sessions, and what improvements do they recommend?

Significance of the Study

This study offers several important contributions. Empirically, it addresses a gap in the literature by examining the cultural, not only academic, functions of PAL within a Thai higher-education context. The findings have the capacity to strengthen institutional understanding of how IaH can be operationalized through structured PAL environments. Practically, the results will inform the development of culturally responsive PAL programs, mentor training curricula, and intercultural engagement strategies at Rangsit University and other institutions aiming to cultivate global readiness among local students. More broadly, the study highlights PAL's potential as a scalable, sustainable mechanism for fostering IC, building inclusive learning communities, and preparing students for participation in multicultural academic and professional environments.

Literature Review

This literature review synthesizes research on PAL, IC, cultural adjustment among Thai students, and the role of PAL as an IaH strategy. While PAL is well documented as an academic support model, recent research suggests that it may also facilitate cultural exchange, particularly when local students work with international peer mentors. The following sections examine the integrative functions of PAL, key theories of IC, cultural barriers among Thai students, the intercultural value of PAL, and existing gaps that justify the present study.

The Integrative Function of Peer-Assisted Learning

PAL is a structured approach in which trained mentors guide students through collaborative tasks and discussion. Studies consistently show that PAL improves academic achievement, confidence, and engagement (Asare, 2025; Bacon et al., 2021). Drawing on Vygotsky's SCT, PAL emphasizes learning through social interaction, allowing students to clarify ideas, share strategies, and engage in dialogue that promotes deeper understanding (Bacon & Torremucha, 2025b; Ellison et al., 2023). Its collaborative, low-pressure structure reduces anxiety and encourages participation, making it a supportive environment for relationship-building (Bacon & Maneerutt, 2024; Slabbert & Du Plessis, 2021). These characteristics position PAL as not only as an academic support mechanism but also as a socially interactive learning environment in which students engage meaningfully through collaboration, discussion, and peer interaction, creating opportunities for connection among students from diverse backgrounds (Bacon & Torremucha, 2025a; Hidayat et al., 2023).

Intercultural Competence and the Process of Cultural Integration

IC refers to the attitudes, knowledge, and skills needed for effective communication across cultures (Acosta-Mosquera et al., 2017). Byram's model highlights openness, curiosity, interpretive skills, and critical cultural awareness as central components (Wang & Teo, 2024). IC develops through repeated encounters that require learners to reflect on differences, question assumptions, and negotiate meaning (Bartel-Radic & Cucchi, 2025). Cultural integration in PAL contexts involves becoming comfortable with shared social norms and developing meaningful relationships across culturally diverse peer groups (Bacon & Torremucha, 2025b; Ellison et al., 2023). Higher education institutions increasingly emphasize IC as an essential set of knowledge, attitudes, and skills that graduates must develop to function effectively in culturally diverse contexts (Acosta-Mosquera et al., 2017). Research on IaH indicates that structurally embedded, campus-based initiatives, such as PAL, can foster IC by enabling students to develop intercultural awareness and sensitivity through regular interaction with culturally diverse peers and faculty within the home institution (Choi & Khamalah, 2017).

Barriers Thai Students Encounter in Cultural Adjustment

Despite growing international enrollment, meaningful interaction between Thai and international students remains limited. Language anxiety, fear of miscommunication, and uncertainty about appropriate cultural behavior discourage many Thai students from initiating intercultural conversations (Pratama et al., 2024). These hesitations can limit students' interaction across cultural groups, thereby reducing opportunities for intercultural learning and contributing to the tendency for students to socialize primarily within culturally familiar peer networks (Waters & Day, 2022). Furthermore, concerns about misunderstanding cultural norms and unintentionally causing offense function as psychological barriers that can inhibit students' willingness to engage actively in multicultural interactions (Witayarat, 2023). International students also experience adjustment challenges, such as unfamiliar academic expectations and social norms, which widen the interaction gap (Bacon & Torremucha, 2025b). These dynamics highlight the need for structured environments that encourage safe, guided intercultural engagement.

The Contribution of Peer-Assisted Learning to Cultural Exchange and Integration

PAL offers a strong platform for cultural exchange because it relies on frequent interaction, shared activities, and collaborative discussion (Bacon & Maneerutt, 2024; Ellison et al., 2023). Research indicates that PAL facilitates supportive peer interaction and collaborative engagement, enabling students to exchange experiences, seek assistance, and develop mutual understanding, while also contributing to the formation of socio academic relationships that enhance students' sense of connection within learning communities (Asare, 2025; Bacon et al., 2021). Through PAL, Thai students can build communication confidence, develop cultural awareness, and broaden their perspectives when working with international mentors. The informal, conversational nature of PAL allows cultural insights to emerge naturally during academic collaboration (Bacon & Torremucha, 2025a; Slabbert & Du Plessis, 2021). The multi-week structure of PAL facilitates repeated peer interaction within a low-pressure, cooperative environment, supporting the gradual development of interpersonal relationships and conditions associated with intercultural learning (Bacon et al., 2021). These features position PAL as an effective IaH strategy for promoting cultural integration within Thai universities.

Identified Gaps in the Scholarly Evidence

Although PAL's academic benefits are well established, research on its intercultural impact remains sparse, especially in Southeast Asia contexts. Few studies examine how PAL enhances IC in Thailand, cultural awareness, or personal development among host-country students. Existing research focuses heavily on international students' adjustment, leaving Thai students' experiences underrepresented. Moreover, little empirical work identifies how cultural learning occurs within PAL sessions in Thailand or what challenges students encounter in intercultural collaboration. These gaps underscore the need for research that investigates PAL as an IaH mechanism capable of developing IC and cultural integration among Thai university students.

Methodology

Research Design

This study used a mixed methods research design to examine how PAL supports the development of IC among Thai students majoring in digital media and technology. The approach was informed by Byram's IC framework and Vygotsky's SCT, which emphasize learning through guided interaction and meaningful communication. A questionnaire and semi structured interviews were used to gather both numerical and descriptive data, allowing for a comprehensive understanding of students' experiences in PAL sessions.

Population and Sample

The population consisted of Thai undergraduate students enrolled in a digital media and technology program at a private university in Thailand. A total of 30 students participated in the study. All participants were first year students who regularly attended PAL sessions as part of their academic coursework. These students were selected because they interacted directly with international peer mentors, making them appropriate for investigating the cultural and interpersonal dimensions of PAL.

Data Collection Instruments

Data were obtained through a questionnaire and English pretest and posttests. The questionnaire measured five areas: interaction with international mentors, cultural awareness, communication confidence, collaborative learning, and personal development. Items were rated using a five-point agreement scale. The English pretests and posttests evaluated whether students' English proficiency improved as a result of their involvement in this 10-week PAL study.

Validity and Reliability

Validity

Content validity was established through expert review. Three specialists in education and language studies evaluated the questionnaire items using the Item Objective Congruence method. Each item was assessed for clarity and relevance to the research objectives. All items received positive scores, indicating strong alignment with the intended constructs.

Reliability

Reliability was determined by calculating Cronbach alpha to measure the internal consistency of the questionnaire. The instrument was pilot tested with a separate group of students who were not included in the main study. The questionnaire produced a Cronbach alpha value of 0.964, which indicates an excellent level of internal consistency and confirms that the items measured related aspects of intercultural learning.

Data Collection Procedures

Data collection occurred across ten weeks at the university PAL center. At the end of their final session, the thirty participants were invited to complete the questionnaire after receiving an explanation of the study purpose. A group of volunteers then participated in follow-up interviews. All data were collected anonymously, and confidentiality was safeguarded throughout the entire process. Only the researchers had access to the original records.

Data Analysis

Quantitative data from the questionnaire were analyzed using descriptive statistics to summarize trends in interaction, cultural awareness, confidence, and personal development. Interview responses were transcribed and examined using thematic analysis. This process involved coding participant statements, grouping similar ideas, and identifying recurring themes that supported or clarified the quantitative findings. The integration of both data sources provided a detailed understanding of how PAL contributed to the development of IC among Thai students in digital media and technology.

Results

Rationale and Overview

This section presents the regression analysis examining the relationship between initial English proficiency and later performance among Thai digital media and technology students who

participated in the PAL program. Although the broader purpose of the study was to explore IC and student learning experiences, the English pretest and posttest scores provided an opportunity to determine whether the PAL environment contributed to measurable change in students' formal English proficiency.

Regression analysis enables evaluation of whether posttest performance can be predicted from pretest scores and whether any systematic improvement occurred over the ten-week program. Because the PAL sessions emphasized collaboration, interpersonal communication, and interaction with international peer mentors rather than intensive language training, English test scores were expected to remain stable. Nevertheless, the analysis was necessary to assess whether the program contributed to academic outcomes beyond its intercultural goals.

The data consisted of matched English proficiency scores for thirty students, collected before and immediately after the PAL program. Questionnaire results indicated high satisfaction with program structure, interaction with international mentors, collaborative learning, and perceived personal development. These findings support interpretation of the regression results but were not used as predictor variables because they were not collected at the individual level.

Preparation of Data

The dataset contained thirty complete pairs of English pretest and posttest scores. All participants had valid entries for both testing points. Initial inspection of the data revealed that pretest scores varied widely among students, reflecting a diverse range of English proficiency levels. The average posttest score was slightly lower than the average pretest score, suggesting little overall improvement in formal language performance.

Descriptive statistics were calculated to identify patterns in the data. Some students demonstrated increases in their scores, some remained stable, and others experienced slight declines. Because changes appeared inconsistent and small in magnitude, regression analysis was useful for determining whether any observed improvements or declines were associated with initial proficiency.

A scatterplot of the pretest and posttest scores revealed a consistently upward pattern: students with higher initial proficiency tended to retain higher scores at the end of the program. The points formed a clear linear trend, justifying the use of simple linear regression. No extreme outliers were present, so all thirty cases were included in the final model.

Model Specification and Assumptions

The regression model was specified with posttest English score as the dependent variable and pretest English score as the independent variable. The purpose of the model was to determine whether the initial score could predict later performance and whether any systematic improvement occurred during the program.

The assumptions of linear regression were evaluated. The scatterplot indicated a linear association between the two variables. The distribution of residuals was examined through visual inspection and showed an approximately symmetric pattern without extreme skewness. Residuals plotted against fitted values displayed a relatively even spread, supporting the assumption of equal variance. The Durbin Watson statistic was close to 1.2, which is suitable for cross sectional data of this size.

Given the limited sample size, the analysis relied on a single predictor model. More complex models were not pursued because additional predictors were not available at the individual level. The simple regression model provided a clear and interpretable test of the relationship between pretest and posttest English performance.

Regression Results

The regression analysis revealed that the pretest English score was a strong and statistically significant predictor of the posttest score. The resulting regression equation was: Posttest score equals 9.68 plus 0.81 times the pretest score.

The intercept of 9.68 represents the predicted posttest score for a hypothetical student with a pretest score of zero. Although no students in the sample approached such a value, the intercept is required for the model. The coefficient of 0.81 indicates a strong positive relationship between starting proficiency and later performance. For every additional point in the pretest score, the posttest score increased by slightly more than zero point eight points.

The coefficient was statistically significant, with a t value of about 7.51 and a probability value less than point zero zero one. This confirms that the relationship did not occur by chance. Students who began the program with higher proficiency generally maintained their advantage throughout the ten-week period.

The coefficient of determination, R squared, was approximately 0.67. This indicates that 67% of the variance in posttest scores could be explained by pretest scores. The associated F statistic was 56.37 with a probability below point zero zero one, demonstrating that the model was a strong overall predictor of posttest outcomes.

To further examine the effect of the PAL program, a second regression model was constructed using gain scores. Gain was calculated as posttest minus pretest for each student. The average gain score was slightly below zero, at approximately minus zero point eight, showing a minimal overall decline in English proficiency during the program.

In the gain model, the regression coefficient for pretest score was negative, about minus zero point nineteen, meaning that students with higher initial proficiency tended to experience slightly larger decreases. However, this relationship was not statistically significant. The probability value was approximately point zero nine, which is above the common significance threshold of point zero five. The R squared value for this model was 0.10, indicating that pretest scores explained only ten percent of the variance in gain scores.

The results demonstrate that the PAL program did not produce uniform improvement in English proficiency. Gains varied from student to student, but there was no consistent pattern associated with initial proficiency.

Interpretation of Findings

The regression analysis supports the conclusion that the PAL program did not lead to measurable gains in formal English proficiency over the ten-week period. The strong association between pretest and posttest scores indicates that most differences in performance were already present at the beginning of the program. The slight decrease in the average test

score and the limited explanatory power of the gain score model further reinforce this conclusion.

These findings align with the design and goals of the PAL sessions. The program emphasized collaborative projects, intercultural dialogue, and constructive peer support rather than explicit English language instruction. As a result, the environment was well suited to developing IC, communication confidence, and team-based problem solving, but less likely to produce significant improvements in standardized test performance.

The questionnaire data indicated overwhelmingly positive student perceptions of the program. Participants reported greater comfort in cross cultural communication, increased motivation to engage in collaborative tasks, and strong satisfaction with the support provided by international peer mentors. These self-reported outcomes suggest that the program contributed meaningfully to students' academic and personal development despite stable English test scores.

The results also align with research on language learning, which shows that significant gains typically require extended and focused instruction. Programs centered on intercultural development more often produce benefits in confidence, fluency, and communicative willingness rather than improvements on formal language assessments. The PAL program therefore appears to have supported the development of interpersonal and intercultural skills essential for success in diverse academic environments.

Summary

The regression analysis showed that initial English proficiency was a strong and reliable predictor of later performance among Thai digital media and technology students in the PAL program. The program did not generate significant collective gains in formal English proficiency, and individual gain scores varied without a consistent relationship to starting ability.

These results should be interpreted in light of the program's emphasis on intercultural learning rather than language instruction. Students benefited in ways not captured by standardized tests, including increased confidence, heightened intercultural awareness, and stronger engagement in collaborative learning. Future research should collect individual-level questionnaire data, directly measure intercultural competence, and extend program duration to examine longer-term effects. Overall, English proficiency remained stable, while the PAL program produced meaningful developmental outcomes aligned with its intercultural and collaborative objectives.

Discussion

Interpretation of Key Findings in Relation to Research Questions

The purpose of this study was to examine how PAL sessions involving international peer mentors contributed to the intercultural, personal, and academic development of Thai students majoring in digital media and technology. The results demonstrate that the PAL program functioned as a meaningful site for cultural learning, interpersonal growth, and collaborative engagement even though it did not produce measurable gains in English test performance. The following discussion interprets the findings in direct relation to each of the four research questions.

RQ1: How do PAL sessions facilitate cultural exchange between Thai students and their international peer-mentors?

The findings show that cultural exchange occurred primarily through sustained interaction, shared problem solving, and informal conversation. Students reported that working closely with Burmese mentors allowed them to learn about different cultural practices, perspectives on academic tasks, and communication styles. Because the program encouraged small group collaboration, Thai students engaged in frequent dialogue in a supportive environment, which made intercultural communication feel natural rather than forced. This aligns with the theoretical view that intercultural learning is most effective when it is embedded in authentic, task-based interaction rather than through explicit instruction. The regular contact that took place over the ten-week period played an important role in building trust, reducing social distance, and allowing cultural insights to emerge gradually. The findings therefore affirm that PAL can serve as a practical form of IaH by creating structured opportunities for everyday intercultural exchange within the university setting.

RQ2: In what ways do PAL sessions influence Thai students' cultural awareness, sensitivity, and intercultural competence?

Students' questionnaire responses and interview reflections indicate that participation in the program enhanced their cultural awareness and intercultural sensitivity. Many students described gaining a clearer understanding of how cultural background shapes communication preferences, expectations during group work, and approaches to academic problem solving. Exposure to international mentors encouraged openness to diverse viewpoints and helped students challenge assumptions about other cultures. Students also reported improved confidence when interacting with individuals from different cultural backgrounds, a key indicator of IC. Although measurable changes in English proficiency were limited, the program clearly supported the affective and behavioral components of IC highlighted in Byram's model. The findings reinforce the argument that intercultural growth does not require international mobility but can be fostered effectively through structured campus-based engagement with culturally diverse peers.

RQ3: What personal development outcomes do Thai students experience as a result of participating in intercultural PAL sessions?

Students experienced several personal development gains that extended beyond intercultural learning. They reported increased communication confidence, greater willingness to participate in collaborative discussions, and improved comfort in expressing ideas in both informal and academic settings. The PAL environment also strengthened motivation and provided an encouraging space where students felt supported by both peers and mentors. Many students described a sense of belonging that grew as they worked with international mentors who were approachable, patient, and willing to share their experiences. In addition, students developed stronger problem-solving skills through project-based tasks that required negotiation of ideas and shared responsibility. These outcomes demonstrate that PAL can positively influence personal growth even when academic test scores remain unchanged. The findings align with sociocultural perspectives that view learning as a process that unfolds through participation in a community where knowledge and confidence are co constructed through interaction.

RQ4: How satisfied are Thai students with the cultural exchange opportunities in PAL sessions, and what improvements do they recommend?

Overall satisfaction with the PAL sessions was very high. Students reported that the sessions were enjoyable, motivating, and helpful for understanding course material. They valued the supportive relationships formed with international mentors and appreciated the opportunity to learn from individuals who brought different cultural backgrounds into the learning space. Although students were satisfied with the cultural exchange opportunities, several recommendations emerged. Some students suggested increasing the number of sessions or extending the program duration to allow for deeper cultural engagement. Others requested more structured cultural sharing activities alongside the academic tasks. These suggestions indicate that students recognize the potential of the program and desire even richer intercultural interaction in future iterations.

Practical Implications of the Findings

The findings of this study offer several practical implications for educators, administrators, and program designers. First, the results demonstrate that PAL can be used as a low cost and scalable strategy for promoting intercultural learning in disciplines such as digital media and technology where international collaboration is increasingly important. Institutions can incorporate cultural awareness activities into existing PAL structures without placing additional burden on teaching staff. Second, the strong student satisfaction suggests that international peer mentors can play a valuable role in building inclusive learning environments and reducing social barriers between groups. Third, the lack of measurable English proficiency gains indicates that programs seeking language improvement should incorporate focused language support instead of relying on intercultural interaction alone. Finally, mentor training programs should include guidance on facilitating intercultural conversation and addressing cultural misunderstandings so that mentors feel prepared to support both academic and cultural aspects of the learning process.

Scholarly Contributions of the Present Study

This study contributes to the growing body of research on IaH by providing empirical evidence from a Thai university context where intercultural interaction between local and international students is often limited. It expands understanding of how PAL can function not only as academic support but also as a site for IC development. The findings offer insight into how Thai students interpret and experience intercultural communication when guided by international mentors from neighboring countries. The study also adds to the scholarship on intercultural learning in technology related fields, an area where cultural diversity is becoming increasingly relevant due to the global nature of digital markets and collaborative work in the technology sector.

Limitations and Implications for Further Investigation

Several limitations should be acknowledged. The sample size was relatively small, which limits the ability to generalize the findings to all Thai university students. The study relied on self-reported questionnaire data, which may be influenced by social desirability bias or limited self-awareness about intercultural growth. The program lasted ten weeks, which may not have been long enough to capture deeper or more sustained changes in IC or language development.

Furthermore, the absence of individual level questionnaire data prevented statistical analysis that could link specific aspects of the program to specific learning outcomes.

Future studies should consider larger and more diverse samples, longer program durations, and mixed methods approaches that include observational data or performance-based assessments of IC. Longitudinal research would also be valuable for determining whether the intercultural gains observed in this study persist over time and whether they translate into improved academic or professional performance in multicultural settings.

Conclusion

This study offers important insights into how PAL can advance intercultural learning and personal development among Thai students in a digital media and technology program. The findings show that sustained engagement with international peer mentors created a supportive environment where cultural exchange occurred through collaborative tasks, shared problem solving, and informal dialogue. Students demonstrated increased awareness of cultural perspectives, greater openness to diversity, and enhanced confidence when communicating across cultural boundaries. These outcomes reflect key dimensions of IC identified in established theoretical models and illustrate the potential of campus-based interaction to function as an effective form of IaH. Although the program did not produce measurable gains in English proficiency, this result aligns with the central purpose of the PAL sessions, which emphasized interpersonal communication, shared learning, and intercultural engagement rather than intensive language instruction. The stability of the English test scores therefore underscores the distinction between linguistic development and intercultural growth and suggests that meaningful cultural learning can occur without significant changes in formal language performance.

Strong levels of student satisfaction further confirm the value of the PAL environment, as participants consistently described the sessions as academically supportive and personally enriching. Students highlighted the importance of relationships formed with international mentors and expressed interest in extending the duration and depth of intercultural activities. For institutions, these findings demonstrate that PAL can function as a scalable and sustainable strategy for promoting IC within existing academic structures, enabling universities to broaden the reach of IaH by embedding cultural learning into routine academic experiences. Future research should involve longer program durations, incorporate direct assessments of IC, and examine the experiences of both local students and international mentors. Longitudinal studies would also provide valuable evidence regarding the lasting impact of PAL on students' readiness for participation in multicultural professional environments.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that ChatGPT was utilized solely for proofreading and language refinement, and that no AI technologies were used to generate, analyze, or interpret the research content, data, or conclusions.

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Nonprofits and Innovation in Education Using Technology

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The Asian Conference on Education 2025
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Abstract

Rapid technological advancement is reshaping the global labor market, with digital skills becoming a prerequisite for the majority of future jobs. While automation is expected to transform nearly half of all occupations, its benefits are unevenly distributed, risking a deepening of existing educational and socio-economic inequalities. This paper examines the role of non-governmental organizations (NGOs) in mitigating digital inequality through technology-enabled education, particularly for underserved and vulnerable communities. Drawing on global datasets, academic literature, and two case studies from Team4Tech's NGO partnerships in India and Vietnam, the paper argues that access to technology alone is insufficient to improve learning outcomes. Instead, evidence suggests that technology integrated with teacher professional development and community contextualization produces meaningful and scalable impact. The paper concludes with policy recommendations for integrating proven NGO-led EdTech models into national education frameworks and calls for longitudinal research to support evidence-based decision-making.

Keywords: digital inequality, EdTech, NGOs, teacher training, SDG 4, learning loss, education policy

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Introduction

The future of work is increasingly shaped by automation, artificial intelligence, and digital transformation. According to the World *Economic Forum's Future of Jobs Report (2020),* approximately 50% of jobs are expected to undergo significant transformation due to automation, while only 5% are likely to be completely eliminated. Notably, nearly 90% of jobs will require some form of digital competency. While these shifts present new opportunities, they also pose serious risks for populations lacking access to quality education and digital skills.

Without proactive intervention, technological advancement is likely to exacerbate existing inequalities, disproportionately affecting young people, low-skilled workers, and marginalised communities. This paper explores how NGOs, operating at the intersection of education, technology, and community engagement, play a critical role in addressing these disparities. By analyzing global data and real-world NGO interventions, the paper seeks to contribute to academic discourse on scalable and equitable EdTech solutions.

Digital Transformation and Educational Inequality

- **Automation, Skills, and Workforce Disruption**

The World Economic Forum highlights that while job displacement due to automation is limited, job transformation is widespread. This shift necessitates large-scale reskilling and upskilling, particularly for vulnerable populations who are least equipped to adapt. Without targeted interventions, the digital divide threatens to translate directly into labor market exclusion.

- **Learning Loss and the Impact of COVID-19**

Educational inequality has been further intensified by the COVID-19 pandemic. Global estimates from the World Economic Forum report on impact of Covid-19 affected learning (2022) indicate a 10% increase in learning poverty, defined as a child's inability to read and comprehend age-appropriate text by the age of 10. School closures disproportionately affected students from low-income households, where access to digital devices, stable internet, and trained educators was limited.

The Digital Divide: Access Versus Capability

- **Global Connectivity Gaps**

Data from the International Monetary Fund (2020) and the International Telecommunication Union (2021) reveal stark disparities in internet access. While high-income regions such as North America and parts of Europe show near-universal connectivity, large portions of Africa and South Asia remain significantly underserved. These gaps limit the effectiveness of digital education initiatives if not explicitly addressed.

- **Demographic Inequalities in India**

Research on historical inequalities in India published by the *London School of Economics (2023)* demonstrates that digital access varies sharply across gender and social identity.

Scheduled Castes and women experience lower levels of smartphone penetration and significantly reduced usage of financial and educational applications. These trends highlight that device ownership alone does not equate to meaningful digital participation and underscore the importance of digital and financial literacy.

Beyond Access: The Importance of Pedagogy and Teacher Capacity

Multiple studies emphasize that technology access alone does not produce improved learning outcomes. A literature review by the Stanford Center for Opportunity Policy in Education concludes that successful digital learning environments are characterized by a balanced integration of technology and skilled educators. Technology-assisted learning initiatives that include teacher training demonstrate substantially higher effectiveness than those focused solely on infrastructure.

This finding has significant implications for education systems in low-resource contexts, where teacher preparedness often lags behind technological deployment.

The Role of NGOs in Education Systems

According to the *UNESCO Youth report 2022: Non-state actors in education: who chooses? who loses? Non-State Actors in Education*, approximately 350 million learners worldwide, would become the sole responsibility of governments if non-state actors ceased operations. NGOs contribute uniquely to education systems by offering contextual expertise, community trust, and operational flexibility.

According to the SDG Coordination Center, NGOs are aligned with Sustainable Development Goal 4 (Quality Education) as facilitators by:

- Implementing targeted, community-specific interventions
- Providing infrastructure and human resources
- Generating citizen-oriented data
- Supporting accountability and transparency
- Accelerating progress toward SDG targets

Their proximity to communities allows NGOs to design solutions that are both inclusive and adaptable, making them valuable partners for public education systems.

Team4Tech's NGO Impact Accelerator Model

Team4Tech operates as a nonprofit impact accelerator that leverages skilled volunteers and technology to support NGOs through a structured four-pronged approach which includes: Funding for NGOs, skilled volunteering projects, a global online community of practice and curated regional hubs. Technology functions as a lever rather than an end in itself, with impact measured across defined educational and organizational parameters.

Case Study 1: Kidspire, Vietnam

Kidspire works with orphaned youth in Vietnam and has enabled approximately one-third of its beneficiaries to pursue higher education. Through mentorship from Team4Tech volunteers, students developed a mobile application for book sharing. The project was selected as one of

twelve global finalists from over 1,700 teams in the 2021 Global Technovation Challenge for Girls, demonstrating both technical competence and applied learning outcomes.

Case Study 2: Ek Tara, India

In India, Team4Tech supported Ek Tara through the development of a learning management and monitoring system (Goonjan) for approximately 1,200 students. Over a three-month period, volunteers designed a user-friendly data platform and trained teachers in digital classroom tools, including Google Classroom. Within one year, Ek Tara reported a 35% improvement in learning outcomes, illustrating the effectiveness of teacher-centered EdTech interventions.

Policy Implications

The findings from global data and NGO-led interventions suggest several policy priorities:

1. **Scalability and Sustainability:** Governments should formally integrate proven NGO-developed EdTech models into national education frameworks.
2. **Teacher Professional Development:** Dedicated funding must be allocated to training educators to effectively leverage technology as a pedagogical tool.
3. **Evidence-Based Policy:** Longitudinal and comparative studies on NGO-led EdTech interventions are essential to guide large-scale investments.
4. **Public-Nonprofit Collaboration:** Strong partnerships between governments and NGOs can accelerate progress toward equitable education systems.

Conclusion

Digital transformation presents both opportunity and risk for global education systems. Without intentional design, technology can deepen inequality rather than reduce it. This paper demonstrates that NGOs play a critical role in bridging the gap between access and impact by integrating technology with pedagogy, teacher training, and contextual understanding. Embedding these proven models into public policy frameworks is essential for building inclusive, future-ready education systems aligned with global development goals.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, a Generative AI tool, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical, spelling and structural errors to enhance readability.

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Transforming the Landscape: How Project-Based Learning is Evolving Material Science Education

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Abstract

Integration of industry-linked initiatives with project-based learning (PBL) in material science education promises to transform the way students become engaged and attained mastery of the academic contents. The involvement of industry partners, an element of this educational model, is crucial for simulating the professional scenarios in addressing real-world challenges. Students acquire invaluable insights and experiences that help bridge the gap between academia and industry. Mentorships rendered by the industry experts not only provide different perspectives that are aligned with current industry standards, but also ensure projects are theoretically sound and practically relevant. In the process, students are equipped with the essential skills to meet the demands of the material science industry for a seamless career transition. Our research highlights the benefits of PBL in facilitating the learning process and outcomes. PBL fosters a shift towards formative, skills-based assessment methods with an emphasis to promote continuous feedback and personal growth throughout the project delivery. This hands-on approach supports students' development to become life-long learners who possess higher-order cognition and 21st-century skills, including critical thinking, creativity, problem-solving, teamwork and communication. A study, involving five different projects in small groups of four, demonstrates improvements in cognitive and psychomotor abilities while the affective domain remains stable. Through PBL, students gain a profound understanding of material science principles and extend their technical skillsets. The study aims to uncover optimal strategies and best practices to develop dynamic learners with enhanced intellectual engagement, as well as promote inclusive, collaborative, and progressive educational practices that reflect industry standards.

Keywords: industry-linked, project-based learning, cognitive, psychomotor, affective skills

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Introduction

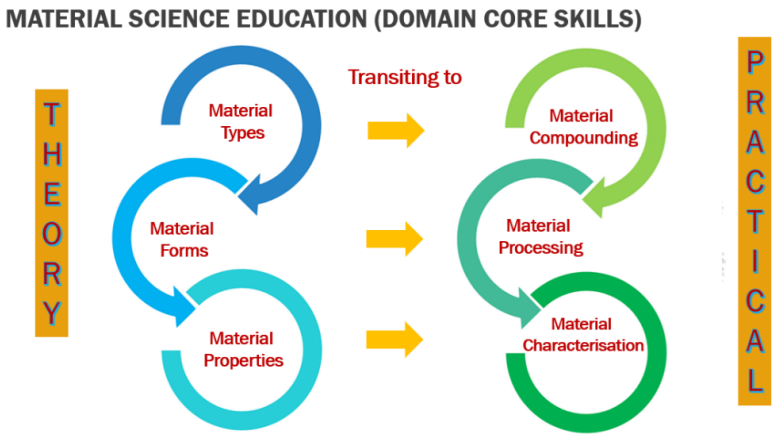
The current research highlights the inaugural implementation of industry-linked projects within the Diploma of Applied Chemistry (DAPC), marking a significant milestone in Material Science education at Singapore Polytechnic (SP). By addressing the following two central questions, this study aims to uncover the transformative potential of industry-linked PBL in reshaping the educational landscape. As the pilot initiative in material science education at the institution, it sets the stage for future iterations and refinements, paving the way for more engaging, dynamic and impactful learning experiences.

1. How does the integration of industry collaboration within project-based learning transform the development of core skills and knowledge in material science education?
2. What impact does industry-driven project design within project-based learning have on student learning outcomes in material science education?

The training model (see Figure 1) is built upon a seamless integration of theoretical knowledge and practical application, cultivating a hands-on learning environment that encourages both intellectual curiosity and real-world readiness. Firstly, conceptual learning is introduced to students across a variety of materials, including but not limited to, polymers, ceramics, metals, and composites as well as their corresponding atomic structures and the fundamental principles that govern their behaviour. This understanding is further reinforced through a diverse range of instructional methods, including rigorous laboratory experiments that critically investigate how various material types and forms can directly affect their properties and performance. The hands-on experiences consolidate the development of students' analytical thinking and technical proficiency in material compounding, processing, and characterisation under varying conditions. By translating this knowledge into a prototype, the journey begins with careful material selection for compounding to meet the project brief, followed by prescribing processing techniques that unlock specific characteristics suited to the intended applications. These processing techniques not only transform raw materials into usable forms but also allow for precise tuning of material attributes. The properties of materials are subsequently characterised using appropriate instrumentation and testing methods to assess key features such as mechanical strength and thermal stability. As a result, a comprehensive understanding of the intrinsic nature of materials and interactions of processing methods and conditions are essential for material science students, empowering them to optimise material performance for a wide range of applications.

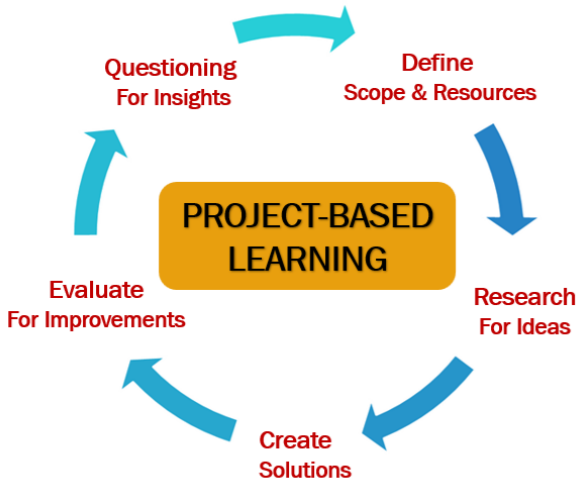
Figure 1

The Material Science Education Model



A hallmark of this initiative is its strong emphasis on PBL, which connects theoretical concepts with authentic real-world challenges faced by the industry. Students engage in optimising material performance through material compounding, processing, and characterisation. Beyond the dynamic and multidimensional integration of theory and practice, students emerge with critical thinking, problem-solving, teamwork, communication, and project management skills within a simulated professional environment, in addition to technical expertise. This development is nurtured throughout the five phases of the PBL iterative workflow, as shown in Figure 2. The process will be elaborated on in greater detail in the Methodology section.

Figure 2
The Five Phases of PBL



Literature Review

Industry-integrated PBL has emerged as both a pedagogical and practical evolution, driven by the demands of today's workforce, which are characterised by rapid technological change, global competition and evolving skill requirements for innovation. This meaningful progression aims to develop the cognitive, collaborative, and adaptive competencies that graduates need to thrive amidst the demands of the 21st century. As a result, there is an impending need for pedagogical models that more effectively align academic learning with employability (Naseer et al., 2025; Pan et al., 2023).

Traditional PBL is rooted in John Dewey's experiential learning philosophy and William Heard Kilpatrick's project method (Dewey, 1938; Kilpatrick, 1918). Empirical research on this inquiry-driven pedagogy consistently demonstrates benefits such as enhanced academic performance, positive affective attitudes, collaborative problem-solving abilities, and higher-order thinking skills (Almulla, 2020; Biazus, et al., 2022; Condliffe et al., 2017; Zhang et al., 2023). Nonetheless, traditional PBL has notable limitations. Recent reviews of higher education highlight that school or simulated scenarios are often overly simplified, lacking the unpredictability and complexity found in authentic professional environments. Ongoing challenges such as academia's readiness, the implementation of appropriate assessment strategies and the need to balance guidance, are factors that require further deliberation. (Admiraal, 2020; Marinho et al., 2020; Zhang et al., 2023).

Consequently, industry stakeholders now play a pivotal role in addressing longstanding gaps in graduate readiness, including adaptability, cross-functional collaboration, and contextual

decision-making for real-world employment. By embedding industry ecosystems within the established PBL framework, students engage with open-ended, evolving projects that mirror the complexity of contemporary workplaces. Integrating external partnership requires negotiation with multiple stakeholders, management of evolving requirements, and navigation of incomplete data and contextual constraints (Admiraal, 2020; Naseer et al., 2025; Popli et al., 2024). Throughout this process, students' professional identities and capacities for adaptive expertise are deepened through mentoring, workplace familiarisation and iterative feedback from industry leaders.

Empirical studies (Marinho et al., 2020; Pan et al., 2023) have also reported that sustained partnerships benefit both academia and industry. Industry partners gain cost-effective access to innovative ideas, new opportunities, and potential solutions for challenges they may not have the internal bandwidth to address. Furthermore, key success elements include structured peer interaction and enhanced group awareness which support high-quality collaboration (Zhang et al., 2023). Academic supervisors contribute by ensuring deliverables meet both curricular standards and industry objectives. Naseer et al. (2025) also mentioned that such collaborations nurture industry-savvy, agile, and employable professionals, leading to improved self-reported employability competencies, engagement, and learning satisfaction.

Methodology

Twenty Year Two students from the Diploma of Applied Chemistry (Material Science specialisation) students (n = 20) were recruited for this study. These participants were divided into five project teams of four. Each project theme is curated and sponsored by industry partners who provided the overarching project direction and key requirements in response to current market needs. This collaboration enabled students to gain invaluable insights into authentic professional practices and industry expectations. This approach also equipped them with the requisite skills and confidence to excel in their future careers in the field of material science. Under the guidance of experienced educators and industry experts, the students were tasked with delineating specific project goals, developing innovative solutions, and managing their projects from inception to completion using PBL. In this highly collaborative environment, students were encouraged to leverage their unique strengths, thereby enhancing their collective problem-solving, decision-making, and investigative abilities. The diversity within each team simulated real-world professional settings, preparing students to navigate complex interpersonal dynamics and develop essential transferable skills.

As depicted in Table 1, the collaborative process begins with the Questioning phase, the industry partners present their pain points and challenges encountered in product development or material performance while academic stakeholders brainstorm innovative ideas to address these real-world issues. In the subsequent Define phase, clear project objectives are established, hypotheses and technical requirements are formulated, and resources are allocated with guidance from industry partners regarding their expectations, technical specifications, operational constraints, and any specialised materials provided. During the Research phase, students conduct comprehensive literature research into material compounding and properties, analysing the latest technological advancements and relevant case studies. Industry collaborators support this stage by providing proprietary data, access, and sharing best practices. In the Create phase, research findings are integrated into iterative product prototyping or solution development, accompanied by material characterisation and performance testing. The industry partners mentor by contributing practical perspectives to frame project directives as well as insightful feedback on project findings. Finally, the Evaluate

phase involves reflective improvement and consolidation of deliverables for industry collaborators, with the feasibility of the proposed solution validated to ensure alignment with business goals in material science. This integrated approach ensures that both academic inquiry and industry needs are addressed throughout every stage of the collaboration.

Table 1
The Role of Academia and Industry Partners in the PBL Model

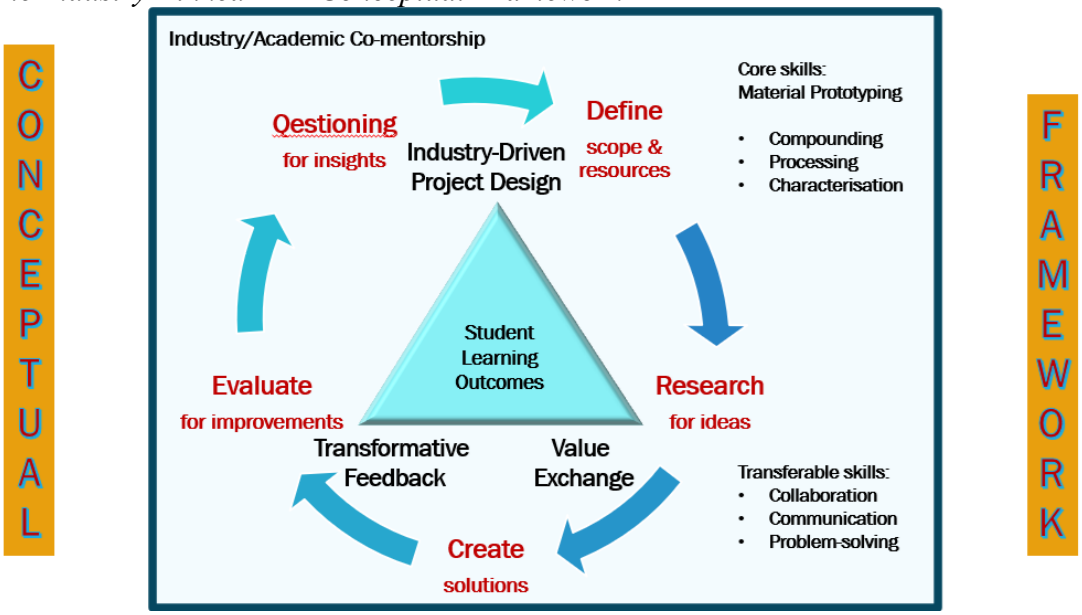
Phase	Academic Activities	Industry Engagement	Outcomes & Value Exchange
Questioning	Brainstorm for innovative ideas	Present industry pain points and challenges faced	Conceive insightful questions aligned with industry needs
Define	Define project objectives, hypotheses, technical material requirements and resources allocation	Set industry expectations and provide technical specifications, operational constraints and any specialised materials	Mutually establish project scope and measurable deliverables of currency and relevance
Research	Conduct literature research to meet project objectives	Provide proprietary data, access and best practices	Establish robust data and knowledge base, exposure to cutting-edge practices/ innovation in materials
Create	Integrate research findings into hands-on iterative product prototyping or solutioning	Mentor by contributing practical perspectives and insightful feedback on project findings	Develop prototypes or solutions collaboratively that are applicable to industry
Evaluate	Perform reflective improvements and consolidate deliverables to industry collaborators	Validate feasibility of proposed solution aligned with business goals	Foster knowledge exchange and advance innovation in materials

In order to assess students' learning, a structured questionnaire adapted from the Learning Self-Efficacy Scale (L-SES) for Clinical Skills (Kang et al., 2019), was administered. This instrument was designed to profile self-perceived learning and confidence in the cognitive, affective, and psychomotor domains, providing a multidimensional view of each student's educational development. Pre- and post-survey responses were collected at beginning and end of the semester using Microsoft forms. The self-assessment questionnaire is based on a five-point Likert scale. Participants indicate their perspective of each statement, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). This scaling provides a quantitative measure of student perceived self-efficacy in each domain. Qualitative results through interviews were also solicited around the PBL learning experiences and challenges encountered.

Results and Discussions

The integration of industry collaboration into PBL is crucial for bridging academic outcomes with real-world demands. A conceptual framework (see Figure 3) encapsulates three key pillars: industry-driven project design, value exchange and transformative feedback. The model is structured around clear milestones, measurable outcomes, and ongoing reflection. Students are empowered to track their progress, adapt their strategies, and demonstrate growth not only in technical skill but also in collaboration, problem-solving, and professional communication. The result is a holistic learning environment where students are committed to making meaningful contributions.

Figure 3
The Industry-Linked PBL Conceptual Framework



At its core lies the belief that this training will equip students with a rigorous academic foundation alongside the practical skills valued by employers. The first element, Industry-Driven Project Design, ensures the strategic partnership mirrors authentic workplace challenges. Through co-mentorship by industry professionals, students are exposed to a wide range of insights, methodologies, and real-world expectations (Lee et al., 2025; Pee, 2022; Srinivas, 2023).

The second element, Transformative Feedback, enables students to benefit from ongoing and contextualised feedback from their industry mentors, delivered through iterative sessions across the project timeline. This feedback enhances technical fluency feasibility, efficiency, and market relevance. The dynamic dialogue and critiques sharpen practical skills and nurture a mindset of innovation and resilience in students. They encourage iterative refinement, real-time adaptation and the development of essential skills in critical thinking and problem-solving.

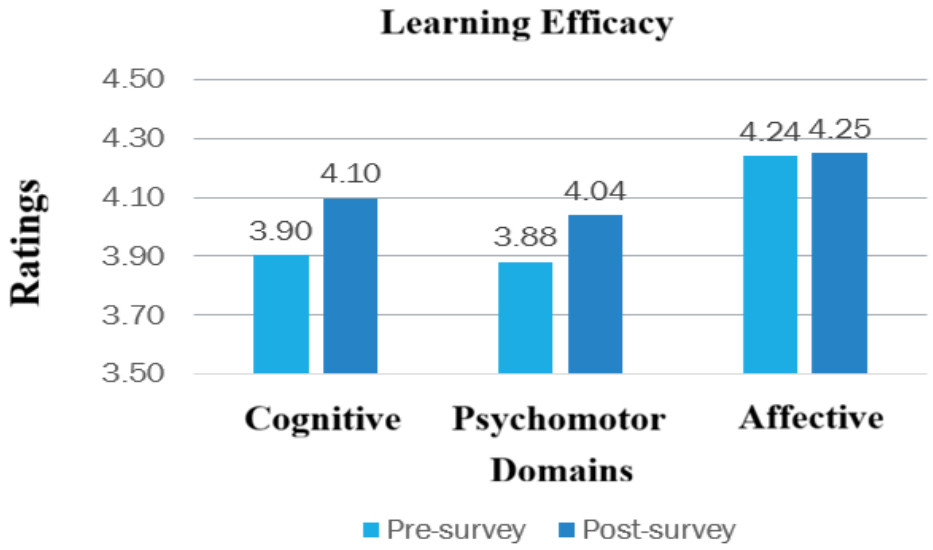
In the final element, Value-Exchange, purposeful alignment of academic and industry efforts through co-mentorship, feedback loops, and shared resources allows all stakeholders to participate in a vibrant ecosystem of continuous improvement and co-innovation. The exchange of knowledge, resources and innovation between academia and industry offers substantial benefits to both parties. Industry partners gain direct access to emerging talent and their fresh perspectives. This synergy allows companies to explore new ideas with reduced risk

and ensures that educational curricula remain aligned with industry needs (Marinho et al., 2020). Meanwhile, students receive hands-on experience, networking opportunities, and exposure to authentic industry practices and standards. They are empowered to tackle complex, real-world problems, think with agility, and transition smoothly into professional roles, while educational institutions reinforce their role as vital hubs of research and development.

Cumulative outcomes, and values that drive both educational and industrial advancement (Ahmed et al., 2024; Geetha et al., 2025; Pan et al., 2023) are presented throughout each industry-integrated PBL phase (see Table 1). In the Questioning phase, students cultivate the ability to pose insightful questions rooted in authentic industry needs, laying a foundation for relevance and impact. During the Define stage, stakeholders collaboratively establish strategic direction with a clear, shared understanding of project goals and measurable deliverables of currency and relevance. The Research phase deepens expertise by building a robust knowledge base and fostering exposure to the latest innovations in material science. In the Create stage, students and industry professionals work together to develop prototypes or solutions that have direct applicability, effectively bridging theory and practice. Finally, in the Evaluate phase, students deepen their understanding through applied feedback while industry gains access to emerging talents and novel solutions that can inform future practices in a cost-effective manner.

Figure 4

Changes in Students' Learning Efficacy Before and After Intervention



The self-reported L-SES average scores for the pre- and post-surveys are depicted in Figure 4. They offer valuable insights into the multifaceted nature of student learning and development within industry-integrated PBL context. The quantitative data reflect improvements in learning efficacy across cognitive, psychomotor, and affective domains (Vuoriainen et al., 2025; Zhang et al., 2023). The qualitative results further elaborate on these measurements (from 3.90 to 4.10) and identify areas for refinement in implementation. Within the cognitive domain, students demonstrated strengthened mental skills through both the recall and application of technical knowledge acquired in their coursework. Even though students felt some aspects of their learning are highly specialised, they managed to apply these skills for authentic challenges such as equipment failures or variations in materials. In addition, when procedural uncertainty arose, students were challenged to go beyond standard textbook approaches. They were motivated to conduct independent research, troubleshoot and make adaptive modifications to

workflows and processing parameters, combining both research and experimentation. Based on their problem-solving skills and ability to reason logically in devising solutions, students could operate advanced instruments and made real-time adjustments to the processing parameters as necessary. Instead of relying exclusively on published data, students critically established appropriate process parameters via material characterisation and implemented measures to prevent equipment malfunctions. During regular communication sessions with project mentors, students demonstrated their ability to articulate technical concepts, requirements, project sequences and their interconnections clearly to the stakeholders. In the face of operational constraints, students were able to account for the underlying causes to external collaborators and make informed decisions regarding their strategies. These experiences reinforced their capacity to provide step-by-step explanations of each part of the project and its role within the overall process.

Students also showed improvement for the self-reported measurements (from 3.88 to 4.04) within the psychomotor domain. Their marked improvement in technical competency was evident through hands-on demonstrations and qualitative interviews. They were able to precisely execute the operational steps and action required for their technical assignments, as demonstrated when they confidently adjusted equipment such as extruders, TGA, DSC, and SEM during practical sessions. Many students reported completing these technical tasks smoothly and with increasing proficiency. Throughout the project, students proactively monitored their technical competency and continuously looking for ways to improve. For instance, when challenges arose, they adapted by exploring different approaches to project tasks such as modifying extruder operational parameters or SEM settings to address unexpected results. This adaptability highlights their willingness to experiment and integrate new methods in pursuit of better outcomes. Moreover, students made a conscious effort to monitor their understanding of course contents and technical skills. They regularly assessed their own progress and made necessary adjustments, ensuring alignment between theory and practice in a PBL context. Although occasional obstacles such as complex tasks or equipment limitations resulted in fluctuations in self-efficacy, students experienced notable growth in innovation and self-regulation.

In the affective domain, students' attitudes, values, emotions and motivation towards learning remained generally consistent (from 4.24 to 4.25) throughout the project. Nevertheless, the qualitative analysis showed that most students reported feeling more engaged, committed, and confident when faced with real-world challenges. Their motivation notably increased as project goals became clearer and as they observed tangible outcomes from their efforts. However, a minority noted that information-seeking behaviours might falter under deadline pressure, unfamiliar tasks and resource constraints. This range of experiences emphasises the setting of realistic expectations and providing targeted support to sustain engagement. Students repeatedly stressed they value the receipt of technical guidance, prompt feedback and practical advice, especially regarding process optimisation or mastering new techniques, when dealing with uncertainty or stress. Therefore, the ongoing guidance from supervisors and team were instrumental in fostering a sense of purpose. These can come in the form of facilitating communication with stakeholders, clarifying deliverables, ensuring quick access to resources and collective team efforts in maintaining positive emotions were all vital for enhanced outcomes when refining project approach. Despite occasional setbacks, the majority of students appreciated the practical experience gained from industry-oriented tasks. The open-ended format of the projects promoted exploration and independent learning, expanded their learning horizons.

Recommendations

The shift toward industry-linked PBL has led to advancements in students' cognitive and psychomotor abilities. However, the pilot implementation revealed that many students initially faced uncertainty in meeting industry project expectations due to perceived gaps in their competencies and available resources. To address the challenges of balancing structured guidance with student autonomy, it is strongly recommended to enhance student preparedness. Specific gaps identified through post-project interviews prompted more targeted support in strengthening technical report writing and core material science competencies, particularly in processing techniques prior to project commencement.

To mitigate the considerable stress experienced by students, measures such as built-in buffers within project timelines should be implemented, allowing for more thoughtful consolidation and reporting of findings. Regular check-ins and open forums can further alleviate anxiety as students make conscious efforts to meet the expectations of academic and industry stakeholders.

Beyond technical proficiency, it is crucial to place greater emphasis on developing transferable skills that foster students' holistic growth. Cultivating self-directed learning, effective teamwork, and a collaborative culture grounded in inclusivity, mutual respect, and open-mindedness are vital attributes for real-world success. In this environment, supervisors play a pivotal role by reinforcing positive team dynamics, celebrating collective small wins, recognising individual contributions, and fostering a sense of belonging within diverse groups. By integrating these strategies, academia can empower students to thrive as adaptable, resourceful professionals in material science. Granting students greater autonomy in project selection can further enhance their motivation and instil a stronger sense of ownership over their learning experiences.

Conclusions

Through the purposeful integration of industry collaboration within PBL, material science education at Singapore Polytechnic has experienced a transformative evolution. Joint supervision by both industry collaborators and academic mentors enables projects to be co-designed in response to current, real-world issues, ensuring that learning is grounded in robust theoretical understanding while firmly situated within practical application. This intentional bridging of theory and practice ensures that graduates are well-prepared to contribute to the material science sector. Ongoing and transformative feedback provided by industry professionals further enriches students' learning journey, shifting them from passive recipients to proactive problem-solvers. Reflective practices embedded throughout these experiences promote continuous evaluation of students' cognitive, affective and psychomotor development, aligning their growth with the technical demands of the evolving industry landscape. As cohorts progress through their projects, clear advancements, particularly in communication skills, are observed. During professional interactions with industry stakeholders, students become more equipped at articulating project workflows, outcomes, and challenges with minimal assistance from their academic mentors. Beyond the notable gains in technical execution, logical sequencing, and confidence, this holistic approach further exposes students to external perspectives that emphasise market relevance and adaptability in real-world settings. As a result, it fosters resilience and cultivates a mindset of continuous improvement. The reciprocal exchange of value between academia and industry creates a vibrant learning ecosystem, empowering students to acquire hands-on technical proficiency and develop professional

networks while the industry partners benefit from fresh perspectives and cost effectiveness in project solutioning. This tripartite partnership ensures that PBL remains agile, relevant, and impactful in effectively bridging the gap between scientific theory and the practical development of material solutions, while instilling critical 21st-century transferable skills such as self-directed learning, problem-solving, collaboration, and communication. These industry-infused, hands-on experiences position students advantageously for the ever-evolving landscape of material science.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

Generative AI tools, including Perplexity, Copilot, and ChatGPT, were used to improve the manuscript's clarity and coherence, as well as for literature searches and reference identification. The authors remain solely responsible for all substantive content, critical analysis and interpretations.

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The Role of Identity-Based Curriculum in Social-Emotional Learning

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Abstract

Identity is defined as a set of experiences and beliefs that make-up a sense of personhood. Markers of identity, such as gender, race and class are socially constructed and intersectional. They are influenced by self-curation, aspirations and how others perceive us. This interplay between the cultural identity of the students and hegemonic structures provides a tension that can and will play a role in classroom culture (Krzesni, 2015). I have chosen to focus on the importance of an educational program that advocates for the exploration of identity within the K-12 life stage because it is essential for young people's heritage and histories to be valued and represented. While they are growing intellectually and emotionally, this form of validation provides innumerable benefits both academically and socially. Methodologically, I have created two social science modules, at the elementary, middle and high school levels, to demonstrate how these values can be put into practice. This paper will contribute to the growing study of identity-conscious education and how to cultivate a respectful community in an institutional setting. It will detail the facets of this curriculum and showcase how students (n = 45) engaged with the scholarship, produced work and applied a critical lens at their respective developmental stages. The responsive classroom appreciates the distinctions that cosmopolitanism provides and the study of the leaders within activist movements for racial and indigenous justice, gender equality and ability rights will allow for the intentional and deliberate study of issues of power negotiation and systemic issues.

Keywords: education, identity, social-emotional, curriculum, multiculturalism

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Introduction

Identity is defined as a set of experiences and beliefs that make-up a sense of personhood; it's influenced by self-curation, aspirations and how others perceive us. It is multi-faceted in nature and can exist in opposition to various forms of self. Examples of markers of identity are gender, race and class but they are all socially constructed and we all perform a multitude of these markers with our intersectionality. This integral intersection between the cultural identity of the students and hegemonic structures provides a tension that can and will most often play a role in the classroom culture as well (Krzesni, 2015).

I have chosen to focus on the importance of a curriculum that is conscious and advocates for the exploration of identity within the K-12 grades because it is essential for children's heritage and histories to be valued and represented. While they are growing intellectually and emotionally, this form of validation and respect provides innumerable benefits both intellectually and socially. Having grown up in the multicultural setting that is Toronto, Canada, I feel indebted to the educators and institutions that created a safe and respectful environment to perform all aspects of my Asian American identity. I strive to cultivate a similar social and emotional space in my institutional community.

Within our increasingly cosmopolitan world, it is essential to curate and implement identity-conscious curriculum that recognizes the importance of cultural diversity. The responsive classroom appreciates the distinctions that multiculturalism provides and the study of the leaders within activist movements for racial and indigenous justice, gender equality and ability rights will allow for the intentional and deliberate study of issues of power negotiation and systemic issues. The changemakers unit for second graders will engage with a developmentally appropriate curriculum that is grounded in children's literature and art to make meaning from the critical engagement. Similarly, with middle schoolers engaging with memoirs and high schoolers creating cultural maps, they are provided with the intellectual and affective avenues to explore their positionality and become civic-minded.

Project Summary

The project aims to explore the theoretical underpinnings of why identity-conscious curriculum is beneficial from early childhood to high school for both intellectual and social-emotional development. Educators and their pupils exist in relation to one another within the classroom setting. The difference in power can bring forth problematic dynamics if the culture is not guided with respect and consideration of this differential. Emotional intelligence and the ability to discern the motivations of people's choices is key to fostering a positive learning environment. Having interest in delving into the nuances of human nature allows an educator to build this sensitivity and interact with students in a more effective manner. Educators should be committed to fostering a child's intellectual development and emotional maturity:

> The prereflective or primitive form of the pedagogical relation is already found in various relations of everyday life: in the conversational relation, in the helping relation, and in every event where a certain influence toward formative growth is exercised by one person towards another.
>
> The pedagogical relation differs from these incidental formative relations in that the pedagogue is 'given' special responsibility for the young person. (Van Manen, 1994, 11)

There is a history of problematic curriculum and the harm that it can cause will support the need for this respectful and reflexive approach. Indigenous children are often in search of curriculum that respectfully honors and acknowledges their histories. Problematic discourses such as portraying native people as uncivilized and destructors of human development are forms of oppression for the populations who are instructed with these racist and limited perspectives. Their forms of history, such as oral narratives or art, are not always acknowledged within formal academic circles of the discipline and certain voices are given precedence over others (Krzesni, 2015). It is important to make the distinction between respectfully incorporating these histories and knowledge into curriculum through asset pedagogies compared to curating lessons to simply assimilate children of color into larger frameworks of normative discourses to civilize and discipline them (Paris, 2012).

I will outline a two-week elementary curriculum that begins with the concept of power differentials and how this dynamic can create both conflict and the potential for social transformation. The students will then study the lives and work of leaders who combated racial discrimination and fought for gender and disability rights. Then, I will suggest how these principles can be extended through the study of memoirs for middle schoolers and cultural mapping for high school-aged students.

Through the activism of racialized students bringing their lived realities of thriving and existing in predominantly white schools, administrators and educators alike have had to re-examine the curriculum and their approach to teaching. Having the courage to have difficult discussions and feeling the discomfort of confronting past wrongs can lay the foundation for a more inclusive institution. Exploring these concepts can be difficult for white teachers who need professional development to grapple with these issues and may want to avoid conflict within the learning and professional environment. In spite of these feelings of apprehension, a teacher should examine his or her own identity since this impacts their approach to class management and pedagogical style (Talusan, 2022). The lack of diversity in the field of education itself needs to be recognized and further examined. The fact that eighty percent of teachers identify as white women who are mostly from middle-class backgrounds, while 7 percent of educators are Black, 6 percent are Latinx and an even smaller percentage or Asian American or Indigenous people, has implications for what children internalize about who is teaching them and the systemic reasons why (National Center for Educational Statistics, 2016). Teachers of all identities need to grapple with and promote moving beyond deficit-based models but instead implement democratic and pluralist teaching approaches that integrate the multiculturalism that is now represented by the student population. This diversity in histories and skill sets within the classroom is an opportunity to go beyond marginalizing and viewing students of color as a liability (Paris, 2012).

Description of Setting and Population

The project is inspired by my time in a second grade classroom at The Pike School in Andover, Massachusetts that is a well-established independent school. Though the school is located in an affluent suburb, it attracts attendees from the greater Boston area and New Hampshire who are of varying financial standing. The lower school serves students from grades pre-K to 4 and then the upper school houses youth from grades 5 to 8. The student population is richly diverse. Within my second grade classroom, eight of the students are bi-racial or racialized and the school is committed to culturally diverse education that also focuses on social justice at a developmentally-appropriate age. There are monthly Diversity Equity Inclusion Justice professional development meetings for the faculty and staff to support the

implementation of this curriculum. The predominantly white faculty is a contrast to the increasingly racialized student population.

Project Statement

Why is it important to curate and implement an identity-conscious curriculum within the classroom at the elementary level?

A. Students will feel that their identities are recognized and valued within larger knowledge systems.
B. As children are refining their sense of self, they should be provided with a respectful and safe classroom culture in which to grow.
C. The instability of identity formation and performativity further reinforces the importance of being a reflexive educator who is agile and can cultivate a responsive classroom.

Having the opportunity to further refine their identity in a group setting is beneficial for all of the students because they are guided on how to conduct themselves in a reflexive but mindful way. By finding historical and cultural commonalities, a culture of open-minded engagement is fostered and encouraged (Krzesni, 2015).

Previous Literature

Theories and research-based approaches relating to culturally responsive curriculum support the benefits of adopting and implementing these strategies within the classroom. Further refined by Emily Style (1988) for the National SEED project, the concept of *mirrors and windows* helps students to build empathy through reflexive self-examination and recognizing other nuanced perspectives. By framing this reflexivity through mirrors and windows, it allows educators to thoughtfully select material for children to see a reflection of themselves and further develop their identity and also use the window to gain perspective on other realities that may be unfamiliar but provide important personal growth. Being cognizant of biases and lowering the defensive walls can provide the space for important forms of transformation as educators. Reflecting on past practices guarantees discomfort and but facing this ugliness allows for new pedagogical pathways and honors the process (Nelson & Wilson, 2010).

Epistemology is influenced by the social conditions and the relational identities of the theorists themselves. Therefore, pedagogy should be cognizant of these biases when creating curriculum. Problematic epistemologies can reinforce discriminatory forms of dominant power relations that create subordinate positioning (Fanon, 1952). To counter these hegemonic beliefs, anti-oppression curriculum is student-directed that allows them to practice creativity and encourage nuanced ways to critically assess current theories and practices. The lives of the students themselves are embedded in the process to allow for the building of rapport and confidence between instructor and learner (Orr, 2002).

There are several foundational aspects of the identity-conscious curriculum, but at its crux is how the curriculum recognizes the role of positionality and how identity creates different realities for individuals within the social realm. The reckoning as a racialized person is reinforced by societal norms that dictate one's access and positioning within the hierarchy. An individual's identity allows them to negotiate the systemic norms and their access and advantages can vary according to the context. But for racialized persons, the fluidity and

possibilities can be more limited and troubling (Steele, 2010). The order of things often demands that people perform to make gains but the process of code switching can be oppressive and dehumanizing in itself. As an educator, being aware of stereotypes when interacting with students is essential to creating an inclusive environment. By acknowledging these biases, the reflexive teacher can build authentic connections with the children to ensure that they feel seen and heard. This especially comes into play during the creation and implementation of assessments to gauge learning gains. Certain racialized groups have to negotiate a psychological barrier that can impact their performance. They are dealing with what Steele (2010) and his colleagues term *identity contingencies* where one's identity enables and demands them to negotiate their social condition.

Goals, Objectives, Implementation Steps, and Timeline

I. The goals of the Changemakers curriculum of students in the second grade include:
Objective Number 1: To curate a developmentally-appropriate two-week unit that focuses on the role of Changemakers in political transformation to combat systemic issues and work towards equity.
Objective Number 2: To put into practice the belief that identity-conscious curriculum is beneficial for the social-emotional development of children since representation and valuing the richness of a classroom's cultural composition enhances the intellectual and social outcomes for young people.
Objective Number 3: Education plays an important role in challenging problematic and dominant narratives that reinforce discriminatory and reductionist conceptualizations of society.

Literature provides the avenue for young people to be reflexive and cultivate their empathy by gaining insight into identity and life situations that may be both familiar or far from their own realities. Cultural identity is always in the midst of being formed and it's this instability that allows for hybridity and nuance. The performativity of identity means that the presentation of certain aspects may shift according to the context and the norms required for that time and place. Cultural mapping is a practice that allows children to reflect and pinpoint some of these relational aspects of their identity (Enciso, 1994).

I. The facets of a two-week unit on Changemakers for second graders
   A. The unit will incorporate read-alouds that will allow the young people to explore more abstract concepts such as power inequalities and discriminatory practices. The titles and brief summaries can be found here: https://docs.google.com/document/d/10kBxY9GJWhLqQHN2-CaOIBm7Dafd9v1PJCpgkSd-wXY/edit?tab=t.0
   B. Leaders in the activist movements throughout history that combat racism, gender equality and disability rights will be featured.
   C. We will recognize the power of naming and language and will therefore be inspired by the artwork of the *Guerilla Girls*. The students will think of an adjective that describes a Changemaker, create a piece of art, a portrait and conduct research to write a paragraph about how the leader enacted change.
   D. The unit will be mapped out in the curriculum development graphic organizer for the Understanding by Design model found here: https://drive.google.com/file/d/1GgJ8NzsbupWBUwp2xZPD39F43teY3ZDh/view

To build a collective sense of affinity, role models are an essential aspect of putting activism and social justice at the forefront of popular culture. Certain identities are provided with the privilege of not having to prove their social standing or worth. The ability to find one's place in the social world through the examination and study of one's identity allows them to make meaning about the global realm. This form of identity-conscious pedagogy enables students to have social-emotional health to thrive as individuals while pursuing their passions and interests (Krzesni, 2015).

Figure 1

The Children's Literature That Will Be Featured in the Changemakers Unit

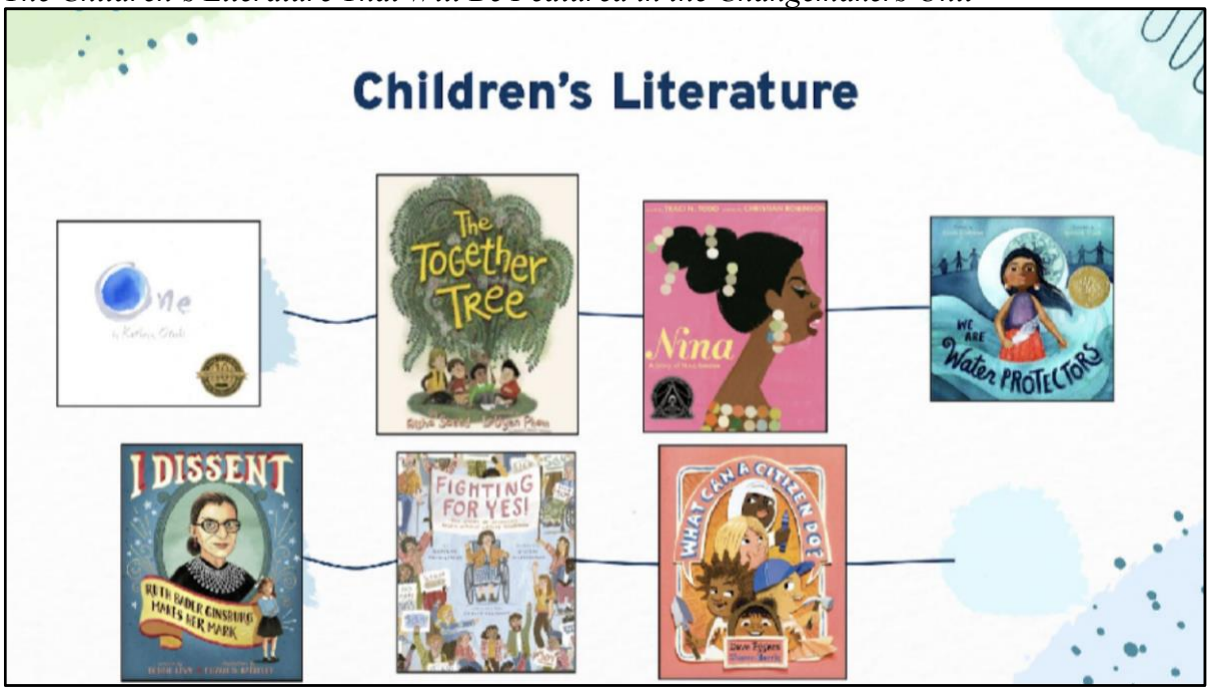
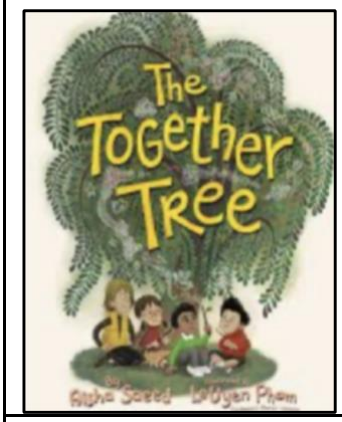
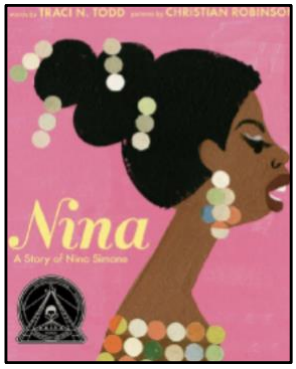
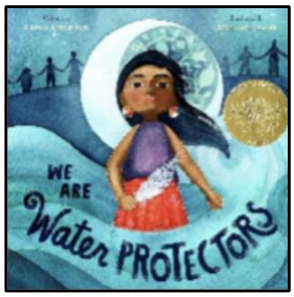
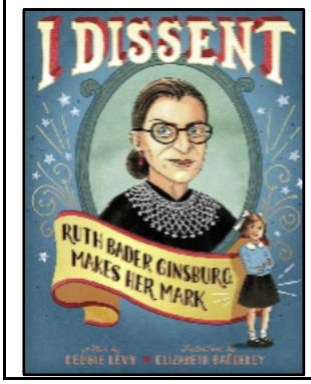
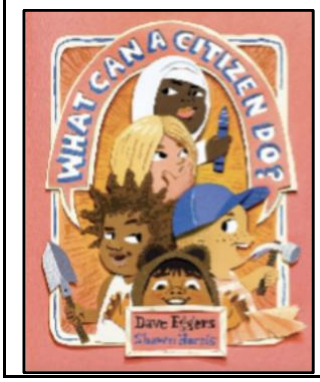


Table 1

Children's Literature for the Changemakers Unit

Title	Summary
	There is a power differential between the different characters within this book where they define their distinctions through their shapes and colors. The stakeholders are intimidated by the aggression of red but it only takes one player to change the dynamic and ask empathetic questions to work towards equity and inclusion in the end. Through their innovative way of being, they shifted what it means to count.

	Starting at a new school is made even harder for Rumi who is bullied for being reserved and different. His fellow student Han, takes a stand and suggests for the aggressor to be inclusive and compassionate. It is with Rumi's willingness to build friendships that under the shade of a willow tree, all the children gather to find shelter and to cultivate the joy of playing together.
	Nina Simone is a talented musician who has longed for a place to practice her gifts and to belong. She is resilient in the face of discrimination and does not let exclusion define who she can become. As her fame rises she is called to a larger cause of fighting for the rights of African Americans with the Civil Rights movement. Her music speaks of the struggles but also the gloriousness of knowing precisely who you are and what you deserve.
	Water is of central importance for many Indigenous cultures and held as a source of sacred power. It is from water that we emerge as infants and it allows us to thrive and survive during our time on earth. With development, environments are being tested and Native Americans are asking us to take care and be cautious about how we should be caring for nature at large.
	The importance of critical engagement with the world has always been the crux of Ruth Bader Ginsberg's life and character. She has been able to recognize when healthy debate and collaboration can bring about conditions that are fair and just for many of the stakeholders involved. Moving from polarization towards greater understanding is how she existed in the world and how she inspired such spirit in others.

	Judy Heumann has used the physical and systemic barriers in her life to drive her desire to work towards greater access and rights for those with disabilities. She commits herself to a politics of peaceful dissent to collaborate and work towards enacting section 504 of the law that would create a more inclusive society.
	The conceptualization of a citizen is vast and open according to the authors but the most important aspect is that individuals are engaged and willing to work towards a respectful pluralist society. The actions can take on a multitude of options as long as they are committed to critically engage with existing systems and redefine barriers.

Results and Outcomes

Eurocentric pedagogy can alienate students who feel excluded and underrepresented in the epistemology that is presented. By valuing and drawing on the culturally diverse classroom, the cultural capital of the identities who are part of the relational environment provides enrichment to both the educator and pupil alike. Accounting for the distinctions between the students is a linchpin of *culturally diverse pedagogy* and considers their perspectives and heritage. By fostering classroom practices that recognize and place this knowledge at the forefront empowers the students by providing representation of their rich cultural histories. Showcasing the work of role models from their affinity groups is one way to have a grounded and tangible way to study the social and political context of systemic issues. With the integration of the theories and experiential knowledge, the students will be compelled to critically engage with the political landscape (Parhar & Sensoy, 2011).

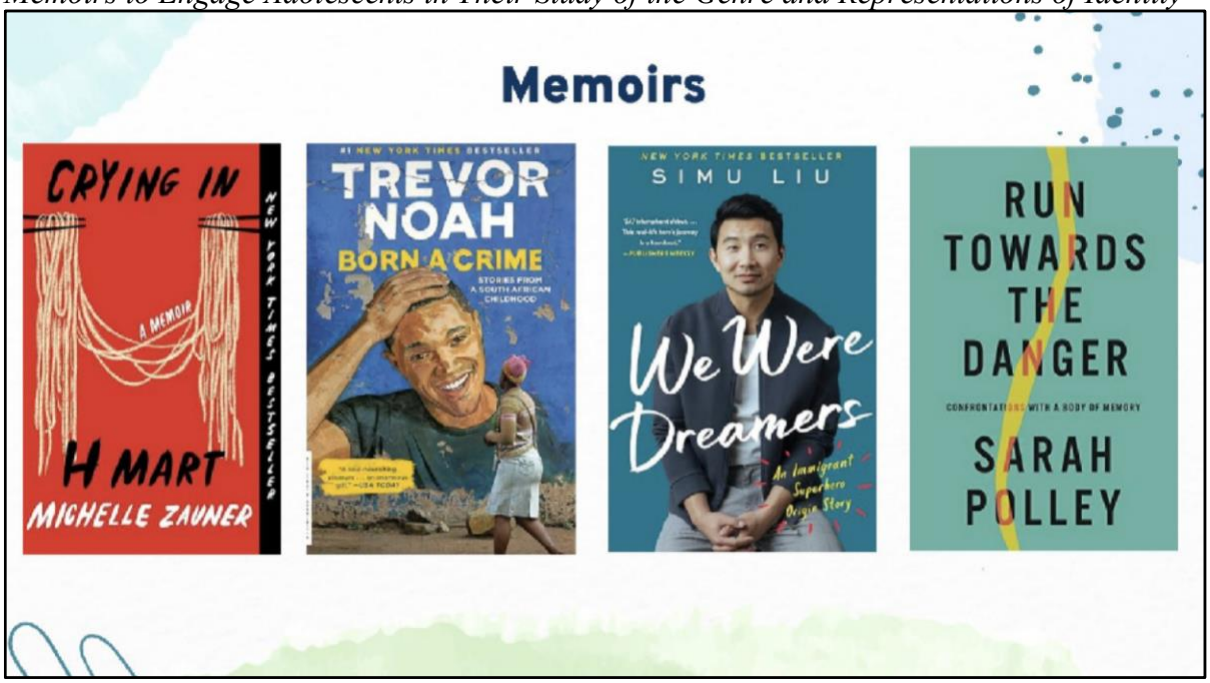
I. With the detailed outline for the curriculum, an educator, both in the independent and public school setting could implement the analysis, discussions, art project and research project with their second grade students to guide and support important issues of social justice and the collaborative strategies of Changemakers.
II. If educators do not have the same resources to purchase the books or materials, the titles can be borrowed from the library and adjustments can be made with regard to the art supplies that support the study of the leaders and systemic issues.
III. In a developmentally appropriate manner, the students would have continued their engagement with social studies issues that are culturally diverse and deeply considers the importance of these histories of social and political change.

Middle-School Curriculum

Memoirs are a genre that will compel adolescents to be inspired by the journeys of aspirational leaders who share their cultural affinity. From Trevor Noah's examination of growing up as a multi-racial child in South Africa where the history of apartheid reverberates in every aspect of life to Simu's Liu's meditation on navigating the expectations of an Asian-Canadian family, these talents provide tangible examples of struggle, resilience and self-acceptance. They are also at the center of their story and can shape their narrative without intervention from public opinion or social pressures.

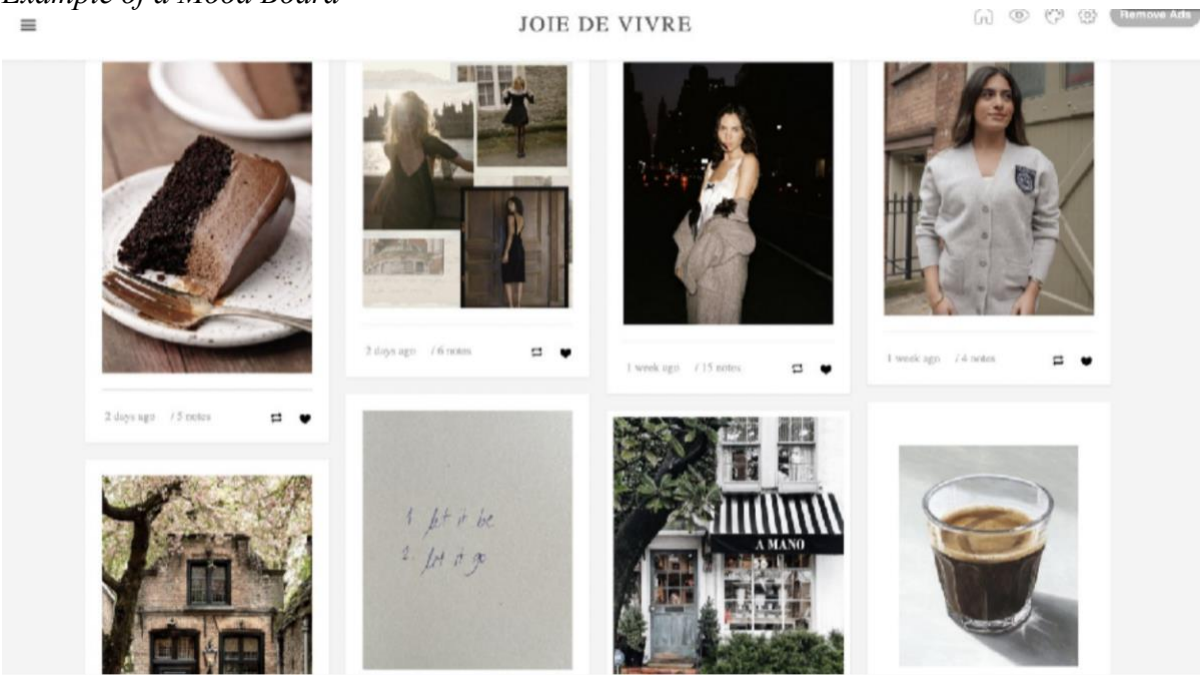
Figure 2

Memoirs to Engage Adolescents in Their Study of the Genre and Representations of Identity



After studying these texts, middle-schoolers can be encouraged to create their own visual mood boards to reflect on what influences their identity-formation and how these facets draw from family, educational community and the wider public. After this exercise, they can change the scale and write of one moment that they feel significantly impacted their sense of self. This will build the confidence to practice their voice, since they are the experts of their story, and they will practice the writing structure of providing context, citing evidence and then elaborating on why this moment was particularly impactful.

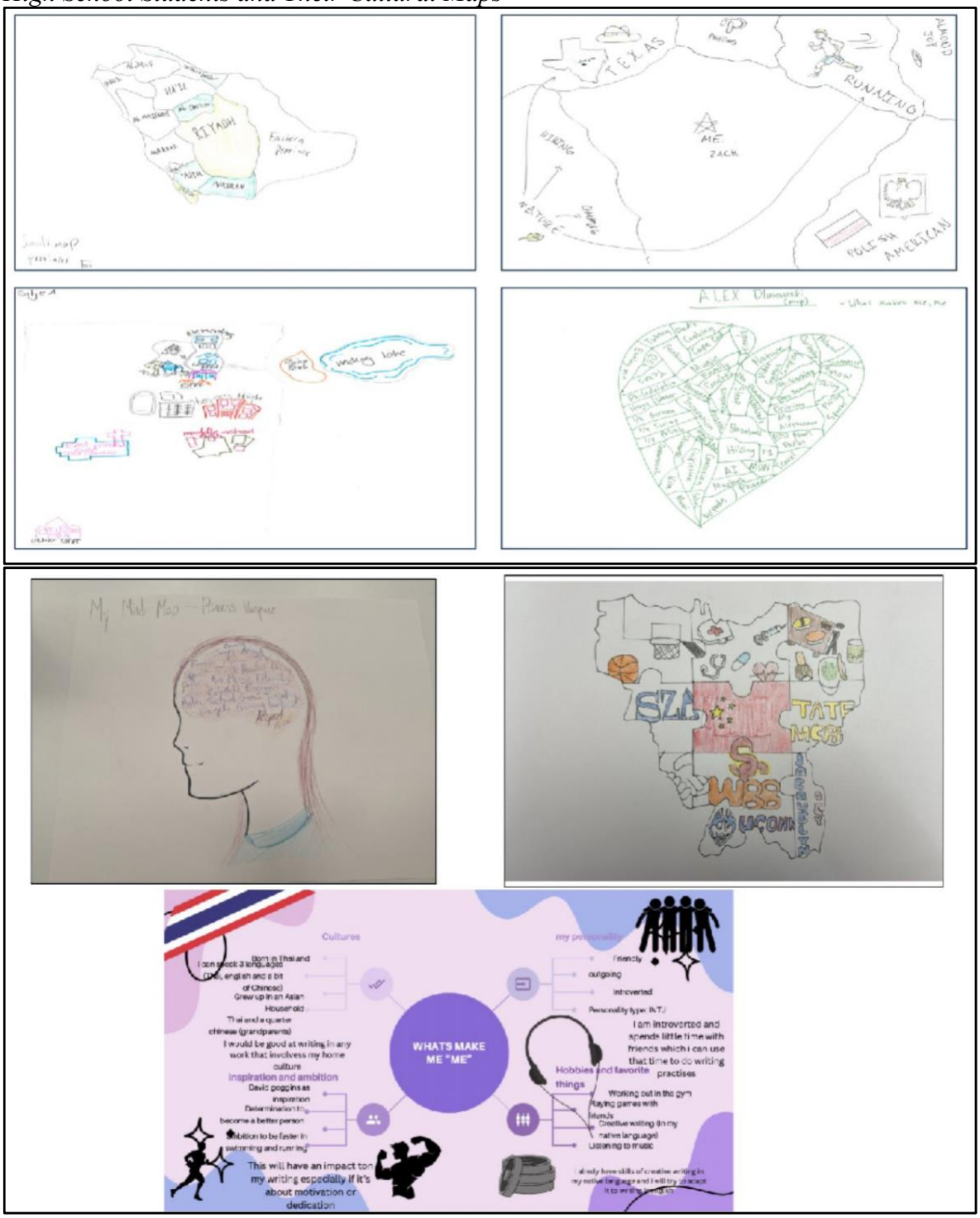
Figure 3
Example of a Mood Board



High School Curriculum

For older students in grades 9–12, they are ready to take on more abstract renderings of identity. Inspired by the work of Tim Cresswell (2011), students can create an identity map that demonstrates how places are given significance by the people who inhabit them. The cartography can range from the geopolitical, identity-based to cultural. The expansive scope of this project allows students to grapple with the challenge of working with a multitude of possibilities and rather than be daunted, instead be inspired. It can be challenging to feel that there is no concrete "right" answer and rather they need to revel in the discomfort that they are the agents of this meaning making.

Figure 4
High School Students and Their Cultural Maps



Conclusion

Upon re-examination and evaluation, the objectives of the curriculum and capstone project were successful according to the learning outcomes of the second grade class. Through representation, study and appreciation of cultural diversity and the leaders within the community, students will feel validation while further refining their sense of self. With the

examination of larger issues of power negotiation and the establishment of dominant narratives, the students can critically engage with the material and challenge existing inequalities.

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"Flipping" the L2 Classroom: Peer Teaching With Student-Generated Materials

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Abstract

This study examines learner perspectives of student-generated materials (SGMs) in the second language classroom. In this research project, students took on the role of the teacher in a "flipped" learning approach. 22 students were given an open-ended survey asking them about the positive and/or negative aspects of creating materials and leading discussions, and what they learned about themselves after the experience. On the positive side, results showed that student engagement with the learning materials had increased, student leaders were able to understand how to deeply research their chosen topic in the L2, peers developed stronger relationships, and students could recognize areas to improve in their own language skills through observing others' discussions. These successes led them to taking more responsibility for their learning and feeling more empowered. On the negative side, students reported that selecting topics and writing meaningful discussion questions was challenging due to the wide range of proficiency levels in the classroom. They also found it difficult to take notes and synthesize information from many groups. Overall, students found the experience beneficial to critically understanding their academic English level but also reported that they needed teacher guidance to help organize lessons and further build their skills.

Keywords: flipped learning, peer teaching, student-generated materials, authenticity

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Introduction

Second language acquisition (SLA) theories in the past focused heavily on grammar-translation and the writing of long vocabulary lists (Pangeran, 2025). This teaching approach, popular in the early to mid-1900s, was beneficial for improving reading comprehension skills but was largely ineffective in developing learners' communicative competence. The Direct Method, which emerged soon after, placed emphasis on oral communication in natural settings with linguistic accuracy. Communicative Language Teaching (CLT), still practiced today, is the most popular teaching method, focusing on functional communication and authentic tasks in a variety of familiar and unfamiliar settings (see Ellis, 2021 for a brief history). As the concept of learner autonomy became more widespread in second language learning (Holec, 1981), SLA began to shift from CLT to more learner-centred teaching approaches. Task-based language teaching (Nunan, 2004), project-based Learning (Markham, 2011), and flipped learning classrooms (Baker, 2000; Bergmann & Sams, 2012) are all examples of current teaching methods which aim to promote learner development and encourage deeper learning through active exploration of real-life content. This study describes a flipped classroom approach in a freshman English course using student-generated materials (SGMs) to help students improve their communicative competence. Three aims guided this research:

1. To help learners increase talk time during lessons by encouraging them to prepare for lessons in advance and actively participate in discussions.
2. To promote learner autonomy by encouraging learners to take on leadership roles and assess learning strengths and areas to improve through critical self-reflection.
3. To understand student perspectives of challenges faced in the flipped classroom and benefits to their learning.

This model of learning provided a more interactive and reflective learning environment within the language classroom. To understand exactly how the flipped approach works, it is necessary to first give an overview of the approach and review other key terms. This will be followed by an explanation of the course structure and learner perceptions of the new approach.

Overview of the Flipped Learning Approach

Characteristics of a Flipped Learning Classroom

For this study, the researcher followed Shibukawa's (2024) three central characteristics of flipped teaching. The first characteristic aimed to reduce lecture time by encouraging students to prepare for each lesson in advance so they could use the 90 minutes of lesson time more effectively to discuss the content deeply. Preparation typically involved reading newspaper articles or other authentic L1 sources or watching videos. Students were asked to write notes and summarize the content to show deep understanding of the learning materials and then formulate their own personal opinions about the topic. The second characteristic involved maintaining the primary/primary relationship of applying knowledge gained from preparation to the lesson to the lesson discussions. That is, as preparation was a direct prerequisite to the following lesson's plan, if the student did not prepare for class, they would not be able to participate fully in the discussions. For the third characteristic, the preparation and lessons must be inseparable and aligned. Therefore, structural elements were included in lesson preparation such as vocabulary acquisition, note-taking to answer comprehension questions during class, and providing questions that facilitated deeper thinking. Assessment was conducted based on in-class activities and feedback given as a class as well as individually. In this way, while

preparing for class, students could envision their participation and feel more confident about joining in the discussions.

The Flipped Classroom and Learner Development

One of the main reasons for employing a flipped classroom was to help students reflect more deeply on their language abilities and become a more active participant in the learning process (as opposed to passively waiting for teacher instruction). Students in the freshman English course had different proficiency levels and reasons for wanting to improve their English, thus the flipped approach was considered as a suitable option to help learners self-reflect on their performance each week and set their own learning goals. Learner development was promoted in four ways:

1. *Self-pacing:* Learners were able to work at their own pace during lesson preparation. That is, they were free to read or watch the input materials as often as they wished and revisit difficult sections.
2. *Higher order thinking*: Critical thinking skills were encouraged especially through note taking. Writing notes and summaries helped students to deepen their understanding of the input materials and organize their thoughts by considering which information to keep or discard. Students were not given comprehension questions until the following class and thus had to understand the content fully to successfully answer questions.
3. *Engagement with learning materials*: Students actively engaged with lesson materials by selecting their own topics. Teacher-selected topics sometimes did not connect with student life which reduced engagement. Topic-selection gave students more ownership as there was personal interest in the content and it was more relevant to student life.
4. *Leadership skills and self-reflection*: Students reflected on skills through designing learning materials, leading discussions, managing the lesson time, helping to keep group discussions flow smoothly and reflecting on personal language strengths and areas to improve based on discussions they observed.

Student-Generated Materials in a Flipped Learning Classroom

A key strategy in the researcher's flipped classroom was handing over the control of the class to learners to further increase interaction through increased levels of collaboration and discussion. Each week, a group of students worked together collaboratively to create a lesson plan based on the structure of the lesson modelled in the first few classes of the semester. They were given one 90-minute lesson to decide on an academic topic, decide on roles, and split up tasks to prepare for teaching their lesson. Tasks included finding authentic L1 articles or videos that suited the language proficiency and interests of their peers, designing warm-up tasks (e.g., true/false quiz, personal questions, reorder information, or picture prompts), extracting difficult vocabulary from input materials to assist with comprehension, writing comprehension questions, followed by deeper questions to share viewpoints. All interaction was done in English during the class time and facilitated by the teacher. Discussions between the group about the lessons continued outside of the classroom via email or text message (in either the L1 or L2). The group leader and members communicated with the teacher in English through a Google document to share the materials and ask for advice. The key benefit of having students prepare, design, discuss, and use their own materials was lowering barriers during class discussions and increasing motivation as students were more supportive of their peers during student-led discussions (over teacher-produced content). A second benefit was that leaders could identify and reflect on their own strengths and areas to improve from observing other student discussions.

Research Context

The researcher has been using a flipped teaching approach for over a decade with 2nd to 4th year students in elective courses. Students in elective courses tend to be more motivated to participate in lessons as they have selected the course by themselves and are more mature and linguistically proficient than freshman students. Curricular changes over the past year at the researcher's university, however, have introduced a flipped teaching approach into mandatory freshman classes. As the proficiency level of first-year students is lower than those enrolled in elective classes, the researcher decided to use a smaller class for a pilot study to establish if the flipped classroom was effective with lower proficiency learners.

In Yan et al.'s (2024) study on the impact of flipped learning on the proficiency levels of mixed-level learners, they found that lower-proficiency level students' significantly improved listening and reading comprehension skills over their counterparts in more traditional classrooms where the teacher produced the learning materials (original content or from a textbook) and the students prepared for class as a secondary role. These results were also found in other studies (such as Ebron & Mabuan, 2021; Lee & Wallace, 2018). The rationale given for this is that the flipped approach, done correctly, offers scaffolding, clear instructional goals, more opportunities to collaborate and interact with peers, and more exposure to recast during preparation thereby enabling students to self-identify correct forms and supporting language acquisition. In this research, findings were similar. However, the researcher also noted that more proficient learners in this course saw additional improvements in writing and speaking skills (mainly note taking and verbal summaries) through consistent practice in each lesson. Improvements were not measured empirically in this study. Rather, the researcher asked students about their perceived improvements in self-reflective activities.

The number of students in typical freshman classes averaged between 25–30 students. The number of students enrolled in the researcher's pilot class totalled 25. One student was unable to continue the course and dropped out in the third week; thus, 24 students participated in the pilot study. This made it easy to separate the students into six groups of four for weekly group tasks and student-led discussions. If another student had quit the course, the researcher knew that a group of 3 students could still manage the work effectively with more guidance from the teacher, if required. Table 1 explains the structure of the course design:

Table 1

Flipped Learning Course Design

Lesson	Classroom Activity
1	Orientation. Explanation about the structure of discussion course and assessment methods
2–4	Teacher-led model discussions to help students understand and become accustomed to the structure of the lessons (preparation methods, discussion, and summary of thoughts) and focusing on specific discussion skills to be practiced and assessed.
5	Peer-collaboration for student-led discussions
6–11	Student-led discussions and reflection. **In lesson 8 there is a mid-semester self-assessment to check progress and teacher overall comments about discussion skills observed and areas to improve as a class. Individual assessment reports explaining strengths and weaknesses were presented to students leading the discussions*
12–13	Teacher-led discussion and self-assessment of discussion skills
14	Observation and critical analysis of peer discussion to prepare for the final
15	Final discussion (audio and video recorded)

Assessment was broken down into four parts: lesson preparation (30%), class discussion and participation (30%), teacher evaluation of the final discussion (20%), and two self-assessments by students regarding their own efforts, not their language skill (20%).

Research Aims and Results

The three aims of this study were to use a flipped classroom to increase student talk time, to facilitate learner development through self-reflection, and to understand the challenges freshman student faced during the flipped approach and any perceived benefits. The next sections show the results followed by a discussion of key insights.

Increasing Student Talk Time

Student talk time in EFL teaching focuses on maximizing the amount of time a student uses to communicate in the L2 by shifting the focus away from teacher explanation. This makes the classroom more learner-focused and improves communicative competence, which was the overall objective of the freshman course. In past textbook-driven courses, which provided compartmentalized learning, students were typically asked to respond to warm-up and further discussion questions during lesson time without being required to prepare for the lesson in advance. There was little connection or transference of skills between classes, and assessment procedures for communication classes were usually a monologic presentation at the end of the course.

By moving comprehensible input (reading and watching videos) outside the classroom in the flipped approach however, the majority of class time was focused on communication, inquiry, and student observation which helped the teacher to offer real-time support. In practical terms, there was a carefully organized sequence of tasks. First, students began the lesson with a conversation warm-up activity or game related to the topic. The language used was informal so that students could enjoy sharing personal stories about their life. This was followed by a discussion of any new vocabulary learned while preparing for the lesson. Students were expected to *use* the vocabulary they encountered in the input materials or new vocabulary they learned on their own. The teacher then asked various comprehension questions about the homework input materials which the students needed to answer as a group using only the notes they had written for homework. Through problem-solving and co-construction of knowledge, students were able to piece together enough information to answer the questions correctly. All discussions were done mainly in English. Students' L1 was mostly used to clarify misunderstandings. Students were then asked to think more critically about the topic by sharing viewpoints. Deeper discussion questions were provided before the class, and students were expected to do research and formulate opinions to share with their group members. Students were expected to use academic language including transitional words and phrases and specific discussion skills in this part of the lesson (e. g., expanding on their viewpoints giving specific real-world examples, acknowledging others' opinions, and involving others in the discussion so that each student participated equally). They were free to use dictionaries or translators to help them express their ideas effectively. If a student did not prepare for the lesson, they were not able to contribute much to the discussions and became an observer. This describes the primary/primary relationship between preparation and lesson discussion referred to earlier Shibukawa's (2024). During comprehension checks and discussions, the teacher was easily able to note who was not speaking and who did not bring in notes. This made assessment simpler for the teacher. Each week, the teacher changed the groups, so students could speak with different classmates. Toward the end of the 90-minute class, students in each group had to

summarize what they had discussed and present it to the whole class. Students were asked to select different students each week so that every student had an opportunity to build confidence in public speaking. These tasks and strategies were successful in reducing teacher talk time and training students to be more active speakers rather than passive listeners.

Facilitating Learner Development

The second aim of the study was to help students take more responsibility for their learning. This was achieved in several ways.

Self-Reflection

In lesson 1, students discussed what they perceived to be strengths and weaknesses in their language learning and then reflect on what they wished to improve upon in the course. In lesson 8, students were asked to revisit their reflection to check if they were on track to achieving their goals. Students were also asked to reflect on their language skills (reading, writing notes, listening, speaking, and vocabulary) at the mid-point of the semester and reflect on what they needed to do to participate fully for the rest of the semester. In the last class of the semester, students completed a final reflection to think about what they had achieved and how they felt about their performance over the 15 weeks of lessons.

Time-Management

In the flipped approach, managing time to complete preparations was crucial to how well students performed during class. Input materials were limited to approximately 5 minutes for readings or videos. If students did not understand it the first time, they could work at their own pace and go through the input materials as often as needed. This helped to foster stronger time-management skills.

Increased Responsibility and Accountability

For student-led discussions, students assigned themselves specific roles to make the lesson go as smoothly as possible. They had to select a suitable topic and produce learning materials that would increase learner engagement and motivation to speak. During the lessons, leaders were able to observe their peers in discussion which gave them insights into their own level of performance. That is, through peer observation, students could understand new viewpoints that they had not discussed previously with other group leaders and understand various communication strategies used by other students. The leaders were also expected to help guide discussions and keep peers on track, so group members did not slip into the L1. This increased responsibility gave students a greater sense of accountability over their learning.

Motivation

As flipped learning is learner-centred, it is important for the students to maintain motivation throughout the duration of the course. Activities were thus designed to enhance both intrinsic and extrinsic motivation to match various student needs. Intrinsic motivation tasks were activities that helped students to feel an individual sense of achievement, such as topic selection based on interest and progress checks to assess growth. Extrinsic activities, focusing on grades or rewards, were done through self-assessment of effort as part of students' final grade as well

as the teacher giving positive feedback on homework preparation to encourage them to prepare fully for lessons.

Student Experiences With Flipped Learning

The final aim of this research was to understand students' perceptions of challenges and benefits of a flipped learning course (if any). 24 students were given an open-ended survey asking about the positive and negative aspects of creating materials and leading discussions, and what they learned about themselves after the experience. The positive and negative aspects, extracted directly from surveys, are presented as Table 2 in the students' own voices. Underlined text in the table illustrates the main challenges and benefits.

Table 2

Challenges and Benefits of Flipped Learning as Perceived by Students

Challenges	Benefits
• **Trying to achieve consistency** with input from three group members is difficult. • **Managing the lesson time** is difficult. You have to listen, monitor groups, write notes, and stand at the front. • **It is important to read more on the topic** and get a lot of knowledge from various aspects as a leader so that you can answer questions deeply and deepen discussions. • **Writing notes on the whiteboard during synthesis is difficult** because you cannot write every word. You have to listen to the whole opinion and write key words. **I need to practice how to take notes in real time**. We can watch the video many times for homework. • **It is difficult to lead with limited English**. There are many times when I have to speak with no preparation.	• **Choosing a fun topic and finding input videos** gave me many perspectives. We had to choose a video that many students could understand. • **I found that the process to make conclusion [during synthesis] is more fun** than hearing their conclusion. • It was challenging, but fun to lead discussions. **It surely broadened my perspective.** • I found that when discussions stray away from the point**, I could learn how to bring it in the right direction.** • Being a leader means doing many things, **but it is more effective than simply talking.** • **I want to study more about the topic by myself after hearing other perspectives**. I learned many new ideas I did not think about as a leader.

On the negative side (challenges), students reported five main points: (a) negotiating on topics and input materials with group members became difficult as everyone had to vote on several decisions about topics as well as watch and/or read all the choices of input materials; (b) time-management skills are crucial not only for preparation but especially when leading discussions; (c) without a deep knowledge of the topic, leaders are unable to help keep the discussion on track; (d) writing notes in real-time during summary reports is more difficult than when preparing for class as students are able to rewatch or reread parts that they did not understand; (e) students need to have a sufficient level of English to lead as they are not simply presenting a topic, but facilitating discussions.

There were six points on the positive side (benefits): (a) Students enjoyed selecting topics that that suited their interests and watching interesting videos; (b) experiencing higher-cognitive levels of thinking by processing large amounts of information from various groups during

synthesis made students feel a greater sense of achievement rather than just picking up main points in one group to summarize; (c) Students were able to broaden perspectives and gain new viewpoints as they joined different groups throughout the lesson; (d) Understanding how to redirect discussions when they went off track was a useful skill that students found beneficial. They learned how to do it by asking probing questions in a Socratic inquiry style, or by politely interrupting the conversation and redirecting students to where they diverted from or offering a new perspective; (e) Students found multi-tasking a more enjoyable process than simply participating in the discussion. This involved monitoring groups, observing, writing notes, and helping to deepen the discussion; (f) Some of the leaders mentioned that they actually became more curious about the topic and wanted to read more after hearing a new perspective.

On the whole, both challenges and successes experienced helped the students feel more empowered about their learning. Many students found the experience interesting and different from what they were accustomed to in traditional classes. Although beneficial in many aspects, they also reported that without teacher guidance to help organize lessons and further build their skills, they would have struggled and lost motivation. This is an important point that teachers need to consider if they choose to use a flipped learning approach in their L2 classrooms. Two key insights which emerged from this study are presented below.

Key Insights From Using Student-Generated Materials in a Flipped Classroom

Understanding the Flipped Approach Fully

One of the key points is the importance of fully understanding the core principles of the flipped classroom approach before implementing it. Students need to prepare fully for classes with clear learning goals in mind or lessons will be ineffective. Teachers should not only think about the potential benefits but also prepare for challenges such as increased preparation and workload, developing fair assessment methods, and considering what to do if students do not embrace the approach. If teachers employ a flipped classroom just for the sake of it or because other teachers are doing it without understanding how to scaffold lessons and motivate students, both teachers and students may lose interest and fail to see the purpose of the lessons. Thus, to implement a successful flipped learning classroom, teachers should write clear learning goals and organize a plan of action. Starting with one or two classes as a pilot project can help teachers to build a more structured course later. Professional development through researching the approach in terms of underlying theory and practice and speaking with colleagues can help to further prepare teachers.

Reflection on Learning

Self-regulation is a crucial part of being a university student. Through the flipped approach, students can understand how to set goals, develop leadership skills, manage their time, overcome challenges, and reflect on how to improve their learning competencies. These skills will help students to become more independent learners. However, this requires the teacher to provide structured guidance and provide regular feedback to students. In order to help students achieve a higher level of learning, teachers themselves need to go through the process and reflect on their teaching. This can be done by improving planning skills, managing their time better, and understanding how to set clear, achievable goals for themselves.

Conclusion

Over the past decade, the researcher has found that the flipped learning classroom to be equally beneficial and challenging to both the teacher and students. Working with higher-proficiency learners is easier but watching lower-proficiency learners improve can be more rewarding. The researcher found that using a flipped approach with freshman students was more challenging than working with more mature students in elective classes as it required more structure in learning materials and effort from the teacher to sustain motivation.

It was difficult for many students to prepare for lessons if the content was unfamiliar to them. This required learning new vocabulary and rewatching videos several times to understand the content fully. If students found it exhausting to prepare, they lost motivation to participate in the lesson. Thus, it was important for the teacher to find content at an appropriate level which was also interesting to students. This is a time-consuming endeavour. The solution for the researcher was to use student-generated materials. Lesson plans created by students were used as models for the following year's students, as well as added immediate reusable resources for future lessons that were more in line with student interests.

Once the students began leading discussions, the entire class dynamics changed. Students were more engaged in their learning as they wanted to support their peers. For the teacher, the pressure of preparing content that may or may not have appealed to a younger generation was reduced. Helping discussion leaders to facilitate class activities meant that the researcher could spend more time observing student performance for individual assessment.

For teachers considering adopting a flipped classroom approach, it is advisable to consider if it is worth the considerable effort and initial time investment to develop the course. The flipped classroom is a valuable tool when implemented well but can be a nightmare if students reject it. Teachers should thus think carefully about their student population and the culture of the institution before making any decisions. If the goal of the university is to develop autonomous learners, and students are aware of this, there is a higher chance of success. If students prefer a traditional style of L2 learning, it might be better to embrace a more traditionally structured teaching framework such as prepare-practice-production (PPP) that guides students slowly to learning outcomes. In the end, teachers must choose the best approach that meets learning objectives, matches the teacher's style, and aligns with institutional goals rather than choosing the shiny, new educational tool that other educators claim as successful.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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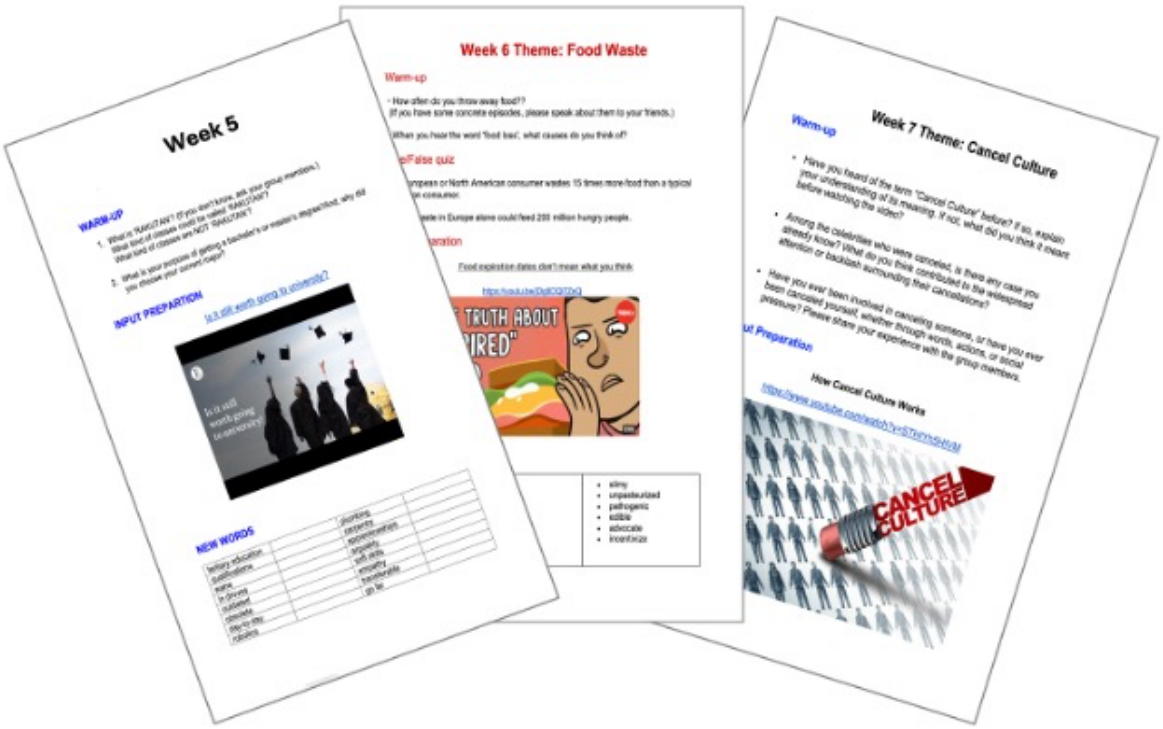
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Appendix

Example of Student-Generated Materials Used in the Flipped Classroom



Shifting Exclusion to Inclusion: Introducing a Reflective Framework to Support Student Teacher's Understanding of Inclusion

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Abstract

This paper introduces a reflective framework intentionally developed to support initial teacher education (ITE) students to expand their understanding of inclusion. The framework is grounded in the view that an authentic understanding of inclusion must begin by bringing exclusionary practices to our consciousness (Ballard, 2013). The tool combines Likert-scale and open-ended prompts to guide critical reflection. Students are guided to identify and reflect on exclusionary moments tamariki experience, as observed within their Early Childhood Education (ECE) environment. Prompts encourage students to consider how exclusion impacts the child, revisit their thoughts in the moment, and examine changes they could implement in future practice. Developed with an awareness of the diverse worldviews held by student teachers in Aotearoa New Zealand, the framework honours individual perspectives, creating space for identity-informed responses. This paper outlines the theoretical basis for the framework, its design process, and how it was introduced within an ITE programme. Early patterns of engagement will be briefly discussed, not as outcomes, but as indicators of how the tool may encourage deeper, ongoing reflection. This pilot study invites discussion around the role of structured reflection on exclusion and how this may impact student's developing understanding of inclusion.

Keywords: inclusion, exclusion, reflection, initial teacher education

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Introduction

Everyday exclusion in ECE environments is embedded in systems and ways of doing, even sometimes well-intentioned practice. Educationalists have long discussed the need to interrogate our own beliefs and perceptions first when building an individual teaching philosophy and understanding of inclusive practice. This study explores whether recognising and revisiting potentially uncomfortable moments can deepen this understanding for students. The small pilot study is guided by the idea of first needing to understand exclusion before inclusion (Ballard, 2013). To explore this, a reflective framework was created. Combining Likert and open-ended questions, asking student teachers to identify and examine moments of exclusion within their ECE setting. 18 Year One students participated, revisiting and examining their perception of exclusion within their environments. This paper shares an overview of the project, theoretical basis of the framework, the methodology, and a brief thematic analysis will share insights from responses received in its implementation so far. The paper is positioned as exploratory with further analysis and discussion to follow.

Context: Aotearoa

Recent data published in Aotearoa highlighted challenges kaiako are facing having the confidence to respond to diverse needs within their ECE environments (Education Review Office, 2022; Hood & Hume, 2024). Kaiako are frequently requesting more strategies, more knowledge. While intentional teaching strategies have their place, how these are implemented and included within a learning environment can be influenced by one's personal teaching philosophy, beliefs, and understanding. Creating truly inclusive education environments calls for us to go beyond the "strategy"; we must identify and expose factors that have created the reverse in the first place (Ballard, 2013). To do this kaiako must examine their perception, revisiting scenarios they observe or experience and reflecting on if there are adaptions that could be made.

In Aotearoa, Early Childhood environments follow the curriculum document Te Whāriki:

> Te Whāriki is an inclusive curriculum - a curriculum for all children …. It holds the promise that all children will be empowered to learn with and alongside others by engaging in experiences that have meaning for them. (Ministry of Education [MOE], 2017, p. 13)

This study is anchored in a rights-based approach to participation; the United Nations Convention on the Rights of the Child (1989) declares every child has the right to access equitable and inclusive learning environments. An additional governing document for kaiako, Our Code Our Standards. This requires all kaiako in Aotearoa to position inclusive practice as an ethical commitment of the profession (Teaching Council of Aotearoa New Zealand, 2017). Together these documents place a legal requirement for kaiako in Aotearoa to be creating inclusive spaces for tamariki and to be protecting their rights for participation within these. To do this, kaiako must have the confidence to advocate and remove barriers to participation tamariki experience. Understanding how these requirements play out in everyday environments is crucial for our student teachers to build the confidence to (McAnelly & Gaffney, 2025).

Initial Teacher Education

Students need to experience and understand the theoretical knowledge that accompanies topics of inclusion; students need this theory of practice to be able to think and reflect critically (Ballard, 2013). This framework stands to accompany the content delivery model of teaching. Across Aotearoa, within ITE programmes the topic of inclusion is covered throughout. Students are often taught with traditional content delivery; tasks may be set where students are asked to reflect on ways to create a more inclusive environment or respond to individual needs. An initial literature search was conducted, to surface additional models or studies exposing moments of exclusion and reflecting on these; similar studies were not surfaced. In a study conducted, Dayman (2020) explored the role ITE plays in modelling inclusive pedagogies and promoting deep understanding of inclusion within education settings. Dayman (2020) identified that even though ITE in Aotearoa aims for inclusion, the discourses and beliefs held by student teachers and teacher educators often still include deficit framing or exclusionary assumptions. Describing a gap where further individual exploration of these beliefs is needed. This shift in understanding begins in ITE, at this level educators instructing the students can use reflection as a tool to guide exploration of beliefs and a changing of these beliefs (Dignath et al., 2022). A report published by the Education Review Office (2022) highlights the value of reflection as a tool to develop understanding of inclusion. Reflection has the power to surface assumptions that students once had, deepen empathy for others by revisiting scenarios again and to activate the critical consciousness that guides them in building their own understanding of inclusion (Minott, 2019).

Theoretical Foundations of the Framework

Ballard (2013) suggests that to authentically understand inclusion, we must first understand exclusion; one cannot exist without the other. Until we expose the underlying causes and influences of these within an environment, we cannot authentically build inclusive spaces. Ballard calls for us to identify the many influences within an environment that shape the experiences of others, although does not explicitly state how. This framework begins by starting with ourselves, attempting to activate a shifting in perception, interrogating our own belief systems. By first exploring instances where tamariki have experienced exclusionary practice within ECE settings, reflection could raise awareness of the intentional or sometimes unintentional ways this is happening. Reflecting in this manner may identify ingrained habits or behaviours of teachers, potentially shaping a more inclusive mindset and aligning with Ballard's call for interrogation of how exclusion comes to be (Rapp & Corral-Granados, 2021).

As a bicultural nation in Aotearoa, when designing the framework, inspiration was drawn from Te Ao Māori worldview. Acknowledging and respecting that understanding develops through relationships with people, places, and things, within our personal identity, not in isolation. Identity and culture shape understanding. Upholding the mana of each participant means recognising their participation and contribution is shaped by their identity as a person. Who they are and what experiences they bring with them in that moment. Macfarlane & Macfarlane (2019) call for researchers to listen to culture when designing studies; their plea to scholars to ensure research methods and studies are culturally responsive, acknowledging cultural identities of those who may engage, and inviting individual world views. The framework ensures space for culturally informed responses and values. Open-ended questions are frequent and throughout the framework, inviting students to share responses rooted in their identity.

He Awa Whiria (Macfarlane et al., 2024) became a visual inspiration for the framework. In its true form representing the intersecting of Maramatanga Māori and Western theory. Each stream crossing paths over time, to braid a new stream of knowledge. Neither of more importance than the other, both upholding the mana of each other, interacting together over to time to build a new stream of knowledge. The reflective framework design was inspired by the braiding of knowledge streams metaphor, not as a methodology but as a visual representation. The reflective framework represents one stream; student's thoughts and perception of exclusion represent the other. They cross paths over time within the reflective process, with the potential for a stream of knowledge: a deepened understanding of inclusion, to be created one that is internal and personal to the participant.

A third theoretical influence in the creation of this framework is the work of Paulo Freire (1970/2018). His work challenges us as kaiako to interrogate our belief systems and expose our inner thoughts, revisiting what we have internalised because of the system we are raised in, and experiences we have had. Reflection becoming something that does not just revisit moments of practice but exposes potential for change and implements this. Recent research by Qi and Sterling Henward (2024) reinforced Freire's ideas that critical reflection within ECE is not just about noticing moments; it is about examining underlying assumptions about these. Local research by Kahuroa et al. (2023) explored Freire theory within an ECE context, with children as participants in the reflective process. This study adapts those pedagogical ideas to an ITE context with student teachers using the guided reflection to examine these moments in time, deepening their understanding of how the systems they are within influence outcomes for our tamariki. Aligning Freire's discussions of critical consciousness and the role this plays in inclusion for all (1970/2018).

With these ideas influencing the framework reflective questions which explore the reason for the exclusion, how it felt for the child, and as kaiako have been included. Participants are then guided to examine what they may do differently next time in an attempt to interrogate their critical consciousness. The act of searching for exclusion within their settings may activate an internal process of exploring their understanding of what this truly looks like, challenging their own belief systems. Through this process participants are encouraged to expose their unconscious assumptions, to surface an awareness and understanding of inclusion and what this may look like in everyday practice within their environments.

Framework Design

The framework visual below symbolises a process or circle of reflection. Reflection does not need to be linear as this shows; the process of reflection can move in any direction, with those engaging returning to previous thinking, jumping ahead a step etc.

Figure 1
Example of Questions Asked Within the Reflective Framework



Methodology

Students in their first semester of Diploma of ECE or Bachelor of ECE were invited to participate. First semester students chosen for initial pilot study as majority are new to the sector and starting to build their professional philosophy as well as an understanding of inclusion. Of those invited, 18 students chose to participate. Students completed the framework via anonymous google forms. Time was allocated in class or at home to complete. The framework was introduced when students were exploring inclusion within their curriculum content. The framework was designed to encourage personal responses, Likert Scale and Open-ended questions were included to ensure this was possible. Ethical considerations taken into account included participation being voluntary; no loss to learning impacted those who chose not to participate. There was acknowledgement this could be a triggering topic; support for students was offered on information sheets via MIT counselling services and other external agencies. A thematic analysis of responses was conducted by the publishing author, themes discussed under headings of some framework questions within this paper. This initial study, being exploratory in nature, highlighted future iterations needing to take place to deepen analysis.

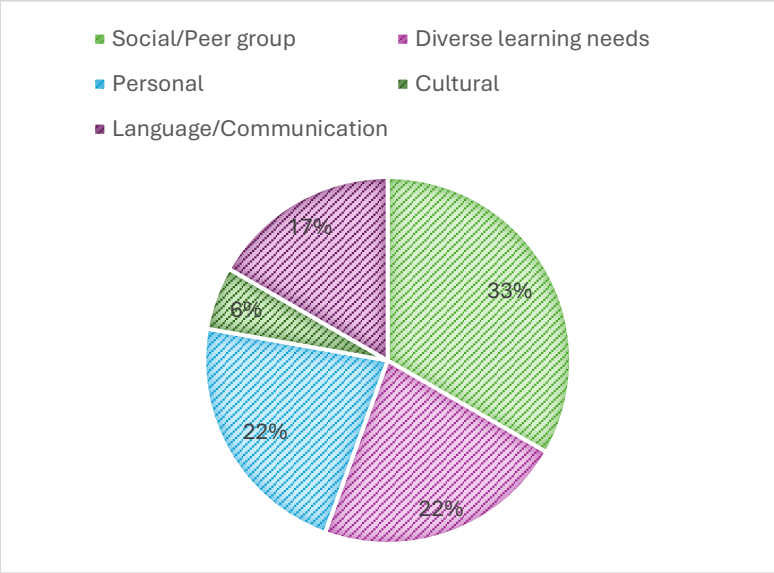
Patterns of Engagement and Early Insights

As this was a pilot study, data is presented as patterns of engagement with the framework rather than as definitive outcomes.

Forms of Exclusion Identified

Individual perception of exclusion appears to be shaped deeply by the environment they are within, and their internalised beliefs. This is seen in the variety of responses given. Although themes are identified here, there was not one response identical to the other.

Figure 2
Types of Exclusions Identified



The open-ended nature of this question inviting potentially culturally informed answers to be shared, respectful of the individual idea each participant has—creating space and valuing this is a personalised reflective journey. Together Ballard and Freire suggests that the surfacing of these moments is the first step toward critical consciousness (Ballard, 2013; Freire, 1970/2018). Responses to this question aligning to the intention behind the framework. Bringing to the surface minor, or micro exclusions that at times may be normalised and critically examine individual understanding of these moments.

Emotional Responses to Exclusion

When asked "how did you feel as this was happening?", participants emotional responses ranged from empathy or sadness to acceptance. Revisiting these moments, appeared, for some, to activate a deeper understanding of the impact on the tamariki involved. Possibly showing a further step towards critical consciousness. "I find that very unfair as you can see in their eyes they were keen to try…"

Participants perception of exclusion shaped their emotive responses, highlighting how these responses are personal, and identify-informed. For some it was distressing to revisit, for others it is normalised, respecting that there is a difference in beliefs and this is ok. While some responses empathised with the external influences not the child, this shows how personalised thoughts and perceptions are for each participant.

Reflections on Future Practice

71% of participants proposed something they would do differently next time. A lot were personal changes to practice, not systematic. A few participants shared they would not do anything differently, accepting what happened or that it was not their place to become involved, reflective of their role as a student teacher. This may indicate that confidence is still growing. The data shows the potential of this question inspiring deeper thought and attempting to transform acceptance of these moments, to ones of awareness and potential for action. Aligning with Freire in that the reflective process did not just bring moments to the surface but brought

about thoughts of change. Further consideration is needed to plan for and identify a measurement of this change from written reflection into practice.

Shift in Thinking

78% indicated they value inclusion more now, while 22% indicated no change had occurred. For many participants, an internalised change was reported. Suggesting potential for this approach in activating critical consciousness and guiding a deeper understanding of inclusion for students. “I think this is because reflecting on the experience showed me how easy it is for kids to feel left out.”

Noticing exclusion, examining the situation and one's individual role in enacting change a process which is unique to each participant. Dayman’s (2020) study concluded that content delivery on inclusion can be influenced by the bias and approach of lecturers, for example whether this is a social or medical model of inclusion. The personal nature of responses recorded in the study indicates the potential for this approach as a way of mitigating this possibility.

Limitations and Implications for ITE

This is a small pilot study, with 18 first-year students engaging. Results are there for indicative; further inquiry and future adaptations of this approach are needed. The study was limited to one ITE institute, where the researcher is known to participants. Participants are first year students, mostly new to ECE with concepts such as inclusion and reflective practice. The changes recorded are based on the day of reflection. Data shown is not a measurement of change of practice, but potentially a change of thinking. While this pilot shows potential in this approach, further exploration is needed. Further consideration is needed to plan for and identify a measurement of this change from written reflection into practice.

There is opportunity within ITE as students are building their own teaching philosophy and being introduced to the idea of reflecting through a critical lens. Guided reflection which surfaces moments unique to the student’s experiences, show potential in raising awareness of the many factors which influence how a child experiences their ECE environment. Along with supporting students to make the theory to practice link more explicitly.

Conclusion

Creating inclusive spaces does not require only a series of strategies; it involves exposing everyday moments that matter and interrogating one’s beliefs. Reflective practice shaped in this way could be how we get there. This pilot study has illustrated a pedagogical approach which responds to Ballard’s (2013) call of exposing and examining exclusion to deepen understanding of inclusion. Reflection must go beyond describing events, it must interrogate underlying assumptions to have a transformative impact. Recognising learning does not occur in isolation; this study respects diverse and culturally informed ways of thinking and seeing. The initial exploration of the project has shown potential for this type of reflection for student teachers, adding an additional layer to their learning journey when exploring the topic of inclusion. This pilot highlights future research in the area and implementation with a broader scope of participants needed.

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Is Scholarship the Real Key to Taiwan-Japan Student Mobility? A Literature Review

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Abstract

International student mobility between Taiwan and Japan has garnered increasing attention, driven by shared cultural ties and regional integration efforts. Scholarships are often cited as critical incentives for student exchanges, yet the true influence of financial aid on mobility patterns remains underexplored. This literature review examines whether scholarships are the decisive factor in facilitating student mobility between Taiwan and Japan, or if other structural and policy factors play equally significant roles. A review of academic articles, government reports, and institutional publications from the past two decades was conducted. The analysis focused on scholarship programs, mobility trends, policy frameworks, and identified challenges influencing inbound and outbound flows. Findings reveal that while scholarships such as MEXT and Taiwan Scholarship positively impact enrollment numbers, their effect is mediated by factors including language proficiency barriers, cultural integration challenges, limited credit recognition, and inadequate bilateral agreements. Especially, Japanese student mobility to Taiwan remains low despite scholarship availability, underscoring non-financial barriers. This review challenges the conventional emphasis on financial incentives alone and calls for strategies that enhance mobility quality and equity.

Keywords: student mobility, scholarships, Taiwan, Japan, international education policy, bilateral exchange, higher education

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Introduction

International student mobility has become a critical element of higher education strategies worldwide, particularly in East Asia where regional cooperation and cultural proximity encourage academic exchange (Barnett et al., 2016; T.-M. Chen & Barnett, 2000; Knight, 2012). Taiwan and Japan share a unique historical and cultural relationship that has shaped patterns of student flows between the two countries (Vickers, 2015). Despite numerous scholarship programs designed to promote mobility—such as Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) scholarships and Taiwan's Taiwan Scholarship—the volume and balance of student exchanges remain uneven (Kuroda, 2012; Yonezawa, 2010). These imbalances are influenced not only by policy priorities but also by institutional recognition, economic considerations, and sociocultural perceptions of education quality and opportunity (APEC, 2019; Huang, 2015).

This paper explores the question: Is scholarship the real key to enhancing student mobility between Taiwan and Japan? It reviews academic literature and policy documents to understand the role of scholarships in facilitating mobility, and whether other barriers and structural factors limit the potential of these financial incentives. By examining both inbound and outbound flows, this review aims to provide a nuanced understanding of what drives or hinders Taiwan–Japan student mobility.

Overview of Scholarship Programs and Mobility Trends

Scholarship Programs in Taiwan and Japan

Taiwan offers a range of well-established scholarship programs to attract international students as part of its broader strategy to internationalize higher education and enhance soft power diplomacy in Asia (Andy, 2018). Among the most prominent is the Taiwan Scholarship, jointly funded by Taiwan's Ministry of Education (MOE), Ministry of Foreign Affairs (MOFA), Ministry of Economic Affairs (MOEA), and Ministry of Science and Technology (MOST). This scholarship supports outstanding students from over 100 countries to pursue undergraduate and postgraduate studies in Taiwan's top universities, offering full tuition coverage and a monthly stipend (MOE, 2023). While the initiative initially prioritized Southeast Asian students under the New Southbound Policy (Patriadi, 2022; Y.-J. Wang, 2022), it is also accessible to students from East Asian countries, including Japan, reflecting Taiwan's commitment to broader regional engagement.

Another notable initiative is the Huayu Enrichment Scholarship, which provides financial support for international students to study Mandarin Chinese in Taiwan's certified language centers for 3 to 12 months. The program is designed not only to enhance language proficiency but also to promote cultural exchange. Japanese students, particularly those pursuing area studies or aiming for careers in diplomacy or multinational corporations, have taken advantage of this opportunity to gain both linguistic skills and a deeper understanding of Taiwanese society (Hanada & Horie, 2021). Besides the above, the Taiwanese government also offers specialized scholarships for specific fields (e.g., Traditional Chinese Medicine). These scholarships typically cover tuition fees, living allowances, and some travel expenses. It has been reported that Taiwanese higher education institutions and the government actively attract international students from Asia and worldwide through scholarship policies, particularly in distinctive fields like traditional medicine, emphasizing an academic and culturally integrated learning environment (Pham et al., 2024).

In addition to government-sponsored scholarships, Taiwanese universities such as National Taiwan University, National Chengchi University, and National Tsing Hua University offer their own competitive financial aid packages for international students, further incentivizing student inflow (TBS NEWS, 2024). These scholarships are often merit-based, with consideration for academic performance, leadership potential, and alignment with Taiwan's internationalization goals (MOE, 2021).

On the other side, Japan has long invested in international education as a strategic diplomatic and economic tool, and its MEXT scholarship is the most prominent scholarship for international students in Japan, directly provided by the Japanese government. It covers tuition fees, living expenses, and a portion of travel costs. This scholarship aims to attract and cultivate high-quality international students, addressing Japan's declining birthrate and the need for higher education internationalization. It has been reported that MEXT scholarship significantly impacts international students' academic and life satisfaction. While economic factors are not the sole determinants, the financial support provided by MEXT remains a key attraction (Lagones, 2019). These scholarships support thousands of international students annually, including a significant number from Taiwan, offering full tuition, travel expenses, and a generous monthly allowance (MEXT, 2025; Study in Japan, n.d.). Taiwanese students have traditionally shown strong interest in MEXT due to the high academic reputation of Japanese institutions and geographic proximity. According to recent statistics, Taiwanese students comprise one of the largest groups of international students in Japan, with many pursuing advanced degrees in STEM, business, and social sciences at universities such as The University of Tokyo, Kyoto University, and Waseda University (Okugawa, 2014; Yonezawa & Shimmi, 2017).

The historical relationship between Taiwan and Japan also plays a critical role in sustaining educational exchange. Many Taiwanese view Japanese culture positively, and the shared use of Chinese characters (kanji) lowers the linguistic barrier for Taiwanese students. Moreover, bilateral university partnerships and exchange agreements have increased over the years, with programs such as the Japan–Taiwan Exchange Association's Study Abroad Promotion Project actively funding short-term mobility and joint research opportunities (JTEA, 2025). These initiatives underscore a mutual recognition of the role education plays in strengthening regional ties, yet disparities remain in terms of outbound and inbound flows, often influenced by perceptions of academic prestige, language barriers, and post-graduation opportunities (Huang, 2021).

Mobility Trends Between Taiwan and Japan

Historically, Taiwan has consistently sent significantly more students to Japan than it has received from Japan, reflecting an enduring asymmetry in bilateral academic exchange (Newfields, 2019). According to statistics from the Japan Student Services Organization (JASSO), over 8,000 Taiwanese students were enrolled in Japanese institutions in 2022, making Taiwan one of Japan's top source countries for international students (JASSO, 2023). In contrast, fewer than 1,000 Japanese students were studying in Taiwan during the same period, a number that has remained relatively stagnant over the past decade (MOE, 2023). This disparity persists despite the existence of multiple scholarship programs on both sides, which aim to enhance accessibility and bilateral flow. Taiwan's scholarship programs are open to Japanese nationals, although the majority of recipients tend to come from Southeast Asia (MOE, 2021). On the Japanese side, the MEXT Scholarship has played a pivotal role in supporting Taiwanese students pursuing undergraduate, master's, and doctoral degrees in Japan. The

MEXT program, which includes categories such as research student, teacher training, and Japanese studies scholarships, is highly competitive and offers full tuition, a monthly stipend, and travel support. In 2021, over 300 Taiwanese students were awarded various MEXT scholarships (MEXT, 2022).

Despite these efforts to equalize opportunities, recent research indicates that factors beyond financial aid significantly influence student decision-making. Cultural affinity, historical ties, and language proximity strongly motivate Taiwanese students to choose Japan. Japanese culture is widely popular in Taiwan, with anime, fashion, cuisine, and pop music deeply embedded in Taiwanese youth culture (Cheng & Chen, 2015). Furthermore, the shared historical connection stemming from Japan's colonial rule over Taiwan (1895–1945) has left a legacy of Japanese language education and institutional familiarity, which makes the transition to Japanese academic environments more manageable for Taiwanese students (Heylen, 2005).

Japanese students often exhibit a lower propensity for outbound mobility, especially to destinations within Asia. Many Japanese undergraduates show a preference for domestic employment and tend to view study abroad, particularly in non-Western destinations, as carrying higher opportunity costs. Language barriers and the perceived lower prestige of Taiwanese institutions, despite their academic strength, also contribute to this imbalance (Burden, 2020). Moreover, recent qualitative studies suggest that Taiwanese institutions, while welcoming, may lack targeted marketing and recruitment strategies aimed specifically at Japanese students, which limits awareness and attractiveness (Ma, 2014). While scholarship availability on both sides has helped remove financial barriers, the asymmetry in Taiwan–Japan student mobility is underpinned by deeper structural, cultural, and perceptual factors. Efforts to address this imbalance must therefore go beyond funding mechanisms and consider the broader sociocultural and institutional landscape that shapes mobility patterns between the two countries.

Factors Influencing Taiwan-Japan Student Mobility Beyond Scholarships

Language Proficiency and Cultural Barriers

Language remains one of the obstacles to balanced student exchange between Taiwan and Japan. Taiwanese students, depending on their individual linguistic backgrounds, exhibit varying degrees of fluency in acquiring Japanese (Lin, 2023). For Taiwanese students, the requirement to demonstrate proficiency in Japanese, particularly for degree programs taught in Japanese, often presents a significant hurdle. Most Japanese universities require students to pass the JLPT at N2 or higher, depending on the academic field and institution. This level of proficiency demands years of dedicated study, which not all Taiwanese high school graduates or undergraduates possess. Although some universities offer courses in English under initiatives like the Global 30 Project, these programs are still limited in number and tend to cluster in select institutions such as the University of Tokyo, Kyoto University, and Tohoku University (MEXT, 2022). As a result, many Taiwanese students are restricted to either language schools or short-term exchange programs before they are linguistically prepared to pursue full-time study in Japan (Hong, 2016).

Conversely, Japanese students encounter equally daunting challenges when it comes to Mandarin Chinese. Unlike English, which is widely taught across Japan, Chinese is not part of the standard curriculum in most Japanese secondary schools. The tonal nature of Mandarin, combined with the complexity of Chinese characters and grammar structures, presents a steep

learning curve (Rose & Carson, 2014). Although some Japanese universities have introduced Taiwan-focused language and culture courses, such programs remain niche and are often elective rather than core components of academic pathways (Andy, 2018; Sugano, 2014). This linguistic gap significantly limits Japanese students' ability to engage fully with Taiwanese academic content, navigate local life, or participate in internships and fieldwork that require functional Mandarin.

Beyond language, cultural adjustment issues further complicate student mobility. Taiwanese students in Japan often report difficulties adjusting to the more hierarchical and formal academic culture in Japanese universities. For example, classroom interactions in Japan are generally more passive, with limited space for student expression or debate, which contrasts with the more open and discursive classroom style increasingly promoted in Taiwan's higher education institutions (ADB, 2020; Izumi-Taylor et al., 2025). Social integration can also be challenging, as Taiwanese students may feel excluded from tightly knit Japanese peer groups, especially when informal communication is deeply embedded in nuanced cultural codes and polite speech (Jou & Fukada, 1996).

On the other hand, Japanese students in Taiwan may initially find the environment more relaxed and socially open, but they can struggle with cultural expectations around direct communication, food customs, or gender roles—areas that are often under-discussed in pre-departure orientations (Garbutt, 2017; Kheir, 2021). Moreover, although Taiwanese society is relatively friendly to foreigners, Japanese students may still experience a degree of social isolation, especially in smaller universities or cities with limited international student services.

These linguistic and cultural barriers not only impact students' academic performance and day-to-day experiences but also affect broader metrics such as student satisfaction, retention, and return on investment in overseas education (Varghese, 2008). Institutions on both sides have begun to implement support programs—such as buddy systems, intercultural workshops, and expanded language preparation courses—but the reach and effectiveness of such efforts vary widely. For example, National Taiwan University has launched peer mentorship and bilingual counseling services, while Tsukuba University has introduced Taiwan Week and language exchange clubs to promote deeper mutual understanding (Office of International Affairs, 2020; University, 2016).

In sum, while structural and financial resources are increasingly available, the persistent challenges related to language proficiency and cultural adaptation remain central barriers to deepening Taiwan–Japan educational exchange. Addressing these issues requires not only language training and intercultural communication support but also a systemic rethink of curriculum design, pre-departure preparation, and on-campus inclusion strategies.

Academic Compatibility and Credit Recognition

One of the less visible—but critically important—barriers to student mobility between Taiwan and Japan is the lack of academic compatibility and limited mechanisms for mutual credit recognition. Differences in academic calendars, credit systems, grading scales, and curriculum structures often result in bureaucratic and administrative hurdles that discourage participation in exchange or dual-degree programs. For instance, Japanese universities typically follow an April-to-March academic calendar, whereas Taiwanese institutions operate on a September-to-June calendar, which can create significant misalignments in course schedules, exam periods, and semester breaks (Shimmi, 2013). This temporal mismatch makes it challenging for students

to transfer without missing a term or duplicating academic content, often extending their overall study duration.

Moreover, disparities in credit systems further complicate the recognition of coursework. While Taiwan generally uses the Carnegie credit hour system—with one credit representing 16–18 hours of class time—Japanese universities often calculate credits based on contact hours and expected self-study hours combined, leading to inconsistent standards (MEXT, 2020). A 2-credit course in Japan might not be equivalent in workload or content to a 2-credit course in Taiwan, making one-to-one recognition difficult without detailed curriculum mapping or syllabi comparison (Noda et al., 2018).

Another layer of difficulty lies in limited articulation agreements between institutions. While flagship universities such as National Taiwan University (NTU) and Waseda University or Keio University have established some credit transfer arrangements through formal memoranda of understanding (MOUs), these are still the exception rather than the norm. Most smaller or regional institutions lack bilateral agreements, which forces students to seek individual approval for each course credit, a process that can be time-consuming and uncertain (Hotta, 2024). In many cases, credits earned abroad are only recorded as electives or non-degree credits, meaning they do not count toward graduation requirements, thus reducing the academic value of mobility experiences (Hawkins, 2012).

Even in joint-degree or double-degree programs—often viewed as the gold standard of institutional collaboration—structural incompatibilities pose challenges. For example, language and literature departments in Taiwan tend to emphasize comparative analysis, regional contextualization, and Mandarin-Japanese translation, while their Japanese counterparts often adopt a more philological and historically focused curriculum. These differences result in content misalignment, especially in upper-level courses, which makes cross-institutional course recognition particularly difficult (Choe, 2016).

In response to these challenges, regional efforts have been initiated to promote standardization and transparency. The Campus Asia program, supported by the governments of Japan, China, and South Korea, is one example of an attempt to align academic credit systems and promote joint curriculum development in East Asia. However, Taiwan has not been formally included in this initiative due to its unique political status, thereby limiting its ability to participate in multilateral academic harmonization frameworks (L. Chen & Huang, 2022). Some Taiwanese institutions have independently begun experimenting with modularized course designs and credit conversion tables, but these innovations remain localized and lack overarching national policy support.

The lack of streamlined academic compatibility not only undermines student confidence in the transferability of their international coursework but also places an extra administrative burden on university staff, thereby lowering institutional enthusiasm for expanding such programs. Until more robust, transparent, and standardized frameworks are developed—whether through bilateral agreements, credit transfer databases, or regional platforms—academic incompatibility will continue to act as a major friction point in Taiwan–Japan student mobility.

Policy and Institutional Gaps

While Taiwan and Japan both maintain scholarship policies and general frameworks to encourage international academic mobility, bilateral agreements specifically designed to

facilitate student exchange between the two countries remain surprisingly sparse and underdeveloped. The absence of a comprehensive and coordinated policy framework—especially one that reflects the unique educational, linguistic, and cultural dimensions of Taiwan–Japan exchange—has led to piecemeal and fragmented efforts, often dependent on individual universities or short-term initiatives (MEXT, 2025; MOE, 2023).

At the governmental level, Taiwan's MOE offers scholarships such as the Taiwan Scholarship, and Japan provides support through the MEXT Scholarship program (Andy, 2018). While both of these funding streams are generous and cover tuition, living costs, and travel, they are not linked to any structured bilateral student exchange program. As a result, students who receive these scholarships often apply independently and study in their host country without the benefit of reciprocal institutional arrangements, academic advising, or coordinated curricular alignment (E. M. Wang, 2021). Unlike the well-established Campus Asia program between Japan, South Korea, and China, which promotes trilateral student mobility through policy harmonization and joint curriculum development, there is no equivalent trilateral or bilateral framework that includes Taiwan due to geopolitical sensitivities (Goldstein et al., 2016).

Moreover, institutional-level cooperation is highly uneven. A few leading universities such as NTU, Waseda University, and Kyoto University have signed Memoranda of Understanding (MOUs) that include faculty exchanges, joint symposia, and occasionally, student mobility opportunities. However, these tend to benefit elite institutions and are rarely extended to public or private universities in regional areas, where such exchanges could significantly diversify student exposure and broaden access (Kitamura, 2015). As of 2021, only 12 Taiwanese universities had active bilateral student exchange agreements with Japanese institutions as of 2021, compared to more than 50 with the United States (Andy, 2018).

Another major limitation is the lack of targeted promotion and institutional support structures for incoming Japanese students in Taiwan. Unlike Taiwanese students, who are often recruited through language school networks, education fairs, and extensive MEXT-backed campaigns in East Asia, Japanese students interested in Taiwan receive minimal institutional guidance. Many Japanese university international offices lack comprehensive information on Taiwanese universities, scholarship timelines, visa procedures, and housing options (Humphries & Allen, 2023). This results in low inbound mobility numbers from Japan, despite growing Japanese interest in Mandarin language learning and cultural immersion experiences in Taiwan.

At the institutional level in Taiwan, support services tailored to Japanese students are often underdeveloped or non-existent. For example, most orientation materials, campus signage, and academic counseling are provided only in Mandarin and English, but not in Japanese. Student services offices typically lack Japanese-speaking staff, making it difficult for less proficient Japanese speakers to navigate administrative processes (Office of International Affairs, 2020). While both sides have functioning international student offices, usually only the Japanese university provides culturally contextualized counseling, buddy programs, and targeted extracurricular activities to help inbound students integrate (Humphries & Allen, 2023; Rikkyo University, n.d.; University, 2016). In Taiwan, such initiatives are often left to student clubs or individual volunteers rather than embedded in university policy.

There is also a missed opportunity in public diplomacy and soft power initiatives. While Japan's Ministry of Foreign Affairs actively promotes Japan through cultural centers, Japan Foundation scholarships, and language learning programs abroad, Taiwan's efforts to engage Japanese youth through similar channels remain modest. Taiwan's soft power assets—such as

its democratic institutions, vibrant pop culture, and high-tech industries—are attractive to many Japanese students, but without strategic policy promotion or media visibility, these assets are under-leveraged in the realm of educational exchange (Green, 2022).

In short, despite the existence of individual scholarships and informal partnerships, there is no cohesive bilateral strategy for fostering Taiwan–Japan academic exchange. Without explicit governmental prioritization and institutional coordination, the potential for robust, sustainable, and mutually beneficial student mobility between the two countries remains unrealized.

Discussion and Conclusion

Scholarships have long been recognized as critical instruments in lowering financial barriers to international education. Both Taiwan and Japan offer generous support mechanisms to encourage student mobility. These programs provide tuition waivers, monthly stipends, and travel allowances, which have significantly reduced the cost burden for eligible students (MOE, 2021; Study in Japan, n.d.). However, despite scholarships, bilateral student mobility between Taiwan and Japan remains asymmetrical, with Taiwan consistently sending more students to Japan than vice versa. This imbalance suggests that scholarships are not sufficient to foster sustainable mobility. On a structural level, mismatches in academic calendars, credit systems, and degree structures continue to obstruct seamless exchange (Hotta, 2024; Shimmi, 2013). Culturally, language proficiency and integration support are key obstacles. Japanese students often lack access to Mandarin language education and are less prepared to navigate life in Taiwan. Furthermore, Taiwanese institutions outside of major universities offer limited support services tailored to Japanese. Moreover, policy priorities have shaped mobility trends. Since the launch of Taiwan's New Southbound Policy (NSP) in 2016, strategic focus has shifted toward expanding ties with Southeast and South Asian nations, as well as Australia and New Zealand (MOFA, 2025). As a result, Taiwan saw a dramatic rise in students from Vietnam, Indonesia, and Malaysia (Nguyen et al., 2020). While this diversification is valuable geopolitically and economically, it has unintentionally sidelined Japan as a mobility priority.

Based on the synthesis of literature reviewed across policy, institutional, and individual dimensions, we propose an integrated conceptual framework to illustrate how student mobility between Taiwan and Japan is shaped by interconnected drivers at multiple levels. This model provides a foundation for future empirical investigation and targeted policymaking.

Figure 1
Framework for Taiwan-Japan Student Mobility

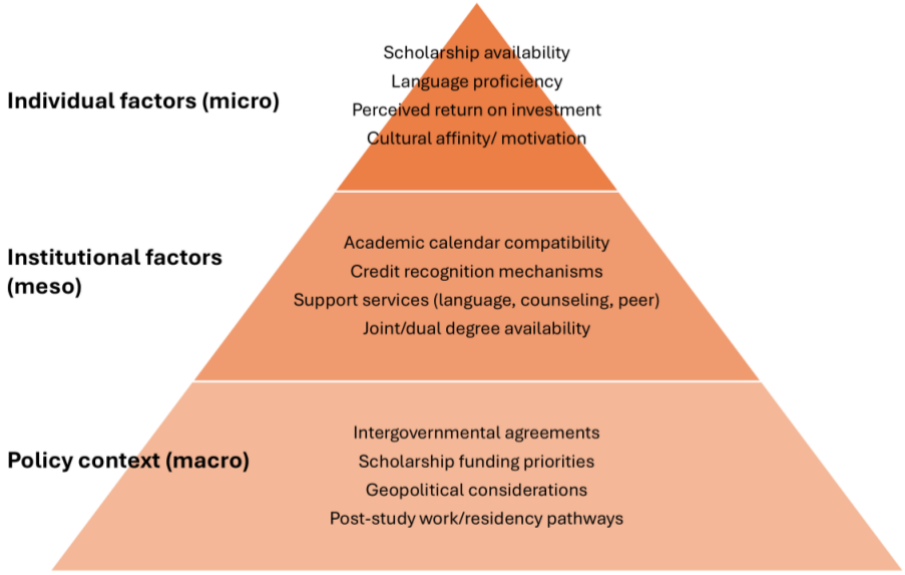


Figure 1 visualizes the dynamic interplay of three interrelated levels of influence: micro (individual), meso (institutional), and macro (policy). At the individual level, student motivations such as scholarship availability, language proficiency, and perceived cultural compatibility determine interest and capacity to pursue mobility. These micro-level drivers are necessary but must be enabled by institutional-level mechanisms, such as compatible academic calendars, formalized credit recognition systems, and embedded student support structures (e.g., buddy programs, bilingual counseling, and inclusive extracurriculars). Without these meso-level enablers, students face significant friction in navigating cross-border education systems. At the policy level, national strategies, bilateral agreements, and funding priorities such as Taiwan's New Southbound Policy or Japan's Campus Asia framework establish the broader mobility environment. In the case of Taiwan–Japan exchanges, current policy frameworks inadvertently sidelining Japan as a strategic partner. Furthermore, Taiwan's exclusion from regional trilateral initiatives like Campus Asia reduces opportunities for multilateral alignment.

This framework is based on Model of Student Integration (1993), which emphasizes the importance of both academic and social integration in student success (Tinto, 1993); Push-Pull Theory (Lee, 1966), which highlights mobility motivations and deterrents (Lee, 1966); and Policy Mobility and Educational Regionalism (Rizvi & Lingard, 2009), which examines how cross-border policies shape institutional behavior (Rizvi & Lingard, 2009). These theories emphasize the need for coordinated action across all levels to achieve reciprocal, high-quality mobility between Taiwan and Japan. The framework also serves as a diagnostic tool for policymakers, institutional leaders, and researchers to design interventions beyond financial aid, addressing structural, linguistic, and policy bottlenecks that impede student flows. Future studies may use this model to assess the effectiveness of targeted reforms or to compare Taiwan–Japan mobility patterns with other East Asian corridors.

In summary, scholarships remain a vital component in encouraging Taiwan–Japan student mobility but are not the sole determinant of successful bilateral exchange. This review underscores the need for integrated policy frameworks that address academic, linguistic, and cultural dimensions. Future efforts should move beyond financial aid to cultivate reciprocal, sustainable, and equitable student mobility that strengthens regional educational ties.

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Investigating the Impact of Chatbot Integration on Learning Effectiveness

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Abstract

As financial instruments become increasingly complex, individuals need stronger financial literacy to mitigate risks—particularly amid growing interest in investment and the rise of scams such as those involving cryptocurrency. Traditional investment education often emphasizes theoretical frameworks while neglecting practical applications and real-world experiences, which can reduce learners' motivation and engagement. Chatbots, powered by natural language processing, offer rich content, instant feedback, interactive dialogue, and personalized learning—fostering engagement, self-efficacy, and learning motivation. These features make chatbots a promising tool for investment education, especially for learners who may feel anxious about complex financial topics or fear making mistakes. However, despite their potential, research on the integration and effectiveness of chatbots in investment education remains limited, highlighting a need for further exploration. This study investigates the impact of integrating chatbot technology into investment education, focusing on learning performance, self-efficacy, cognitive load, and overall learning experience. A total of 23 university students participated in the experiment. The preliminary results indicate that students demonstrated improved learning performance and self-efficacy, experienced a relatively low level of cognitive load, and expressed a willingness to use chatbots in future learning. Students' learning experiences will be further analyzed and discussed. These findings contribute to a deeper understanding of how chatbot technologies can be effectively incorporated into instructional design, guiding future pedagogical innovations.

Keywords: chatbot, learning effectiveness

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Introduction

Investment studies constitute a core and foundational discipline within the field of finance (Bodie et al., 2024). Its theoretical frameworks and logical reasoning not only serve as the basis for professional practice but are also essential for a wide range of financial occupations, including securities analysts, financial planners, senior executives in securities firms, investment-linked insurance agents, and candidates for national financial and insurance examinations. Investment studies encompass not only fundamental concepts of return and risk but also a broad spectrum of financial markets, such as money markets, capital markets, foreign exchange markets, and derivative markets (Hull, 2023). Professionals engaged in investment-related fields are therefore required to develop a comprehensive understanding of these concepts and their practical applications to manage investment portfolios effectively and communicate financial information accurately.

However, current investment education is predominantly delivered through one-way instructional approaches, which in turn leads to suboptimal learning outcomes and low learning motivation (García-Santillán et al., 2025; Oberrauch & Kaiser, 2024). In recent years, increasing attention has been paid to the effectiveness of chatbot applications in educational contexts (Thongsri et al., 2025). By simulating human-like conversations, chatbots are able to provide rich learning resources (Bai et al., 2025) and facilitate interactive question-and-answer processes (Cain & Rajan, 2024). Through interaction and the provision of immediate feedback, chatbots have the potential to enhance students' familiarity with instructional content and thereby improve learning effectiveness in investment education.

The purpose of this study is to construct an investment education learning environment supported by a chatbot, and the research questions are listed below:

1. To investigate whether the students in the chatbot-based learning system (CLS) demonstrate differences in investment education learning performance.
2. To examine whether the students in the chatbot-based learning system (CLS) show differences in self-efficacy toward investment education.
3. To determine students' level of cognitive load in investment education within the chatbot-based learning system (CLS).
4. To explore the learning experiences of the students using the chatbot-based learning system (CLS).

Methodology

The participants were 23 first-year university students from a university in Taipei City. A total of 43% of them were male, and 57% were female. They engaged in a 30-minute learning session using the chatbot-based investment education learning environment. In the study, quantitative data consisted of questionnaires, pre-test, and post-test scores, and qualitative data came from semi-structured interviews. The face-to-face interview was conducted after the experiment and 7 students participated. After the treatment, they were asked to take a post-test, and questionnaires and in-depth interviews were conducted. The instructional materials were developed through consultation with two experienced investment instructors and were aligned with the examination items of the Financial Planning License Competency Test administered by the Taiwan Academy of Banking and Finance to ensure content validity. The cognitive load scale was modified from the instrument developed by Hwang et al. (2013) to assess learners' cognitive load during investment education learning, using a seven-point Likert scale. The Cronbach's alpha is .81. The self-efficacy scale was modified from the instrument developed

by Pintrich et al. (1991) to assess learners' level of self-confidence toward investment education learning, using a five-point Likert scale. The Cronbach's alpha is .78.

Results

A paired-samples t-test was conducted to address the first research question: "Do students using the chatbot-based learning system (CLS) demonstrate significant differences in investment education learning performance?" To answer this question, students completed both a pre-test and a post-test at the conclusion of the intervention. The results revealed a statistically significant difference between pre-test and post-test scores, $t(22) = -22.33$, $p < .01$. Specifically, the post-test scores (M = 76.96, SD = 2.98) were significantly higher than the pre-test scores (M = 47.17, SD = 2.98).

A paired-samples t-test was conducted to address the second research question: "Do students using the chatbot-based learning system (CLS) demonstrate significant differences in self-efficacy toward investment education?" The results indicated a statistically significant increase in students' self-efficacy following the intervention, $t(22) = -7.17$, $p < .01$. Specifically, the mean self-efficacy score after the intervention (M = 3.74, SD = 0.62) was significantly higher than the mean score before the intervention (M = 2.13, SD = 0.81).

To address the third research question, which examined students' cognitive load in investment education within the chatbot-based learning system (CLS), descriptive statistical analysis was conducted. The results showed that the mean cognitive load score was 2.43 (SD = 0.61), which is below the midpoint value of 3, indicating that students experienced a relatively low level of cognitive load during the learning process.

To address the final research question, which explored students' learning experiences when using the chatbot-based learning system (CLS), qualitative analysis of the interview data was conducted. The findings indicated that most students perceived the chatbot as providing immediate feedback that supported and enhanced their learning. In addition, several students reported that the chatbot-supported learning environment increased interactivity, which in turn enhanced their learning motivation and reduced perceived learning pressure.

Conclusions

The purpose of this study was to examine the effects of a chatbot-based learning system on investment education. The findings indicate that learners in this environment demonstrated significant improvements in their investment knowledge, showing that the system effectively supported the learning process. In addition, students exhibited enhanced self-efficacy in learning investment concepts and reported experiencing a relatively low cognitive load while using the system. The interactivity and immediate feedback provided by the chatbot were found to facilitate learning and increase learner satisfaction (Ngo et al., 2024). Moreover, the ease of use of the chatbot guided students in understanding investment concepts more clearly and consistently, while also fostering their self-efficacy and maintaining their motivation to learn throughout the instructional process (Tanveer et al., 2024). The real-time question-and-answer function offered by the chatbot provided a higher level of interactivity compared with traditional instructional methods. Engaging in dialogue and inquiry with the chatbot also helped reduce students' learning pressure, contributing to a more supportive and effective learning experience (Yin et al., 2024).

For future research, it is recommended that the application of chatbot-supported learning be extended to different subjects and age groups, include control groups for comparative analysis, and involve longer intervention periods so that more learners can fully benefit from the advantages provided by these innovative technologies.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author confirms that Grammarly, an AI-assisted writing tool, was used solely for proofreading and improving the clarity and accuracy of language in the manuscript, including the correction of grammatical and spelling errors and rephrasing of sentences. No other AI or AI-assisted technologies were employed to generate content. All ideas, research design, procedures, findings, analyses, and discussions presented in this manuscript are the original work of the author and were developed through careful and systematic research.

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Implementing Contextual Interventions to Improve Teaching Quality: Reflections From a Three-Year School Mentoring Program

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Abstract

This study explores how contextual mentoring interventions can improve teaching quality and leadership in a low-cost private junior high school in rural Indonesia. Over three years, the program accompanied teachers and school leaders through cycles of reflection, planning, and collective action to rebuild post-pandemic stability and instructional confidence. Instead of relying on prescriptive models, the mentoring process followed the 5C Reflective Framework—Characterized Relationship, Comprehensive Concept, Constructive Continuity, Challenging Choices, and Community Context—adapted from the 5M leadership values introduced by Najelaa Shihab, founder of the Guru Belajar Foundation. This framework emphasizes humanizing relationships, conceptual clarity, sustained progress, purposeful challenges, and community empowerment. Data were drawn from classroom observations, reflection logs, and mentoring documentation. Results showed consistent teacher growth (average reflection scores 8.9–9.0 / 10), increased collaboration, stronger leadership identity, and a redesigned school governance system that improved teacher wellbeing and student enrollment. Findings highlight that contextual mentoring grounded in reflective values can generate sustainable, system-level change even in resource-limited school communities.

Keywords: school, mentoring, reflective practice, post-pandemic recovery, teaching quality

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Introduction

In recent years, many schools have been required to navigate rapid changes while recovering from the long-term impact of the COVID-19 pandemic. For schools operating in resource-constrained contexts, these changes often expose deeper challenges related to instructional leadership, teacher confidence, and the sustainability of improvement efforts. While numerous school improvement programs focus on introducing new structures or external interventions, fewer studies document how change unfolds when it is grounded in everyday school practices and local realities.

This paper presents reflections from a three-year school mentoring program implemented in a low-fee private junior secondary school in Indonesia. Rather than applying a standardized reform model, the mentoring process emphasized contextual and reflective approaches that supported school leaders and teachers in making sense of change together. The program focused on rebuilding instructional trust, strengthening collaborative practices, and gradually embedding routines of reflection, planning, and collective action within the school.

Drawing on qualitative data from observations, reflective logs, and school documents, this study explores how contextual mentoring contributed to the development of teacher professionalism and instructional leadership over time. By situating the findings within local leadership values and broader system-level perspectives on school improvement, this paper aims to offer modest but grounded insights into how sustainable change can emerge from within schools, even in settings with limited resources.

Literature Review

Research on school improvement increasingly suggests that sustainable change is shaped less by isolated programs and more by how schools build shared meaning, professional trust, and continuity in everyday practice. Studies on education reform indicate that improvement efforts are more likely to succeed when interventions are aligned with a school's stage of development and adapted to its local context, rather than applied as uniform solutions across settings (Mourshed et al., 2010).

McKinsey's analysis of improving school systems emphasizes that educational change is fundamentally "a system thing, not a single thing." Schools that demonstrate sustained improvement tend to implement coherent sets of mutually reinforcing practices, including instructional leadership, professional learning, data-informed reflection, and collaborative routines. The study also highlights the importance of contextualizing reform—balancing direction and autonomy—so that changes are perceived as credible and workable by educators (Mourshed et al., 2010).

In the Indonesian context, the **5M framework** proposed by Najelaa Shihab offers a practice-oriented lens for understanding educational change. The framework emphasizes leading change through human relationships, shared conceptual understanding, meaningful challenges, continuity, and empowerment of local context. From this perspective, change is viewed as a collective learning process that grows through reflection and dialogue rather than top-down enforcement (Shihab, 2025).

Taken together, these perspectives suggest that contextual and reflective mentoring can support instructional leadership and teacher development in meaningful ways. Rather than positioning

mentoring as a corrective mechanism, the literature points to its role as a facilitative process that helps schools make sense of change and gradually embed sustainable practices within their own realities (Mourshed et al., 2010; Shihab, 2025).

Mentoring Program Overview

This study is situated within a three-year mentoring program conducted in a low-fee private junior secondary school in Indonesia. The mentoring was designed as long-term, school-based accompaniment rather than a one-off training intervention. Across the three years, mentoring activities evolved in response to the school's readiness and were informed by the **5M leadership framework** as a guiding input for reflection and decision-making.

Phase 1 – Building Foundations (Year 1)

- *Focus:* establishing trust, shared understanding, and instructional direction.
- *Mentoring activities:* school visits, leadership dialogues, and guided reflection sessions with school leaders and teachers.
- *5M input:* Memanusiakan Hubungan and Memahami Konsep, emphasizing relational trust and shared meaning around teaching and learning

Phase 2 – Strengthening Practice (Year 2)

- *Focus:* developing collaborative instructional practices and reflective routines.
- *Mentoring activities:* joint planning, classroom observation, reflective discussions, and documentation of emerging practices.
- *5M input:* Memilih Tantangan and Memberdayakan Konteks, supporting teachers and leaders to engage with context-relevant challenges and local resources.

Phase 3 – Consolidating Continuity (Year 3)

- *Focus:* embedding practices into more stable routines and shared leadership processes.
- *Mentoring activities:* refinement of reflection cycles, assessment discussions, and leadership role distribution.
- *5M input:* Membangun Keberlanjutan, focusing on continuity beyond individual mentoring activities.

Throughout the program, mentoring emphasized adaptation to the school's context rather than the application of standardized solutions. The phased approach allowed practices to develop gradually, supporting the school in making sense of change over time.

Method

This study adopts a **qualitative, practice-based inquiry** approach to explore how contextual mentoring supported instructional leadership and teacher development over time. The research is grounded in a three-year mentoring program conducted in a low-fee private junior secondary school in Indonesia, where the author was directly involved as a mentor–facilitator.

Data were collected through multiple sources to capture changes in practice and meaning-making processes within the school. These sources included classroom and school-level observations, reflective journals and logs written by teachers and school leaders, as well as school documents such as instructional plans, assessment records, and mentoring notes. Rather than treating these data as isolated evidence, they were read holistically to understand patterns of growth, challenges, and adaptation across the mentoring period.

Data analysis was conducted through iterative reflective reading, focusing on recurring themes related to instructional leadership, professional collaboration, and reflective practice. The analysis was guided by the principles of contextual mentoring and informed by the 5M leadership framework, allowing themes to emerge from practice rather than being imposed a priori. To enhance credibility, findings were triangulated across data sources and discussed through ongoing reflection with school leaders during the mentoring process.

This study does not aim to generalize findings to all school contexts. Instead, it seeks to provide a grounded account of how change unfolded within a specific school setting, offering insights that may be transferable to similar contexts facing comparable challenges.

Instrument

This study employed **qualitative, practice-based instruments** designed to support reflection and documentation during the mentoring process rather than to measure performance quantitatively. The instruments were integrated into routine mentoring activities and evolved gradually across the three-year period.

The primary instruments included:

- **Reflective logs and journals**, used by school leaders and teachers to document reflections on instructional practices, leadership decisions, and challenges encountered during the mentoring process.
- **Observation notes**, recorded during classroom observations, school visits, and mentoring sessions to capture instructional practices, interactions, and emerging patterns of collaboration.
- **School documents**, such as instructional plans, assessment records, reflection summaries, and mentoring notes, which provided contextual evidence of how practices developed over time.

In addition, the mentoring process was guided by the **5M framework**, which functioned as a reflective lens rather than a measurement tool. The framework informed the design of reflection prompts and mentoring conversations, supporting participants in making sense of change through relational, conceptual, contextual, and continuity-oriented perspectives.

These instruments were not treated as standalone tools but as complementary sources that enabled triangulation and supported a holistic understanding of the mentoring process within the school context.

Findings

The findings are presented as descriptive patterns that emerged from the three-year mentoring process. Quantitative indicators are included to support qualitative observations and documented records.

Theme 1: Growth in Reflective Teaching Practice

Over the mentoring period, teachers' engagement in reflective practice increased and became more consistent. Based on mentoring records, teachers' reflection scores across the five dimensions of the **5C framework** ranged between **8.9 and 9.0 out of 10**, indicating a high level of perceived relevance and usefulness of the mentoring process. Teachers reported feeling

better understood in their professional needs (*Characterized Relationship*), more confident in grasping essential pedagogical concepts (*Comprehensive Concept*), and supported through feedback that encouraged growth (*Constructive Continuity*). Autonomy in choosing learning challenges (*Challenging Choices*) and the application of learning within the school context (*Community Context*) were also consistently rated at similar levels.

In addition to reflection quality, the number of teachers actively documenting reflective practice increased from **2 teachers at the beginning of the program to 6 teachers by the third year**, suggesting a broader participation in reflective routines.

Theme 2: Strengthening Instructional Leadership and School Systems

Alongside changes in teaching practice, school-level systems gradually developed during the mentoring period. Mentoring documentation indicates that the school introduced a new **curriculum structure** and began implementing a more transparent **remuneration system**, reflecting efforts to align instructional goals with governance and leadership practices. These developments were discussed and refined through mentoring sessions rather than imposed as standalone reforms.

Leadership practices also shifted toward more reflective and facilitative roles, with school leaders increasingly using mentoring conversations to guide instructional discussions and decision-making.

Theme 3: Indicators of School Growth and Continuity

School records show changes that suggest increased institutional stability over time. Student enrollment increased from **6 students at the beginning of the mentoring period to 80 students after three years**. While multiple factors may have contributed to this growth, the increase coincided with the gradual strengthening of teaching practices, leadership routines, and school systems documented throughout the mentoring process.

Taken together, these findings illustrate how contextual, reflection-based mentoring was associated with strengthened professional practice, emerging leadership capacity, and indicators of school continuity over time.

Conclusion

This study concludes that contextual, reflection-based mentoring can support gradual improvements in teaching practice, instructional leadership, and school continuity when sustained over time. Rather than producing rapid transformation, the mentoring process contributed to the normalization of reflective routines, collaborative practice, and emerging system alignment within the school. While the findings are drawn from a single case and are not intended to be generalized, they offer practice-based insights into how mentoring grounded in local context may support sustainable change in resource-constrained school settings. Future studies may explore similar approaches across multiple schools or examine how such mentoring models can be adapted at scale.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author used ChatGPT (OpenAI) as an AI-assisted tool to support language refinement, structure organization, and proofreading of the manuscript. The AI tool was used to improve clarity and coherence of the text. All substantive content, data interpretation, and conclusions remain the responsibility of the author.

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In an Educational Kaleidoscope World: Philippine Curricula, Its Problems, and a Proposed Evaluation Framework

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Abstract

Developing a curriculum for a culturally and linguistically diverse nation such as the Philippine archipelago has proven to be difficult. Over the years, many have criticized the curriculum for being over-congested and irrelevant to the issues and demands of the present world. This is compounded by a lack of basic literacy and twenty-first-century skills among basic education learners. Various reforms have been initiated to develop the foundational skills among learners. This includes the K-12 curriculum, which extended the existing ten-year curriculum into a thirteen-year curriculum. However, the K-12 curriculum was proven to be inefficient for many Filipinos who favored the shorter curriculum. Many even deem the curriculum to have failed to prepare students for either work or higher education, both of which were promised by the new curriculum. In the first place, what should have been the goals for a basic education curriculum? This question was front and center as the new Matatag curriculum was crafted early this year. This curriculum aimed to focus on foundational skills and decongestion, yet these solutions have already been proposed in the previous curriculum. Given various solutions to the educational crisis, this paper aims to articulate the problems in previous curricula and compare them with the solutions offered by the curriculum. Moreover, this research seeks to lay the groundwork for research and evaluation of the Philippine curriculum, especially given the novelty of the 2024 Matatag Curriculum.

Keywords: Philippine curriculum, curriculum evaluation, history of education

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Introduction

The Philippine education system has long been plagued with issues in quality and delivery. This has been evidenced by the country's performance in the latest Programme for International Student Assessment (PISA) rankings in 2022, where the government has placed seventy-seventh out of eighty-one countries based on the PISA test scores taken by fifteen-year-olds internationally in the subject areas of Mathematics, English, and Science (Ines, 2023). According to the Organisation for Economic Co-operation and Development, which conducts the PISA every three years, there is a 120-point deficit between the Philippines and the world averages. This indicates that Filipino students lag six years behind their international peers.

The Philippine educational system's dismal performance has long been criticized and lambasted. This has prompted reform in the academic curriculum in the Philippines. The result is the 2024 Matatag Curriculum (hereafter referred to as the Matatag Curriculum), the first curriculum reform in twelve years since the 2012 K-12 Curriculum, which, in turn, is the first to implement a full thirteen-year curriculum. The Matatag Curriculum had various hallmarks, such as decongesting the curriculum by consolidating and eliminating redundant learning competencies, leaving a focus on foundational skills. In this regard, the Matatag Curriculum was able to decongest the curriculum by 70% according to official figures by the Department of Education (Department of Education, 2023). Given that the K-12 Curriculum was laid out in 2012 with a similar aim of boosting the curriculum's competitiveness, how does the Matatag curriculum differ in this regard? How can the Matatag curriculum go beyond a face-saving measure aimed at salvaging the Philippines' long-existing educational woes? These are among the key questions this research seeks to answer.

This research seeks to contextualize the problem on an international stage. While it does not aim to capture the research field in its entirety, this article seeks to delineate the background of the issue at hand and lay the groundwork for further study to evaluate the current Matatag Curriculum. Specifically, this research aims to establish an evaluation framework to help professionals identify and pinpoint issues in the educational sector. This, in turn, can be used by education decision makers to develop a curriculum that is not only effective but also relevant to the Filipino context. Given the complexity of the Philippine education system, it is essential to create a curriculum that not only considers the steps in the implementation process but also the interactions of the curriculum within individuals and societies. Such is the design of the constructed evaluation framework, which will be further elaborated in the next chapter. The following sections will establish the historical and social rationale for the issue at hand and explain why it is essential to draft an evaluation framework that can adequately assess Philippine curricula, especially the most recent 2024 Matatag Curriculum.

Historical and Policy Context of Philippine Curriculum Reform

A decade ago, the Philippine education system was extended from a ten-year curriculum (ranging from grades one to ten) to a thirteen-year curriculum (ranging from kindergarten to grade twelve), the latter of which has been heralded as the global standard. Before this reform, the Philippines was the last country in Asia to require only ten years of basic education in its standard curriculum. Aside from requiring kindergarten and two more years of high school (termed as senior high school), the curriculum has also marked a shift to that of a mother tongue-based multilingual education (MTB-MLE) curriculum for early education until the end of third grade in place of the bilingual education curriculum, where Filipino is

used as the language of instruction for Filipino, Social Studies, Values Education, Home Economics, as well as Music, Art, Physical Education, and Health (MAPEH), while English is used for English, Science, and Mathematics. However, the bilingual education scheme was retained from fourth grade onwards, with the subjects taught in those respective languages. While this is practiced by all public schools as mandated by the Department of Education, private schools are given more leeway in this regard.

The evolution of the Philippine education system is often synonymous with its colonial history. It is an understatement that the four centuries of combined Spanish, American, and, for a brief period, Japanese colonization had a profound impact on the Philippine education system. That said, informal education was already established in pre-colonial times, when the heads of *barangays* (villages) taught basic communication skills and weaponry to their constituents (Orata, 1956). Formal education was introduced by the Spaniards in the 16th century, who aimed to emulate the educational system of the West, with education focusing on religion, numeracy, and literacy. That said, however, the education system during this period was still rudimentary throughout the three centuries of Spanish colonial rule, which ended in 1898, with the belief that education should only be reserved for Spanish students, especially in the *colegios,* which did not accept Filipino students until the mid-1800s (Low et al., 2022). At this time, due to the lack of separation between church and state, education was mainly religion-oriented in nature and was heavily controlled by Filipino Catholic churches. This continued until the Spanish ceded the Philippines to the Americans through the Treaty of Paris in 1898 (Low et al., 2022).

One of the hallmarks of American-colonized education was the shift from Spanish to English as the medium of instruction. At the time the Philippines fell under American control, the colonizers rapidly reopened elementary schools in towns and cities while establishing new schools, especially as the Philippine commission mandated the establishment of a high school for every provincial capital- before this, most Filipino students were only expected to attend until elementary school (Casambre, 1982). At the time, seven years of elementary schooling and four years of secondary schooling were required to complete the basic education cycle and enter university.

As part of “an educational experiment to prepare the people for self-government,” the Monroe Commission later suggested a change in the educational system akin to a K-12 set-up seen today. This was done in stages – first, the seventh grade had to be abolished, after which two more years of high school would have been established. However, only the abolition of the seventh grade was achieved, resulting in a ten-year curriculum for decades. This is partly because the experiment was disrupted by the Second World War, as the curriculum was completely revised by the Japanese, whose goal was to eradicate Western influence and hegemony in favor of the spirit of the Asia Co-Prosperity Sphere, which was conceptualized by Japan just before the Second World War. Though the status quo prevailed after the end of World War II, the system remained a ten-year system until 2016, when grades eleven and twelve rolled out amongst the general population (Orata, 1956).

In 1957, less than a couple of decades after the war, the curriculum was changed to reflect the growing demand for vocational education in the country (Orata, 1959). Prior to this change, the curriculum was designed for students to proceed to higher education; however, schools may choose between a full academic curriculum and one that places a slight emphasis (around 25%) on vocational programs. In the newer curriculum, also known as the 2+2 curriculum, students will take a common curriculum for the first two years of secondary

education, after which students can proceed to focus on either academic or vocational education for the remaining two years of high school. This was fitting considering that the Philippines was undergoing a rapid transition from an agricultural to an industrial nation.

During the Marcos regime, however, there was a change of focus as they placed a higher emphasis on the basic skills – so-called the three R's: reading, writing, and arithmetic. More emphasis was also placed on the principles of the New Society (*Bagong Lipunan*), which aim to echo and justify the authoritarian regime of Ferdinand Marcos (Clarke, 1977). The vocational and academic focuses were temporarily retired for roughly four decades, until the expansion to the K-12 curriculum. In a way, the new expansion revived the academic-vocational split in the last two years of high school; the key difference this time was that the lower division was expanded to four years, which is now known as junior high school today. That said, however, there is already a change in perception on basic education and what its function is in today's society, even during the latter half of the 20th century. What exactly is the purpose of basic education in the Philippine setting? Such a question remains as experts debate on the current and future curricula's purpose.

With the unseating of the Marcos dictatorship, a reform of the Philippine Education system in 1989 followed. By this time, the general subject areas have begun to take shape, resembling the modern-day curriculum. The 1989 New Secondary Education Curriculum and the 1983 New Elementary Education Curriculum features eight core areas: Filipino; Social Studies; Science (Science and Health for grade school students, and Science and Technology for high school students); Mathematics; Music, Art, Physical Education, and Health; Good Morals and Right Conduct (GMRC) or Values Education English; and Technology and Home Economics. In the New Elementary Education Curriculum, however, there is a gradual addition of subjects: in first and second grade, only English, Mathematics, Filipino, and Social Studies (Civics and Culture) are studied. In the third grade, Science and Health, as well as Music, Arts, and Physical Education (MAPE) are added (Ministry of Education, Culture, and Sports, 1986. Finally, Home Economics and Livelihood Education (HELE) is added starting in the fourth grade. At this time, character education is embedded across all learning areas in elementary school, with values education being a separate subject in high school.

However, woes still persist within the Philippine education system. With this, the First Congressional Commission on Education (EDCOM 1) was formed jointly with the Senate and the House of Representatives in order to probe and propose solutions to the educational system's shortcomings (Department of Education, Culture, and Sports, 1993). Some of the solutions include the extension of the school year from a minimum of 185 to 200 school days, with the beginning of the school year moved to the first Monday of June. Moreover, contact time in Science and Technology as well as Technology and Home Economics was increased from 60 minutes to 80 minutes daily.

However, the Philippines' educational crisis continued. More than a decade later, the Philippine Basic Education Curriculum was rolled out, starting in 2002, with an aim to further focus on foundational skills in reading, writing, science, patriotism, and numeracy to improve the literacy rate, with students not being able to read even by the end of elementary school (Department of Education, 2002). Moreover, the curriculum is decongested and further integrated in order to focus on the key areas. Another change was that the areas of Social Studies, Music, Art, and Physical Education, and Livelihood Education were all merged into a subject called Makabayan, which is dubbed to be the "laboratory of life."

Eventually, however, it was realized that the issues could only be solved through further reforming the curriculum by adding two more years. This was thought to have made the Philippine education system more competitive globally. This was materialized through Republic Act 10533, also known as the Enhanced Basic Education Act of 2013. As a result, the K-12 Basic Education Curriculum was crafted. The two-year extension of the curriculum is aimed at allowing for the mastery of concepts while preparing students for either career or further education, depending on the goal of the students. The thought of a curriculum that prepares job-ready students was entertained, given the lack of interest in college among most students. This is especially noticeable as only a minority of Filipino students have historically enrolled in further education despite reforms, with only 41% enrolling in college as of 2023 (Mateo, 2023).

Another feature of the K-12 curriculum is the Mother Tongue-Based Multilingual Education System, as mentioned in the earlier section. Instead of the bilingual system adopted in the past, mother tongue was instituted as the medium of instruction from Kindergarten to Grade Three. This has allowed students to move towards a more gradual adjustment from their first language to the bilingual education system in later grades. Given the complexity of the Philippine language framework, however, many problems arose as a result of the system and its lack of proper implementation. As the country has over one hundred languages across the archipelago, there could be potential barriers and inequities, especially if more resources are dedicated towards materials developed in mainstream languages. Moreover, the shift in language is confusing for both teachers, who had to adjust teaching methods and create new materials, and learners, who faced an abrupt change from the mother-tongue-based system in the earlier years to the bilingual-based system starting in the fourth grade. These changes didn't prove to have an effect as well, as evidenced by the latest PISA rankings, as mentioned earlier, where Filipino students lag almost six years behind their peers on average.

The K-12 curriculum at this time also experienced an identity crisis. Many were confused about the rationale for extending the educational system. Was it to prepare students for further education, or was it to prepare students for future jobs? In other curricula across the world, it was probably neither: for the most part, K-12 systems were solely there to strengthen the basic education and formation amongst the youth: preparation for the future came in secondary, but for the most part, it was still about strengthening foundational skills, which is often the hallmark of most basic education curricula. However, the Philippine senior high school system was meant to prepare students for either academic (which is subdivided into Science, Technology, Engineering, and Mathematics; Humanities and Social Science; General Academic; or Accountancy, Business, and Management strands) or vocational fields, depending on their track. Though these two fields are the most sought-after tracks, there were also special tracks for arts and sports students. That said, the senior high school system consisted of a core curriculum consisting of fifteen required subjects taught across both academic and vocational tracks. As a result of the combination of required core subjects as well as the subjects specific to one's specialization, the senior high school curriculum appears to have an identity crisis: what exactly does senior high school prepare students for? What exactly is it meant to do? This question is further compounded by the lack of acceptance of senior high school graduates amongst blue-collar jobs – in the case of the Philippines, most entry-level jobs, such as cashiers and servers, still require college degrees for the most part. Initially, the K-12 promised job-ready graduates after basic education, but in reality, most social institutions and industries did not readily conform to this and took a while to adjust to the K-12 standard, with some still requiring college degrees up to this day. On the academic side, while the skills of students, many professors still lack the confidence in teaching

university-level material to high school graduates. Moreover, there seems to be redundancies between senior high school and college – for example, students in STEM take general chemistry twice, once in senior high school and once in college. This is due in part to the lack of confidence among Higher Education Institutions (HEIs) and the Commission of Higher Education (CHED), both of which work to prescribe the curriculum for university students. It is safe to say that there is a lack of coordination between the Department of Education and the Commission on Higher Education in this case. This raises another important question: if the goal of senior high school is to prepare work-ready or college-ready students, why is senior high school under the supervision of the Department of Education rather than the Technical Education and Skills Development Authority and the Commission on Higher Education? Regardless if the K-12 aimed to prepare students for university or career, or whether it aimed to strengthen skills and knowledge in basic education instead, the K-12 does not seem to address any of those goals.

With these issues, acceptance of the K-12 curriculum has gradually waned, with legislators proposing a K+10+2 model, as suggested by Former President Gloria Macapagal Arroyo, who wanted to require only college-bound students to study 13 years of basic education, with vocational students ready to graduate after 11 years (Chi, 2023). Many believe that the extra two years of the curriculum are a waste of time and money, when senior high school students could already be in college.

At one end, the curriculum aimed to improve the readiness of Filipino students for work or further education, depending on their goal. It, however, failed to address the qualms of many with previous curricula. As noted by the present Department of Education, the curriculum is still overloaded with redundant competencies. This has led to the institution of the Second Philippine Congressional Commission on Education (EDCOM 2), which has sought to address the Philippines' long-standing educational crisis.

Persistent Systemic Issues in Philippine Basic Education

In order to address the ongoing challenges with the present education system, the Department of Education in 2023 released the Matatag Agenda, which sought to review the curriculum based on the deficiencies highlighted by the PISA Assessment Rankings as well as feedback from various stakeholders (Department of Education, 2023). Given that this shows a strong correlation with the Basic Education Exit Assessment, where low proficiency levels were observed in Problem Solving, Critical Thinking, and Information Literacy Skills. A thorough review of the curriculum was conducted, where it was found that despite the curriculum being decongested multiple times, it was still overloaded with competencies, some of which were misplaced or redundant; thus, recommendations were made to decongest and restructure the competencies in the curricula. Beyond the curriculum, there were also other factors that perpetuated the educational crisis, especially as some teachers lack adequate time or preparation to teach all competencies in the curriculum, with only 20% of the teacher population being able to complete all competencies in a school year.

Again, with previous curricula, the Matatag Curriculum aims to focus on foundational skills such as language, literacy, numeracy, and patriotism. This time, however, the learning areas in grade one have been changed: in the first grade, Reading, Language & Literacy, Mathematics, Good Morals and Right Conduct, and *Makabansa* are taken up by students. The latter is a new subject area more akin to the *Makabayan* subject area of the RBEC in 2002. It still aims to combine social studies with music, art, and physical education- this time,

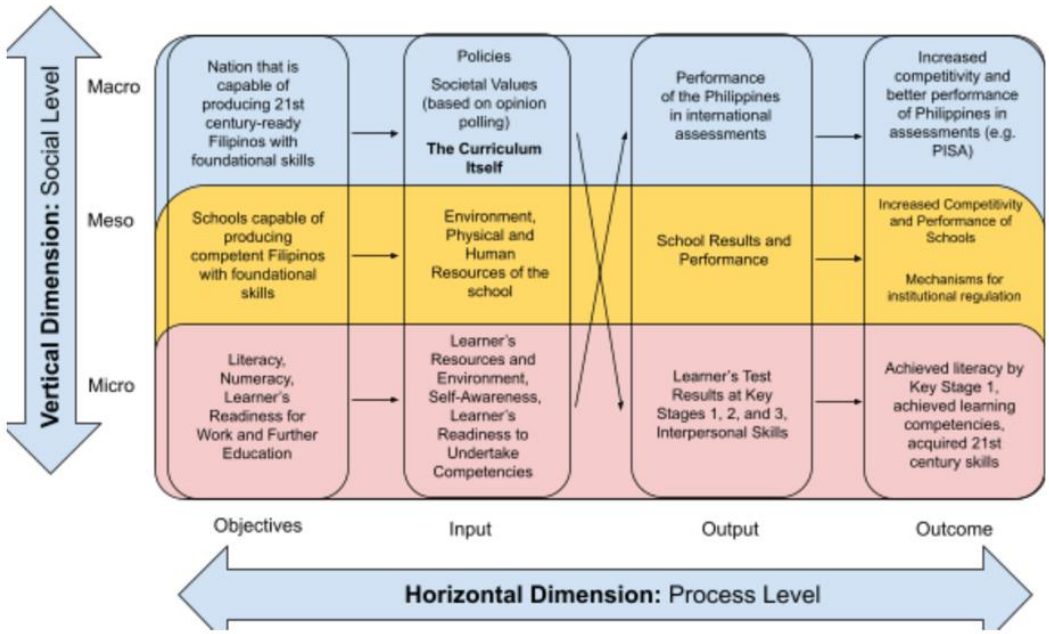
however, the competencies are integrated as one subject rather than multiple sub-areas. English and Filipino have been replaced with Reading and Language subjects, which aim to boost literacy amongst first graders- these are both taught in the common language of the students. Thereafter, students will start learning English and Filipino in second grade, as well as Science starting in third grade. In fourth grade, *Makabansa* is now split into social studies and music, art, physical education, and health (MAPEH). At this stage, technology and livelihood education are also introduced. By this time, students have eight subject areas from grades four to ten, namely Filipino, English, Mathematics, Science, Social Studies, Music, Art, Physical Education, and Health (MAPEH), and Technical and Livelihood Education (TLE). In an effort to decongest the curriculum, the mother tongue was removed, and the medium of instruction was changed back to the bilingual method. While the subjects' competencies are decongested, the contact time remains unchanged from the K-12 curriculum, giving teachers more time to deliver the competencies. Given that the Matatag Curriculum was rolled out this year, only time will tell whether or not the adjustments made will be successful.

With the various changes in each curriculum, the same pattern emerges: the curriculum is found to be too saturated, then reforms are made to decongest it and focus on the key areas. Various innovations were also introduced, such as merging subjects and introducing new ones, such as mother tongue education. However, the same woes exist despite these changes. What makes the recent changes to the curriculum different from the innovations and policies that preceded it? How can one be so sure that these policies will work this time around? These are the questions this research aims to provide a framework for.

A Two-Dimensional Evaluation Framework for Curriculum Reform

This research aims to produce a literature-based multi-dimensional evaluation tool that will evaluate curricula, such as the current curricula, in order to ascertain whether these curricula have succeeded in their goals. This chapter will revisit evaluation models in related literature in order to construct an evaluation tool for curricula within the Philippine context. Moreover, the constructed evaluation tool may also be used to evaluate and compare various curricula, which will be tested in case studies. This evaluation tool uses the learner as the frame of reference, given that outputs and outcomes directly concern the learner’s attitude and performance. The overall evaluation tool is shown in Figure 1.

Figure 1
A Proposed Two-Dimensional Evaluation Framework for Philippine Curriculum



As mentioned, two forms of program logic will be employed. The horizontal evaluation model can also be defined as a goal-oriented approach, which defines the inputs put towards a goal, the output that results from it, and the resulting outcome that arises. Beyond the curriculum itself, there are also factors, especially in the implementation, that hinder the curriculum from achieving its goals. To effectively troubleshoot and identify the sources of problems in the curriculum, a holistic analysis must be incorporated into the evaluatory framework. Given the lack of involvement of resources as well as various extrinsic and intrinsic factors in the curriculum analysis frameworks mentioned in the previous section, this evaluation tool aims to fill in the gap by studying the interactions of various factors within the self (micro level), group (meso level), or society (macro level), which will be further elaborated in the coming sections.

The horizontal program logic is adopted from the regulatory benchmarking model devised by Vilela and Ahn, where the researchers were able to use benchmarking as a form of evaluation of monopolistic energy operators in Brazil, which are aimed at reducing regulatory costs and the establishment of external goals for monopolistic firms (Emans, 1966). The researchers proposed a goal-oriented approach to ensure that benchmarks are met. The outcomes set forward by the framework are, in turn, governed by metrics that were set accordingly, which in turn correspond to the input at the start of the process.

In the case of the goals for the curriculum evaluation tool, it is imperative that these goals be based on the shaping paper of the said curriculum, which explains not only the specific goals targeted by the curriculum, but also outputs and metrics that correspond to the goal. While the primary goal of the new curriculum is to "equip Filipino learners with the necessary skills and competence to prepare them to take on the challenges of the 21st century,"19 The goals are further subdivided into subject areas. For example, the primary goal for the mathematics curriculum is to "become mathematically proficient and critical problem solvers," while that of the first-grade reading and literacy curriculum is for learners to "demonstrate basic literacy in their first language." In the shaping paper, these goals are quantified using an assessment,

feedback, and reflection mechanism – all of which aim to measure the student's proficiency and performance with regard to the concerned learning competencies. These are complemented by nationwide exams such as the Early Language, Literacy, and Numeracy Assessment (ELLNA) assessment taken at the end of third grade, as well as the National Achievement Test (NAT), which tests for mastery of the expected learning competencies at the end of grades six, ten, and twelve. These long-standing indicators will continue to be used to measure the mastery of students. In the past, the 2017 ELLNA results were used as a springboard for the new curriculum, given the students' deficiencies in language (across Mother Tongue, Filipino, and English) as well as numeracy. In the same vein, the 2018 Basic Education Exit Assessment (now the Grade 12 NAT) pointed out the students' deficiencies in not only foundational skills, but also in twenty-first-century skills such as problem solving, information literacy, and critical thinking skills. Given that these outputs are strong indicators of the goals laid out by the curriculum, it is still important to use these metrics in the new curriculum. The inputs in this model refer to the resources as well as other factors that contribute towards an output through a process. In the case of this model, inputs involve aspects concerning intrinsic factors relative to the learner, as well as extrinsic factors such as the learner's environment. This is especially important given the integration of the goal-input-output-outcome process logic with the micro-meso-macro level, wherein there are interactions between the self as well as their environment, which will be discussed in succeeding sections.

In Vilela and Ahn's goal-based model, the goals, outputs, and inputs were accordingly classified according to the type and level of stakeholdership. For example, institutional stakeholders were grouped according to their role in the electricity transmission sector. Moreover, operational stakeholders were further subdivided into supply chain, secondary resources, and the environment (Vilela et. al. 2022). In a way, such goal-based analysis as done by Vilela and Ahn can be complemented by a vertical model, in the form of a micro-meso-macro analysis. Nelhans argues that metrics must also be seen within such a social model to properly qualify and describe quantitative measures, especially as indicators and metrics should be distinct, unobtrusively collected, and should not be directly affected by the measurement tool (Nelhans, 2022).

Nelhans was able to investigate the performance-based research allocation models for researchers at the micro, meso, and macro levels. At the micro level, performance-based research models were also used among individuals, where researchers were evaluated individually, a system that was in use in Umeå University since 2008. As a result of this individual evaluation, researchers feel stress at the individual level, given the competition to publish in order to gain incentives, which in this case is funding for the investigator. This feeling also resonates with students who experience the same phenomenon at the basic education level. With this, it is imperative to integrate the intrinsic and extrinsic factors even at the individual level. In such a case, factors belonging to the macro level, such as policies, can determine the outcome and consequently indicate whether the goal is met. In the case of the goals of the curriculum, all three levels (micro, meso, and macro) share the same goals, but only differ in the societal impact – given that micro is limited to the individual, it is limited to the self's competencies, on the other hand meso and macro levels are concerned with the greater populations – namely the school and the society as a whole.

Conclusion

Over the decades, Philippine education has been shaken and reshaped many times. Each reform brought new arrangements of color and structure, but the pieces inside the tube often remained the same. Those pieces: the systemic issues, the resource gaps, the misalignments, and the uneven learning conditions, are precisely what continue to limit the impact of every new curriculum. Curriculum reform alone cannot fix what is fundamentally systemic. One can revise competencies, restructure learning areas, or extend the number of years in basic education, but unless the very conditions in which these reforms are implemented are addressed, very little changes at the level that matters most: the learner. This is precisely why an evaluation framework is needed not only to identify whether goals, inputs, outputs, and outcomes are aligned, but also to evaluate not just the learner, but the school cultures, the environment, as well as the national structures that shape educational possibilities. Only if there is a more grounded, realistic, and learner-centered approach to understand educational reform can our curriculum evolve into something stronger, more coherent, and truly transformative for Filipino learners.

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Outcome-Based Education in ASEAN Design Education Programs: Implementation, Practices, and Challenges

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Abstract

Outcome-Based Education (OBE) has become a central framework shaping curriculum design and quality assurance in ASEAN higher education, particularly in professionally oriented fields such as design education. This paper examines how OBE is implemented across design-related programs in ASEAN, identifying prevailing practices, key challenges, and innovative approaches. Drawing on regional policy analysis and selected institutional examples from Indonesia, Malaysia, the Philippines, and Vietnam, the study highlights the influence of national qualification frameworks and ASEAN University Network–Quality Assurance (AUN-QA) standards on learning outcomes, teaching strategies, and assessment practices. An in-depth case study of the Design Innovation Program (DIP) at King Mongkut's University of Technology Thonburi (KMUTT) illustrates a distinctive model of OBE implementation through long-term work-integrated learning and industry co-creation. The findings suggest that while OBE enhances transparency, graduate readiness, and industry alignment, its effectiveness depends on sustained collaboration, faculty capacity, and coherent assessment systems.

Keywords: outcome-based education, design education, ASEAN, work-integrated learning, quality assurance

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Introduction

Outcome-Based Education (OBE) emphasizes the clear articulation of intended learning outcomes and the systematic alignment of curriculum, teaching, and assessment to ensure that learners achieve demonstrable competencies (Spady, 1994). It has been widely adopted across ASEAN higher education as a mechanism for improving graduate quality, transparency, and international comparability. In design education, OBE is particularly relevant because programs are expected to develop complex combinations of creative, technical, professional, and interpersonal competencies. This paper explores the implementation of OBE across ASEAN design education programs and examines the opportunities and constraints associated with translating outcome frameworks into effective teaching, learning, and assessment practices.

Methodology

This study adopts an empirical research approach through a qualitative case study methodology. It combines comparative analysis and in-depth documentation to explore the implementation of Outcome-Based Education (OBE) in design-related undergraduate programs within ASEAN. The first layer of inquiry involves a thematic analysis of OBE practices across regional institutions in Indonesia, Malaysia, the Philippines, and Vietnam, drawing from policy documents, academic literature, and quality assurance frameworks such as AUN-QA. The second layer presents an in-depth case study of the Design Innovation Program at School of Architecture and Design (KMUTT), focusing on its real-time implementation of OBE in collaboration with industry partners. This includes the co-development of learning outcomes, teaching strategies, and assessment rubrics with professionals from Jacob Jensen Design and 4digit Thailand. The case exemplifies both challenges and strengths of applying OBE through experiential learning and work-integrated education. This dual-layered, evidence-based qualitative approach allows the study to capture nuanced educational practices and contribute to grounded recommendations for improving OBE in design education across the ASEAN region.

Current Status of OBE Adoption in Design Education Programs (ASEAN)

Across ASEAN, the adoption of OBE has been strongly influenced by the ASEAN University Network–Quality Assurance (AUN-QA) framework, which emphasizes outcome clarity, alignment, and continuous improvement (ASEAN University Network, 2016). In the Philippines, for example, the Commission on Higher Education (CHED) mandated a shift to OBE in 2012, prompting universities to redesign curricula around intended learning outcomes (Commission on Higher Education [CHED], 2012). By 2021, studies indicated that both accredited and non-accredited Philippine institutions were largely compliant with CHED's OBE framework, though they continued to face challenges in fully realizing effective outcome-based teaching. Malaysia has likewise embedded OBE into its national quality framework – all programs (including Art & Design degrees) are aligned with the Malaysian Qualifications Framework (MQF), which requires "a clear definition of the intended outcomes" for each program, supported by appropriate teaching methods and assessments (MQA,2024).

Across the region, many universities have embraced OBE as part of quality assurance and accreditation initiatives. The ASEAN University Network – Quality Assurance (AUN-QA) system, in particular, has been a driver of OBE adoption. AUN-QA assessments focus on clearly defined learning outcomes aligned to program objectives, using these outcomes to

evaluate program effectiveness and ensure students attain the desired competencies (Pham & Vu Nguyen, 2023). In Vietnam, for instance, national standards for program accreditation were essentially "borrowed" from AUN-QA, and since 2009 a number of Vietnamese universities have had their programs (including design majors) assessed under the AUN-QA criteria (Pham & Vu Nguyen, 2023). This trend continues as of 2024, reflecting a broad regional move toward outcomes-based quality standards. Still, OBE implementation is at varying stages across ASEAN: some countries and institutions have fully integrated an outcomes-based approach, while others are still strengthening faculty capacity and understanding of OBE principles. In general, however, the trajectory is clear – outcome-based curricula are now a central feature of design education programs in the region, intended to improve graduate competencies and international comparability.

Notable Examples of OBE Implementation in Design Programs

Numerous ASEAN universities have pioneered notable OBE practices in their design degree programs. A common hallmark is seeking AUN-QA accreditation or similar outcome-focused certifications for these programs:

- Indonesia – Universitas Multimedia Nusantara (UMN): UMN's Visual Communication Design program underwent an AUN-QA international assessment in 2021 and achieved a successful rating. AUN-QA is explicitly an OBE-oriented quality standard, and UMN's program met 11 evaluation criteria covering curriculum design, teaching/learning processes, learning outcomes, resources, and continuous improvement – all centered on outcomes-based education governance (*Universitas Multimedia Nusantara, 2021*). This indicates that the program's curriculum and management were on par with ASEAN OBE standards.
- Philippines – University of the Philippines (UP): At UP Diliman (and its extension in Baguio), several Bachelor of Fine Arts (BFA) programs in design have undergone external quality reviews aligned with AUN-QA. In late 2024, UP subjected its BFA in *Industrial Design* and BFA in *Visual Communication* (among others) to an AUN-QA formatted assessment, examining how well these programs achieve their stated outcomes (Sazon, E. & Ramos, 2025). This reflects a strong institutional commitment to OBE – the design programs are explicitly framing their curricula around expected learning outcomes and having them vetted against regional standards.
- Vietnam – Hoa Sen University (HSU): Hoa Sen University has actively pursued AUN-QA accreditation for its design majors. By mid-2021, HSU's Interior Design bachelor's program had been certified as meeting AUN-QA outcome standards, and in 2022 its Graphic Design program was likewise accredited (Hoa Sen University. (n.d.). Students in these programs benefit from curricula that are transparently aligned to learning outcomes and rigorously evaluated. Such accreditation signifies that teaching, learning, and assessment in those design courses are structured to achieve the intended competencies, and the degrees are more regionally recognized as outcome-based qualifications.
- Malaysia: All public and private universities in Malaysia implement OBE in design programs by requirement of national policy. For instance, a typical Malaysian Art & Design degree program is designed in constructive alignment with program learning outcomes defined under the MQF clusters (e.g. knowledge, cognitive skills, practical and interpersonal skills, etc.) (MQA,2024). As a result, universities like Universiti Teknologi MARA or Universiti Sains Malaysia have mapped their visual arts, industrial design, and related curricula to ensure each course contributes to the graduate outcomes specified in the Malaysian Programme Standards for Art & Design. This systematic

adoption makes Malaysian design degrees a regional model for outcome-based curriculum structure.

These examples illustrate that OBE is not just a theoretical ideal but is actively shaping program design and delivery. Design faculties across ASEAN are revising syllabi, course content, and program objectives to align with outcome frameworks, often guided by AUN-QA or national QA agencies. The result is a growing list of design programs – from visual communication and multimedia design to product/industrial design and design innovation – that explicitly state their expected learning outcomes (ELOs) and continuously assess whether those outcomes are achieved, thereby closing the quality loop.

Teaching and Learning Strategies Aligned With OBE in Design Education

In OBE-aligned design programs, student-centered and experiential learning strategies are emphasized to ensure students achieve the targeted outcomes. Rather than relying solely on traditional lectures, instructors employ methods that actively engage students in applying design concepts and skills. Common teaching and learning strategies in design under OBE include:

- Studio-Based Learning and Projects: The design studio model – where students learn by doing design projects under instructor guidance – is a core pedagogy aligned with OBE. Students tackle practical design briefs (e.g. creating a product prototype or visual campaign), allowing them to demonstrate outcomes like creative problem-solving, technical proficiency, and project management. Program guidelines in the region list *"practical workshop/studio work"* as primary learning activities in art and design fields. This confirms the premise of Dewey that Experiential learning in design education draws on longstanding educational theory that positions learning as emerging through experience, reflection, and interaction with real-world contexts (1938). Through iterative studio projects and critiques, learners progressively attain the intended outcomes (for example, an outcome on *"ability to integrate form and function in product design"* is developed via successive studio assignments).
- Problem-Based and Collaborative Learning: OBE encourages design students to engage in problem-based learning (PBL) – tackling real-world design challenges in teams – to achieve outcomes related to critical thinking, teamwork, and communication. Many ASEAN design programs incorporate collaborative projects (sometimes interdisciplinary) where students must apply design thinking to solve a problem for a "client" or community. This student-centered approach aligns with outcomes on innovation and user-centered design. This supports learning through design and production, not just theory. As Papert discusses, learning through design and production aligns with constructionist perspectives, which emphasize knowledge construction through the creation of meaningful artefacts (1980). It shifts the classroom dynamic from teacher-led to learner-driven, as students must research, ideate, and prototype solutions (with the teacher as a facilitator). Such active learning ensures that by the end of the course, students can "demonstrate…skills" rather than just recall content.
- Industry Engagement and Work-Based Learning: To make outcomes more career-relevant, programs integrate industry-based learning experiences. This can include internships, apprenticeship-style projects, or industry-sponsored studio problems. For instance, some curricula have a required industrial training or fieldwork component in a relevant design industry, which maps to outcomes like professional practice and entrepreneurship. Notably, the Malaysian design program standards highlight Work-Based Learning (WBL) as part of teaching methods. Guest lectures from industry

practitioners and field visits are also utilized to expose students to current industry standards, thereby supporting outcomes related to industry knowledge and networking.

- Constructive Alignment in Teaching: Educators in OBE design programs that consciously align each learning activity with specific course learning outcomes. This principle of constructive alignment means, for example, if an outcome is *"ability to communicate design ideas effectively,"* the course will include activities like design presentations or critiques to build that ability. AUN-QA assessments have in fact helped universities adopt these practices – driving faculty to ensure that curriculum design, teaching approaches, and assessment methods all reinforce the stated outcomes (Pham & Vu Nguyen, 2023). In practice, design lecturers might use scaffolding: early in the term they introduce fundamental skills (drawing, software, theory) via demonstrations and exercises, and later require students to integrate those skills in complex projects, thereby aligning weekly learning tasks with the progressive attainment of outcomes.

Overall, teaching in an OBE context tends to be learner-centric. There is greater use of formative feedback (e.g. weekly critique sessions in studio) so students understand how to improve relative to outcome criteria. The learning environment is often flexible and creative, allowing different students to achieve outcomes through varied means (recognizing that design problems can have multiple valid solutions). By involving students in active creation and reflection, these strategies ensure that by graduation, design students have not only covered the syllabus but have demonstrably achieved the competencies (creative, technical, cognitive, and professional) that the program promises.

Assessment Methods Supporting Learning Outcomes in OBE-Based Curricula

Assessment in OBE-aligned design programs is designed as a feedback and measurement tool to verify that students are attaining the learning outcomes. Key features of assessment practices in this context include:

- Outcomes-Aligned Assessment Criteria: Instead of grading on a curve or simply comparing students against each other, OBE assessments explicitly measure each student's work against the predefined outcomes or criteria. Rubrics are widely used – for every major design assignment or project, instructors develop rubrics listing the expected learning outcomes (or related performance indicators) and assess the level of achievement for each. For example, a project in an industrial design course might be assessed on criteria like *"functional innovation," "aesthetic resolution," "user-centered research,"* each tied to course outcomes. A student's grade thus reflects how well they met each outcome area. ASEAN quality standards emphasize this alignment; Malaysia's accreditation guidelines state that assessment methods *"must clearly measure the achievement of the intended learning outcomes"* (MQA,2024).
- Mix of Formative and Summative Assessments: In line with OBE principles, design programs use both continuous (formative) assessments throughout the term and summative assessments at the end. Continuous assessments may include design exercises, process work (sketchbooks, prototypes), quizzes on theory, and mid-term project milestones. Summative assessments often take the form of final design projects, portfolios, or capstone exhibitions. Importantly, students are typically required to pass both the continuous and final assessment components of a course to ensure they have steadily achieved outcomes and can demonstrate them in a culminating work (Universiti Malaysia Pahang Al-Sultan Abdullah [UMPSA], n.d.). This prevents a scenario where a student crams at the end to pass an exam without having consistently developed the skills. For instance, a Final Year Project (thesis project) in a design

program is a common summative assessment that evaluates a range of program outcomes (from conceptualization and technical execution to presentation and reflection), and it is usually supported by earlier project work and mentorship (formative) leading up to it.

- Authentic and Performance-Based Assessments: Because design is a practice-oriented field, assessments are often performance-based, meaning students must produce artefacts or perform tasks that an entry-level designer would. *Assignments, design projects, presentations, portfolios, and exhibitions* are favored over traditional pen-and-paper exams for assessing higher-order skills. For example, students might be assessed by mounting an exhibition of their design prototypes or by presenting a branding campaign to a panel. These methods are authentic – they simulate real design scenarios – and they directly measure outcomes such as creativity, technical competence, communication, and client responsiveness. A survey of suggested assessment forms for design programs shows a variety ranging from quizzes and observations (for foundational knowledge) to portfolio reviews, peer assessments, case studies, and final exhibitions for integrated skills (Williams & Askland, 2012). The variety ensures each learning outcome (cognitive, practical, interpersonal, etc.) is appropriately evaluated.
- Use of Feedback and Reflection: OBE assessment is often used not just for grading but to support learning. In many ASEAN design courses, after a project is evaluated, students receive structured feedback referencing the learning outcomes (e.g. "your work met the outcome of effective visual communication, but to fully achieve the outcome on research-backed design, more user testing was needed"). Students might be asked to reflect on this feedback and outline how they will improve. This practice helps close the loop – it aligns with the notion that assessment should *"support students' opportunity to learn important things"* and encourage improvement. Thus, assessment becomes part of the learning process in OBE, guiding students toward outcome mastery.
- Quality Assurance of Assessment: Institutions also put mechanisms in place to ensure assessments remain fair and outcome-focused. Many ASEAN universities have assessment moderation or validation processes (often required by QA agencies). For instance, if a design course's learning outcome is *"proficiency in digital modeling software,"* the department might review whether the assignments and grading in that course truly measure that skill. According to regional QA guidelines, assessments should be reliable, consistent, and free of bias. Some programs involve external examiners or industry experts to review capstone projects, ensuring that the assessment of outcomes like industry-readiness is impartial and benchmarked to external standards. Work-based learning outcomes may even be assessed in part by industry mentors (e.g. internship supervisors contributing evaluations of students' performance), as allowed in Malaysian OBE practices.

In summary, assessment in OBE-driven design education is deliberately crafted to *support* the attainment of learning outcomes. Students are continually measured against the outcomes through diverse and practical tasks, and they must demonstrate achievement of each intended outcome to successfully progress. This approach not only upholds academic standards but also gives students clarity on what skills and knowledge they are expected to have at each stage of the program.

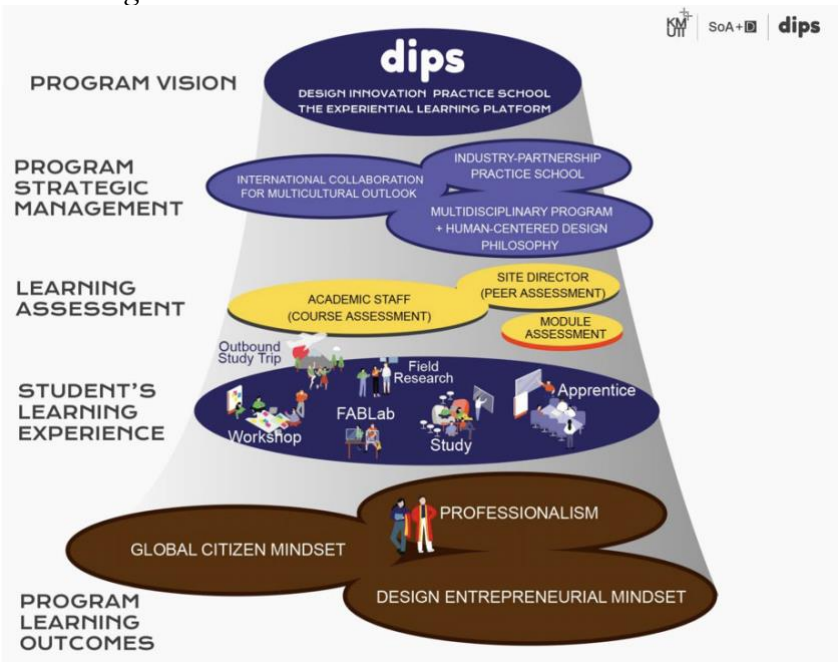
KMUTT Bachelor of Fine and Applied Art in Design Innovation Program (DIP): A Case Study of Challenging OBE Implementation

Program Overview and OBE Alignment

The Design Innovation Program at the School of Architecture and Design, KMUTT, aims to produce graduates who integrate knowledge across arts, social sciences, management, entrepreneurship, science and technology, specifically applying innovative design thinking to enhance quality of life. This multidisciplinary approach provides a strong foundation aligned with clearly defined Program Learning Outcomes (PLOs), ensuring that students attain knowledge, practical skills, ethical values, and personal attributes required by contemporary professional practices (Figure 1).

Figure 1

DIPS Program Overview



Program Learning Outcomes (PLOs)

DIP curriculum strategically integrates OBE practices through well-defined program educational objectives, focusing on six program learning outcomes aligned with Thailand's National Higher Education Qualification Standards.

Design Entrepreneurial Mindset (PLO 1–3)

- PLO 1 Able to design product, service, or system by human-centered-design philosophy.
- PLO 2 Able to produce novel and useful ideas as appropriate responses during a creative task.
- PLO 3 Able to refine ideas to represent value among aspects of business or social impact.

Professionalism (PLO 4–5)

- PLO 4 Posses self-discipline, self initiative.
- PLO 5 Able to communicate and collaborate effectively in workplace.

Global Citizen Mindset (PLO 6)

- PLO 6 Aware of and understand the wider world in similarity or difference of cultural contexts through hands-on experience.

Teaching and Learning Strategies

DIP employs diverse teaching methodologies directly linked to program learning outcomes (PLOs), fostering both academic and professional competencies. This alignment reflects the principle of constructive alignment, in which learning activities and assessment tasks are deliberately designed to support the achievement of intended learning outcomes (Biggs & Tang, 2011).

Foundation Courses

Foundation Courses are designed to prepare first-year students as ready learners by equipping them with essential soft skills, teamwork and self-directed learning capabilities, and a foundational understanding of STEAM disciplines. These courses integrate project-based bootcamps and a book club component, the latter combining English language learning with the development of critical thinking and reflective learning habits. This foundation lays the groundwork for outcomes across PLO 1–6.

Experiential Learning (Work-integration Learning, WiL)

Experiential Learning (Work-integrated Learning, WiL) is implemented through industry partnerships with organizations such as Jacob Jensen Design Bangkok, 4digit Thailand, and Whatnot Start-up Studio. These collaborations emphasize professionalism, technical skills, and real-world design practice aligned with PLOs 1–5. In Wegner's work, he emphasized that work-integrated learning environments function as communities of practice, where students develop professional identity and competence through legitimate participation in authentic design activities (1998).

International Collaborations

International Collaborations, such as the Asia Link Workshop with institutions across Asia, enrich students' global perspectives and foster cross-cultural competencies (PLO 6).

Customized Learning Pathways

Customized Learning Pathways, introduced from the second year onward, enable students to pursue tailored experiences aligned with their personal interests and career goals. These are supported by specialized research labs and innovation centers, including Fablab Bangkok @KX and the Social Design Institute.

Assessment and Evaluation Practices

The program employs a comprehensive assessment approach, including:

- Course-based assessments using KMUTT's Learning Environment version B2 (LEB2) system to systematically track learning outcomes.
- Work-integrated assessments, where student performance is continually monitored by industry supervisors, supplemented by academic feedback through formal presentations and final project evaluations (portfolios or thesis projects).

The rubrics developed through collaboration with 4digit Thailand and JJD focus on three overarching competency clusters.

Performance & Professionalism

- Ability to complete assigned tasks
- Discipline and reliability (meeting deadlines, following processes)
- Collaboration and team coordination

Design & Technical Capabilities

- Human-centered design: Evaluation of how well designs address real user needs
- Creativity and originality: Innovative thinking aligned with project objectives
- Manufacturing feasibility: Understanding production constraints
- Technical and design skills: CAD, 3D modeling, UX/UI principles
- Quality and detail-orientation: Visual refinement, consistency, attention to detail

Soft Skills & Professional Growth

- Presentation and communication: Clarity and persuasiveness in presenting ideas
- Empathy, openness to feedback, and adaptability
- Self-directed learning and research depth

Unique Features

- Dynamic, longitudinal feedback**:** Evaluations occur monthly, tracking student improvement over time.
- Role-based rubric application**:** Differentiated expectations for junior, support, and lead roles in project teams.
- Industry co-supervision: Project leads and industry mentors co-score students and provide narrative feedback.

Quality Management for OBE

Quality assurance is reinforced through a structured **Steering Committee**, which includes academic staff and industry supervisors. This committee regularly reviews and ensures alignment of teaching strategies, learning experiences, and assessment practices with defined outcomes, intervening proactively whenever students face challenges in achieving the outcomes in their work-integrated placements.

Feedback and Continuous Improvement

Feedback from DIP students, collected via surveys and interviews (in 2023), indicates strong satisfaction, particularly with lecturers (4.45/5), teaching and learning methods (4.20/5), and measurement and evaluation processes (4.39/5). This positive feedback validates effective OBE implementation while highlighting areas for continuous improvement, especially regarding the learning environment and curriculum structure transition towards experiential and work-based learning.

Challenges and Implementation Insights

Despite the structured frameworks, DIP faced challenges in achieving seamless integration, notably in communication, synchronization between academic and industry timelines, and foundational skill preparedness among students. Continuous feedback from industry partners emphasized the need for stronger fundamental training, improved scheduling, and better knowledge management to enhance student adaptability to professional environments.

From the academic staff perspective, assessing learning outcomes from design project deliverables—especially in real-client projects—requires a balanced approach that considers not only the quality and completeness of project outputs but also client satisfaction, professional conduct, and learning progression. This dual consideration, combining feedback from both academic evaluators and industry supervisors, ensures holistic evaluation. Moreover, structured reflection activities, where students review client feedback and assess their own work, are critical in helping them not only learn but relearn—a key to cultivating adaptability and professional growth in design innovation.

An important insight from ongoing implementation is that a prolonged period of Work-Integrated Learning—spanning two out of three academic years in DIP's curriculum. It offers significant benefits in terms of professional growth, but may present trade-offs**.** Students gain deeper exposure to real industry settings, cultivate long-term professional connections, and develop habits aligned with workplace culture. However, this often comes at the expense of typical campus life experiences and peer-based learning in traditional academic settings. Striking the right balance between academic community engagement and professional immersion remains an ongoing concern in the program's design.

Effectiveness and Continuous Improvement

The co-created assessment frameworks significantly enhanced students' professional readiness, practical expertise, and industry adaptability. Continuous improvement efforts, facilitated by frequent communication and structured feedback loops, have fostered ongoing refinement in assessment methodologies and teaching approaches, thereby aligning effectively with industry expectations.

Comparative Analysis of OBE Implementation: ASEAN Design-Related Program Examples vs. KMUTT's DIP

- Expected Learning Outcomes: DIP shares the ASEAN norm of outcome clarity but explicitly focuses on design entrepreneurship and global citizenship, reflecting a more targeted emphasis on innovation, entrepreneurship, and professional readiness.
- Teaching and Learning Strategies: DIP's distinctive element is the depth and extent of its WiL strategy, covering two-thirds of the academic experience, surpassing typical ASEAN examples that usually integrate internships and real-world projects as shorter-term components. The foundational first-year experience in DIP uniquely emphasizes self-learning and essential soft skills through integrated modules and bootcamps.
- Assessment of Student Learning Outcomes: While ASEAN peers use outcome-aligned assessments commonly, DIP demonstrates a highly proactive and co-creative approach. DIP's joint academic-industry assessment, rubric development, and continuous, structured feedback loops offer deeper professional integration and more personalized student learning journeys compared to typical regional practices.

Discussion and Conclusion

This study identifies academic-industry collaboration through experiential Work-integrated Learning (WiL) as a key learning approach to effectively achieve career readiness in design education. KMUTT's Design Innovation Program exemplifies this by actively involving industry partners in the co-creation of learning outcomes, curriculum, and assessment rubrics. The deep integration of professional contexts within the academic journey helps students develop competencies directly relevant to the workplace, reflecting actual industry expectations, and preparing them for immediate professional contributions upon graduation.

Furthermore, the role of higher education institutions extends beyond immediate industry needs by preparing students for emerging future skills. The analysis suggests that higher education must proactively engage in future-skills foresight, ensuring that curricula address evolving competencies, particularly soft skills (communication, collaboration, critical thinking), digital literacies, and adaptability to evolving professional trends. These capabilities empower graduates not only to enter current labor markets but also to thrive amidst future uncertainties and technological transformations.

Lastly, the insights gathered point to the importance of flexible personalized learning approaches within OBE frameworks. Offering tailored educational experiences that respond to individual learner goals and industry demands is crucial in maximizing the potential and quality of graduates. Personalized pathways, supported by robust mentoring and reflective practices, optimize educational outcomes by aligning student interests, skillsets, and professional objectives, thereby directly enhancing graduate quality and employability.

Overall, the effective implementation of OBE in ASEAN’s design-related programs, particularly through strategic industry collaboration and future-focused, personalized learning, sets the foundation for delivering high-quality graduates capable of meaningful professional contributions in a rapidly evolving global landscape.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that ChatGPT (OpenAI), an AI-assisted writing tool, was used to support English language refinement and structural editing of the manuscript. The use was limited to improving clarity, coherence, and academic phrasing. The ideas, design, procedures, findings, analyses, and discussion are based on the authors’ research activities and project documentation, and the authors reviewed and finalized all content.

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Admissions Profile as Predictors of Academic Performance in a New Medical School

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Abstract

Higher Education Institutions (HEIs) in the Philippines are committed to deliver quality education and produce competent, highly efficient graduates equipped with values, skills, and knowledge ready to participate in the workforce. This research study determined the admission profiles of the first two group of graduates of the Doctor of Medicine Program of La Consolacion University Philippines, College of Medicine in Bulacan and correlated them to the graduates' overall academic performance. The admissions' profile used were age at the time of admission, sex, collegiate course, general weighted average (GWA) from the collegiate course, National Medical Admissions Test (NMAT) percentile rank, work experience and licensure examination passed. These factors were used and correlated to the student's general weighted average (GWA) from the Doctor of Medicine Program from first to fourth year. In determining the relationship of variables of the admission criteria and the student's overall performance and the significant predictor of students' success, regression analysis was utilized. The research study was subjected to and adhered to the Research and Ethics Committee of the university. Regression analysis revealed that among the admissions' criteria, the students' General Weighted Average (GWA) from their collegiate course, licensure examination passed and National Medical Admissions Test (NMAT) percentile rank were associated with success in the program with a p value result of 0.004, 0.002 and 0.000 respectively. However, it can be concluded that NMAT percentile rank, based on obtained Beta coefficients, is the best predictor of success in the Doctor of Medicine program.

Keywords: medical school admission, academic performance predictors, quality assurance in education, Doctor of Medicine program, predictive validity

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Introduction

In general, the goal of every Higher Education Institution offering a variety of programs is to produce competent and efficient graduates ready to participate in the workforce. La Consolacion University Philippines started the Doctor of Medicine Program in 2017 with very few enrollees. Majority were transferees from other institutions. These aspiring doctors were given a chance to pursue their dream job, which is becoming a doctor to heal and treat patients using their skills, knowledge and most specially a heart that understands every patient condition.

Previous studies in the Philippines revealed that regardless of the type of teaching method and curriculum, the undergraduate general weighted average best correlated with academic performance in medical school (Brizuela et al., 2002; Cunanan, 2020; Villamor & Reyes, 2016). For a Philippine Catholic University, both undergraduate general weighted average (uGWA) and National Medical Admissions Test (NMAT) percentile rank have been found to have a significant moderate linear correlation with the medical school performance (Cunanan, 2020). Factors like positive environment, good teaching style of professors, parents' supervision, social networking, strong motivation for achievement, a clear goal, and ensuring enough sleep during exams have been found to affect the medical student's academic performance (Khan et al., 2020; Shawwa et al., 2015). While there are other factors that may contribute to the medical students' overall performance, this study mainly focused on the admission profile of the students.

This study is delimited to the pioneering and second cohorts of the Doctor of Medicine program at La Consolacion University Philippines during the 2021–2022 academic year. To maintain the focus of the inquiry, subsequent year levels were excluded from the sample. Data collection was facilitated through the University Registrar following the procurement of voluntary informed consent from the participants. For transfer students, academic performance from previous medical institutions was integrated into the computation of their cumulative general weighted average (GWA). Variables were operationalized as follows: "age" refers to the chronological age at the time of matriculation, and the National Medical Admission Test (NMAT) performance was recorded as the overall percentile rank, adhering to the standard two-year validity period of the results.

This research determined the admission profiles of the first two group of graduates of the Doctor of Medicine Program of La Consolacion University Philippines, College of Medicine in Bulacan and correlated them with the graduates' overall academic performance. It also identified the admission criteria which made a significant contribution to the student's overall performance. The results will serve as a basis for improvement of the minimum criteria set by the Commission on Higher Education to ensure student's survival through the rigors of medical school.

Theoretical Framework

The research is theoretically grounded in the premise that a multifaceted admissions profile functions as a reliable predictor of medical students' scholastic success. Specifically, it examines the correlative relationship between academic performance and a suite of independent variables, ranging from prior collegiate performance and standardized test scores to professional licensure and work experience.

Methodology

Adopting a quantitative approach, this study utilizes a descriptive-correlational research design to examine the relationship between the admission profiles of students and their subsequent scholastic achievement. This design is particularly suited for determining the existence, nature, and magnitude of associations between the identified variables. The study focuses on the total population of graduates from the Doctor of Medicine program at the sole medical institution in Bulacan. Academic performance was operationalized through the cumulative General Weighted Average (GWA) derived from Year Levels I to III. Data collection involved a systematic review of secondary records and admission documents retrieved from the University Registrar. To ensure the highest standards of participant protection and data privacy, the research protocol was submitted to and approved by the La Consolacion University Philippines Research Ethics Committee.

Respondents of the Study

A total of forty (40) medical graduates from the 2021 and 2022 cohorts were selected as the primary research participants. Utilizing a universal sampling methodology, the study encompassed the entire population of graduates within the specified timeframe to mitigate sampling bias. Adherence to ethical protocols was prioritized, ensuring that informed consent was obtained from all individuals before accessing their academic records for analysis.

Data Collection and Analysis

The data for this inquiry were derived from archival institutional records, specifically the admission credentials submitted by students upon matriculation. Following the procurement of formal informed consent, participant records were extracted from the University Registrar's database. To ensure strict adherence to data privacy protocols and maintain respondent anonymity, all datasets were de-identified and redacted prior to processing. Ethical confidentiality was rigorously maintained across all stages of the research. Methodologically, a multiple linear regression analysis was employed to model the predictive utility of various admission metrics in relation to cumulative academic achievement. This statistical approach allowed for the determination of the relative weight and significance of each entry variable as a predictor of student success. Ultimately, the findings serve as an empirical foundation for the proposed refinement of the institution's admission criteria.

Results and Discussions

This section presents empirical findings concerning the predictive relationship between student admission profiles and longitudinal academic performance in the Doctor of Medicine program. The results are systematically analyzed and synthesized with existing literature to provide a comprehensive interpretation of the factors that most significantly influence scholastic achievement within the institutional context.

The demographic analysis reveals that a majority of the cohort is female (57%), a finding consistent with global trends in health profession education. The average age of the participants is 24, with a broad age range reflecting a diverse student population. Notably, 72% of the graduates transferred from other Higher Education Institutions (HEIs), corroborating the observation that the institution provides a pivotal pathway for medical education. The undergraduate General Weighted Average (GWA) averaged 2.14, while the

National Medical Admission Test (NMAT) score averaged 62.3. These demographic findings provide the necessary context for the subsequent analytical results.

Table 1
Demographic Profile of Respondents

Demographic Profile	**Summary (Mean)**
Age: Mean (range)	24 (21–32)
Gender: count (percentage)	
Male	17 (43%)
Female	23 (57%)
NMAT Score (mean)	62.3
Collegiate Course: count (percentage)	
Nursing	22 (55%)
Medical Technology	8 (20%)
Other Allied Medical Courses	4 (10%)
Non-Allied Medical Courses	6 (15%)
Undergraduate GWA: mean (range)	2.14 (1.41–3.00)
Licensure Exam Passed: count (percentage)	14 (35%)
Admissions Status: count (percentage)	
Freshman	11 (28%)
Transferee	29 (72%)
General Weighted Average (GWA) in COM: mean (range)	2.44 (1.89–2.82)

Table 2
Admission Profile Affecting Academic Performance

Admissions Profile	**Coefficient**	**P Value**
Age	-0.001	0.68
Gender	0.037	0.368
NMAT Percentile Rank	0.029	< 0.001
Collegiate Course	0.020	0.329
Undergraduate GWA	0.143	0.004
Licensure Exam Passed	0.205	0.002
Admission Status	-0.129	0.017

The analysis revealed that only four admission profile variables demonstrated a statistically significant linear correlation with academic performance ($p < 0.05$). The following details examine the three most prominent predictors identified in the model.

First, the most robust positive determinant of academic success was the possession of a prior professional license. With a coefficient of 0.205 ($p = 0.002$), this factor emerged as the most reliable predictor within the study. This suggests that prior achievement in a rigorous professional context—specifically where knowledge is applied under high-stakes testing conditions—serves as a dependable forecast for higher achievement in medical education.

Second, undergraduate GWA was validated as a statistically significant positive predictor (coefficient = 0.143, $p = 0.004$). While this finding aligns with established academic literature, its predictive strength ranked behind licensure status within this specific cohort.

Third, the NMAT Percentile Rank was found to be a highly significant predictor ($p < 0.001$); however, it exhibited an inverse relationship characterized by a negative coefficient. This outcome warrants further investigation, as it suggests that the NMAT's utility as a positive predictor, when isolated from GWA and licensure status, may be less direct than traditionally hypothesized.

The variables of admission status, gender, and undergraduate academic background were identified as significant negative determinants of scholastic achievement—operationalized as GWA—within the studied medical cohort.

Conclusion

In conclusion, the research demonstrated that undergraduate GWA, NMAT percentile rank, and particularly the attainment of prior professional licensure exhibits a significant linear correlation with academic performance within the medical program. These findings align with existing literature in medical education, confirming that objective academic metrics remain reliable indicators of student success. However, the unique demographic profile of the institution—characterized by a high proportion of transfer students—has positioned prior licensure status as the most robust positive predictor within the admissions model. This insight is particularly salient for nascent or expanding institutions that must evaluate a diverse applicant pool, including those seeking a secondary pathway to medical education.

Based on this empirical evidence, the following recommendations are proposed:

1. Longitudinal Expansion of the Study: It is recommended that this research be extended to evaluate whether the identified entry-level profiles also serve as significant predictors of success in the Physician Licensure Examination (PLE).
2. Institutionalization of a Predictive Scoring System: Most importantly, the institution should establish a validated predictive model for the admissions process. This scoring system should apply evidence-based weights to prior licensure status, undergraduate GWA, and NMAT results to optimize the selection of candidates most likely to achieve academic excellence.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors acknowledge the use of Gemini for language editing and structural rephrasing to improve the manuscript's readability and precision. This assistance was strictly limited to stylistic and linguistic improvements; no other AI technologies were used. The authors reviewed and edited the output to ensure the integrity of the research findings.

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Grounding a Quality Assurance Framework From the Perspectives and Experiences of Deans From PAASCU Level III and IV Accredited Medical Schools

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Abstract

The COVID-19 pandemic severely strained the Philippine healthcare system, exacerbating the shortage of doctors and necessitating the enactment of Republic Act 11509, which spurred a significant increase in new medical schools through government scholarships. Despite this growth, a standardized quality assurance (QA) framework tailored for these new institutions remains absent. This grounded theory study, guided by Hatch and Schultz's Identity Dynamics theory, investigated the experiences of administrators and educators through semi-structured interviews with four deans of accredited medical colleges and three Augustinian formators. Through open, axial, selective, and theoretical coding, the study developed an emergent theory: Quality Medical Education Driven by Core Values. This theory informs a proposed QA framework specifically designed for new medical schools, integrating structures and mechanisms across all institutional areas while remaining intrinsically linked to core values. By addressing the gap in QA guidance, the framework ensures that new institutions deliver education meeting government and accreditation standards without compromising their organizational identity and image. This study affirms that anchoring quality processes in a school's unique identity provides a robust pathway for academic excellence and institutional integrity in the Philippine medical education landscape.

Keywords: medical education, quality assurance framework, grounded theory

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Introduction

The landscape of medical education in the Philippines is navigating a period of unprecedented transformation, characterized by rapid expansion and shifting regulatory priorities. Over the last decade, there has been a notable increase in the number of medical schools, with sixty-one institutions currently authorized to offer the Doctor of Medicine program. While new schools are prohibited from accepting foreign students under Executive Order 285, many established institutions remain populated by local and international students. This surge in quantity has been coupled with a decline in the national passing average for the Physician Licensure Examination, raising concerns regarding the deterioration of educational quality.

The COVID-19 pandemic catalyzed these concerns, exposing a severe shortage of doctors and necessitating the enactment of Republic Act 11509, or the "Doktor Para Sa Bayan" Act. This policy provides medical scholarships and return service programs to ensure at least one doctor is assigned to every municipality, particularly in underserved areas. Consequently, many state universities have fast-tracked applications to establish colleges of medicine, making the security of quality medical education a paramount national priority.

To oversee this growth, the Commission on Higher Education (CHED) organized the Technical Panel for Medicine. This panel ensures compliance with minimum requirements, while alignment with international standards is facilitated through external accreditation agencies like the Philippine Accrediting Association of Schools, Colleges, and Universities (PAASCU). These initiatives reflect CHED Memorandum Order (CMO) 46, Series of 2012 (CHED, 2012), which mandates quality assurance (QA) through competency-based standards and outcomes-based systems. Quality assurance involves establishing mechanisms to ensure desired educational delivery, addressing national needs for a qualified workforce. Furthermore, external monitoring serves as a QA mechanism to assess compliance with standards like International Organization for Standardization (ISO) 9001:2015 (ISO, 2015), which often drive quality concepts based on external market requirements (Dotong & Laguador, 2015).

Quality in medical education can be defined in relative terms as reaching required standards prescribed by external agencies consistently. It involves both the "production side"—the development of competent graduates—and the "perceptual side"—the maintenance of an institution's values and principles. Accreditation implies accountability to the public, ensuring the enhancement of teaching and learning (Joshi, 2012). PAASCU accreditation indicates that a program has met commonly accepted standards and manifested the ability to upgrade academic quality through self-evaluation (PAASCU, 2021). These standards are fundamentally based on the World Federation for Medical Education (WFME) standards, which respect cultural variations while emphasizing that the identity of graduates must align with an institution's vision and mission (Sjöström et al., 2019).

Central to this study is Hatch and Schultz's (2002) Identity Dynamics theory, which suggests that organizational identity is formed through the continuous interaction between internal culture and external image. For medical schools, quality is not just a checklist, but a reflection of how the vision-mission is mirrored in operations.

While PAASCU and WFME assess eight key areas—including Leadership and Governance, Quality Assurance Systems, and Resource Management—there is currently no standardized QA framework specifically for new Philippine medical schools that integrates these standards with unique institutional identities (Karam et al., 2021). This gap is particularly relevant for

the Augustinian Sisters of Our Lady of Consolation (ASOLC), who established the first college of medicine in Bulacan in 2017 (LCUP, 2017). As a school following the Philippine Catholic Schools Standards (PCSS), the ASOLC must ensure its medical program is at par with high-level accredited institutions while remaining a center for integral evangelization and Gospel values (CEAP, 2016).

Consequently, this study aimed to explore institutional documents and narratives regarding the vision and mission of ASOLC schools to define their organizational identity from the perspective of three Augustinian formators. Simultaneously, it investigated the professional experiences of four deans from PAASCU Level III and IV accredited medical institutions. These data were synthesized to develop a grounded theory explaining how high-level accreditation and educational quality are achieved while preserving a mission-based institutional identity. This emergent theory, *Quality Medical Education Driven by Core Values*, served as the foundation for a holistic quality assurance framework designed to embody institutional ideals while satisfying the rigorous quality standards defined by PAASCU.

Methodology

Research Design

This study utilized a qualitative approach to explore the intersection of organizational identity and high-level accreditation in medical education. Specifically, it adopted Grounded Theory, as established by Glaser and Strauss, to generate an explanatory framework from the lived experiences of administrators and formators. The research followed the approach of Corbin and Strauss (2015), which utilizes an initial literature review to stimulate theoretical sensitivity and guide the theoretical sampling process without precluding the emergence of new concepts. This method was essential to understand how medical schools balance the market-driven requirements of external accreditation with the internal, value-driven identity of a religious educational institution.

Participants

The participants were categorized into two distinct groups to provide a holistic view of the phenomenon. First, three Augustinian formators and educators from the Augustinian Sisters of Our Lady of Consolation (ASOLC) were selected through snowball sampling. These participants provided the internal culture perspective, drawing from their experiences in establishing and managing Catholic educational institutions. Second, four deans from medical schools granted PAASCU Level III and IV accredited status were included as participants. As of June 2021, only six medical schools in the Philippines held these elite designations (PAASCU, 2021); four accepted the invitation to participate, representing the external excellence perspective.

Measures and Procedure

The researcher utilized two Interview Protocol Guides (IPG) consisting of open-ended questions. Each IPG underwent a two-phase validation by a panel of experts, achieving high scores on the Validation Rubric for Expert Panel. Interviews were conducted either face-to-face or via virtual platforms, recorded with consent, and transcribed by professional transcriptionists. To ensure data saturation, a Google Form was also sent to participants for supplementary reflections.

Data Analysis

The data analysis plan involved coding collected data through four specific steps based on Corbin and Strauss (2015). Initially, open coding was performed to build categories of concepts to organize data into concept trees. This process involved a close examination of the data, breaking it down into parts, and making constant comparisons until reaching a saturation point where no new categories emerged.

Results and Discussion

Thematic Analysis of the ASOLC Schools' Formators Narratives

The narratives of the Augustinian formators yielded two primary categories that define the organizational identity of their institutions.

Education Guided by Augustinian-Marian Core Values

Table 1 shows that the formators described a philosophy of education that is inherently Christ-centered and guided by the core values of Compassion, Honesty, Community Orientedness, Interiority, Humility, Courage, and Missionary Spirit. These values are incorporated directly into the curriculum and school processes. The trademark of credibility and quality education among these institutions is established through these values, which heavily influence the stakeholders (Vicente & Cordero, 2021).

Table 1
Education Guided by Augustinian-Marian Core Values

Meaning Units/Codes	Category/Theme
Christ-centered	Education Guided by Augustinian-Marian Core Values
Core values incorporated in the curriculum	
Follows CEAP standards	
Employees/personnel exemplifying the core values of Compassion, Honesty, Community Orientedness, Interiority, Humility, Courage, and Missionary Spirit.	
Augustinian Quality Education Philosophy	
Students and graduates practice core values	

Formation of the Mind and Heart

The participants, as seen in Table 2, emphasized that quality education focuses on the development of the students not just in knowledge and skills, but as humble and compassionate professionals. This adheres to Augustinian pedagogy, which stresses an important connection between the human heart and relationships with God and others (Baker, 2016).

Table 2
Formation of the Mind and Heart

Meaning Units/Codes	Category/Theme
Adherence to government and accreditation standards	Formation of the Mind and Heart
Compliance to government regulations and accreditation requirements	
Adherence to Augustinian-Marian core values	
Known for quality education	
Core Values: Compassion, Honesty, Community Orientedness, Interiority, Humility, Courage and Missionary Spirit.	
Augustinian-Marian education reinforced in the curriculum, policies, and practices.	
Big emphasis on development of graduate holistically	
Not just knowledge and skills as professional	
Students and graduates to be humble and compassionate	

Thematic Analysis of the Perspectives and Experiences of Deans

Interviews with the deans of high-performing medical schools revealed the practical and systemic challenges of maintaining excellence through five key categories.

The Rigors of Accreditation

As shown in Table 3, all participants described the accreditation journey as difficult, grueling, and stressful. Despite the human and financial "costs" of accreditation, these were deemed acceptable given the benefits of improved documentation and the implementation of robust procedures (Blouin et al., 2018).

Table 3
The Rigors of Accreditation

Meaning Units/Codes	Category/Theme
Difficult and challenging journey	The Rigors of Accreditation
Discouragement but moving forward	
Requires great effort and grueling preparation	
Costly but worth it	
Challenge of a new survey instrument	
Heavy work, difficult and stressful	
Entails sacrifices especially on monetary gain compared to other units	
Pandemic posed a greater challenge in ensuring quality	

Maintaining Quality in Established Medical Schools

For well-established institutions, evident in Table 4, maintaining quality became easier after the first visit through strict adherence to recommendations and the creation of a Strategic Quality Management Office. Strong administrative support and a desire for continuous improvement were identified as key factors (Villamor & Reyes, 2016).

Table 4
Maintaining Quality in Established Medical Schools

Meaning Units/Codes	Category/Theme
A little easier after the first	Maintaining Quality in Established Medical Schools
Strictly follow accreditors' recommendations and areas for improvement	
Creation and presence of a Strategic Quality Management Office	
No compromise and lowering of standards	
Previous recommendations acted upon promptly	
Conscious of sticking to policies and standards	
Updating beyond the standards	
Needs strong admin support	
Desire to keep improving	
Best to have PAASCU trained accreditors on the team.	
Continue to improve and reinforce policies	

A Shared Goal for Ensuring Quality

Achieving high-level accreditation was identified as a collaborative effort in Table 5. Fostering a Continuous Quality Improvement (CQI) culture at the center of the institution ensures ongoing self-assessment against best education practices (Blouin et al., 2018).

Table 5
A Shared Goal of Ensuring Quality

Meaning Units/Codes	Category/Theme
Accreditation is a shared goal and requires collaborative efforts.	A Shared Goal of Ensuring Quality
Takes a good team of patient, committed, dedicated and hardworking faculty who are one with the institution	
The shared goal to continuously improve and achieve the level of accreditation.	
Team effort	
Meeting PAASCU standards of high level of accreditation should be a shared goal.	
Believing that the recommendations and the criteria per area can be achieved kept the team going.	

The Process of Quality Assurance

As seen in Table 6, the quality assurance process entails a constant cycle of self-evaluation, review, and monitoring. This follows the Plan-Do-Check-Act (PDCA) cycle integrated into the current PAASCU Basic Medical Education Survey Instrument.

Table 6
The Process of Quality Assurance

Codes/Indicators	Category/Theme
Should have continued desire to improve and subject to next level	The Process of Quality Assurance
Honesty on the self-evaluation	
Strictly follow accreditors' recommendations and areas for improvement	
Constant self-checking, review, assessment, and monitoring	
It takes a thorough planning, improving, and monitoring to maintain high level of accreditation.	
Conscious of sticking to policies and standards previously approved	

The Products of Accreditation and Quality Assurance

The final category, shown in Table 7, focused on the outcomes of the QA process. High levels of accreditation equate to high standards of medical education, solidifying the school's reputation and ensuring that graduates are easily matched for postgraduate internships and training locally and internationally.

Table 7
The Products of Accreditation and Quality Assurance

Meaning Units/Codes	Category/Theme
Graduates easily matched for internship and training locally and internationally	The Products of Accreditation and Quality Assurance
Meant increased revenues, tuition fee, compensation, approval of needed facilities, equipment, renovations, models	
Opened a lot of opportunities, student applications and enrolment	
Equates with high standards of medical education	
Level of accreditation solidifies school reputation	

Triangulation and Emergent Theory

By triangulating the data from both the formators and the deans, the study identified that the rigors of external accreditation and the internal core values of an institution are mutually reinforcing. The emergent theory, Quality Medical Education Driven by Core Values, suggests

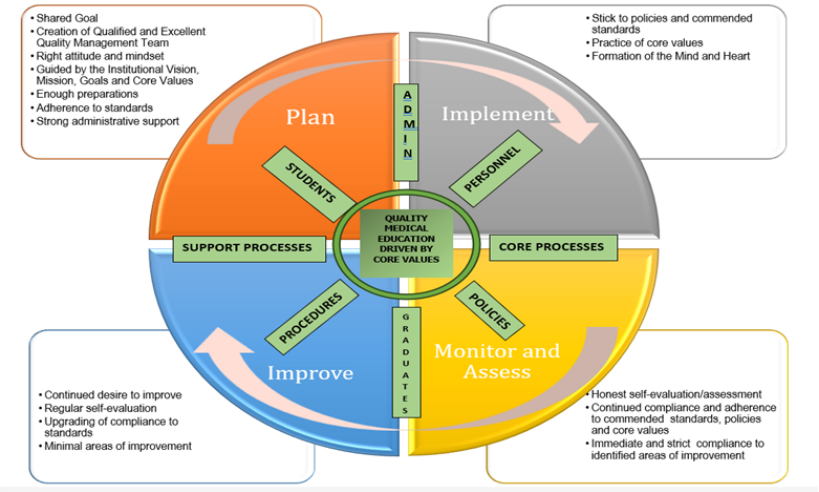
that for new medical schools, a successful quality assurance framework must be intrinsically linked to the school's organizational identity. This alignment ensures that as institutions meet national and international standards, they do not lose the unique mission and values that define their educational purpose.

The Proposed Quality Assurance Framework

To date, there remains a critical gap in standardized quality assurance (QA) frameworks specifically tailored for Philippine medical schools. This study was conducted within the setting of a newly established medical school founded by the Augustinian Sisters of Our Lady of Consolation (ASOLC). Consistent with the broader mission of ASOLC schools, there is a fundamental commitment to ensuring that the quality of medical education is at par with well-established and highly accredited institutions.

Guided by the emergent theory derived from this research—Quality Medical Education Driven by Core Values—the proposed framework as seen in Figure 1 places this central theme at its heart. As illustrated in the dynamic model, these core values must be translatable into observable behaviors practiced by the administration, teaching, and non-teaching personnel. These values radiate through all institutional layers, including curriculum implementation, core processes, support systems, and the eventual competencies of graduates. While PAASCU utilizes a Plan-Do-Check-Act (PDCA) cycle, the narratives of the deans emphasized a similar Plan-Implement-Monitor-Improve (PIMI) cyclical model. The proposed framework integrates these QA structures and mechanisms, ensuring they are driven by core values across all areas of the medical school to promote continuous self-assessment and institutional growth.

Figure 1
The Proposed Quality Assurance Framework



In the Planning Process, a critical success factor for Level III and IV accredited schools is the creation of a dedicated team or office solely responsible for quality delivery and adherence to standards. This team must consist of trained, qualified personnel who possess the right attitude and mindset, viewing quality as a shared goal of the whole institution. Crucially, this entire planning phase must be grounded in the school's distinct organizational identity.

During Implementation, established deans stressed the importance of strict adherence to policies and commended standards, as any deviation can jeopardize accreditation levels. At

this stage, core values are practiced across all institutional aspects, ensuring that curriculum delivery focuses not just on the formation of the mind, but also the heart.

Monitoring and Assessment requires absolute honesty in self-evaluation against standards such as those set by PAASCU. It necessitates continued compliance with policies and core values, where identified areas for improvement are addressed immediately and strictly to sustain academic excellence.

Finally, Continuous Quality Improvement is achieved through a persistent desire to improve, regular self-evaluation, and the constant upgrading of compliance to standards. For this framework to be fully effective, the specific Augustinian-Marian core values—Compassion, Honesty, Community Orientedness, Interiority, Humility, Courage, and Missionary Spirit—must be translated into concrete behaviors. This ensures that the medical school's processes and personnel are not only meeting external benchmarks but are fundamentally fulfilling their unique educational mission.

Conclusion

Based on the findings of this research, it is concluded that Augustinian ideals within ASOLC schools necessitate that every facet of the institution be guided by the Augustinian-Marian core values of compassion, honesty, community-orientedness, interiority, humility, courage, and missionary spirit. These schools move beyond mere technical training by prioritizing the formation of both the mind and the heart, ensuring that students practice these core values alongside acquiring professional knowledge and skills. The experiences of deans from high-level accredited medical schools further illustrate that while accreditation is a tedious and costly quality assurance process, its standards-based approach ensures a school's fitness for purpose and responsiveness to stakeholder needs. For institutions achieving Level III and IV status, continual improvement is a shared responsibility characterized by a "Plan-Implement-Monitor-Improve" (PIMI) cyclical model. Crucially, the non-prescriptive nature of the PAASCU process allows schools to maintain their uniqueness and innovate within their specific institutional contexts.

The proposed quality assurance framework for a new ASOLC medical school provides a strategic roadmap for administrators to ensure program sustainability and excellence at par with established institutions. Theoretically anchored in Hatch and Schultz's Identity Dynamics, the framework recognizes organizational identity as a continuous interaction between internal culture and external image. Through the processes of mirroring, reflecting, expressing, and impressing, the study bridges the gap in quality assurance for new medical schools by aligning the Augustinian-Marian organizational culture with the external standards of PAASCU and CEAP. To deliver quality medical education, all stakeholders—from administration and personnel to students and graduates—must exhibit these core values in their policies, procedures, and core processes.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Google Gemini, was used in refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Google Gemini, no other AI or AI-assisted technologies have been used to generate content in

writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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The Retention of Expatriate Teachers: Exploring Its Influence on Curriculum Design, Teaching Practices, and Student Learning Outcomes

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Abstract

This study examined the influence of expatriate teacher retention on curriculum execution, pedagogical methods, and student academic performance in seven (7) international schools in Asia. This study used a mixed-methods approach, integrating survey data among one hundred fifty-seven (157) expat teachers, fifty-two (52) school administrators, and two hundred five (205) students. Additionally, comprehensive interviews with seven (7) expatriate teachers, four (4) school administrators, and six (6) students were conducted to investigate the impact of faculty stability on academic performance, classroom engagement, and overall student happiness. The findings indicate that high teacher retention improves instructional consistency, fortifies teacher-student connections, and fosters a supportive learning environment, whereas frequent turnover breaks continuity and diminishes student motivation. While the study contains useful information, its reach is limited by the small number of expatriate teacher participants and key persons interviewed, as well as the potential influence of socially desired responses. These aspects should be taken into account when extrapolating the findings to foreign school settings other than the Type C hybrid model in Asia. This research underscores the necessity for deliberate retention plans and professional development to maintain high educational quality in international school environments. The discussion also encompasses implications for school leadership and policy formulation.

Keywords: curriculum design, expatriate teachers, retention, student learning outcomes, teaching practices

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Introduction

The retention of expatriate teachers in international schools is a complex issue that has a substantial impact on the learning outcomes of students, instructional practices, and curriculum design. In order to preserve educational standards, it is imperative to comprehend the dynamics of expatriate teacher retention, as international institutions become more dependent on them to provide high-quality education. The development and implementation of curricula, pedagogical strategies, and ultimately, the academic performance and engagement of students are all influenced by the presence and retention of expatriate teachers, as examined in this dissertation.

Retention is closely correlated with their organizational embeddedness and cultural intelligence, which are essential components of their capacity to flourish in foreign educational environments. Ren et al. (2021) emphasized that the flourishing of expatriate teachers is directly influenced by cultural intelligence, which in turn results in their actual retention This discovery highlights the importance of equipping educators with the necessary cultural competencies to effectively navigate the complexities of international school environments. Yang et al. (2018) observed that the commitment of expatriate teachers to their duties is significantly influenced by the interplay of personal circumstances and workplace factors. This implies that to improve retention rates, educational institutions must establish supportive environments that foster personal and professional development.

Strategic interventions are necessary to enhance retention among expatriate teachers in international institutions, as they encounter obstacles such as culture shock and high turnover rates. Stasel (2023) emphasized that expatriate teachers frequently encounter culture shock, with turnover rates exceeding 60% in certain institutions. To alleviate these concerns, international school leaders must establish comprehensive support systems that cater to the professional and emotional requirements of their educators. Schools can enhance teacher retention and, as a result, improve student learning outcomes by cultivating a sense of community and belonging.

Nonetheless, despite the prospective advantages that expatriate educators offer to international schools, elevated turnover rates within this demographic pose considerable questions about the sustainability of these gains. High teacher turnover undermines the continuity of curriculum implementation, which is crucial for effective learning. Research indicates that teacher attrition, particularly in schools with a significant number of underperforming kids, can severely affect student success (Ronfeldt et al., 2013). Turnover-induced instability might impede the establishment of trustworthy connections between teachers and students, essential for cultivating a supportive learning environment. The absence of consistency in teaching methodologies may result in deficiencies in student learning since incoming educators can be unaware of the established procedures or the particular requirements of the student demographic (Ronfeldt et al., 2013).

To tackle the issues related to expatriate teacher retention, it is crucial to examine the elements that affect their choices to remain or depart. Research has identified various predictors of school commitment among expatriate teachers, including personal circumstances, working situations, and systemic educational characteristics (Yang et al., 2018). Cultural intelligence significantly influences the success and retention of expatriates, indicating that educators who are adept at managing cultural differences are more likely to sustain their roles (Ren et al., 2021).

Furthermore, *organizational embeddedness*, defined as the degree of employees' connection to their jobs, has been demonstrated to positively affect retention outcomes (Ren et al., 2021).

Hence, the retention of expatriate teachers in international schools is a multifaceted issue that is influenced by a variety of factors, such as organizational culture, curriculum coherence, and cultural intelligence. Teaching practices and student learning outcomes are affected significantly by the interaction of these elements. It is essential to comprehend the dynamics of expatriate teacher retention to maintain educational quality and cultivate positive student experiences as international schools continue to confront the obstacles of a globalized education landscape.

Methodology

This study employed a mixed-methods research design to examine the impact of expatriate teacher retention on student learning outcomes, teaching practices, and curriculum design. Structured survey questionnaires were utilized to collect quantitative data from administrators, teachers, and students. The general patterns of responses were described using descriptive statistics, such as mean and standard deviations. Inferential statistics, specifically one-way ANOVA, were used to investigate differences between groups based on variables such as the duration of teacher retention.

Concurrently, qualitative data were collected from open-ended responses and analyzed using thematic frameworks. Initially, the data was familiarized through repeated reading, and subsequently, initial codes were generated to capture significant patterns throughout the participants' narratives. This process was followed by thematic analysis. These codes were subsequently reviewed and categorized into broader categories, from which primary themes and sub-themes were inductively derived. The study ensured that statistical trends were enriched with contextual depth drawn from the participants' perceptions, while also providing a comprehensive understanding of how expatriate teacher retention influences key areas of international education by integrating the quantitative results with qualitative insights.

Specifically, quantitative data were gathered via surveys distributed to 157 expatriate educators, 52 school administrators, and 204 foreign pupils. To enhance and enrich the comprehension of patterns identified in the survey responses, qualitative data were collected via individual interviews with 11 participants, namely, seven expatriate teachers and four school administrators. A focus group discussion was held with six international students to gather their collective ideas and experiences regarding teacher retention and its perceived impact on learning.

Results and Discussion

The primary finding emphasized the “impact of expatriate teacher retention on curriculum development.” Two sub-themes arose within this theme: “teacher participation in curriculum development” and “curriculum improvement through retention.” Additionally, the challenges identified under “Theme 4: Challenges Posed by Teacher Turnover to Curriculum Stability” directly address “Question 1: How does the retention of expatriate teachers influence curriculum design and its implementation in international educational settings?” These challenges, particularly those found in “Sub-theme 4.1: Disruptions Caused by Teacher Turnover,” offer compelling evidence of the impact of teacher retention on curriculum outcomes. High turnover disrupts curriculum alignment because new teachers often lack

familiarity with established structures, leading to instructional instability, as noted by participants. Although fresh perspectives were occasionally appreciated, the primary concern was that turnover disrupts the consistency of the curriculum. In contrast, curriculum development and continuity were positively impacted by low attrition. Therefore, this theme transcends the mere identification of obstacles; it explicitly elucidates the impact of retention on the design and execution of curricula, thus illustrating the necessity of continuity in the teaching staff to preserve the stability of the curriculum in Type C international schools.

Quantitative findings indicated that teachers significantly acknowledged expatriate teacher participation in curriculum design, yielding a mean score of 4.15 (SD = 1.148), whilst administrators assessed the influence as modest, with a mean of 3.06 (SD = 0.85). Despite the one-way ANOVA results indicating no statistically significant differences among groups concerning years of teacher retention ($p > 0.05$), the consistently elevated means imply that long-term expatriate teachers substantially enhance curricular coherence, diversity, and innovation across various educational contexts.

The second significant result focused on the "effect of expatriate teacher retention on pedagogical practices." Sub-themes recognized in this domain encompass "pedagogical strategies," "innovative instructional methodologies," and "assessment protocols." Educators indicated that retention significantly impacts pedagogical practices (M = 3.6, SD = 1.012), emphasizing a transition towards more student-centered and dynamic teaching methodologies. Likewise, the implementation of innovative pedagogical methods, including project-based and inquiry-based learning, received a high rating (M = 3.66, SD = 0.789), indicating that educators with longer tenure in their institutions are more adept at enhancing and innovating their teaching practices. Assessment procedures were judged to improve due to teacher retention, as both teachers and administrators noted that retained expatriate teachers employ a broader range of effective and adaptive evaluation approaches. No significant differences were detected in the ANOVA tests among groups ($p > 0.05$), reinforcing the notion that retention uniformly improves teaching quality, irrespective of tenure duration.

The third significant finding is on the "impact of expatriate teacher retention on student learning outcomes," which includes the sub-themes of "academic achievement," "student engagement," and "student satisfaction." Educators assessed the influence of retention on academic performance to a significant degree, with a mean of 4.18 (SD = 0.687), which was closely reflected in student evaluations (M = 3.67, SD = 0.922) and administrative evaluations (M = 3.88, SD = 0.808). Teachers observed that student involvement was significantly influenced (M = 4.5, SD = 1.004), suggesting that consistent, experienced educators are essential in promoting student enthusiasm and active participation. Students and administrators likewise believe that involvement was significantly influenced, albeit to a lesser degree than teachers' assessments. The findings indicated uniformly excellent scores for student satisfaction across all groups. Despite the one-way ANOVA results indicating no statistically significant differences ($p > 0.05$), the marginal p-value for student engagement among teachers ($p = 0.058$) implies a potential trend, suggesting that perceptions of engagement may vary slightly based on teacher retention, warranting further investigation in future research.

The results collectively underscore that the retention of expatriate teachers substantially improves curriculum design, elevates teaching techniques, and positively impacts student academic and emotional outcomes. The uniformity of replies among stakeholder groups highlights the importance of maintaining expatriate teachers in international schools. It is essential to acknowledge that contextual variables, such as curriculum style, cultural setting,

and student body mix, undoubtedly influence these correlations. The aforementioned characteristics, together with the study's restriction of omitting local educators from the sample, indicate significant avenues for future research to comprehensively grasp the intricate dynamics of teacher retention in varied educational contexts.

The analysis of the quantitative and qualitative data indicates that the retention of expatriate teachers significantly enhances the academic and operational quality of international schools. The research validated that long-term expatriate educators significantly enhance curriculum creation, pedagogical innovation, and sustain elevated levels of student achievement, engagement, and satisfaction. The impacts were consistently detected among several responder groups: teachers, administrators, and students, and were evident in the robust mean scores given throughout the study.

The study indicated that expatriate professors who stay at an institution for prolonged durations contribute stability, coherence, and innovation to curriculum design and execution. Their continuous presence facilitates a comprehensive grasp of institutional objectives, educational frameworks, and student requirements, hence enhancing curriculum efficacy. While administrators assessed the influence somewhat lower than teachers, the alignment of attitudes highlights the importance of retaining expatriate teachers in enhancing curriculum achievements.

Summary

The findings revealed that expatriate teachers with prolonged retention are more inclined to utilize varied and student-centered teaching methodologies. Their understanding of institutional culture and instructional frameworks enhances innovation in the classroom, encompassing project-based learning, differentiated instruction, and diverse assessment approaches. The absence of statistically significant differences among groups in the ANOVA analysis indicates that these opinions are broadly held, supporting the conclusion that continuous teacher presence enhances instructional quality irrespective of years of employment.

The study confirms the beneficial effects of expatriate teacher retention on curriculum design, teaching methods, and student results, while also acknowledging its limits. The sample notably excluded local teachers, hence limiting the generalizability of the findings to the wider educational community. Future research should integrate the viewpoints of local educators to enhance the knowledge of retention dynamics. Moreover, subsequent research should investigate how factors such as curriculum type (e.g., IB, AP, bilingual programs), cultural setting, and student demographics influence the relationship between teacher retention and educational outcomes. Notwithstanding these constraints, the findings of this study provide significant insights for educational leaders aiming to improve the quality and stability of their institutions via deliberate expatriate teacher retention initiatives.

Recommendations

This study presents various recommendations aimed at improving expatriate teacher retention and optimizing its beneficial impact on curriculum design, instructional methods, and student learning results in international educational contexts.

School leaders and administrators are urged to formulate and execute comprehensive retention strategies specifically targeting expatriate teachers. These tactics may encompass competitive remuneration packages, explicit professional advancement trajectories, and robust institutional support structures that cultivate a sense of belonging and enduring commitment. Given that retained expatriate educators significantly enhance curricular stability and innovation, schools ought to pursue efforts that incentivize teachers to extend their tenure beyond short-term contracts. Integrating expatriate teachers into the school culture via mentorship programs, leadership training, and joint curriculum creation projects is likely to enhance individual teacher satisfaction and institutional success.

Secondly, specialized professional development should be provided for both novice and veteran expatriate educators. The data indicate that extended retention is associated with enhanced innovative teaching practices and improved student outcomes, so it is crucial to provide support to teachers throughout their tenure. Structured orientation programs and continuous coaching are crucial for newly hired expatriate teachers to expedite their adjustment and integration into the school's pedagogical philosophy. Experienced expatriate educators can maintain their engagement and motivation over time through advanced professional development options that emphasize leadership abilities, curriculum innovation, and cross-cultural competencies.

Third, foreign schools must meticulously consider the influence of teacher retention on student engagement and satisfaction. The findings indicate that a consistent teaching staff significantly enhances students' academic performance and emotional engagement in their learning experiences. Schools are consequently urged to constantly observe teacher turnover and evaluate its impact on student welfare and academic achievement. Establishing feedback systems that gather student insights on instructional continuity and assistance could assist administrators in making educated judgments on staffing and retention strategies.

Fourth, although this study concentrated solely on expatriate teachers, subsequent research should include the experiences and perspectives of local teachers to offer a more thorough knowledge of teacher retention dynamics. Incorporating local educators would provide a more comprehensive comparison of diverse staff profiles and assist in determining if the advantages noted in expatriate teacher retention are similarly applicable to local personnel or if distinct techniques are required for other groups. Furthermore, subsequent studies ought to examine how contextual variables, like curriculum type (IB, AP, bilingual programs), cultural influences, and student demographics, affect the association between teacher retention and educational outcomes.

Educational policymakers and accrediting organizations overseeing international schools are urged to acknowledge teacher retention as a vital measure of institutional quality. Policies that endorse extended contracts, facilitate professional mobility within educational networks, and encourage cultural integration activities can enhance retention rates and, subsequently, improve educational outcomes for students. Additionally, future research may focus on the precise reasons why expatriate teachers opt to stay or leave foreign schools. Understanding these motivations, whether personal, professional, contractual, or cultural, may provide more insight into the elements that influence teacher retention. Furthermore, a comparison examination of local and expatriate instructors could offer helpful details about who has a higher retention rate and why. Such research may uncover disparities in dedication, institutional support, or integration of issues that affect the length of their teaching tenure. These findings could help create more targeted retention strategies for each group.

Hence, the retention of expatriate teachers should be regarded not merely as a human resources issue but as a strategic imperative that significantly influences curriculum quality, pedagogical innovation, and student achievement. Implementing these ideas may enable international schools to establish more stable, dynamic, and effective learning environments that benefit all constituents of the school community.

Conclusion

The study concludes that the retention of expatriate teachers substantially enhances student learning results across various dimensions. Teachers, students, and administrators acknowledged that academic performance, engagement, and general satisfaction are enhanced when educators remain in the school community for extended periods. In the realm of student involvement, the elevated mean scores across educators indicate that the relational and motivating dimensions of learning are significantly affected by teacher continuity. Despite the absence of significant differences in the ANOVA results, the nearly significant finding concerning student engagement indicates that this aspect may be further affected by the duration of teacher retention.

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A special thanks goes to you, the expatriate educators, who have committed your time, energy, and passion to shaping young minds beyond borders. Your dedication to teaching in unfamiliar settings, your resilience amidst change, and your unwavering belief in the transformative power of education have been a source of inspiration for this research. And to you, the students whose lives have been touched by these educators, may your journeys be enriched by the continued support and presence of those who guide you.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Appendix

Result Tables

Table 1. Demographic Profile of Respondents

Expatriate teacher Profile	Frequency	Percentage
Gender		
Female	80	51
Male	76	48.4
Prefer not to say	1	0.6
Age		
21-30	14	8.9
31-40	51	32.5
41-50	64	40.8
51-60	21	13.4
60+	7	4.5
Years of Teaching Experience		
1-3 years	7	4.5
4-7 years	24	15.3
8-10 years	33	21
Less than 1 year	1	0.6
More than 10 years	92	58.6
Retention (in Years, current school)		
1-3 years	59	37.6
4-7 years	54	34.4
8-10 years	17	10.8
Less than 1 year	17	10.8
More than 10 years	10	6.4

Table 2. Descriptive Statistics of Pedagogical Strategies

Pedagogical Strategies of Teachers	N	Mean	Standard Deviation	Quantitative Interpretation
How much influence do expatriate teachers have on pedagogical strategies at your school?	157	3.6	1.012	Great Extent
How would you describe the teaching methods at your school?	157	3	0.832	Moderate Extent
To what extent do expatriate teachers use innovative teaching methods (e.g., student-centered learning, project-based learning)?	157	3.66	0.789	Great Extent

Table 3. Descriptive Statistics of Assessment Procedures

Assessment Strategies	N	Mean	Standard Deviation	Quantitative Interpretation
Teacher Perception				
How involved are expatriate teachers in curriculum design at your school?	157	4.15	1.148	Great Extent
Do you think the retention of expatriate teachers positively impacts the curriculum at your school?	157	3.87	0.932	Great Extent
How would you rate the impact of expatriate teachers in enhancing the diversity and effectiveness of the curriculum?	157	3.85	0.946	Great Extent
Administrator Perception				
To what extent do expatriate teachers influence the curriculum design at your school?	52	3.06	0.85	Moderate Extent

Table 4. Descriptive Statistics of Students' Academic Achievement

Academic Achievement	N	Mean	Standard Deviation	Quantitative Interpretation
Teacher Perception				
Do you believe the retention of expatriate teachers affects student academic achievement positively?	157	4.18	0.687	Great Extent
Student Perception				
How do you think the retention of expatriate(foreign) teachers impacts your academic performance?	205	3.67	0.922	Great Extent
Administrator Perception				
How important is teacher retention in improving student learning outcomes at your school?	52	3.88	0.808	Great Extent

Table 5. Descriptive Statistics of Student Engagement

Student Engagement	N	Mean	Standard Deviation	Quantitative Interpretation
Teacher Perception				
How does the retention of expatriate teachers influence student engagement at your school?	157	4.5	1.004	Very Great Extent
Student Perception				

How often do you feel engaged and motivated in class when taught by expatriate(foreign) teachers?	205	3.55	0.936	Great Extent
Do you believe that expatriate(foreign) teachers improve the learning experience at your school?	205	3.72	0.927	Great Extent
Administrator Perception				
How do you assess the impact of expatriate teacher retention on student engagement and satisfaction?	52	3.79	0.936	Great Extent

Table 6. Descriptive Statistics of Student Satisfaction

Student Satisfaction	N	Mean	Standard Deviation	Quantitative Interpretation
Teacher Perception				
How satisfied are students with the quality of teaching provided by expatriate teachers?	157	3.83	0.718	Great Extent
How would you rate the overall impact of expatriate teacher retention on student satisfaction with their learning experiences?	157	3.93	0.743	Great Extent
Student Perception				
How satisfied are you with the quality of teaching at your school, especially by expatriate(foreign) teachers?	205	3.63	0.954	Great Extent
Administrator Perception				
How do you assess the impact of expatriate teacher retention on student engagement and satisfaction?	52	3.79	0.936	Great Extent

Table 7. One-Way ANOVA Results for the Effects of Teacher Retention on Student Learning Outcomes According to Teachers

Teacher Group		Sum of Squares	df	Mean Square	F	Sig.
Student Achievement	Between Groups	2.581	4	0.645	1.38	0.243
	Within Groups	71.062	152	0.468		
	Total	73.643	156			
Student Engagement	Between Groups	9.095	4	2.274	2.333	0.058
	Within Groups	148.154	152	0.975		
	Total	157.248	156			

Student Satisfaction	Between Groups	3.615	4	0.904	1.663	0.162
	Within Groups	82.615	152	0.544		
	Total	86.229	156			

Table 8. One-Way ANOVA Results for the Effects of Teacher Retention on Student Learning Outcomes According to School Administrators

Administrator Group		Sum of Squares	df	Mean Square	F	Sig.
Student Achievement	Between Groups	2.823	4	0.706	1.088	0.373
	Within Groups	30.485	47	0.649		
	Total	33.308	51			
Student Engagement	Between Groups	0.283	4	0.071	0.075	0.989
	Within Groups	44.39	47	0.944		
	Total	44.673	51			
Student Satisfaction	Between Groups	0.283	4	0.071	0.075	0.989
	Within Groups	44.39	47	0.944		
	Total	44.673	51			

Table 9. One-Way ANOVA Results for the Effects of Teacher Retention on Student Learning Outcomes According to Students

Student Group		Sum of Squares	df	Mean Square	F	Sig.
Student Achievement	Between Groups	1.145	4	0.286	0.332	0.856
	Within Groups	130.881	152	0.861		
	Total	132.025	156			
Student Engagement	Between Groups	3.24	4	0.81	0.947	0.438
	Within Groups	129.971	152	0.855		
	Total	133.21	156			
Student Satisfaction	Between Groups	4.511	4	1.128	1.164	0.329
	Within Groups	147.209	152	0.968		
	Total	151.72	156			

Embracing Aging Through Lived Experience: Elderly Fulfillment Narratives as Foundations for Educational and Community-Based Interventions

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Abstract

As the global population ages, including in the Philippines, the roles of psychology, social work, and health sciences professionals become increasingly crucial. Their work is integral in promoting the well-being of the elderly. This study examines how elderly Filipinos perceive life fulfillment, focusing on the role of positive emotions, social engagement, and a sense of purpose. Using a qualitative phenomenological approach, in-depth interviews were conducted with 15 elderly individuals from Central Luzon. The results revealed that family support, spirituality, and community involvement are central to their sense of fulfillment, presenting opportunities for enhancing their well-being. Conversely, social isolation and financial insecurity, while challenges, can be addressed through targeted interventions. The study underscores the transformative potential of integrating gerontological content into educational programs in psychology, social work, health sciences, and education. This integration can equip future professionals with the empathy, cultural awareness, and skills necessary to address the emotional, cognitive, and social needs of aging populations, inspiring them to make a significant difference in the lives of the elderly. Ultimately, the study supports the development of community-based interventions and learning materials, such as the educational guide "Embracing Aging," which draws directly from elderly narratives and promotes positive aging by providing practical advice, psychological insights, and cultural perspectives. These initiatives can contribute to the development of more age-inclusive, compassionate, and culturally grounded professional practices.

Keywords: elderly, well-being, life fulfillment, spirituality, qualitative

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Introduction

As the world ages at a rapid pace, many countries, including the Philippines, face the challenging task of providing a meaningful life for their elderly citizens. The government already has over 7.5 million older adults and is experiencing a rapid increase in the older age group, where it is projected that older people will make up a sizable percentage of the population by 2030. This demographic shift highlights a pressing need to examine the physical, emotional, and social aspects of life satisfaction among the elderly population, whose well-being not only affects the individual but also contributes to broader societal development. As the elderly population is rapidly growing, their experience in old age becomes increasingly dependent on healthcare, economic security, family support, and opportunities for social interaction (Cruz et al., 2022).

The elderly in the Philippines live in a socio-cultural environment that reflects traditional family roles, but is also influenced by modern economic realities. That special setting allows for a traditional yet family-centered culture that guarantees emotional and economic support, yet simultaneously presents challenges such as declining health, loneliness, and economic uncertainty. Current trends in aging in the Philippines highlight the crucial role that health and social services must play in promoting the well-being of older adults. While considerable effort is being invested in government social welfare programs, including the National Health Insurance Program, these often prove to be only partially effective and insufficient to meet all the requirements of the elderly. The rise of social isolation and mental health problems, such as depression, is experienced among elderly Filipinos, specifically those residing alone, without adequate support from their family. Programs that promote community engagement and increase contact with others are presented by Cruz et al. (2022) as ways to enhance psychological well-being in old age, particularly during times when traditional family support structures break down due to migration and urbanization.

In an aging society, there is a need for academics, policymakers, social workers, mental health advocates and professionals to understand the perspectives of the elderly. Such an understanding could be established by developing comprehensive strategies that are responsive not only to the physical needs of the elderly but also to their mental and social needs. The results of the study would constitute significant contributions to the academic and mental health program discourse regarding aging, aiming to make the aging of the Filipino elderly an honored and fulfilling part of life.

The study supports the integration of gerontological insights into academic programs—particularly in psychology, education, social work, and health sciences—so that future professionals are better equipped with the cultural competence, empathy, and applied knowledge to serve aging populations. One such output is the educational guide “Embracing Aging Through Lived Experience,” a tool that translates qualitative data into practical, culturally responsive intervention strategies.

Review of Related Literature

Pursuing life fulfillment among older adults is a complex and multidimensional issue driven by psychological, social, health, and economic factors. In a world where older adults are increasingly found in all countries, including the Philippines, such dynamics will need to be studied with the hope of improving the quality of life for older adults. This review examines four key themes: psychological well-being, social support, health, and economic security.

Physical Health and Psychological Well-being

Psychological well-being is a factor that influences how older adults perceive their life fulfillment. It encompasses aspects of emotional regulation, life satisfaction, and resilience. Indeed, scientific research demonstrates that engaging in meaningful activities is necessary to enhance psychological well-being and, consequently, overall life fulfillment. According to Chen et al. (2022), participation in hobbies, volunteer activities, and community work is more positively associated with psychological well-being and less likely to lead to life dissatisfaction. Those who are elderly and whose daily lives carry a sense of meaning tend to be happier and are more satisfied with their lives.

Lifestyle and environmental conditions do play a significant role in psychological well-being. The elderly derive happiness from religion and community activities because such activities enhance their social relations and sense of belonging. As Cruz et al. (2022) postulated, older Filipinos typically participate in religious and community activities that enhance their social network, thereby facilitating the repair process of their emotional support systems. Such cultural attachment assumes a psychological appreciation of the act, as it helps the elderly enhance their quality of life in old age by supporting groups.

Conversely, living alone and experiencing poor health, limitations in daily activities, and symptoms of depression are associated with lower levels of life satisfaction according to Kandapan (2023) as cited by Cho et al. (2023), several studies have found that the decline in physical health capabilities is associated with a decrease in life satisfaction as one ages. Besides the physical and relational factors, psychological factors such as personal resilience add value to the experience of life fulfillment. According to Tricǎ et al. (2024), while old age presents numerous challenges, resilience enables the elderly to adapt relatively more easily to change, which can be interpreted as an accumulative positive attitude towards the physical, mental, and social changes that characterize old age. Understanding these psychological dimensions will be beneficial in developing interventions to enhance the well-being of the elderly within the distinct cultural context of the Philippines.

Social Support and Family Dynamics

Social support is essential for developing life satisfaction among older adults, particularly within their familial and community environments. In most developing countries, such as the Philippines, the traditional family structure remains the primary support system for many families. Noquiao (2021) discovered that among the older aged population, strong familial bonds are related to higher life satisfaction. This is more explicitly manifested when families reside under the same roof in a multi-generational family setup. These relationships are deeply emotional and provide a sense of meaning and belonging, while offering a practical form of support.

However, changing family dynamics, exacerbated by urban migration and economic challenges, can threaten traditional support structures. Community involvement serves as a substitution for bond disruption in the family circle. Involvement in community or neighborhood activities enables older persons to form new friendships and social relationships, which are significant for their mental health (Cruz et al., 2022). Programs concerning social interaction maintenance will be a life-fulfilling activity because they offer new possibilities for friendship and companionship. No doubt, social networks are highly significant because they

act as a buffer against loneliness and serve as a source of shared experiences and mutual support among peers.

Economic Security and Financial Well-being

The other aspect is economic security, as it plays a vital role in defining older adults' life satisfaction. It further empowers the elderly to remain independent and capable of accessing medical services, as well as engaging in leisure activities. Filipino elders have faced significant financial challenges due to inadequate pensions, low incomes, and insufficient savings.

The results of a study by Li et al. as cited by the study of Papi et al. (2021) showed that life satisfaction in older adults is associated with the level of education, financial resources, self-assessment of health, receiving financial support from the children and satisfying their support, staying at home, seeing and visiting neighbors, and inviting them to dinner. Moreover, Cruz et al. (2022) note that there is a direct and straightforward link between economic difficulties and lower life satisfaction among older adults. Economic constraints often characterize their inability to fulfill some of the most basic needs and participate in social activities, which, in turn, boost feelings of inadequacy as well as isolation. Two of the more universal predictors of loneliness that recent systematic reviews have highlighted include poor health and financial insecurity, with most of these focusing on populations from high-income countries (Dahlberg et al., 2022).

Financial security, as studied by Lutz et al. (2021), enables the elderly to engage in activities of interest and maintain their capacity for independence, providing evidence that economic assets contribute to overall well-being. In addition, Bierman et al. (2023) stated that financial stress can have devastating negative consequences not just on the symptoms of depression but much more significantly down the line for anxiety and anger. This occurs mainly because the problems in affording everyday needs rob the elderly of a sense of mastery and self-esteem. However, they also feel less socially significant as their financial problems worsen. This threat that an increasing level of financial strain in later life poses is therefore not only to heighten individual distress, but also, particularly with this creating a population of older adults who are even more powerless and marginalized, it is deeply worrying since the proportion of elderly around the world is growing fast.

This psychological burden highlights the importance of addressing economic issues through integrated psychological mechanisms and financial education. Endowing them with these financial management tools would certainly increase autonomy and satisfaction in their later years. Economic security, generally speaking, apart from improving access to health services and social interaction, contributes to the independence and dignity that old age can enjoy.

The Role of Religion and Spirituality in Aging

Lima et al. (2020) mentioned that various studies and research have been conducted to understand the relationship between spirituality and quality of life among the mentally ill elderly. Though the outcomes of the relationship cannot be universalized for all social groups of older people, there is some scientific proof that the same relationships improve the quality of life, enhance social exchange and social life, provide meaning to life, help face the finitude of life, and promote an optimistic outlook on aging. Moreover, based on the study by McManus (2024), studies consistently demonstrate a positive correlation between spirituality, religiosity, and mental health, supporting improvements in life quality, social interactions, and positive

attitudes towards aging. The belief in the transcendent or divine emerges as a significant dimension contributing to the meaning of life, resilience, and health promotion among older adults.

Research indicates that religion and spirituality play a significant role in supporting older adults, thereby making the aging process more manageable. Malone (2018) stipulated that such factors provide comfort and strength to the elderly as they navigate the challenges of aging. Lima et al. (2020) state that the belief in the transcendent or the divine represents an important dimension in the quality of life of older people, contributing to the meaning of life, resilience in the face of difficulties, and acting positively as a factor in health promotion. Furthermore, it highlighted that spirituality is crucial for coping with chronic diseases and for improving the quality of life for older adults. This study further postulated that it is only through spirituality wherein people find meaning beyond their challenges. Moreover, it plays a vital role in facilitating social interaction, which is essential for maintaining mental well-being.

In the Philippines, where Catholicism is dominant, the elderly exhibit strong religious affiliations. This cultural context shapes their coping resources and general life satisfaction. According to qualitative research by Pausanos (2013) on spirituality among elderly Filipinos, religious practices provide a framework for understanding life challenges, thereby enhancing their level of life fulfillment.

A notable study conducted by Basileyo (2019) found that spirituality and resilience significantly contribute to life satisfaction among older adults, especially those with chronic illnesses. The study highlights that spirituality acts as a mediating factor in reducing anxiety and enhancing overall well-being in aging populations, including the Filipino elderly.

Moreover, empirical evidence has supported the connection between religiosity and mental health. For instance, a research investigation by Coelho-Júnior et al. (2022) reveals that higher religious activity is correlated with reduced depressive and anxiety conditions among elderly populations. This is particularly relevant for the Filipino communities in which collective worship and community support are integral parts of everyday life.

Synthesis of Literature Review

Literature reviews on the well-being of the elderly suggest that several factors influence life satisfaction. These encompass physical health, social support, economic security, and spirituality. Of these, the psychological factor seems to be highly predictive of life fulfillment among the elderly. Numerous studies have demonstrated that engaging in meaningful activities, such as hobbies and community involvement, can enhance emotional control and resilience (Chen et al., 2022). Higher life satisfaction is associated with positive engagement in these activities, and poor physical health and social isolation negatively affect psychological well-being (Cho et al., 2023; Kandapan, 2023). In terms of social support, the traditional family structure prevalent in the Philippines is crucial for the satisfaction of elderly life (Noquiao, 2021). Rising trends in urban migration and changes in family dynamics are disrupting traditional support systems, ultimately leaving many older people isolated. Community involvement has become a critical alternative source of support for individuals experiencing loneliness, fostering new social relationships that lead to a reduction in loneliness (Cruz et al., 2022).

Economic security is yet another predictor of how well one will fare in old age. Financial security enables the elderly to be more independent in meeting their health needs and engaging in social activities, all of which contribute to a person's overall life satisfaction (Cruz et al., 2022; Papi et al., 2021). On the other hand, the lack of economic security raises perceived inadequacy and social withdrawal with relative risk to mental health problems in terms of anxiety and depression Bierman et al., 2023. Financial education and support are recommended interventions in reducing such tensions, thereby enhancing the maintenance of autonomy and dignity through older age. Finally, religion and spirituality are part of the coping mechanisms for most elderly, especially in the Filipino culture. Religious practice provides them with meaning, emotional resilience, and social support, thereby improving their mental health and overall life fulfillment (McManus 2024). Spirituality will not only help an older adult cope with and withstand the physical and emotional battles but also enable them to feel a sense of belonging with others, which is important for their well-being (Malone, 2018).

To summarize, the integration of psychological, social, economic, and spiritual factors may foster the well-being and life satisfaction of the aged. The studies presented herein serve as a springboard for developing culturally salient intervention strategies for elderly individuals in the Philippines.

Purpose of the Study

This study explores the lived experiences of elderly Filipinos to identify the key determinants of a well-lived life in later adulthood. In the context of the Philippines' ongoing demographic shift toward an aging population, it becomes increasingly important to understand how older adults define fulfillment through emotional resilience, meaningful relationships, spiritual grounding, and community involvement. Rather than focusing solely on physical health, this research emphasizes the psychological, social, and cultural factors that influence the well-being of the elderly.

Ultimately, the study contributes to the national and academic discourse on aging by providing nuanced insights into how elderly individuals construct meaning and purpose in their lives. It advocates for a holistic, culturally responsive approach to elder care—one that honors their narratives and leverages them as foundations for community-based and educational interventions. The findings inform not only policy and practice but also the development of learning materials and psychosocial programs that empower both older adults and the professionals who serve them. Through this lens, aging is not merely a period of decline but a continued journey of reflection, growth, and active participation in society.

Research Objective

Central Question: What are the perspectives of elderly Filipinos on the factors contributing to a well-lived life, and how do these perspectives influence their overall sense of life fulfillment?

Research Questions:

1. What characteristics do elderly Filipinos associate with a well-lived life?
2. What factors do elderly Filipinos perceive as obstacles to achieving a well-lived life?
3. How do elderly Filipinos evaluate their own lives about the concept of a well-lived life?
4. At what point do elderly Filipinos feel they have attained a well-lived life, and how do they describe that experience?

Methodology of the Study

The methodology employed in this study used a qualitative phenomenological approach to explore the perspectives of elderly Filipinos regarding life fulfillment. This design was chosen to capture the in-depth, lived experiences of the participants, focusing on their subjective perceptions of what constitutes a well-lived life. The study aimed to identify key themes related to life fulfillment by analyzing the narratives of the elderly within their socio-cultural and economic contexts.

Research Design

This study employed a qualitative phenomenological research design to elicit the views of elderly Filipinos regarding the factors that contribute to a well-lived life and, most importantly, how these viewpoints influence their overall sense of life fulfillment. This study employs qualitative research, which is well-suited for exploring the in-depth lived experiences and subjective perceptions of the elderly regarding their understanding and interpretation of fulfillment. Moreover, this research design considers the meanings that key informants attribute to their experiences, with the expectation of uncovering complexities surrounding aging, well-being, and fulfillment in the Filipino context (Neubauer et al., 2019).

Key Informants of the Study

The key informants for this study comprise 15 elderly Filipinos, aged 65 to 92 years, from Central Luzon. This age range covers the “young old,” “old old,” and “oldest old” groups. Participants were selected through purposive sampling to capture a broad cross-section of experiences and opinions. The inclusion criteria required respondents to be Filipino, residing in Central Luzon, and aged 65 and above. Additionally, participants must not have demonstrated significant cognitive decline, which would mean they can engage in a coherent conversation, allowing them to demonstrate informed consent. Such a criterion will ensure that participants can adequately express their views on the concept of a well-lived life. Individuals with cognitive impairments such as dementia or Alzheimer's disease, or those experiencing severe physical or mental health crises, were excluded. Additionally, participants who were unable to communicate effectively in Filipino or English were also excluded, as effective communication is essential for capturing the depth and richness of the collected data.

Instrument of the Study

The primary tool for gathering information was a semi-structured interview guide, which explored the viewpoints of elderly Filipinos regarding the factors that constitute a well-lived life and how these factors affect their overall life fulfillment. This format allows for flexible yet focused interviewing, enabling participants to produce their thoughts and feelings in their own words. The interview guide includes open-ended questions and prompts based on the central research question, as well as probing questions developed during the study's conceptualization phase. These questions allowed participants to reflect on their life experiences and share insights about their definitions of a well-lived life, the barriers to achieving it, and their thoughts on the social, economic, and emotional factors that influence overall life satisfaction.

Data Collection

Semi-structured interviews were conducted. This approach enabled participants to converse spontaneously while still allowing the researcher to use the predetermined questions to maintain structure. The interview began with rapport-building questions followed by questions centered around the general notions the participants have regarding a well-lived life. Debriefing questions were also provided to provide closure and clarify any points that needed further clarification. Interviews were conducted in either Filipino or English, based on the participants' preference. For those who consented, the interviews were audio-recorded to ensure accurate transcription for analysis.

Data Analysis

Thematic analysis of transcriptions, employing a qualitative methodology, was conducted. The researchers then compressed the data into manageable units and systematically categorized them into sub-themes and themes, uncovering the elderly's perceptions of a well-lived life. It was an iterative process during which data familiarization was used to generate initial codes, identify sub-themes, and finalize and review themes, including validation of the findings through member checking and triangulation. This rigorous analytical approach has helped clarify the diverse perceptions that elderly individuals have about a well-lived life, contributing to a deeper understanding of their experiences and, thus, informing the development of interventions tailored to their needs.

By maintaining rigor and transparency, the researchers ensured that their interpretations were credible and dependable, making the study findings trustworthy. The analysis process demonstrates how successful qualitative methodology can be in uncovering rich insights into complex phenomena and generating knowledge that informs both theory and practice in older adults' perception of life fulfillment.

Ethical Consideration

Conducting research with human participants, especially those from vulnerable populations such as the elderly, raises important ethical considerations. Given that this study aims to understand life satisfaction among the elderly Filipino population, it was guided by several ethical requirements that ensure the welfare and rights of research participants are safeguarded throughout all phases of the study. Informed consent was obtained in writing, as participants received an open and comprehensive explanation of the research purpose, procedures, risks, and all the benefits before participating in this study. This procedure was conducted in a manner that respects the participants' literacy levels and cognitive skills, allowing them to make well-informed decisions about their involvement.

Personal data collected was treated confidentially. Anonymous information was ensured to be untraceable in the transcripts and reports by using pseudonyms. All written documentation and electronic and hardcopy data collected were kept safe and accessed only by authorized researchers. The creation of a safe and respectful environment in which all sensitive topics can be discussed has been carefully considered by the researchers, as some of these topics are likely to be sensitive and evoke strong emotions. Participants were encouraged to respond in full but were also informed that they could choose not to answer some questions that might cause them concern. Appropriate measures, such as debriefing, will be provided in case participants experience distress that may occur during or after the interviews. The researchers demonstrated

sensitivity to the specific vulnerabilities of the elderly, especially those who are socially isolated or have health issues, ensuring that participants felt valued and heard throughout the study. In particular, an effort was made to determine whether the participants were under undue influence or coercion when they joined the study.

Results and Discussion

Characteristics Elderly Filipinos Associate With a Well-Lived Life

Elderly Filipinos associate a well-lived life with three interconnected elements: faith in God, perseverance through life's challenges, and the success of their family, particularly their children. Faith serves as their spiritual foundation, providing guidance, strength, and meaning in old age. Perseverance reflects their resilience and hard work, often motivated by their responsibility to support and secure a better future for their families. Ultimately, the success and unity of their children validate their sacrifices, giving them a sense of fulfillment and legacy. These spiritual and familial values work together to shape their understanding of a meaningful and well-lived life.

Perceived Obstacles to a Well-Lived Life Among Elderly Filipinos

Elderly Filipinos identified several obstacles to living a well-lived life, including neglect of spirituality, lack of self-discipline, unhealthy habits, and financial difficulties. The absence of faith was seen as leading to poor decision-making, loss of motivation, and vulnerability to vices. These issues often result in financial instability and family neglect, which further diminish life satisfaction. Over time, these interconnected challenges create a cycle of regret, stress, and reduced fulfillment, especially as individuals reflect on their later years.

How Elderly Filipinos Evaluate Their Lives As Well-Lived

Elderly Filipinos evaluate their lives based on three key aspects: personal contentment through faith, family success, and reflection on sacrifice and hard work. Faith allows them to look back on life with gratitude and peace, regardless of material circumstances. The success and stability of their children serve as a major source of fulfillment and validation of their lifelong efforts. Reflecting on their sacrifices and perseverance enables them to find meaning in past hardships and affirm that their lives have been worthwhile.

Defining the Moment a Well-Lived Life Is Attained

Elderly Filipinos believe they have attained a well-lived life when they experience peace, fulfillment, and stability in spirituality, family, and personal contentment. A strong relationship with God provides moral guidance and inner peace, while witnessing the success of their children and grandchildren confirms the value of their sacrifices. Achieving emotional, relational, and financial stability allows them to feel secure and content, marking the point at which they consider their life truly well-lived.

Conclusion

The present study examined how elderly Filipinos define a well-lived life and the factors that shape their sense of fulfillment. Findings indicate that a well-lived life is viewed as an integration of spirituality, family success, perseverance, and personal contentment. These

elements are deeply interconnected and reflect cultural values and personal beliefs formed across the life course.

Spirituality as a Foundation of Fulfillment

Participants consistently identified spirituality and their relationship with God as central to life fulfillment, serving as a source of meaning, moral guidance, and resilience. This highlights the value of purpose-oriented interventions that encourage spiritual reflection, such as community-based reflection activities, gratitude practices, and legacy-sharing programs aligned with the PERMA domains of Meaning and Positive Emotion.

Family Legacy and Intergenerational Bonds

Life satisfaction was closely tied to the success and well-being of children and grandchildren, with fulfillment understood as a shared, family-centered experience. Interventions that promote family legacy—such as storytelling, intergenerational projects, and reflective writing—can strengthen relationships and support the PERMA domains of Relationships and Accomplishment.

Perseverance and Life Meaning

Resilience and perseverance in the face of hardship emerged as core to elders' sense of identity and fulfillment. These experiences suggest that meaning is often derived from sustained effort and responsibility despite adversity.

Addressing Barriers Through Community Support

Participants identified obstacles such as spiritual neglect, poor financial habits, diminished motivation, and family disconnection. These findings point to the importance of preventative education and community-based support systems to strengthen purpose, discipline, and social connectedness in later life.

Recommendations

Based on the findings, several recommendations are proposed to enhance the well-being and life satisfaction of elderly Filipinos. These focus on strengthening community involvement and identifying directions for future research to better address factors influencing life fulfillment in later life.

Community Involvement

Communities may prioritize the development of spiritual support networks, as spirituality plays a central role in how elderly Filipinos define a well-lived life. Faith-based activities such as collective worship, spiritual support groups, and reflective gatherings can provide meaning, guidance, and emotional support. Strengthening family engagement through intergenerational activities and family-centered workshops is also recommended, as life satisfaction among the elderly is closely tied to family harmony and the success of younger generations.

Addressing financial insecurity is equally important. Educational institutions, local government units, and non-government organizations may collaborate to offer

intergenerational financial literacy programs tailored to older adults. These may include workshops on budgeting, retirement planning, pension access, government benefits, and healthcare expense management. Such initiatives empower elderly individuals with practical skills, promote autonomy, and reduce a major barrier to life fulfillment.

Promoting social participation through senior citizen clubs, hobby-based groups, and community events can further enhance emotional well-being by strengthening social support networks and fostering a sense of belonging.

Directions for Future Study

Future research may examine how spirituality interacts with socioeconomic status in shaping life satisfaction among elderly Filipinos. Longitudinal studies exploring the impact of financial stability on emotional well-being may also provide deeper insight into life satisfaction across time. Investigating gender differences in perceptions of a well-lived life could further clarify how family roles and responsibilities influence fulfillment. Cross-cultural studies may help identify both universal and culturally specific determinants of well-being in old age. Additionally, research on the role of digital platforms and social media in fostering connectedness, spirituality, and family involvement among the elderly is recommended, given the growing influence of technology on social relationships.

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A Video Game Telemetry Project: Modeling Data Science and Machine Learning in Educational Research

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Abstract

This paper models a process for exploring questions situated in digital video games and broader educational contexts. Findings from an ongoing study are used to outline a process to extract data from the encapsulating social media ecosystem using applied data science, artificial intelligence (AI), and machine learning (ML) techniques. Previous efforts involving Delphi techniques to examine player behavior and social discourse across online game environments (Schrader et al., 2020) tend to be cumbersome and laborious. Alternatively, educational data science techniques, in conjunction with AI and ML, provide mechanisms to triangulate data from three distinct sources: player discussions about performance on social media, game telemetry data, and game outcomes. In this study, researchers applied supervised and unsupervised machine learning approaches alongside statistical and learning analytics methods to extract and analyze behavioral patterns to evaluate if players' social media assertions about success aligned with the actions they take (Baker & Siemens, 2014; Siemens, 2013). Findings reveal that players' claims often reflect personal anecdote rather than observable behaviors that are linked to success. This work carefully outlines the integrated process (e.g., ML with public APIs) as a model for educational researchers to engage in similar studies. We advocate for broader utilization of data science, AI, and machine learning in research contexts that represent large, complex, but publicly available datasets (e.g., telemetric user data). This session serves as an entry point for researchers who are new to AL and ML, especially those investigating learning in contexts with high-volume data streams.

Keywords: educational data science, artificial intelligence, machine learning, video games, research methods

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Introduction

Researchers have used many and varied arguments to assert that the study of video games is a relevant, important, and useful area of inquiry, especially in the context of education and educational psychology. These arguments range from the extraordinary popularity of games and games' pervasive reach across age bands and cultures across the world. The tremendous annual global revenue of approximately $455 billion (Clement, 2024) and the massive scope of many titles that have millions of players worldwide (e.g., World of Warcraft) (Active Player, 2025) undergird these respective arguments.

When considered as a partner in cognition or context for learning, as opposed to a programming or design content, researchers also assert that the educative value of games involves them as informal learning contexts and situated environments (Barab et al., 2005; Squire, 2006), simulacra or digital petri dishes (Kafai, 1996; Schrader et al., 2016), or even tools for assessment of learning (i.e., stealth assessments, McCreery et al., 2019). The examination of games has deepened our collective understanding across a variety of topics, such as literacy (Gee, 2003), cognition and cognitive skills (Bediou et al., 2018), spatial reasoning, problem-solving, decision-making, personality, motivation, goal orientation, self-directed learning (Connolly et al., 2012), and social and collaborative learning.

Further, video games and the social platforms that encapsulate them represent a growing class of non-traditional online learning environments (OLEs) (Barab, 2014; Schrader et al., 2017; Steinkuehler & Squire, 2017). These environments are data rich, globally distributed, and characterized by continuous interaction, rapid feedback, and emergent patterns of behavior (Schrader et al., 2020; Schrader & McCreery, 2012). Unlike classrooms, learning management systems, or even massive open online courses, games generate intensive, time-stamped behavioral data as a byproduct of participation. At the same time, they are supported by expansive social ecosystems, including discussion forums, social media, and streaming platforms. As such, these tools serve as a third space, where players exchange views about their activities, discuss performance, and articulate the needs for success. Collectively, these systems present both an opportunity and a challenge for educational researchers. There are abundant learning data, but their extraction requires novel, and often complicated, methods to capture the complexity of these environments.

Despite sustained interest in games as learning contexts, much of the existing research relies on methods that are not necessarily aligned with the properties of contemporary OLEs or poised to take full advantage of their technological capabilities (McCreery et al., 2011; Schrader et al., 2017). Surveys, interviews, and expert-driven techniques such as Delphi studies have proven useful for identifying constructs, perceptions, and socially validated hypotheses, but they are labor intensive, slow to iterate, and heavily reliant on self-report. More importantly, these approaches often elevate belief about play, rather than objective data related to learning and performance within the system itself. As a result, there remains a gap in the field's understanding about concrete, observable behaviors in these systems and what players believe about performance.

Fortunately, recent advances in educational data science, learning analytics, and applied machine learning offer additional tools for researchers who are addressing questions of this ilk (Baker & Siemens, 2014; Romero & Ventura, 2020; Siemens, 2013). Public application programming interfaces (APIs) in harmony with contemporary modeling techniques make it possible to collect, process, and analyze large volumes of behavioral and social data from

online platforms. However, many educational researchers lack concrete skills, methods, and models for how these tools can be integrated into praxis. Further, examples are commonly drawn from fields outside of educational research and emphasize technical novelty or isolated analytic techniques.

As a result, this study demonstrates how applied data science, artificial intelligence, and machine learning techniques can be integrated with learning analytics and educational research practices to examine learning and behaviors in a complex online environment. Specifically, the paper illustrates a replicable workflow that triangulates (a) game telemetry data, (b) social discourse from online communities, and (c) game outcomes to examine the relationship between players' claims about success and the behaviors that predict it. Rather than advancing a new theory of learning or asserting causal claims about games, this work is intended to serve as a model. In this way, it is methodological in nature and offers as a practical, worked example for researchers seeking to study learning and performance in data-intensive, non-traditional OLEs. Ultimately, this work describes the end-to-end process, which connects data acquisition, modeling, and interpretation in the context of education and educational psychology.

Literature Review

The work presented here is expanded from previous work in novel contexts. Further, it is grounded in three complementary and related perspectives: complex systems, educational data science and learning analytics, and prior mixed-methods research in online game environments.

Prior Mixed-Methods and Delphi-Based Work

The present study builds directly on prior mixed-methods research that used Delphi techniques, surveys, and factor analytic methods to identify socially validated hypotheses about successful gameplay (Carroll, 2023; Schrader et al., 2020). That work demonstrated the value of leveraging player communities to surface domain-specific knowledge and to operationalize constructs in novel contexts (i.e., the League of Legends). Although informative, Schrader et al. (2020) noted key limitations to existing methods. In the case of Delphi studies, they are arduously slow, difficult to scale, and dependent on expert judgment and consensus. Moreover, they capture *beliefs* about success rather than direct behavioral evidence of it.

Building on this, the current work acknowledges the limitations and extends them. Further, social discourse remains a valuable data source. However, it is analyzed at scale using automated methods (e.g., AI, Term Frequency-Inverse Document Frequence (TF-IDF), and KMeans). In this analytical pipeline, behavioral hypotheses are not taken at face value, but are derived using scalable approaches and evaluated against quantitative findings (i.e., telemetric results). In this sense, the present work represents an evolution from expert- and discourse-driven inquiry toward an integrated, data science-informed approach that remains compatible with educational theory and interpretation.

Games as Complex Systems

From a learning sciences perspective, digital games exhibit all the characteristics of a complex system (Hilpert & Marchand, 2018; Jacobson et al., 2019; Schrader et al., 2020;

Wilensky & Jacobson, 2014). They consist of multiple interacting components (e.g., players, rules, roles, resources, objectives, feedback mechanisms) that operate across time and scale. Micro-level actions (e.g., movement, resource collection, coordination with teammates) function dynamically to evolve into macro-level outcomes (e.g., victory, defeat, or sustained performance improvement). Most importantly, these different levels of interactions are nonlinear, emergent, and multidimensional (i.e., compound over time). Said another way, small differences in timing or coordination can produce disproportionate effects on outcomes. As such, learning and performance in games cannot be fully understood through static snapshots or isolated variables.

Ontological framing using a complex systems lens has two important methodological implications. First, it requires data that reflect interactions over time rather than punctate, momentary events. Second, this view necessitates analytic approaches and analyses that can handle high-dimensional, interdependent features without assuming simple linear relationships. Traditional educational methods tend to collapse performance into measured change at specific points in time (e.g., pretest–posttest designs or retrospective self-report). These approaches, even those that include time series, are poorly suited to address the high levels of complexity and change in these systems, especially where learning evolves continuously.

Educational Data Science and Learning Analytics

Educational data science (EDS), including the related domains of educational data mining and learning analytics, provides a complementary methodological framework (Baker & Inventado, 2014; Romero & Ventura, 2020; Siemens & Gašević, 2012). Broadly, these fields emphasize the collection, analysis, and interpretation of large-scale data about learners and their contexts with the goal of understanding and improving learning. While much EDS research has focused on institutional systems such as learning management systems and MOOCs, EDS methods are also applicable to non-traditional OLEs, like games. Further, EDS also emphasizes interpretability and human-in-the-loop analysis, particularly when models are used to support educational inference rather than prediction alone.

When applied to games, EDS techniques enable researchers to move beyond proxy measures of learning and toward direct observation of behavior. Specifically, telemetric data (i.e., data that are automatically gathered by the systems) include information about specific actions that are captured during gameplay. These typically include time-stamped, sequential data that correspond to in-game events as they unfold during play. These data offer fine-grained records of actions, sequences, and timing. When interpreted using machine learning models and data science techniques, these data can be used to identify patterns associated with success, failure, or change over time.

Methods

This study employed a multi-stage, integrated methodological approach designed to examine learning-relevant behavior in a complex online environment using large-scale, naturally occurring data (Baker & Siemens, 2014; Creswell & Plano Clark, 2017). The methods were intentionally organized to reflect an end-to-end research workflow common in educational data science and learning analytics: data acquisition, preprocessing and feature construction, modeling, and interpretation. Rather than privileging a single analytic technique, the approach triangulated complementary methods to address distinct but related questions about

behavior, discourse, and outcomes. Game telemetry data were used to model observable performance patterns over time, while social discourse data were analyzed to capture players' articulated beliefs about success. These data sources were then examined through a set of analytic pipelines that balanced interpretability, predictive utility, and scalability. Collectively, the methods were selected to be transparent, replicable, and adaptable to other non-traditional online learning environments, with an emphasis on demonstrating process rather than establishing causal claims.

Data Sources and Acquisition

To demonstrate an integrated research workflow, data were collected from two primary sources: game telemetry from League of Legends and social discourse from Reddit. These sources were selected because they represent complementary perspectives on learning and performance—one behavioral and outcome-oriented, the other discursive and interpretive.

Game Telemetry Data

League of Legends provides public access to detailed gameplay data through the Riot Games API (Chen, 2015; Lee et al., 2015). Using this API and some code in Python, match-level telemetry was collected, including timestamped event logs, player statistics, team outcomes, and contextual information about each match (see Figure 1). The data consisted of 100,000 match timeline files in structured JSON format, each containing timestamped logs of every in-game event (e.g., kills, objective captures, structure destruction, and resource accumulation). There are roughly 1,000 events per match. The final dataset included more than 100 million events.

Figure 1
Riot Games API Scrape



Note. Scrape was executed over the course of 24 hours and included high-level players over the last year.

To make these data analytically tractable, raw events were processed through an extract–transform–load (ETL) pipeline. Events were aggregated into fixed temporal bins (e.g., three-minute intervals) at the team level, producing count-based features that captured the evolving state of each match. This approach preserved temporal structure while reducing noise and dimensionality, allowing subsequent models to focus on patterns of interaction rather than individual actions in isolation.

Social Discourse Data

Social data were collected using an API for a widely used discussion platform that hosts multiple communities dedicated to League of Legends strategy, coaching, and improvement (i.e., Reddit). Researchers have argued that these spaces function as "Third Places" and data from these contexts reflect shared activity, interest, and social functions (Haythornthwaite et al., 2018; Steinkuehler & Williams, 2006). Using the Reddit API, posts and comments were scraped from selected subreddits over defined time windows. Queries targeted advice-oriented and instructional discourse, using keywords commonly associated with improvement and gameplay strategy.

Data consisted of roughly 20,000 posts with a range of 80–250 tokens per post. A token is a basic unit of text, including words and punctuation. The resulting corpus underwent a multi-stage cleaning process, including deduplication, removal of deleted or low-information entries, normalization of text, and retention of minimal metadata for traceability. Engagement indicators such as upvotes and comment counts were preserved to provide contextual information about the visibility and social validation of claims. When completed, roughly 80–90% of the text remained usable. This supported the idea that the scrape was successful and secured usable data that was suitable for large-scale text analysis.

Data Processing Techniques

Following acquisition, telemetry data were processed through a series of extract–transform–load (ETL) procedures designed to support downstream modeling while preserving interpretability. Raw telemetry events were parsed, validated, and aggregated into fixed temporal bins (i.e., 3 minutes) at the team level, producing structured, count-based features that captured evolving gameplay dynamics. This transformation reduced noise, mitigated sparsity, and enabled comparison across matches of varying duration.

Social discourse data required parallel but distinct processing steps. Text was cleaned and normalized, duplicates and system-generated artifacts were removed, and documents were organized into structured corpora suitable for vectorization. Where appropriate, datasets from multiple sources were aligned using shared temporal windows and contextual metadata, allowing behavioral and discourse patterns to be examined in relation to one another. These processing steps were critical for ensuring that subsequent analyses reflected meaningful patterns rather than artifacts of data collection or platform-specific noise.

Analytical Pipelines

The central contribution of this paper lies in the modeling of three complementary analytical pipelines. Each pipeline addresses a different aspect of learning and performance in complex online environments, and together they illustrate how educational researchers can integrate data science techniques into coherent workflows.

Pipeline 1: Principal Components Analysis Dimension Reduction and Logistic Regression

The first pipeline employed principal component analysis (PCA) followed by logistic regression to model match outcomes based on telemetry-derived features. PCA was used to reduce the dimensionality of the binned event data while retaining the majority of variance. This step served both computational and conceptual purposes: it mitigated multicollinearity among event counts and provided a compact representation of overall patterns of play.

Logistic regression was then trained on the resulting components to predict binary outcomes (win/loss). This approach offers several advantages for educational research. It is computationally efficient, relatively interpretable, and aligns well with learning analytics traditions that prioritize transparency and replicability. While limited in its ability to capture complex nonlinear interactions, the PCA–logistic regression pipeline provides a stable baseline against which more sophisticated models can be compared.

Pipeline 2: Gradient Boosting and SHAP Interpretation

To address the limitations of the linear decision boundary in logistic regression and limited interpretability of factors, a second pipeline employed gradient-boosted decision trees (XGBoost) trained on the same temporally aggregated telemetry features. Unlike logistic regression, gradient boosting can model nonlinear relationships and interactions among features without strong distributional assumptions. This makes it particularly well suited to complex systems where the impact of an action may depend on timing, context, and co-occurring events.

Model interpretation was supported using SHapley Additive exPlanations (SHAP), which attribute contributions of individual features to model predictions. SHAP values were used not as definitive explanations, but as interpretive aids that highlight which types of events and temporal patterns were most influential in predicting outcomes. This combination of predictive power and post hoc interpretability provides a pragmatic balance between model performance and educational insight.

Pipeline 3: Social Discourse Modeling

The third pipeline focused on modeling social discourse at scale. Text from Reddit posts and comments was vectorized using term frequency–inverse document frequency (TF-IDF) representations and clustered using unsupervised methods such as k-means and non-negative matrix factorization. These techniques identify recurring themes and topics without requiring manual coding or predefined categories.

To support interpretation, representative terms and excerpts from each cluster were examined, and AI-assisted summarization was used to generate concise descriptions of dominant themes. Importantly, this step was treated as an analytic aid rather than an authoritative interpretation. Human judgment remained central in evaluating whether identified themes aligned with established gameplay constructs or reflected common misconceptions.

Together, these three pipelines illustrate how behavioral data, predictive modeling, and discourse analysis can be integrated within a single research design. The following sections

use this integrated workflow to examine points of convergence and divergence between what players say about success and the behaviors that predict it.

Results

The integrated analytical pipelines yielded complementary results that illustrate how different data sources and modeling approaches surface distinct, and at times conflicting, accounts of performance and success. Rather than reporting exhaustive model metrics, the results are organized around the types of patterns each pipeline revealed and the role those patterns play in informing educational inference.

Telemetry-Based Modeling Results

Across modeling approaches, telemetry-derived features reliably supported prediction of team-level match outcomes. The PCA and logistic regression pipeline demonstrated that a reduced set of latent dimensions derived from temporally binned event data was sufficient to predict win–loss outcomes at rates well above chance. These dimensions reflected broad axes of play that combined multiple event types rather than isolated actions, suggesting that performance emerges from coordinated patterns of behavior over time rather than single metrics. When manipulating the number of factors, results also indicated that there was a sufficient amount of area under the curve (AUC) and accuracy rating (see Figure 2). For reference, an AUC is an indication of a model's ability to classify outcomes, where .50 is random guessing and 1.0 is perfect prediction.

Figure 2

Principal Components Analysis Model Fit Statistics (12 Factors)

```
PCA components kept: 12 | variance: 0.3707
AUC: 0.9640453554796121
ACC: 0.90475

Report:
              precision    recall  f1-score   support

           0      0.911     0.897     0.904     19955
           1      0.899     0.913     0.906     20045

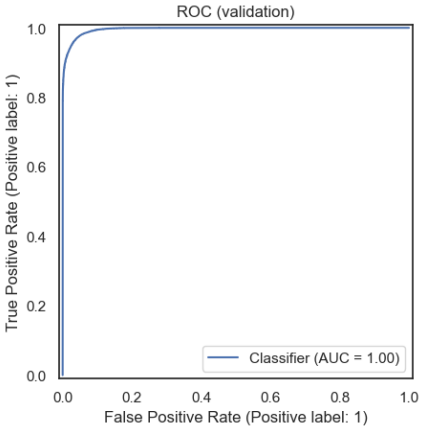
    accuracy                          0.905     40000
   macro avg      0.905     0.905     0.905     40000
weighted avg      0.905     0.905     0.905     40000
```

Note. The original model retained 102 components. This model retained 12 components and was 90% accurate.

The gradient-boosted models further improved predictive performance by capturing nonlinear interactions among event types and temporal windows (see Figure 3). SHAP analyses indicated that certain event categories exerted differential influence depending on when they occurred within a match. For example, early structural objectives and coordinated team actions were consistently associated with increased likelihood of victory, whereas other frequently discussed actions showed weaker or context-dependent relationships with outcomes. Importantly, no single feature dominated predictions across all matches; instead, influence was distributed across interacting behaviors, reinforcing a complex systems interpretation of gameplay.

Figure 3

XGBoost Model Fit Statistics and Receiver Operator Curve



	1-score	support
	0.965	20000
	0.965	20000
	0.965	40000
	0.965	40000
	0.965	40000

Note. The original model retained 102 components. This model retained 12 components and was 90% accurate.

Social Discourse Modeling Results

Unsupervised clustering of Reddit discourse revealed recurring themes related to improvement and success, including vision control, lane management, jungle tracking, champion selection, and role-specific responsibilities. These themes were highly stable across clustering methods and aligned closely with constructs identified in prior Delphi-based research, suggesting that large-scale discourse modeling can recover socially validated knowledge structures without manual coding.

However, discourse frequency and salience did not consistently correspond to telemetry-based indicators of success. Topics that were heavily discussed or strongly emphasized within the community were not always those most strongly associated with winning behavior in the telemetry models. In many cases, discourse emphasized actions that were highly visible, role-specific, or cognitively salient, even when their aggregate relationship with outcomes was modest.

Cross-Source Contrasts

When examined together, the results highlight a systematic divergence between discourse-driven accounts of success and behaviorally grounded patterns derived from telemetry. Social data captured how players explain, justify, and narrate success, while telemetry data captured how success is enacted through coordinated behavior over time. These perspectives were not mutually exclusive, but they were not isomorphic. The contrast between them provides a methodological insight: reliance on either discourse or behavior alone yields an incomplete account of learning and performance in complex online environments.

Findings and Discussion

Collectively, these findings are highly informative relative to playing the game: League of Legends. More broadly, the findings also demonstrate the value of integrating applied data science methods into educational research on non-traditional OLEs. First, the results confirm that large-scale telemetry data can be leveraged to model performance patterns in ways that are interpretable and theoretically meaningful when paired with appropriate analytic

techniques. Even relatively simple models, when applied to well-constructed features, yielded stable and informative results.

Second, the analysis of social discourse underscores the importance of distinguishing between beliefs about learning and observable learning-relevant behavior. Player communities generate rich, socially validated knowledge, but that knowledge is shaped by anecdote, role identity, and visibility rather than systematic outcome associations. From an educational perspective, this mirrors well-documented discrepancies between self-report and behavioral measures in formal learning contexts.

Third, the integration of these data sources illustrates a practical instantiation of learning analytics principles in an informal environment. Rather than treating machine learning models as endpoints, the workflow emphasized interpretation, comparison, and triangulation. In doing so, it offers a model for how educational researchers can engage with AI and ML tools without ceding epistemic authority to them.

More broadly, the findings reinforce the argument that learning in complex systems is best understood through patterns of interaction rather than isolated variables. Success in games—and by extension, in other complex OLEs—emerges from coordinated, temporally situated behavior that cannot be fully captured through surveys or single indicators. The methods demonstrated here provide one avenue for addressing this challenge at scale.

Limitations

Several limitations should be acknowledged. First, the study is situated within a single game context, and the specific behavioral patterns identified are not assumed to generalize directly to other games or learning environments. The contribution of this work lies in the process rather than the transferability of particular findings.

Second, the modeling approaches employed, while robust, are sensitive to feature construction and aggregation choices. Different temporal binning strategies or alternative representations of events may yield different patterns. Similarly, although SHAP provides useful interpretive affordances, it does not offer causal explanations and should be interpreted cautiously.

Third, social discourse data reflect participation biases and platform-specific norms. Not all players contribute equally to online discussions, and highly visible discourse may overrepresent certain roles or playstyles. These limitations mirror those of traditional qualitative methods and underscore the importance of triangulation.

Future research should explore the application of this workflow to other online learning environments, including learning management systems, collaborative platforms, and serious games. Longitudinal analyses that track change over time and designs that integrate additional data sources, such as communication logs or physiological measures, may further enhance understanding of learning in complex systems.

Recommendations

Based on the methods and findings presented, several recommendations are offered for educational researchers and methodologists seeking to study learning in complex, data-intensive online environments.

First, researchers are encouraged to move beyond single-method designs when investigating learning in non-traditional OLEs. Telemetry, discourse, and outcome data each provide partial views of learning and performance; relying on any one source risks oversimplification. Integrated workflows that triangulate behavioral and discursive data are better suited to capturing the dynamic and emergent properties of learning in complex systems.

Second, educational researchers should treat data processing and feature construction as substantive methodological decisions rather than technical preliminaries. Choices about temporal aggregation, unit of analysis, and representation fundamentally shape what patterns can be detected and interpreted. Explicit documentation of these decisions enhances transparency and supports replication, particularly when adapting workflows to new contexts.

Third, machine learning models should be deployed with interpretive intent rather than predictive emphasis alone. While predictive accuracy is valuable, educational relevance depends on the extent to which model outputs can inform understanding of learning processes. Techniques that support post hoc interpretation, such as dimensional reduction or feature attribution methods, are especially important when working with complex behavioral data.

Finally, discourse from online learning communities should be treated as a complementary analytic resource rather than a proxy for behavior. Social data are invaluable for understanding how learners make sense of their experiences, but they should be examined alongside behavioral evidence to avoid conflating salience with efficacy. This distinction is particularly important when educational interventions or design recommendations are informed by learner-generated content.

Conclusion

This paper presented a methodological exemplar for studying learning-relevant behavior in complex online environments using applied data science, learning analytics, and machine learning techniques. By modeling an end-to-end workflow that integrates game telemetry, social discourse, and outcome data, the study demonstrates how educational researchers can leverage publicly available, high-volume data sources to examine learning beyond traditional instructional settings.

From an educational perspective, the central contribution of this work lies not in the specific findings associated with a particular game, but in the process by which those findings were generated. The workflow illustrates how learning can be studied as an emergent, interactional phenomenon, and how discrepancies between what learners say and what they do can be examined systematically rather than assumed or dismissed. This approach aligns with contemporary views of learning as distributed, situated, and dynamic.

As learning increasingly occurs in digitally mediated and informal environments, educational research methods must evolve accordingly. The model presented here offers one pathway for that evolution—one that balances computational power with theoretical grounding and human interpretation. It is hoped that this work encourages broader adoption of integrated data science approaches in education, while reinforcing the importance of methodological rigor, transparency, and educational relevance.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author confirms that AI or AI-assisted technologies have been used to improve the readability of this manuscript. However, the ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Challenges and Most Significant Achievements of Students Participating in a Community-Based Research Service-Learning Course: A Qualitative Interview Study

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Abstract

This qualitative interview study examines the work and output achieved in a specific teaching project that focused on the complex social issue “social inequality, poverty and housing” from students' perspectives. The teaching project included elements of community-based research and service-learning, lasted two semesters and was carried out at the Ruhr University Bochum as part of the bachelor degree programme in geography. This study aims to develop an understanding of the challenges and difficulties the students faced. In addition, we were interested in finding out what the students considered to be their most significant achievement made in the project work. We conducted qualitative interviews with 13 students, out of the 15 students who participated until the end of the course. Two of the very open interview questions focused on the mentioned research objectives. After transcription and pseudo-anonymisation, the interviews were analysed using qualitative content analysis (inductive category formation method). It became apparent that the challenges were primarily in the following areas: defining the direction of research, defining the research questions, and difficulties in finding a community partner. The students considered the most significant achievements to be in the areas of acquiring a community partner, good teamwork and team building. Despite the restrictions imposed during the COVID-19 pandemic and the necessary changes to the course structure, the study's results provide important insights for course instructors who wish to adopt similar teaching approaches, highlighting the challenges faced by students and their achievements.

Keywords: challenge, performance, students, community-based research, service-learning

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Introduction

The effects of service-learning have been the object of various empirical studies. A good overview is provided by the reviews of Celio et al. (2011), Conway et al. (2009) and Eylers et al. (2011). Other teaching approaches, such as research-based teaching and learning or community-based research, which we combined with elements of service-learning in our university course, have also been, and continue to be, the subject of empirical studies. The effects of the research-based teaching and learning approach are discussed in Thiem et al. (2023) and Wessels et al. (2021). The benefits of both approaches are well documented in the literature; therefore, there are many reasons to use them in higher education. On the other hand, project-oriented courses that are planned and implemented according to these teaching approaches place increased demands on students in terms of independent work, self-competence and motivation. As a rule, the necessary amount of work cannot be precisely determined; it evolves as the project progresses. Such university project courses also place high demands on instructors, often increasing their workload, requiring greater flexibility, and necessitating a different understanding of their role as university lecturers.

As part of the accompanying research for a community-based research service-learning course on social inequality, poverty, and homelessness in the old industrialised region of the Ruhr area, we were interested in how the participating students perceived the challenges they faced. And what they personally consider to be their greatest achievement. To be able to draw conclusions for our own teaching practice, in the sense of whether the additional effort required by such university courses for students and instructors is worthwhile.

Our qualitative research study focused on the following two research questions:

- What major challenges did the students have to overcome in the project? (RQ 1)
- What are the most significant achievements that the students have made in the project from their personal point of view? (RQ 2)

The course examined was an elective course within the “study project” module in the third year of the bachelor's programme in geography at Ruhr University Bochum. In this module, collaborative team-based project work on a specific scientific topic or question is the main focus, using various scientific data collection and analysis methods (cf. Geographisches Institut der Ruhr-Universität Bochum, 2022). The development of the specific course design, which attempted to combine elements of both teaching methods mentioned above – service-learning and research-based teaching and learning or community-based research – in an innovative way, as well as the accompanying research for the course, was funded by a teaching grant from the university (university programme research-based learning, cf. Ruhr University Bochum, 2020) and a follow-up funding from the Institute of Geography.

An important component of the year-long course was working in student research teams under the guidance of the responsible instructor, who also served as the study's principal investigator. Ultimately, three student teams remained, each working on a research topic of their own, selected from the overarching topic of social inequality, poverty, and homelessness. There were 16 students, 15 of whom successfully completed the course. The student research teams' research topics were selected in consultation with community partners, social organisations in the case-study cities of Bochum and Essen. Before the COVID-19 pandemic began, several meetings were organised with representatives of social organisations, our community partners. In addition, on some of these occasions, contact was also made with homeless or formerly homeless people, and informal discussions were held. Following the outbreak of the COVID-

19 pandemic, the course was converted to an online format. The final assessment for students consisted of a group presentation of the results achieved and a written project report per group. Table 1 in Bittner (2025) identifies which elements of the course described above are attributable to the service-learning approach and the research-based teaching and learning approach. More detailed information about the course participants is provided in Bittner and Kempchen (2024).

Methods

In this section, we present the study's research design and describe the data collection and analysis procedures employed.

Research Design and Setting

We designed a qualitative study to investigate the challenges and achievements of students in a community-based research service-learning course. We sought to address our research questions with the greatest possible openness and were interested in personal narratives and detailed information from a limited number of study participants. The qualitative approach, therefore, seemed appropriate (cf. e.g. Creswell & Poth, 2018; Flick, 2018; Kruse, 2015; Panke, 2018). The study participants were recruited after the end of the university course "social inequality, poverty and housing" in the bachelor degree programme in geography by approaching the students who had attended the course. Participation in the qualitative interview study was voluntary for the students. Of the 15 course participants, 13 agreed to take part. The course, which was examined as part of accompanying research funded by a teaching grant from the university, lasted one year and took place in the academic year 2019 and 2020.

Participants

Among the students involved in the study, more were female. Five were male (38.5%), and eight were female (61.5%), who gave their consent to give an interview. The study participants were between 21 and 27 years old (see Appendix A). More than 80 % were born and raised in the federal state of North Rhine-Westphalia in Germany.

Data Collection

We obtained data through qualitative, highly open-ended interviews. The interviews followed an interview guide developed in advance, according to the procedures described by Helfferich (2011) and Kruse (2007, 2015). In a multi-stage process, a large number of possible interview questions were developed for the comprehensive research study, which included further sub-studies with other research focuses, checked for suitability, and subsumed and sorted. An interview guide comprising 12 narrative-generating key questions was developed. For each key question, follow-up questions were formulated to maintain the flow of the conversation and elicit longer responses to the key question and additional information. In addition, potential follow-up questions were noted in the interview guide in advance to be asked as needed.

The following two very open-ended and narrative-generative key questions in the longer interview guide related to the two research questions of the sub-study presented in this paper:

- In the first phase of the project, what has been the most difficult task or the biggest challenge you have faced personally? Could you please describe it in more detail?

- From your point of view, in the first phase of the project, what is the biggest and most significant achievement you have made so far in the project work? Could you please describe it in more detail!

Because the study coincided with the COVID-19 pandemic and social distancing regulations were in place, the interviews were conducted online. The Zoom conference system was used for this purpose. The second author of this paper was responsible for conducting the qualitative interviews. We sought to minimise the influence of power imbalances on the interview process. The interviews were therefore conducted by the student assistant working in the project, a master student in geography specialising in urban and regional development. Immediately after the interview, the interviewer noted the specific features and peculiarities of the interview situation in a postscript. The interviews were recorded using a digital audio recording device. The total interview duration, covering all 12 key questions in the interview guide, ranged from 21 to 60 minutes. They were transcribed in full according to the rules of the transcription system by Dresing & Pehl (2018), content-semantic transcription. Pseudonymisation was carried out.

Data Analysis

We chose qualitative content analyses to analyse the interview transcripts, following the approach described by Mayring (2010a, 2010b, 2022a; Mayring & Frenzl, 2019). MAXQDA Pro software, version Release 22.8.0 (Kuckartz, 2010; Rädiker & Kuckartz, 2019) was used by the principal investigator of this research study to perform the data analysis software-assisted, to compile interview transcripts, audio files, postscripts and data collection instruments in a project folder and to document the processing and analysis steps carried out. The use of the AI-assistant for data analysis was deliberately avoided. In this context, we refer to Mayring's (2025) study results, which support our concerns. The data analysis performed corresponds to the inductive category formation method described by Mayring (2010a, 2010b, 2022a). The categories were derived from the interview transcripts, which were read and analysed line by line. The context unit for the analysis was defined in advance as the interview transcript. The coding unit was set to the clear meaning component. It should be noted that the interview quote examples listed in Appendix B, C, and D for the individual categories are generally longer for illustrative purposes and may also include several related sentences.

Results

This section summarises the main findings of the qualitative interview study. The results are presented in the order of the two research questions addressed. We follow Mayring's (2010b, 2022a) recommended presentation of the results and report frequencies for the main categories in the tables. The reference here is the documents, the interview transcripts.

Major Challenges

First, we turn to the results of RQ 1, which addresses the most significant challenges in the project. The inductive category formation process resulted in the following main categories: “define the direction of research”, “define research questions”, “difficulties finding a community partner”, “appointments/ establishing contact with vulnerable individuals”, “appointments/ establishing contact with social organisations”, “coping with circumstances caused by the COVID-19 pandemic”, “counteract lack of motivation”, “coming/ working together as a team”, “recruitment of community partners (decision-making)”, “finding a theoretical background” and “giving a presentation”. The frequencies for these main categories

are shown in Table 1. The following three main categories are most commonly represented: a) define the direction of research (53.8 %, 7 out of 13 interviewees), b) define research questions (38.5 %, 5 out of 13 interviewees), and c) difficulties finding a community partner (23.1 %, 3 out of 13 interviewees).

Table 1
Frequencies of Main Categories (Documents With Codes) – Major Challenges and Difficulties of the Students in the Community-Based Research Service-Learning Course

	Documents	Percentage	Percentage (valid)
Define the Direction of Research	7	53.1	53.8
Define Research Questions	5	38.5	38.5
Difficulties Finding a Community Partner	3	23.1	23.1
Appointments/ Establishing Contact with Vulnerable Individuals	2	15.4	15.4
Appointments/ Establishing Contact with Social Organisations	2	15.4	15.4
Coping With Circumstances Caused by the COVID-19 Pandemic	2	15.4	15.4
Counteract Lack of Motivation	2	15.4	15.4
Coming/ Working Together as a Team	2	15.4	15.4
Recruitment of Community Partners (Decision-Making)	1	7.7	7.7
Finding a Theoretical Background	1	7.7	7.7
Giving a Presentation	1	7.7	7.7
DOCUMENTS with code(s)	13	100.0	100.0
DOCUMENTS without code(s)	0	0.0	-
ANALYSED DOCUMENTS	13	100.0	-

These main categories can be summarised as three overarching themes, which are also reflected in the structure of the following, more detailed presentation of the results for RQ1: challenges related to the research process in general, challenges related to working with community partners and vulnerable people, and other challenges.

Challenges Related to the Research Process in General

The main categories “define the direction of research”, “define research questions” and “finding a theoretical background” fall under the theme *challenges related to the research process in general.*

The most difficult task for the students here, by far the most frequently mentioned, was to determine the direction of their research, to decide on a research topic. In doing so, various points had to be taken into account. Firstly, a research topic had to be identified that could be realistically investigated within the existing framework of a two-semester course, and that was clearly defined, with a well-defined scope. Secondly, there was the difficult task of reconciling the different ideas and preferences of the students in the team and agreeing on a research topic, a specific direction of the research.

Q1: “I would say that the most difficult task in the project was really figuring out exactly what we wanted to specialise in and what we wanted to achieve in the end, so that it wasn't too broad”.

Q2: “I believe (the biggest challenge was) that you work out together with the team a suitable topic or question that can be addressed and also seems feasible to work on”.

Q3: “And then I think the first big issue was finding a topic. Because I think we were all a bit unsure about what we should do next. Some people may have had different ideas. And then we had to agree on something. I think that was the first big challenge”.

Q4: “It was difficult to find a topic, or rather to find a team and then agree on a topic. This was because very different preferences and interests were expressed. But in the end, we managed to make everyone happy”.

Challenges Related to Working With Community Partners (Social Organisations) and Vulnerable People

The main categories “difficulties finding a community partner”, “recruitment of community partners (decision-making)”, “appointments/ establishing contact with vulnerable individuals” and “appointments/ establishing contact with social organisations” fall under the theme *challenges related to working with community partners (social organisations) and vulnerable people.*

The category “difficulties finding a community partner” appeared most frequently in the interviews. Not only were actual difficulties addressed here, but also the fear of possibly not finding a suitable community partner for the project work. The students received support in this regard, but ultimately approached and selected partners independently as a team.

Q5: “The fact that we didn't find a partner at the beginning, which was kind of stupid. The other teams had something and we were the only ones who didn't have anyone. And we didn't know why, because we had put in just as much effort as the others and we never got any feedback, no rejections, nothing. And I think the important thing was that we just stuck together and encouraged each other, otherwise I don't think it would have worked. So the point about not having a community partner at the beginning (…)”.

Q6: “ What I would say is the thoughts about what to do if all the (possible) community partners decline to take part. So this fear that you'll be left on your own with nothing, and then you feel bad, as if you haven't achieved anything, so I would add that”.

In addition, it was stated that it was a challenge for the team to agree on the choice of a potential community partner. The appointments with representatives of social organisations as well as with homeless people or people who had previously been affected by homelessness were seen as a challenge because the situations were unfamiliar to the students and it was not easy to prepare for them.

Other Challenges

Another challenge mentioned, which falls within the realm of *self-management*, is motivating oneself and the team. In addition, the special circumstances arising from the COVID-19 pandemic, the associated uncertainty, and the impact on teamwork due to contact restrictions. *Challenges in teamwork*, coming together as a team, working in a team, and the distribution of tasks in the team were also addressed.

Most Significant Achievements

The results for RQ 2, i.e. the question of which significant achievements the students have made in the project, are now presented. The categories inductively derived from the text material during the coding process are shown in Table 2.

Table 2
Frequencies of Main Categories (Documents With Codes) – Most Significant Achievements of the Students in the Community-Based Research Service-Learning Course

	Documents	Percentage	Percentage (valid)
Acquisition of the Community Partner	5	38.5	38.5
Good Teamwork	4	30.8	30.8
Determined Work in the Team	2	15.4	15.4
Team Building	2	15.4	15.4
Writing the Final Report	1	7.7	7.7
Preparation of Interview Guidelines	1	7.7	7.7
Preparation of Literature Excerpts	1	7.7	7.7
Ideas and Suggestions to Share Responsibility in the Team	1	7.7	7.7
Good Organisational Skills	1	7.7	7.7
Being Motivated and Committed	1	7.7	7.7
Being Able to Inspire the Community Partner for the Research Project	1	7.7	7.7
Presentation of the Research Design and Research Topic	1	7.7	7.7
Adherence to Deadlines	1	7.7	7.7
Structuring the Final Report	1	7.7	7.7
Successfully Managing a Period With Many Deadlines	1	7.7	7.7
DOCUMENTS with code(s)	13	100.0	100.0
DOCUMENTS without code(s)	0	0.0	-
ANALYSED DOCUMENTS	13	100.0	-

The four most common categories in the interviews are: a) acquisition of the community partner (38.5 %, 5 out of 13 interviewees), b) good teamwork (30.8 %, 4 out of 13 interviewees), c) determined work in the team (15.4 %, 2 out of 13 interviewees) and d) team building (15.4 %, 2 out of 13 interviewees).

Achievements Related to the Research Process in General

The main categories “writing the final report”, “preparation of interview guidelines”, “preparation of literature excerpts”, “ presentation of the research design and research topic” and “finding a theoretical background” fall under the theme *achievements related to the research process in general.* Each of these categories appeared once in the interviews.

Achievements Related to Working With Community Partners (Social Organisations)

The theme *achievements related to working with community partners (social organisations)* includes the following two categories: “acquisition of the community partner” and “being able to inspire the community partner for the research project”.

Two interview quotes are provided for illustration purposes.

Q7: “I would say that we as a team, but also each of us individually, and I myself, managed to secure the community partner and convince them of our merits. We invested a great deal of energy and time to make this happen, especially after receiving so many rejections. I believe this is a commendable achievement”.

Q8: “Then I would also mention again that we were able to win (name of the social organisation) as a cooperation partner and convince him of our cause”.

Other Achievements

Other achievements mentioned can be subsumed under the themes *achievements in teamwork* and *achievements in self-management.* The students stated that they had grown closer together as a team, that they got on well with each other, that they communicated well with each other, that they managed to distribute tasks fairly and to manage finding ideas together as a team, to carry out the necessary steps in a determined manner and strive towards the goal. *Achievements in self-management* include “adherence to deadlines”, “good organisational skills”, “being motivated and committed” and “successfully managing a period with many deadlines”.

Strengths and Limitations

A strength of this research study was the use of a qualitative research design. The highly open-ended interview questions, without predetermined answer categories, enabled the study participants to identify and describe the challenges and difficulties they encountered in the project, as well as the most significant achievements in their subjective assessment. Their views were heard and given greater weight than would have been the case in a quantitative study. In this context, the use of a student research assistant to conduct the interviews has proven successful. This prevented any power imbalances from arising and created the conditions for an open and relaxed atmosphere during the interviews.

One of the major limitations of the study is the small number of participants, attributable to the size of the university course. For the results of a qualitative study using qualitative content analysis to be generalisable, a larger number of study participants is typically required (Mayring, 2022b). When the results are examined independently of the frequencies of the main categories and with a focus on the categories themselves, the findings indicate relevance beyond the specific university course examined in this study. In addition, it should be noted that the necessary changes to the course schedule due to the COVID-19 pandemic have had a certain impact on the study results. Specifically, this meant that, approximately halfway through the course, university regulations prohibited direct contact between students and vulnerable individuals and social organisations. In addition, work within the student teams and between the students and the instructor had to be converted to a purely virtual format. Looking again at the two research questions examined: “What major challenges did the students have to overcome in the project?” and “What are the most significant achievements that the students have made in the project from their personal point of view?”, it becomes clear that such changes have an impact on the subject of the study. Certainly, if the original course concept had been retained, there would have been further challenges to those already mentioned by the students. Challenges related to direct, personal contact with vulnerable individuals, to data collection and analysis for the student research projects, and related to close contact with representatives

of social organisations would have been expected. Perhaps, other achievements would also have been of great importance.

Discussion, Reflection

When asked about the biggest challenges and difficult tasks in the project, there were unexpectedly frequent references to the first phase of the research cycle, namely determining the direction of one's own research and defining specific research questions. On the one hand, this is certainly due to the aforementioned necessary changes to the course process and content caused by the COVID-19 pandemic, which undoubtedly led to an overemphasis on challenges in the initial project phase during the interviews. However, this can also be attributed to the fact that it was the first small research project in which the students were involved. In this project, guided by an experienced instructor but otherwise working independently within a research team, the students collaborated with community partners on their research topic. In general, the results highlight the significance of the teaching concept of "research-oriented teaching and learning" and the importance of integrating it into university teaching early in the course of study. Beyond acquiring theoretical knowledge during their studies or learning about individual aspects of scientific work, such as literature search, reading, and writing scientific texts integrated into various courses in the bachelor degree programme, students are given the opportunity to gain insight into the entire research process at an early stage and to participate in a research project under guidance. The knowledge gained here is indispensable to a future academic career and also fosters early interest in research. Through conducting practical research activities, as well as scientific writing, and giving oral presentations of interim and final results. Students are also optimally prepared for their first independent research work, which is usually the writing of the bachelor thesis. The challenges and difficult tasks identified and further described by the students arise from the specific experiences gained and should be understood not only as challenges or difficulties but also as elements of a holistic experiential learning process (cf. Kolb & Kolb, 2009; Kolb, 2015). They promote students' problem-solving skills as well as their ability to adapt to new, complex situations.

This also applies to the challenges and difficult tasks mentioned above, which arise from the service-learning elements that have been integrated into the course, the recruitment of the community partners, the collaboration with these social organisations in the case study cities of Essen and Bochum in the Ruhr area, and, in the case of our study project, the collaboration with vulnerable individuals. Practical experiences gained through working with others who hold different professional positions, representatives of social organisations, in project meetings, personal conversations, telephone contact, or email, are valuable and will be of great importance for the future professional lives of the students. Meeting and interacting with people whose lived realities differ significantly from those of students, and the challenges that arise from this, enable students to broaden their perspectives, think beyond their own academic horizons, and learn openness, respect, and tolerance when encountering others. Bittner & Kempchen (2025) provided detailed insights into the learning outcomes achieved through visits to social organisations and contact with vulnerable people, including homeless and formerly homeless individuals.

Among the most important achievements mentioned by the students, two additional areas stand out: achievements in teamwork and achievements in self-management. Particularly noteworthy here are good teamwork and the successful composition of the team. In addition, personal, organisational and motivational skills. Teamwork skills and self-competence, including

organisational and motivational abilities, are also important prerequisites for a successful start to professional life.

Conclusion and Direction for Further Research

Fundamentally, the study's results demonstrate the importance of the two teaching approaches employed: research-oriented teaching and learning (community-based research) and service-learning. It should be noted, however, that, due to necessary deviations from the original course concept resulting from the COVID-19 pandemic, the teaching concept, “research-based teaching and learning”, came to the fore somewhat. Beyond theoretical knowledge, learning outcomes are achieved through the general challenges of long-term team-based project work, guided completion of the research cycle, and collaboration with community partners. All of which are highly relevant for further university study, academic pursuits, and future careers in other fields. Despite the limitations of our study, we believe that the main categories identified from the data on the challenges and difficulties mentioned by the students in the project, as well as the particular achievements, are also fundamentally relevant to teaching projects that include elements of research-based teaching and learning or community-based research and/or service-learning. Verifying this and expanding the identified categories require further empirical studies with larger sample sizes.

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Authors’ Contributions

JB: principal investigator, conceptualisation, design and methods, data analysis, drafting the paper. JK: conducting the interviews and contributing to interview guideline development, reviewing the manuscript.

Conflict of Interest Statement

The authors have no conflict of interest to declare.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that *Deepl Translator*, *Grammarly* and *Pro Writing Aid* were used in the writing process of this paper, to translate individual passages of text, interview quotes, individual words, and to improve the linguistic and grammatical quality of the written text. Subsequently, the text was usually adapted, reviewed and edited by the first author. No linguistic smoothing was applied to the interview quotes; instead, the spoken wording was reproduced realistically. The last version of the paper underwent a final proofreading process by the two authors, who assume responsibility for the content of the publication.

The analysis of the qualitative interview data (qualitative content analysis) was deliberately carried out without the use of AI-assisted technologies. The AI-supported coding tool (AI-assist) offered for some time by the MAXQDA software that the first author employed for data analysis, was not used at all and also not activated for use in the software.

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Appendices

Appendix A

Interviewees

Name	**Sex**	**Age**
Nico Gunf	male	24
Wolfram Wagner	male	21
Lotte Heinrich	female	22
Amelie Scheibe	female	21
Ludmila Mude	female	21
Norma Girschner	female	22
Berta Schleich	female	22
Enno Roskoth	male	21
Alfons Eberth	male	21
Rosi Trupp	female	22
Hans-Jochen Löffler	male	21
Maria-Luise Haase	female	22
Carmela Spieß	female	27

Appendix B

Category System with Sample Quotes – Major Challenges and Difficulties of the Students in the Community-Based Research Service-Learning Project

- **Define the Direction of Research**
  Sample Quote: "It was difficult to find a topic, or rather to find a team and then agree on a topic. This was because very different preferences and interests were expressed. But in the end, we managed to make everyone happy." *(Carmela Spieß, female, age: 27)*
- **Define Research Questions**
  Sample Quote: "And then I found it very difficult to come up with a research question that was explicitly precise and not too general. That's where we had the most difficulties, because various factors meant that we had to adapt again and come up with new research questions. I found that the most difficult part." *(Berta Schleich, female, age: 22)*
- **Difficulties Finding a Community Partner**
  Sample Quote: "That we didn't find a partner at the beginning, which was kind of stupid. The other teams had something, and we were the only ones who didn't have anyone. And we didn't know why, because we had put in just as much effort as the others, and we never got any feedback, no rejections, nothing. And I think the important thing was that we just stuck together and encouraged each other, otherwise I don't think it would have worked. So the point about not having a commitment partner at the beginning and then, luckily, getting out of that motivational slump caused by COVID." *(Amelie Scheibe, female, age: 21)*
- **Appointments/ Establishing Contact With Vulnerable Individuals**
  Sample Quote: "In any case, making contact, first with the organisations and then with the homeless people, I found that difficult, but it turned out that it wasn't so bad. That was actually my only concern (unintelligible). Because (unintelligible) I thought it would be okay, because I'm someone who can deal with difficulties like that, but it was still a challenge for me."*(Lotte Heinrich, female, age: 22)*
- **Appointments/ Establishing Contact With Social Organisations**
  Sample Quote: "Accordingly, I would say that the most challenging aspect was really the meetings with our community partner and those affected, because it was simply a new situation that I hadn't encountered before. With our community partner, it wasn't quite as new. Not with them per se, but with an organisation like that. But yes, of course, preparing for it and then carrying it out was definitely the most demanding thing we did, and definitely the most interesting." *(Nico Gunf, male, age: 24)*
- **Coping With Circumstances Caused by the COVIC-19 Pandemic**
  Sample Quote: "So, the lack of teamwork due to COVID-19. The fact that we had no direct contact within the team. And you can have as many Skype meetings as you like, but sitting next to each other, listening to each other, letting each other finish speaking, and asking each other questions—I think that only works in real life. And that was the biggest challenge." *(Rosi Trupp, female, age: 22)*
- **Counteract Lack of Motivation**
  Sample Quote: "And that you didn't lose your motivation or your courage in the end. I think that was the biggest difficulty, the biggest hurdle in the course of the study project so far." *(Maria-Luise Haase, female, age: 22)*
- **Recruitment of Community Partners (Decision-Making)**
  Sample Quote: "At the beginning, it was really about finding a project partner. The process of agreeing on one and focusing on it. Thankfully, we managed to do that on the first attempt." *(Wolfram Wagner, male, age: 21)*
- **Finding a Theoretical Background**
  Sample Quote: "Yes, I would say that (was?) theory formation." *(Hans-Jochen Löffler, male, age: 21)*
- **Giving a Presentation**
  Sample Quote: "A big challenge. For me, at least, it may only be a small thing, but giving presentations is still a big challenge for me. I actually enjoy giving presentations. It's just that I find it very difficult because of the language. That's why giving presentations in German is a big challenge for me. Yes." *(Norma Girschner, female, age: 22)*

Appendix C

Category System with Sample Quotes – Most Significant Achievements of the Students in the Community-Based Research Service-Learning Project

- **Acquisition of the Community Partner**
  Sample Quote: "The greatest achievement. Well, I think the greatest achievement is winning (name of the social organisation) as a partner. But that's not something I can take credit for myself; it was achieved by the group as a whole." *(Enno Roskoth, male, age: 21)*
- **Good Teamwork**
  Sample Quote: "Everything so far, okay. So, I think the greatest achievement is that we as a team have actually managed to get along well with each other. That we communicate regularly, that no one has to be asked to do anything. That we have somehow managed to actually become a team. And I think that has to do with the fact that I talked a lot and divided up the tasks a lot. As I said, I tried to divide them fairly. And I think it's great that everyone contributes on their own initiative every week without being asked. That's the result of several months of work, and I think it's fantastic." *(Carmela Spieß, female, age: 27)*
- **Determined Work in the Team**
  Sample Quote: "And that we have really made progress. And done really good work so far. And hopefully will continue to do so. That this has really distinguished us as a group so far. To continue working on this with determination, so that we can stay up to date and not fall behind." *(Wolfram Wagner, male, age: 21)*
- **Team Building**
  Sample Quote: "That we somehow managed to actually become a team." *(Carmela Spieß, female, age: 27)*
- **Writing the Final Report**
  Sample Quote: "But then write the final report as well." *(Ludmila Mude, female, age: 21)*
- **Preparation of Interview Guidelines**
  Sample Quote: "Then there's also the creation of guidelines. This has already been done in (methods of urban and regional analysis?). But now it needs to be done again on a much larger scale and also, let's say, more importantly, with a more empirical approach." *(Ludmila Mude, female, age: 21)*
- **Preparation of Literature Excerpts**
  Sample Quote: "That's difficult, it's actually just a series of small steps. For example, I've never done excerpts before. I did it, fine." *(Ludmila Mude, female, age: 21)*
- **Ideas and Suggestions to Share Responsibility in the Team**
  Sample Quote: "I don't know if you can call it an achievement, but the fact that I agreed to do it at the beginning, when I don't think we even had a team manager yet, to say that I'm not a fan of it, or that I communicated honestly with my group and said: I'm not a fan of placing the responsibility on just one person—the team leader—but that I said from the outset that we are all team leaders in a way. (…)." *(Amelie Scheibe, female, age: 21)*
- **Good Organisational Skills**
  Sample Quote: "And, yes, in general, that we were able to organise everything so well with our organisational partners, but also that we were able to participate in the events, meaning that we demonstrated our commitment." *(Lotte Heinrich, female, age: 22)*
- **Being Motivated and Committed**
  Sample Quote: "That we have already shown commitment." *(Lotte Heinrich, female, age: 22)*
- **Being Able to Inspire the Community Partner for the Research Project**
  Sample Quote: "Then I would also mention again that we were able to win (name of social organisation) as a cooperation partner and convince him of our cause." *(Nico Gunf, male, age: 24)*
- **Presentation of the Research Design and Research Topic**
  Sample Quote: "That I, or rather my team, managed to guide us to the point where we were able to present our research, our research questions, our topics, our hypotheses, and then also present how far we had come by a certain date. In other words, that we were able to deliver a truly accurate status of our research by a specific date. And that, as team leader, I was able to guide the team to ensure that this was achieved on time." *(Alfons Eberth, male, age: 21)*

The table continues on the next page. The categories "writing the final report" and "structuring the final report" could be merged, but we decided to keep them as two separate categories.

Appendix D

Continuation - Category System with Sample Quotes – Most Significant Achievements of the Students in the Community-Based Research Service-Learning Project

- **Adherence to Deadlines**
  Sample Quote: "That I, or rather my team, managed to guide us to the point where we were able to present our research, our research questions, our topics, our hypotheses, and then also present how far we had come by a certain date. In other words, that we were able to deliver a truly accurate status of our research by a specific date. And that, as team leader, I was able to guide the team to ensure that this was achieved on time." *(Alfons Eberth, male, age: 21)*
- **Structuring the Final Report**
  Sample Quote: "I would say that our greatest achievement was finding and establishing a precise structure and table of contents for our final report. This made the work easier, as we knew exactly what we wanted to achieve and what we wanted to have. This allowed us to work in a more structured and precise manner." *(Berta Schleich, male, age: 22)*
- **Successfully Managing a Period With Many Deadlines**
  Sample Quote: "Well, I already think that the phase where we had a lot of appointments was very demanding, so I think that I achieved a lot during that time. But I still think that a lot was accomplished in March and April, not only by me, but also by my group. And it was all self-motivated. We decided that for ourselves. It wasn't planned. It just happened that we set ourselves a meeting every Wednesday morning so that we could meet regularly and stay in touch. But we got a lot done during that time. And I also achieved a lot. Yes." *(Norma Girschner, female, age: 22)*

SoTL and University Teachers' Professional Development: The Implementation of the Teaching Practice Research Program in Taiwan

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Abstract

In a constantly changing higher education environment, university teachers' teaching and students' learning have received greater attention. As a result, the Scholarship of Teaching and Learning (SoTL) is gaining ground as a practical research inquiry that closely reflects university teachers' disciplinary teaching practices and advances their professional development. This study examined the influence of SoTL practice in the Taiwanese context, with particular attention to the Teaching Practice Research Program (TPRP). TPRP is a government grant program that supports individual instructors in conducting SoTL research. By interviewing six university teachers who engaged in the TPRP, we provided evidence that the SoTL inquiry benefited their academic development and professional careers. Two critical areas of impact have been revealed: teaching effectiveness and their professional careers as higher education educators. Participants reported that drawing on evidence from their TPRP projects motivated them to advance their teaching practice to support students' learning, pursue teaching innovation, and teach effectively. Despite encountering structural barriers, such as disciplinary alienation and career stagnation, the instructors maintained a positive attitude. They valued the TPRP for supporting their professional development, driving educational innovation, fostering networking and collaboration with peers passionate about advancing teaching and student learning, and, most crucially, strengthening their identity as higher education educators. Finally, this study suggested a SoTL researcher-friendly culture that encouraged instructors in teaching advancement and accepted their efforts is needed in the current higher education environment.

Keywords: Scholarship of Teaching and Learning (SoTL), teaching practice research program, higher education instructors' professional development

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Introduction

The Teaching Practice Research Program (TPRP) is a Taiwanese public grant program that funds higher education teachers to conduct Scholarship of Teaching and Learning (SoTL) research. In this study, university instructors' perceptions of TPRP were examined. In particular, whether participation in the TPRP program would benefit their professional growth and careers as higher education educators was the primary focus. Before delving into this issue, it is necessary to understand the concepts of SoTL and TPRP.

The Scholarship of Teaching and Learning

The Scholarship of Teaching and Learning (SoTL) is a research paradigm that closely reflects university lecturers' teaching practices. In the past 35 years, the concrete definition of SoTL has been debated (Brew, 2012; Hung & Huang, 2022; Hutchings et al., 2013; Hutchings & Shulman, 1999; Kern et al., 2015; Waller & Prosser, 2023). It begins with the concept of the Scholarship of Teaching, proposed by Boyer in 1990, which elaborates on the university faculty's role in research and teaching. However, over the past 35 years, as the higher education landscape has changed, this research paradigm has broadened its definition relative to the original concept.

Hutchings and Shulman (1999) suggested that, in the SoTL inquiry, not only the issue of teaching but also students' learning should be considered. This led to a shift toward SoTL inquiry to advance teachers' teaching and students' learning, both of which are critical (Waller & Prosser, 2023). Secondly, unlike disciplinary research, the SoTL inquiry emphasized researchers' identities as both researchers and teachers, and its primary focus is on addressing actual educational issues in the classroom, particularly by evaluating students' learning outcomes and enhancing their learning effectiveness with the researchers' reflection on the teaching practice (Kern et al., 2015; Trigwell, 2021). Furthermore, its research orientation made SoTL a rigorous process with evidence-based outcomes and critical reflection (Fanghanel, 2013; Hutchings & Shulman, 1999). Combining these features, using Waller and Prosser's definition, SoTL inquiry is:

> a research-informed, evidence-based, critical yet collegial reflection on teaching and learning process, with the aim of improving practice within the aligned disciplines and professions. Most often, SoTL-based research projects are conducted by discipline-based staff inquiring into and reflecting on their own practice to improve their teaching and learning. (Waller & Prosser, 2023, p. 32)

Teaching Practice Research Program

The Teaching Practice Research Program (TPRP) is a government grant program that funds individual university teachers to conduct SoTL research. It was launched in 2017 and was the first grant program for individual lecturers from the Ministry of Education, Taiwan (Fwu & Lee, 2020). The background of the TPRP implementation has several reasons, such as responding to international trends in SoTL research, addressing shortcomings in teaching improvement measures, promoting multi-track faculty promotion, and shaping a SoTL culture in higher education (Chen, 2014; Fwu, 2013; Fwu & Lee, 2020; Huang, 2020; Hung & Huang, 2022).

Like other SoTL practices, the TPRP encourages instructors to identify classroom-based challenges in their educational settings and to utilize evidence-based research to enhance teaching quality and promote students' learning effectiveness (MOE Teaching Practice Research Program, 2024). However, this government grant has distinct features. It has a national project office, established by the MOE, which manages the program's administrative work, reviews, and approves projects. It also emphasizes the role of higher-education institutions, namely universities, in supporting and shaping the SoTL community and network within and across institutions to enable lecturers to conduct SoTL inquiries (Fwu & Lee, 2020; MOE Teaching Practice Research Program, 2024).

Another unique characteristic is its standardized requirements for applicants and the overall scale of funding. The grant requires university faculty members to integrate their SoTL projects into their courses. Instructors may select the option that best aligns with their TPRP research from the courses they teach within 10 subject fields, such as STEM, Social Science, Humanities, or three thematic areas, for example, University Social Responsibility (USR); this option cannot be decoupled from the course content (MOE Teaching Practice Research Program, 2024). From 2018 to 2023, the grant annually subsidized approximately 1,500 university teachers to conduct TPRP across various disciplines (MOE Teaching Practice Research Program, 2024).

TPRP and Professional Development

The current literature on the TPRP generally focuses on its mechanisms and its impact on the Taiwanese higher education landscape. However, little research addresses the TPRP's influence on individual instructors' professional development, particularly from the lecturers' perspective. To bridge this gap, this study provided essential insights into university lecturers' perceptions of the TPRP's impact on teaching effectiveness and on individual instructors' professional growth. Our research question was: Do university teachers perceive that engaging the TPRP benefits their professional development in teaching effectiveness and their careers?

Methodologies

The purpose of this study is to explore university lecturers' perception of the relationship between the TPRP and their professional development as higher education instructors. To gather in-depth insights, this study employed purposive sampling and snowball sampling to recruit participants (Douglas, 2022). Six participants, predominantly from the STEM and Business fields, were involved in the research. All participants had experience conducting their TPRP projects from 2018 to 2023 academic years. Moreover, their teaching experience exceeded three years, with some experienced lecturers having taught for more than ten years in higher education.

Regarding data collection, this study utilized individual, synchronous online interviews with semi-structured questions (Douglas, 2022). The interviews were conducted from May to June 2024. For data analysis, this study employed a reflexive thematic analysis approach (Braun & Clarke, 2019). While reflexive thematic analysis centers on thematic coding, it actively embraces the researcher's "subjectivity" and "reflexivity", recognizing that their understanding of the context inevitably informs the analysis. (Braun & Clarke, 2019, p. 590). Drawing on the researcher's prior experience in managing TPRP projects in higher education institutions, the researcher employed reflexive thematic analysis to conduct rigorous data analysis.

In addition, since the sample size was small, generalizing the result was not the purpose. Instead, the researcher presented multiple perspectives from participants' responses to present their attitudes toward the TPRP, their experiences engaging in TPRP projects, and how this mechanism influenced their professional development (Creswell & Creswell, 2023). Through a diligent qualitative research process, this study obtained valuable information that supports subsequent research findings.

Research Findings

Through systematic investigations, this research highlighted two critical aspects of the TPRP's impact on university teachers' professional development: teaching effectiveness and their professional careers as higher education educators.

Teaching Effectiveness

Within the SoTL inquiry context, the TPRP supported university teachers in reframing their teaching to be student-centered to address classroom problems (Fwu & Lee, 2020; Hung & Huang, 2022). Based on the participants' responses, this could be further divided into strategic methods for promoting student learning and professional growth in teaching. Participants attempted to introduce diverse pedagogies to foster students' active engagement. This included adapting innovative instructional materials to meet the students' needs, dividing the course contents into smaller elements to make the content easier to understand, introducing collaborative learning strategies such as problem-based learning (PBL) to make students acquire and apply knowledge with their peers, and utilizing a flipped classroom to make students actively engaged in the learning process. These strategies were also widely used in TPRP practices within the Taiwanese SoTL inquiry community (Chung & Hsu, 2023; Hung & Huang, 2022).

Utilizing appropriate methods to assess students' learning outcomes was another critical element mentioned by participants (Fanghanel, 2013). For instance, a participant observed that students often believed they had acquired knowledge from lectures or textbook practices without applying it to other contexts. To tackle this issue, the participant collaborated with colleagues in the same field to develop error-type quizzes to promote students' self-correction in acquiring core content knowledge and to enhance engagement in effective learning. According to the participant, this targeted assessment design successfully improved students' overall learning effectiveness. Regarding lecturers' professional teaching development, participants reported that they employed evidence from their TPRP project to support teaching innovation and self-reflection, thereby enhancing their overall teaching effectiveness (Kern et al., 2015). Generally, participants reported that involvement in the TPRP supports both lecturers' teaching and students' learning effectiveness, which aligns with one of the central goals of the TPRP (MOE Teaching Practice Research Program, 2024).

Professional Careers as Higher Education Educators

Compared with overall positive responses regarding the TPRP's impact on advancing instructors' teaching development, participants were less optimistic about their professional careers after participating in the TPRP. Despite participants' concerns about their professional careers, as depicted in the following section, they also discussed how this program benefited their professional development, particularly through continuous teaching innovation, TPRP

networking and collaboration, and the strengthening of their identity as higher education educators.

In their interview responses, participants indicated that, because student composition and areas of focus in higher education changed each year, they had to refine their teaching annually to meet students' needs in a constantly evolving higher education environment. As mentioned, participants continued to adopt innovative pedagogical approaches to improve students' learning outcomes, hence providing opportunities for their professional learning through teaching practice and conducting SoTL inquiry.

Participants also noted another significant impact of the TPRP mechanism. Since providing the SoTL inquiry and teaching innovation workshops or experience sharing activities, held by the established program office, the six regional bases, as well as the institutions, it created a space for those passionate about teaching excellence and SoTL inquiries to exchange ideas, share research insights, and even generated the opportunity to collaborate with their colleagues within and across disciplines. (Fwu & Lee, 2020; Hung & Huang, 2022). Although there is little literature and direct evidence on how these mechanisms have influenced instructors' professional careers, participants in this study indicated that the TPRP community clearly promoted their academic professional development.

Thirdly, and perhaps most significantly, the TPRP strengthened participants' identities as tertiary education educators. Through engagement with the TPRP, instructors recognized that their roles encompass not only expertise in disciplinary research but also a commitment to guiding students in acquiring and applying professional knowledge (Burdick & Hallman, 2022; Nixon et al., 2001). However, this did not mean that participants shifted their identities to teachers and discarded their professional research expertise. In contrast, participants noticed that involvement in the TPRP inquiry facilitated the integration of their disciplinary expertise with their evolving teaching roles.

Structured Challenges and Concerns

While discussing the benefits of professional development for their careers, participants in this study raised several concerns that led them to hesitate to change their career paths to become merely SoTL researchers. Conversely, most participants still prioritized subject-specific research as more important to their careers than SoTL research.

Participants reported that participating in the TPRP required them to adopt different inquiry methods, which required additional time and effort to learn. Especially for those with a STEM disciplinary background, the TPRP or SoTL inquiry was considered a social science or educational inquiry, prompting them to acquire new knowledge of pedagogical theories, educational literature reviews, and social science inquiry procedures and analyses. Those from the business area also encountered a similar difficulty in the SoTL inquiry. Although they invested considerable effort in conducting TPRP research, improving teaching methods, and innovating teaching practices, their contributions were rarely recognized by peers in their disciplines, leading to feelings of disciplinary alienation. Similar findings were reported in Webb and Tierney's (2020) study.

Additionally, at the institutional level, participants encountered career barriers, particularly the lack of recognition for their efforts to advance teaching and to support students' learning effectiveness. This lack of recognition has then hindered their merit, promotion, and even

tenure opportunities, since most higher education institutions still require traditional disciplinary research for career advancement. This forced instructors into a difficult choice: investing time in high-quality SoTL inquiry and teaching innovation or publishing in their core field to gain more credit for career advancement.

Following directly from this career concern is the hesitation to publish their TPRP outcomes in journals or at disciplinary education conferences. Most participants chose instead to prioritize solving immediate classroom problems, thereby limiting the TPRP program's broader scholarly impact and its ability to influence the wider academic community.

Conclusion

This study explored the impact of the Teaching Practice Research Program (TPRP) on the professional development of university instructors in Taiwan. The findings demonstrated significant influence in some key areas, including teaching advancement, professional networking, disciplinary and interdisciplinary collaboration, and an awareness of being an educator who guides students in acquiring and applying disciplinary knowledge. Despite noting that conducting the TPRP, a form of SoTL inquiry, created career barriers due to the lack of formal recognition of their teaching efforts and their identity as SoTL researchers, participants maintained a positive attitude. They valued this governmental funding for its role in driving educational innovation, supporting professional development, and strengthening their identity as both disciplinary experts and educators.

These findings partially align with other research on SoTL and professional development, such as Webb and Tierney's (2020) comparative case study of SoTL practices in teaching-oriented and research-focused universities across two countries, particularly with the transformation of researcher identity and the challenges of career alienation. However, the Taiwanese TPRP is unique due to its top-down mechanism. By funding lecturers to conduct SoTL inquiries, promoting teaching excellence, and collaborating with universities to foster student-centered learning environments, the TPRP Program Office provides a sustained, structural support system that distinguishes the Taiwanese context from other international practices.

Regarding implications, this study suggests that a top-down mechanism benefits in fostering a SoTL researcher-friendly culture within the higher education environment. Currently, the lack of recognition of instructors who engage in the SoTL inquiry and teaching advancement is a primary barrier. Firstly, it undermines university teachers' willingness to prioritize students' learning achievement. Moreover, it hinders institutions' shift in attitudes toward acknowledging instructors' teaching excellence. This includes incentivizing their efforts, such as introducing multi-track promotion and funding for teaching-related research. Such shifts could broaden the impact of SoTL beyond individual classroom practice and influence the wider research-oriented academic community. Although some critical voices might be encountered on its bureaucratic elements, introducing a top-down mechanism from the government and mandatory institutional support might provide a solution to advance SoTL practitioners' teaching practice and to acknowledge their research efforts not only at the institutional level but also across the Taiwanese higher education landscape, thereby recognizing SoTL research as equally important as disciplinary research.

Finally, this study acknowledges certain limitations. The small sample size may not fully represent the comprehensive views of all SoTL researchers involved in the TPRP; however, these in-depth interviews provide valuable qualitative insights into how university instructors'

perceptions of the SoTL inquiry and its influence on their professional development. Secondly, the research scope could be expanded beyond STEM and business fields to the social sciences and humanities, yielding a more comprehensive understanding of lecturers' perceptions. Thirdly, this study did not cover those research-oriented higher education institutions. The perspectives of faculty at research universities are also a topic worth exploring. Further research is recommended to broaden the scales and the coverage of both disciplinary and institutional types.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing tool, and Google Gemini, an AI-assisted technology, were used to proofread and refine the manuscript's language. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly and Google Gemini, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are original and derived from appropriate and systematic conduct of the research.

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Creativity in Action: Building Preservice Teachers' Creative Self-Efficacy Through Lesson Design and Implementation

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Abstract

Creativity is a key characteristic for individuals navigating the modern world. As such, teachers are expected to foster creativity in students—directly, by explicitly setting creativity as a learning outcome, and indirectly, by modeling creative behavior in the classroom. In both cases, teachers require creative self-efficacy, or a belief in their own creative ability. Therefore, teacher education programs must cultivate creative self-efficacy in preservice teachers. However, longitudinal research tracking preservice teachers' creative self-efficacy over time remains limited. This study addresses this gap by examining the development of creative self-efficacy in 23 preservice teachers (3 male, 20 female) enrolled in a teacher education program in Thailand. Participants were assessed at the beginning and end of two courses—Course A and Course B—taken in the second and fourth years of the program, respectively. Course A was theory-oriented and focused on instructional methods and lesson planning. More practically, Course B emphasized the design and rehearsal of instruction. A Likert-type questionnaire served as the research instrument. Although the Shapiro-Wilk test indicated that the data were normally distributed ($p > .05$), Mauchly's test revealed a violation of the assumption of sphericity ($p < .05$). Consequently, the Friedman test with Conover's post-hoc comparisons was used instead of repeated-measures ANOVA to analyze the data. The results showed a significant increase in participants' creative self-efficacy during Course B, highlighting the importance of creativity in lesson implementation rather than in lesson design alone. Sources of creative self-efficacy are discussed from a theoretical perspective, and practical implications are proposed.

Keywords: creative self-efficacy, preservice teacher, teacher education, teaching rehearsal

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Introduction

Since creativity is crucial for addressing complex problems (Treffinger, 1993), it has been considered one of the essential competences of the 21st century (Newton & Newton, 2014). Consequently, creativity has been established as an educational goal (Fasko, 2001). In pursuing this goal, teachers play a critical role through nurturing students' creativity (Mellou, 1996). To do so, they may adopt various approaches, such as teaching for creativity, creating a classroom environment that supports creativity, and serving as role models of creative individuals (Soh, 2017). Regardless of the approach, teachers need to possess creative self-efficacy (Li et al., 2017)—in other words, they must believe in their own creativity (Nemerzitski & Heinla, 2020). Therefore, to achieve the goal of fostering creativity among young generations, it is imperative that teacher education programs develop teachers' creative self-efficacy so that they can, in turn, facilitate their students' creativity (Paek & Summers, 2019).

Several efforts have been made to develop teachers' creative self-efficacy. For instance, aligning with the notion of "teaching as a design science" (Laurillard, 2012), Henriksen et al. (2020) engaged teachers in designing elements relevant to their work (e.g., curriculum, instruction, and materials). They observed that such activities can help teachers begin "to see themselves as creative individuals" (p. 223). Similarly, Liu et al. (2024) used a design thinking process through which preservice teachers designed instruction, courseware, and micro-lessons. The authors found that this process enhanced preservice teachers' creative self-efficacy. These studies resonate with research—though conducted with K–12 students—indicating that design-based learning provides a context in which individuals use creativity and strengthen creative self-efficacy (Ladachart et al., 2022, 2024). Hence, it is worth examining the potential of design-based learning in the context of teacher education.

Irrespective of whether or not they involve design-based learning, attempts to develop preservice teachers' creative self-efficacy in teacher education programs have tended to focus on individual courses (Eyup, 2023; Liu et al., 2024). Little is known about whether or how preservice teachers develop their creative self-efficacy throughout a teacher education program. To address this gap, research that longitudinally tracks preservice teachers' creative self-efficacy is needed. Situated in the Thai context, the present study focuses on two courses of a teacher education program in which preservice teachers used their creativity in designing lessons. However, the two courses differed regarding whether preservice teachers had opportunities to implement their lessons—that is, whether their creativity was put into action. Altogether, this study offers insights into which elements of the courses are effective in fostering preservice teachers' creative self-efficacy and provides recommendations for advancing teacher education programs.

Literature Review

According to Puente-Diaz (2016), creative self-efficacy is a construct based on the social cognitive theory proposed by Bandura (1982), who defined self-efficacy as "judgements of how well one can execute courses of action required to deal with prospective situations" (p. 122). This notion is based on the premise that the more individuals believe they can succeed at a task, the more likely they are to complete it (Bandura, 1978). Later, Tierney and Farmer (2002) applied the concept of self-efficacy to the context of creative work by defining creative self-efficacy as "the belief one has the ability to produce creative outcomes" (p. 1138). Following Bandura (1978), creative self-efficacy is based on the premise that the more people believe in their creativity, the more likely they are to work creatively. However, because

creativity is relevant across many types of work, other terms, such as “creative confidence” (Kelley & Kelley, 2013), may be used with meanings similar to creative self-efficacy.

Creative self-efficacy is also applied in education (Unal & Tasar, 2021). In this context, teachers are no longer expected to implement pre-developed lessons, but instead design their own lessons that are adaptable to students' learning needs (Jordan, 2016). In doing so, they must harness not only “what is known about teaching to attain the goal of student learning, [but also] the implementation of its designs to keep improving learning” (Laurillard, 2012, p. 1). This process necessitates creativity, as Noddings (2013) notes:

> Teachers do not need to find a method or theory that they will follow slavishly. Rather, they need to analyze a multiplicity of ideas and put their creative power to work in answering questions such as: Where could I use this? For what purpose? With whom? In what context? (p. 210)

From this perspective, teachers are therefore regarded as designers (Henriksen et al., 2020) who use and exercise creativity in their work, for example, to develop curriculum, instruction, and assessments.

Research has demonstrated several benefits of teachers' creative self-efficacy. For example, Cayirdag (2017) found that it is strongly related to teaching behaviors that foster creativity. Similarly, Huang et al. (2019) observed a significant association between creative self-efficacy and positive attitudes toward teaching for creativity. Moreover, Li et al. (2017) revealed that creative self-efficacy mediates the relationship between teachers' proactive personality and their innovative working behaviors. Given these benefits, researchers have recommended developing teachers' creative self-efficacy (Paek & Summers, 2019). In this regard, Creely et al. (2021) suggest providing teachers with opportunities to take risks in creative endeavors. Drawing on Bandura (1978), Mathisen and Bronnick (2009) have emphasized mastery in using creativity, vicarious experiences through observing others using creativity, and persuasion from others to use creativity as primary sources of creative self-efficacy.

The importance of creative self-efficacy has also been recognized among preservice teachers in teacher education programs. Yuce et al. (2023), for example, found that creative self-efficacy is a mediating factor linking metacognitive knowledge with openness to diversity and challenge. Thus, as with teachers working in schools, preservice teachers should be prepared to develop creative self-efficacy (Eyup, 2023). One promising approach is to provide preservice teachers with experience in designing lessons (Liu et al., 2024). This approach aligns well with the notions of “teaching as a design science” (Laurillard, 2012) and “teachers as designers” (Henriksen et al., 2020). However, the extant literature remains limited in identifying which elements in such design-based experiences foster preservice teachers' creative self-efficacy. Recognizing this gap, and considering that tracking preservice teachers' creative self-efficacy across courses involving lesson design could provide valuable insights, the following research question was formulated:

- How do preservice teachers develop creative self-efficacy during teacher education programs, and to what extent do courses involving lesson design contribute to this development?

Methodology

Given its purpose of tracking preservice teachers' creative self-efficacy over time, this study employed a longitudinal methodology (White & Arzi, 2005). According to Arzi's (1988) definition, longitudinal studies are those "in which information on the same subjects was collected at least twice, over a time span of at least one calendar year extending beyond the boundaries of a single school year" (p. 23). In this study, preservice teachers' creative self-efficacy was assessed four times across one and a half years within a teacher education program. Throughout this extended period and within an uncontrolled setting, several factors could have influenced preservice teachers' creative self-efficacy, making casual conclusions about whether the intervention led to the expected-for outcomes unlikely (Tytler, 2009). Hence, this paper aims instead to offer descriptive insights into the development of this aspect. The study's context, participants, and procedures are described in the following sections.

Context

This study was conducted within a four-year teacher education program at a university in northern Thailand. It was a dual-degree program in which preservice teachers simultaneously pursued two bachelor's degrees—one in an academic major and one in education. The academic majors included various disciplines in the sciences (e.g., mathematics, physics, chemistry, and biology) and the liberal arts (e.g., Thai language, English language, music, and dancing art). However, as detailed below, this study focused only on preservice teachers majoring in physics and biology, based on convenience sampling. The program is organized into three semesters each year, except for the final year, which has two semesters. Preservice teachers majoring in physics and biology are required to complete 162 and 165 credits, respectively. These credits are categorized into three groups: general education (39 credits), disciplinary education (87–90 credits), and teacher education (36 credits).

General education includes courses considered necessary for all undergraduates, including preservice teachers in all majors. These courses are organized by the university's Division of Educational Services, concentrated in the first two years of the program, and relate to various dimensions of life, such as language, citizenship, health, personality, aesthetics, technology, and multiculturalism. Disciplinary education comprises courses focused on academic disciplines according to preservice teachers' majors. For those majoring in the sciences, these courses are organized by the university's Faculty of Science. While they focus on developing preservice teachers' scientific knowledge, skills, and attitudes within their majors, they also cover related fields such as mathematics. These courses are evenly distributed in the first two years and double in number in the third year. The first semester of the fourth year is devoted to a seminar and an independent study in the major.

Teacher education includes courses designed to meet the criteria for teaching licensure. These courses are organized by the university's School of Education, have similar content regardless of preservice teachers' majors, and are distributed evenly across the first three years of the program. During the first year, preservice teachers take three courses: an introduction to the teaching profession; educational psychology; and the social, economic, and technological influences on education. In the second year, they take a course on educational technology in the first semester and one on curricular structures and lesson planning in the second semester. In the third year, they take two courses: educational measurement, assessment, and research in the first semester and building relationships with parents and communities in the second. In the

first semester of the fourth year, they take a course on teaching rehearsal. The second semester of the fourth year is devoted to a school-based practicum.

Participants

The targeted group for this study comprised all preservice teachers majoring in physics (N = 6: three males and three females) and biology (N = 31: six males and 25 females). These preservice teachers entered the program in 2021. Using convenience sampling, they were selected because they had taken two courses—one on curricular structures and lesson planning and another on teaching rehearsal—taught by the first author during their second and fourth years, respectively. All but one female agreed to participate in the study, providing consent after being informed of its objective (i.e., tracking their professional identities over time) and committing to provide data for the research. However, due to the long duration of the study, only 23 of the 37 participants completed all four measurements: two females majoring in physics and three males and 18 females majoring in biology. Hence, data from these participants were used to address the research question.

Instrument

The unidimensional scale developed by Karwowski (2016) was used to assess participants' creative self-efficacy. This scale was chosen because it is designed to measure creative self-efficacy in general contexts—that is, it does not specify a particular task requiring creativity. Consequently, the term related to teaching was added to the scale, as indicated by square brackets in Table 1, to better align it with the purpose of the present study. The scale used for this study comprised six items. As in the original, each item asked participants to indicate their level of agreement on a 7-point scale ranging from 1 to 7. After the scale was translated from English to Thai, it was reviewed by three experts and revised to ensure equivalence in meaning between the two languages. The scale was then piloted with 39 preservice teachers at another university. The results indicated that the scale demonstrated acceptable reliability, with a Cronbach's alpha of 0.86 exceeding the standard level (0.70).

Table 1
Items Measuring Creative Self-Efficacy

No.	Item
1	I know I can efficiently solve even complicated problems [related to teaching].
2	I trust my creative abilities [in teaching].
3	My imagination and ingenuity distinguishes me from my friends.
4	Many times, I have proven that I can cope with difficult situations [in teaching].
5	I am sure I can deal with problems [in teaching that require] creative thinking.
6	I am good at proposing original solutions to problems [in teaching].

Data Collection

Data were collected at four timepoints: at the beginning and at the end of two courses—one on curricular structures and lesson planning (hereafter Course A) and another on teaching rehearsal (hereafter Course B). At each timepoint, participants spent about five minutes completing the instruments via a digital platform during class sessions. Given this timeframe, descriptions of each course are worth noting. In Course A, participants learned about the goals and structures of the national curriculum, relevant instructional methods, and how to write a lesson plan. Due to its extensive content, Course A was delivered mainly through lectures and discussions. At the end, each participant created a lesson plan for a final assignment. In Course B, participants created their lesson plans on self-selected topics and took turns enacting those lessons with classmates acting as students. Thus, although both courses required participants to be creative in designing their lessons, they varied in whether participants' creativity was put into action.

Data Analysis

Data were analyzed using descriptive and inferential statistics computed in JASP software (Goss-Sampson, 2020). First, the reliability of the instrument was assessed at each timepoint, resulting in Cronbach's alphas of 0.99, 0.99, 0.98, and 0.94 for the four measurements taken in order. Descriptive statistics were then calculated to obtain the means and standard deviations (SDs) of the scores at each timepoint. Subsequently, inferential statistics were used to compare the means across the four timepoints. Although the data were normally distributed according to Shapiro–Wilk tests ($p > .05$), Mauchly's test indicated a violation of the sphericity assumption ($p < .05$). Consequently, the Friedman test was applied instead of repeated-measures ANOVA (Okoye & Hosseini, 2024). When a significant difference was detected, Conover's post-hoc comparisons were conducted to determine which pairs differed significantly. For all inferential analyses, the significance threshold was set at .05.

Results

Using a Likert-type scale comprising six items, this study examined 23 preservice teachers' creative self-efficacy across four timepoints during their second and fourth years in a teacher education program. Upon averaging the scores on the six items (with a full score of 7), descriptive analyses indicated that participants' creative self-efficacy was rather stable during Course A and before Course B, with means of 4.68 (SD = 1.00), 4.70 (SD = 0.97), and 4.54 (SD = 0.94) at the first, second, and third timepoints, respectively (see Figure 1). However, their creative self-efficacy improved to reach a mean of 5.17 (SD = 0.70) after Course B. The Friedman test revealed a significant difference across these timepoints: ($\chi^2(3) = 13.722$, $p = .003$, with an effect size of 0.20 as calculated by Kendall's W. Conover's post-hoc comparisons indicated that only the mean at the fourth timepoint significantly differed from the means at the previous timepoints. The results of these statistical analyses are summarized in Table 2.

Figure 1

Changes in Participants' Creative Self-Efficacy

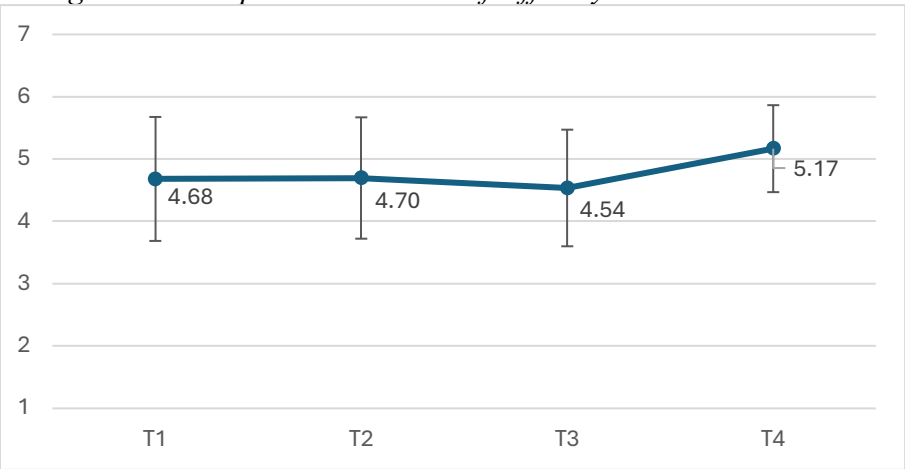


Table 2

Results of Conover's Post-hoc Comparisons

Timepoint		T-Stat	df	W_i	W_j	r_{rb}	p
T4	T1	3.675	66	46.500	75.500	0.729	< .001
	T2	2.155	66	58.500	75.500	0.542	.035
	T3	3295	66	49.500	75.500	0.852	.002

Discussion

This study explored 23 preservice teachers' creative self-efficacy over the course of a teacher education program in Thailand. Data were collected from these participants using a Likert-type scale at four timepoints during their second and fourth years in the program. Statistical analyses revealed that the participants' creative self-efficacy remained relatively stable over time, except during the period when they took a teaching-methods course. Given the lack of longitudinal research on preservice teachers' creative self-efficacy in teacher education programs, this study provides evidence that such programs may not sufficiently support the development of preservice teachers' creative self-efficacy. The lack of this development may, in turn, limit preservice teachers' ability to foster students' creativity (Cayirdag, 2017) through designing innovative lessons, demonstrating creative behaviors, and establishing environments supportive of creativity (Huang et al., 2019; Li et al., 2017).

Since participants' creative self-efficacy improved across Course B but not across Course A, the differing characteristics of these courses warrant special attention. According to Faikhamta et al. (2018), teacher education programs in Thailand have traditionally followed a theory-into-practice model, in which preservice teachers take university-based courses to acquire theoretical knowledge outlined by the Teachers' Council of Thailand (2019) before applying such knowledge in school-based practicums. Thus, most university-based courses emphasize theory over practice (Rupavijetra & Rupavijetra, 2022). With this emphasis on theoretical learning, university-based courses may not provide preservice teachers with sufficient opportunities to exercise their creativity. Consequently, their creative self-efficacy tends to

remain stable throughout the years of university-based coursework, as demonstrated in this study.

However, Course B showed the potential to promote preservice teachers' creative self-efficacy. This course was a teaching-methods course in which participants designed lessons and engaged in teaching rehearsals. This finding aligns with Liu et al. (2024), who found that preservice teachers' creative self-efficacy improves through experiences in designing instructional materials, courseware, and micro-lessons within a course focused on educational technology. In contrast, Course A, which also involved lesson design, did not appear to produce a similar improvement. The different outcomes of these two courses suggest that preservice teachers' creative self-efficacy is more likely to improve when their lesson designs are implemented rather than merely drafted. This explanation can be further understood through considering the sources of self-efficacy in general and the sources of creative self-efficacy in particular.

According to Bandura (1978), individuals develop self-efficacy for any task through four primary sources: mastery experiences, vicarious experiences, social persuasion, and emotional arousal. Similarly, creative self-efficacy develops mainly through these sources in relation to the use of creativity (Mathisen & Bronnick, 2009). In this regard, design provides a context for applying creativity (Ladachart et al., 2022, 2024). Based on these insights, Course B likely offered participants richer mastery experiences in using creativity to design lessons, more opportunities to observe creativity in classmates' teaching rehearsals, and more creativity-supportive feedback than Course A did. These factors may have contributed to the significant improvement in participants' creative self-efficacy across Course B. By contrast, Course A might have offered participants fewer opportunities to experience or observe creativity in their own and others' teaching practice, which could likely explain the absence of a similar increase in their creative self-efficacy.

Implications

The results of this study have several implications. Given that participants' creative self-efficacy remained relatively stable over time, teacher education programs should place more explicit emphasis on developing this characteristic among preservice teachers. As this study and prior research (Eyup, 2023; Liu et al., 2024) have shown, such development can be promoted by providing preservice teachers with opportunities to use creativity in their coursework. Although courses may differ in how creativity is applied (e.g., designing lessons, using educational technologies, or developing assessments), it is crucial that preservice teachers actively engage in creative practices. By doing so, they are likely to gain mastery and vicarious experiences, as well as receive social persuasion to use creativity. Without these resources, preservice teachers are unlikely to develop creative self-efficacy, which reduces their ability to nurture students' creativity—a human asset that is becoming increasingly essential in the 21st century.

Limitations

This study has several limitations. It was conducted in Thailand with a small group of preservice teachers who were conveniently selected; therefore, the results may not be generalizable to other preservice teachers. Moreover, owing to the longitudinal timeframe, it was not possible to fully control conditions under the investigation, and certain threats to validity (e.g., history, maturation, and retesting) may have affected the results (Ohlund & Yu, n.d.). Additionally, a single scale was used to measure creative self-efficacy. Consequently, the

findings of this study should be regarded as descriptive insights rather than definitive conclusions. Further research is needed to examine preservice teachers' creative self-efficacy in other contexts. The results of such studies would help verify or refute the findings of this study, particularly regarding the stability of creative self-efficacy throughout teacher education programs and the impact of creative practices in lesson design and enactment on its development.

Conclusion

Given the crucial role of teachers' creative self-efficacy in promoting students' creativity, this study employed a Likert-type scale to longitudinally explore how 23 preservice teachers developed their creative self-efficacy during the second and fourth years in a teacher education program in Thailand. The findings revealed that their creative self-efficacy generally remained stable over time, with the exception of a teaching-methods course (Course B) that focused on lesson design and implementation. These results suggest that Course B provided a context for applying creativity in practice. Through this engagement, participants had opportunities to gain mastery and vicarious experiences, as well as social persuasion to use creativity, all of which might have contributed to their development of creative self-efficacy. While further research is needed to verify these insights, the study highlights the importance of offering such opportunities in other courses of teacher education programs for such development.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that ChatGPT was used in proofreading and refining the language used in the manuscript. The usage was limited to enhancing the manuscript's readability. The final version of the manuscript was edited by humans. The authors further declare that apart from ChatGPT, no other AI or AI-assisted technologies have been used to modify the manuscript's content. The ideas, design, procedures, findings, analyses, and discussion are originally written and derive from careful and systematic conduct of the research.

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When English Isn't Enough: Rethinking English Teaching in Indonesia Through Overseas Experiences

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Abstract

The global expansion of English presents significant challenges for non-native speakers navigating its use across diverse cultural contexts. Pursuing higher education in a foreign country requires skills to adapt and be aware of local cultures to communicate effectively, even when English is used as the medium of interaction. This study examined the communication challenges experienced by Indonesian students studying in India, where English is a second language. The study was grounded in Byram's Intercultural Communicative Competence (ICC) framework, focusing on intercultural knowledge, skills of interpretation and interaction, attitudes, and critical cultural awareness. This study employed a mixed-methods design, utilising a five-point Likert scale and open-ended questions through an online questionnaire to collect the data from Indonesian students in India. The data were analysed using descriptive statistics and content analysis, with ICC levels classified using established scoring criteria. The study involved 55 Indonesian students in India who met the participation criteria. Results showed a high overall level of ICC with a mean score of 3.76. Additionally, language-related challenges were the most prevalent, with 23 students reporting difficulties tied to accents, pronunciation, speech pace, and unfamiliar vocabulary. Cultural differences affected 21 students, who had difficulty interpreting body language, gestures, tone, and physical interaction norms, while 11 students reported no communication challenges during their stay in India. These findings suggest that language proficiency alone is insufficient without intercultural awareness; therefore, short-term pre-departure intercultural training and the long-term integration of cultural competence into English learning are needed to better support students' communication experiences abroad.

Keywords: intercultural communication, intercultural awareness, English language teaching, curriculum development

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Introduction

English now functions as a global lingua franca, enabling communication among speakers from diverse linguistic and cultural backgrounds. Rather than belonging to a single nation, English has evolved into multiple localised forms influenced by speakers' identities, experiences, and cultural norms. As a result, communication in English does not rely on native-speaker norms but adapts to context, intention, and mutual understanding. This dynamic use of English reflects its possible and pluralistic nature, where meaning-making depends not only on grammar and pronunciation, but also on intercultural awareness and the ability to negotiate meaning across cultural differences.

Indonesia and India share similarities as culturally rich, multilingual nations with long histories of diverse ethnic groups and local languages. However, the role and status of English differ significantly in each context. In India, English holds the status of an associate official language alongside Hindi and is widely used for administration, higher education, and interethnic communication (Dwivedi, 2015; Sharma, 2019). In contrast, Indonesia positions English as a foreign language with limited presence in everyday communication and institutional use (Daflizar et al., 2022). This is reflected in national proficiency data, where Indonesia ranks 80th out of 116 countries globally and 12th out of 23 countries in Asia (English First, 2024), with proficiency concentrated mainly in urban areas in Java. These distinctions highlight that while both countries engage with English, its functional role in society and daily interaction differs considerably.

Amid these contextual differences, an increasing number of Indonesian students are pursuing higher education in India. This situation presents an opportunity to explore how Indonesian students who come from a country where English is a foreign language navigate communication in a multilingual environment in India. A successful communication abroad requires not only linguistic competence but also intercultural sensitivity and adaptability. Insight from such research can inform English language teaching in Indonesia, encouraging a shift from traditional linguistics-focused instruction toward a more communication-oriented and interculturally responsive pedagogy.

Theoretical Framework

In the context of globalisation, individuals across countries are increasingly connected through international mobility, technology, education, and economic exchange (Sarwari et al., 2024). This interconnectedness has expanded cultural encounters, making diversity more visible and enabling a broader exchange of values, perspectives, and experiences (Abdalla & Mohammed, 2020). As cross-cultural interactions become more common, the role of cultural awareness grows increasingly significant, particularly for intercultural speakers who must be capable of recognising, understanding, and responding to cultural differences (Permatasari & Andriyanti, 2021). The development of intercultural competence influences how individuals think, behave, and perceive themselves and others, shaping their ability to interact meaningfully within diverse social contexts (Gutiérrez-Santiuste & Ritacco-Real, 2023).

Byram's (1997) Intercultural Communicative Competence (ICC) model provides a comprehensive framework for understanding the skills required to navigate intercultural encounters. His model consists of five key components: knowledge of one's own and others' cultures, attitudes of curiosity and openness, critical cultural awareness for evaluating cultural practices and perspectives, skills of interpreting and relating cultural meanings, and skills of

discovery and interaction, which enable individuals to engage in intercultural dialogue effectively. This framework positions language learning not merely as linguistic mastery but as a process that integrates cultural understanding, interpretation, and socially responsive communication.

Milton J. Bennett's Developmental Model of Intercultural Sensitivity (DMIS) conceptualises intercultural awareness as a developmental progression from ethnocentrism to ethnorelativism (Bennett, 1993). Bennett's DMIS further explains this growth as a staged progression. The model consists of two major orientations: ethnocentrism, which includes denial, defense, and minimisation, where individuals view their own culture as central and struggle to recognise or value differences; and ethnorelativism, consisting of acceptance, adaptation, and integration, where cultural differences are acknowledged, respected, and incorporated into one's thinking and behaviour. Together, these theoretical perspectives underscore that intercultural communication necessitates more than linguistic proficiency; it demands an evolving capacity to perceive, interpret, and engage with cultural diversity in ways that foster understanding, mitigate miscommunication, and promote respectful global interaction.

Research Question

Building on the increasing need for intercultural competence in global communication and the theoretical perspectives, this study aims to explore how intercultural communicative competence concepts manifest in real intercultural contexts. To align theory with lived experience, the research focuses on Indonesian students in India and examines two key aspects:

1. What is the level of Indonesian students' intercultural communicative competence using English in India?
2. What is the communication challenge faced by Indonesian students in India?

Research Methodology

This study employed a mixed-methods research design, combining quantitative and qualitative approaches through a survey conducted using a questionnaire. The data were collected by circulating a questionnaire via Google Forms from July 2 to 11, 2025. The questionnaire consisted of 22 questions addressing the intercultural communicative competence (ICC) of Indonesian students and their experiences communicating in English in India, along with an open-ended question regarding the communication challenges they encountered in the Indian context.

The participants of this study are Indonesian students studying in India from various academic levels, including Bachelor's, Master's, and Doctoral programs. Those participants have been staying in India for at least six months, as per the participants' criteria.

The data analysis employed descriptive quantitative and content analysis to interpret the findings. The ICC level was determined by calculating the mean score following the classification used by Saricoban and Oz (2014) and Shevimel-Shania (2020): low (1.0–2.4), moderate (2.5–3.4), and high (3.5–5.0).

Findings and Discussion

Participants' Demographic Data

A total of 125 Indonesian students were reported to be studying in India across bachelor's, master's, doctoral, and student-exchange programs from June 2024 to May 2025. 104 out of 125 students were successfully contacted in July 2025, since several students had completed their studies. Based on the inclusion criteria, 82 students qualified to participate, having lived in India for at least six months. The questionnaire was distributed to all eligible students, and 55 responded voluntarily. Among the participants, 30 were male (53.6%), and 25 were female (46.4%). In terms of academic level, 12 students (21.4%) were enrolled in bachelor's programs, 31 (55.4%) in master's programs, and 12 (23.2%) in doctoral programs.

Students' ICC Level

The reliability test showed a Cronbach's alpha value of .933, demonstrating excellent internal consistency. All 22 questionnaire items were confirmed as valid, with significant correlations at the 0.01 and 0.05 levels (2-tailed). The overall Intercultural Communicative Competence (ICC) level of participants was high, with a mean score of 3.76.

Students' Challenge in Daily Communication

The communication challenges reported by the participants varied across language and cultural factors. The most common issue was language-related, particularly accent and pronunciation difficulties, reported by 13 students, who noted challenges understanding Indian or other non-native English accents. Another 10 students mentioned difficulty following conversations due to fast speech and unfamiliar vocabulary, including slang and mixed Hindi–English expressions. Cultural differences also played a role, with 8 students reporting confusion related to body language, gestures, and physical interaction norms, such as interpreting the Indian head movement or differing expectations for personal space. Additionally, 13 students experienced challenges related to communication styles, including directness, interruptions, and differing interpretations of tone or friendliness. Meanwhile, 11 students reported no communication difficulties during their experience in India.

Table 1
Students' Communication Challenges

Communication Challenge Category	Sub-category	Number of Students	Few Samples of Students' Answers
Language	Accent/ Pronunciation	13	• Understanding different English accents, especially Indian or other non-native accents, was difficult at first. I often had to ask people to repeat themselves (Student 20) • The accent and how they pronounce the words are a bit challenging for people who come to India for the first time (student 42) • I still can't really adjust to my friends' accent (student 18)
	Speak too fast and Unfamiliar word/phrase	10	• Sometimes they speak too fast and use some words that I have never heard of (student 1) • Some friends speak very fast, especially when they're excited. It can be hard to catch everything they're saying in real-time (student 21) • Use of local slang and Hinglish. Many of my Indian friends mix Hindi and English in conversations. Sometimes I don't understand the slang or Hindi phrases they use, which makes it hard to follow the conversation (student 18)
Cultural Difference	Body language/ gesture	8	• Sometimes don't understand their body language (student 11) • How they treat foreigners like me, in case of touching, I mean, in India, they (guys) are common to touch the other guy, but in Indonesia, that thing is absurd and weird (student 29). • Understanding when a head bobble means "yes," "maybe," or "I have no idea what you just said." It was like learning a new dialect without subtitles (student 46)
	Others	13	• In Indonesia, we tend to be more indirect and polite when expressing disagreement. But I noticed that some of my friends from other countries are more direct, which sometimes felt too blunt or confusing (student 22) • Some people sometimes cut my sentences when I tried to explain something which they thought was right (student 33) • Our different speech intonations often make me misunderstood (student 45) • I feel that when women are overly friendly (smiling often) to men, it is considered that we are flirting (student 50)
No challenge		11	• I don't face any difficulty (student 12) • There are no issues (student 5) • No problem (student 6)

Table 1 illustrates that 80% of all participants (44 students) faced communication challenges in various categories, 42% (23 students) in the language challenge category and 38% (21 students) in the cultural differences category. Meanwhile, 20% of all participants (11 students) faced no communication challenges.

Recommendations and Program Development

Competency in intercultural communication is a crucial aspect that enables individuals to observe, be open, interpret, and relate effectively, as well as be critically aware of cultural differences. Moreover, applying intercultural communication competency in daily interactions results in effective intercultural dialogue. On the other hand, intercultural sensitivity, according to Bennett's DMIS, reveals how an individual perceives themselves in relation to others.

The findings highlight that English proficiency alone does not guarantee successful communication, as students with high ICC levels still experienced challenges that required greater tolerance and acceptance of cultural differences. The results show that, although students understand the importance of ICC, the findings in Table 1 (samples of students' answers) reflect limited intercultural sensitivity, as several students viewed cultural differences through an ethnocentric lens and struggled to acknowledge or value diversity. This suggests that language competence must be supported by intercultural awareness to facilitate more effective and meaningful communication and minimise misunderstanding.

To address the intercultural sensitivity issues, short-term and long-term programs can be designed to strengthen preparatory programs for students before they study in India. Therefore, based on the findings, this study suggests implementing a short-term pre-departure intercultural program to address students' limited intercultural sensitivity despite their awareness of ICC. Given that English proficiency alone was insufficient and some students exhibited ethnocentric orientations, an online pre-study program is proposed for Indonesian recipients of Indian government scholarships, as their dispersed geographic locations make offline implementation impractical. The program should introduce India as a multicultural and multilingual society, highlight local language diversity, and emphasise cultural similarities between India and Indonesia to foster openness and tolerance. This initiative could be jointly coordinated through collaboration between the Indonesian and Indian Ministries of Education or their respective embassies, thereby strengthening students' intercultural awareness and preparedness prior to their academic mobility.

As a long-term strategy, this study recommends integrating intercultural competence into English language instruction in the Indonesian English teaching curriculum, particularly within communication-oriented courses, to systematically develop students' intercultural awareness. Given that English in the Indonesian context is primarily used for interaction with speakers of other nationalities, embedding cultural competence into English learning can better prepare students for intercultural communication and support the development of sustainable intercultural communication competence.

Conclusion

In conclusion, although students demonstrate a high level of intercultural communicative competency, they continue to experience challenges, particularly related to language differences such as accent and intonation, as well as cultural variations in gestures and

communication styles. These findings indicate that English proficiency alone is not enough and must be complemented by intercultural awareness to minimise misunderstanding. Therefore, integrating cross-cultural learning into English education and providing structured pre-departure preparation programs are essential. Future collaboration with Indonesian and Indian institutions could support the development of a specialised cross-cultural short course to better prepare students for intercultural interaction

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Promoting Professional Identity and Cross-Cultural Understanding in Cabin Crew Education Through Instagram-Style Simulation Reports

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Abstract

This study employs an action research method to examine the effectiveness of Instagram-style simulation reports in enhancing learning motivation, professional identity, and cross-cultural understanding among aviation service students. Twenty-three students from a university aviation service department (including two students with special learning needs) participated in two cycles of Look-Think-Act action research, engaging in Instagram posting tasks centered on role-playing and cultural themes. Students portrayed their ideal flight attendant roles by wearing professional attire for photographs and writing accompanying captions. In the second phase, they selected specific international routes and incorporated cultural hashtags to demonstrate cross-cultural service competencies. Quantitative results revealed mean scores of 4.18, 4.27, and 4.17 for learning motivation, professional identity, and cross-cultural understanding, all exceeding the 4-point threshold. Qualitative analysis identified a three-stage professional identity development process: surface attraction, operational awareness, and value internalization. The multimodal and interactive design effectively promoted student engagement, with special needs students demonstrating strong adaptability by overcoming traditional text-based barriers through visual expression. This research suggests that the cyclical refinement process of action research may enhance teaching effectiveness, and that Instagram simulation reports could promote professional identity and cross-cultural competency development. The findings provide empirical evidence for innovative and inclusive pedagogical approaches in aviation and vocational education. Future research could expand to diverse cultural backgrounds and institutional settings, incorporating AI tools for more objective learning behavior analysis.

Keywords: professional identity, cross-cultural understanding, aviation service education

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Introduction

The core objective of aviation service education is to cultivate students' cross-cultural communication skills and professional competencies, as flight attendants function as critical intermediaries between airlines and international passengers, requiring high cultural sensitivity and adaptable service skills (Bennett, 2009). Following the recovery of the global aviation industry post-pandemic, route diversity and passenger culture have steadily increased, resulting in more complex service challenges (IATA, 2023). Action research, emphasizing iterative cycles of practice and reflection, has been extensively applied in vocational education to enhance students' professional identity and learning outcomes (Meihami & Werbińska, 2022).

However, traditional aviation service education still faces challenges, including limited language proficiency, insufficient learning motivation, and restricted cross-cultural understanding, which hinder some students from developing professional identity and intercultural skills (Perrodin et al., 2024). While social media presents innovative teaching opportunities that enhance student engagement and self-expression, there remains a gap in systematically applying such strategies for university-level aviation students, especially those with special learning needs, to improve learning efficacy (Ganjoo et al., 2021).

This study primarily employs an action research approach to investigate the effects of Instagram-style simulation reports on aviation students' learning motivation, professional identity, and cross-cultural understanding. Particular attention is given to the participation experiences of students with special learning needs. Through role-playing, cultural themes, and multimodal design, this study explores how these elements impact professional development and cross-cultural competency, aiming to provide an innovative, inclusive, and evidence-based teaching model that fosters diversity in aviation education (Aydin, 2019; Deci & Ryan, 2008; Yiu et al., 2022).

Literature Review

Learning Motivation Theory

Learning motivation critically influences student engagement and academic performance. Self-Determination Theory (SDT), proposed by Deci and Ryan (2008), identifies autonomy, competence, and relatedness as three fundamental psychological needs that foster intrinsic motivation. When educational environments satisfy these needs, students demonstrate increased engagement and sustained motivation. SDT has been widely applied in vocational education, with studies confirming that autonomy-supportive teaching strategies significantly enhance students' motivation and professional identity (Bui et al., 2017; Bureau et al., 2021). For students with limited language proficiency or learning difficulties, creative and inclusive learning environments are essential to boost participation and self-efficacy (Deci & Ryan, 2008). Emotional support from teachers and peers can alleviate anxiety in special needs students, improving their motivation and resilience. Inclusive education and diverse support systems have been shown to enhance the learning engagement and life quality of students with disabilities (Vasyukov et al., 2024).

Creative Learning and Simulation-Based Teaching

Simulation-based learning is proven effective in vocational education for enhancing practical skills and professional identity. Role-playing and contextual simulations facilitate decision-

making and interaction in realistic settings, reinforcing motivation and confidence (Schunk, 2012). In aviation education, simulation trainings improve operational skills, decision-making, and situational awareness while reducing risks and costs (TEM Journal, 2023). The use of multimedia and visualization tools further stimulates interest and creativity, increasing student engagement (Ganjoo et al., 2021). This study employs Instagram-style simulation reports combined with multimodal expression and role-playing to demonstrate potential for promoting autonomous learning and professional identity. Students creatively use images and texts to express their understanding of occupational roles, thereby enhancing motivation and supporting multimodal approaches in vocational training.

Cross-Cultural Competence and Aviation Service

Cross-cultural competence encompasses cultural awareness, emotional sensitivity, and behavioral adaptation, essential for high-quality aviation service (Gudykunst, 2005). Simulated cross-cultural scenarios, such as role-playing and cultural context simulations, effectively enhance cultural understanding, communication skills, and empathy among students (Wendorf Muhamad & Yang, 2019). Social media platforms like Instagram offer real-time interaction and cultural exchange, facilitating the development of language strategies, multi-modal expression, and intercultural communication skills (Alvarez Valencia & Benavides, 2019; Ganjoo et al., 2021). Therefore, this study integrates social media with simulation-based learning and designs cultural-themed tasks to promote students' comprehension, respect, and application of diverse cultural service concepts.

Application of Social Media in Education

Social media's network characteristics and multimodal functions provide highly interactive and creative learning environments. Instagram notably increases student engagement and sense of community in digital courses (Ganjoo et al., 2021). Short videos and instant interaction strategies enhance learning time and outcomes (Song et al., 2022). As digital natives, Generation Z students are especially adept at adjusting to these platforms. Arnold and Paulus (2010) found that experiential learning via social media strengthens knowledge internalization and collaborative learning, fostering learning communities. This study applies this concept in vocational education, using Instagram simulation reports as innovative teaching media, aiming to create interactive learning environments aligned with digital natives' learning habits.

Research Method

Research Design

This study adopts Stringer's (2008) action research model, which consists of three iterative stages: Look, Think, and Act, to investigate the effects of Instagram-style simulation reports on aviation students' learning motivation, professional identity, and cross-cultural understanding. To enhance scientific rigor, mixed quantitative and qualitative methods were integrated. Two teaching cycles were conducted from September 2024 to January 2025, allowing continuous revision and improvement of instructional strategies.

Participants

Participants included 23 aviation service students (13 females, 10 males) from a university, with an average age of 21 years. The cohort included two students with special learning needs

(one with a specific learning disability and one with autism spectrum disorder). To protect privacy during qualitative analysis, these students are referred to as Special Student 1 (SS1) and Special Student 2 (SS2). Aligned with Stringer's (2008) participatory principles, students acted as co-constructors of knowledge, with their feedback directly informing instructional adjustments.

Data Collection Instruments and Procedures

Look Phase

Three scales measured student outcomes:

1. Learning Motivation assessed via Guay et al.'s (2000) Situational Motivation Scale, covering intrinsic and extrinsic motivation.
2. Professional Identity measured with an aviation service-specific scale adapted from Yu et al. (2021).
3. Cross-Cultural Understanding evaluated based on Chen and Starosta's (2000) Intercultural Sensitivity Scale.

Each scale comprised five items scored on a 5-point Likert scale from strongly disagree (1) to strongly agree (5). Surveys were administered anonymously post-instruction.

Students completed Instagram format simulation reports:

1. In the first cycle, students role-played as ideal flight attendants, wearing uniforms and posting photos with captions expressing their occupational perceptions and expectations.
2. In the second cycle, students selected flight routes (e.g., Japan, Middle East) and incorporated cultural hashtags (e.g., #ramadanservices) in posts to demonstrate multicultural service awareness.

These reports facilitated detailed analysis of students' learning trajectories and self-presentation.

Think Phase

1. Descriptive statistics (mean, SD, range) and internal consistency (Cronbach's α) were computed using Stata 17.0 to identify factors influencing motivation, identity, and cultural understanding, guiding qualitative inquiry (Stringer, 2008).
2. Braun and Clarke's (2006) six-step thematic analysis was employed, including data familiarization, coding, theme development, review, definition, and reporting. Emphasis was placed on SS1 and SS2's feedback and behavior observations. Student representatives participated in reflection meetings to ensure diverse perspectives. Triangulation of quantitative, qualitative, and classroom observations enhanced the validity and applicability of findings.

Act Phase

Teaching activities in the first cycle focused on enhancing students' intercultural sensitivity through multi-national flight scenarios, requiring Instagram posts portraying professional images and service concepts. In the second cycle, based on reflective feedback, cultural integration and innovative service design were emphasized. Students compared dietary habits,

etiquette, and service needs across different cultures to foster communication skills and empathy (Ganjoo et al., 2021).

To deepen professional identity, Instagram simulation scoring criteria were refined per student feedback. Classroom sessions incorporated professional language training, service demeanor, and workplace scenario simulations, encouraging internalization of professional roles.

Overall, the action process involved ongoing monitoring and iterative adjustments through student feedback, thematic analysis, and observations, ensuring teaching strategies adapt dynamically to meet learners' needs and embody the continuous growth ethos of action research cycles (Stringer, 2008).

Results

Quantitative Analysis

A total of 23 valid questionnaires were collected. The average scores for learning motivation, professional identity, and cross-cultural understanding were 4.18 (SD = 0.31), 4.27 (SD = 0.42), and 4.17 (SD = 0.39), respectively. The Cronbach's alpha values for the three dimensions were 0.62, 0.79, and 0.87, indicating good reliability for the professional identity and cross-cultural understanding scales (Guay et al., 2000; Yu et al., 2021). All scores exceeded 4, demonstrating a generally positive evaluation by students of the Instagram simulation report and a high level of learning acceptance.

Comparing the two teaching cycles, professional identity scores significantly improved in the second cycle, demonstrating the effectiveness of iterative instructional adjustments. Special needs students (SS1 and SS2) exhibited upward trends, especially in cross-cultural understanding, supporting the inclusive benefits of multimodal teaching (Rose & Meyer, 2002). An initially low score observed in the first cycle, linked to a lack of sufficient support for a special needs student, improved notably after targeted instructional support was provided, reflecting the positive impact of action research cycles on learning outcomes (Deci & Ryan, 2008).

Qualitative Analysis

Thematic analysis following Braun and Clarke's (2006) six-phase procedure identified three core themes highlighting changes in students' motivation, professional identity, and intercultural understanding, supported by special student cases.

Motivation: From Extrinsic to Intrinsic Engagement

Students generally felt the Instagram simulation report offered a more engaging and creative learning experience, with feedback noting it was more enjoyable and motivating than traditional reports. This shift from extrinsic task completion to intrinsic self-driven engagement aligns with self-determination theory's internalization process (Ryan & Deci, 2020). The introduction of cultural-themed tasks in the second cycle reinforced professional commitment and responsibility by linking assignments to career aspirations (Cesario et al., 2022).

Professional Identity: Immersive Three-Stage Construction

Students' professional identity development followed three phases:

1. Surface attraction, initially drawn by visible aspects like uniforms and service demeanor;
2. Operational awareness, understanding the technical skills and responsibilities involved in aviation service;
3. Value internalization, embracing service as a personal mission and core value.
4. This progression exemplifies the practice-reflection spiral model proposed by Kemmis et al. (2014). The second cycle's service presentation task accelerated students' shift from observation to enactment and internalization, deepening professional role awareness.

Cross-Cultural Understanding: From Knowledge to Empathic Action

Beyond memorizing cultural facts such as dietary restrictions, students developed empathic, situational strategies to bridge communication gaps, for example using eye contact and smiles to overcome shyness. This movement from cultural cognition to cultural action supports Chen and Starosta's (2000) intercultural sensitivity model. Instagram's hashtag interactions (e.g., #ramadanservices) encouraged students to actively investigate cultural contexts, bolstering learner autonomy and cross-cultural agility.

Special Students Participation: Inclusive Practice of Action Research

SS1 (learning disability) relied on peer and teacher support to complete visual tasks, expressing that photograph-based work was easier and more enjoyable. His work was adopted as a teaching exemplar in the second cycle, embodying the collaborative co-construction spirit of action research (Stringer, 2008).

SS2 (autism) utilized digital tools and structured steps to craft culturally themed posts, demonstrating digital media's potential to support learners balancing freedom with structure (Odom et al., 2010).

Both showed marked improvement in cross-cultural understanding and self-expression in the second cycle. Class observations and interviews highlighted the crucial roles of ongoing teacher-student interaction and peer support in fostering engagement (DuPaul et al., 2022). The iterative reflection and adjustment of the action research process ensured the inclusion of marginalized voices, affirming the empirical value of inclusive education.

Discussion

Transformation of Learning Motivation in Action Research Cycles

This study reveals that Instagram-style simulation reports, as a multimodal learning tool, effectively facilitate the internalization of students' learning motivation within Stringer's (2008) Look-Think-Act cyclical framework. Students shifted from passively completing assignments to actively exploring professional roles and self-realization, consistent with the psychological needs for autonomy, competence, and relatedness emphasized in Self-Determination Theory (Deci & Ryan, 2008).

Within the action cycles, continual reflection and adjustments led to higher levels of creativity and autonomy in the second cycle. Students proactively researched cultural variations in service contexts during hashtag assignments and demonstrated creative expressions of intercultural understanding. This transformation encapsulates the core spirit of action research: learning becomes more adaptive and generative through reflective practice and re-engagement.

Immersive Construction of Professional Identity

Students' professional identity developed progressively through three phases: surface attraction, operational awareness, and value internalization. The role-playing facilitated by the Instagram simulation created a low-risk, highly contextualized environment for professional exploration, enabling students to safely embody the professional identity without the anxiety or apprehension possible in traditional internships.

This immersive process helped students move from visual interest to conceptual understanding, culminating in an internalized professional value system. Notably, students with special learning needs exhibited distinct learning pathways and modes of expression, demonstrating that multimodal teaching provides effective inclusive support, fostering professional identity construction. Reflective feedback further deepened students' commitment to their vocational mission, shifting focus from external appearance to internalized values.

Contextual Development of Cross-Cultural Understanding

Instagram's interactive hashtag feature offers unique educational value in cross-cultural learning. Students not only acquired cultural knowledge but also developed practical empathic strategies, such as using smiles to bridge language barriers and adapting tone according to passenger cultural backgrounds. This capacity to translate knowledge into action aligns with the knowledge internalization and situated practice pathways detailed in action research theories (Kemmis et al., 2014).

Additionally, the digital platform's algorithmic content push created an implicit curriculum effect, exposing students to broader cultural content and prompting active inquiry into hashtag conventions (e.g., #ramadanservices). This phenomenon suggests new pedagogic approaches for integrating digital media in vocational education.

Limitations and Future Directions

The study's limitations include a small sample size (n=23) and reliance on some self-reported data, which may introduce subjectivity. Future research should extend to diverse nationalities and institutions to evaluate the generalizability of this teaching method. Integrating AI and digital tools for analyzing Instagram interaction analytics could provide more objective insights into learning motivations.

Conclusion

This study preliminarily validated the educational effectiveness of Instagram-style simulation reports in aviation service education through an action research approach. The findings indicate that this instructional strategy supports improvements in students' learning motivation, professional identity, and cross-cultural understanding. Qualitative evidence further highlights how elements of autonomy, creative expression, and role-playing within the curriculum

enhance learner engagement. The multimodal and interactive design especially provides additional support and participation opportunities for students with special learning needs, helping to overcome traditional language and expression barriers.

However, limitations such as a small sample size and the study's timeframe necessitate further investigation across diverse backgrounds, larger samples, and prolonged instructional practice. Future research is recommended to expand to students from different nationalities or institutions and to incorporate AI and other digital tools for objective analysis of learning behaviors and interaction data. Developing fair evaluation metrics for visual and creative outputs will also help recognize diverse modes of learner performance.

Overall, this study contributes a novel, inclusive teaching model grounded in empirical evidence for aviation and wider vocational education. It encourages future research to continue exploring the potential and challenges of digital native pedagogies, thereby advancing innovative and equitable educational development.

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Chemistry Laboratory Engagement: STEM Students' Perceptions, Confidence, and Career Aspirations

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Abstract

The growing demand for STEM professionals underscores the importance of effective laboratory-based instruction in senior high school science education. This descriptive–correlational study investigated the perceptions, confidence, and motivations of 465 Grade 12 STEM students from NU Fairview, Inc. toward face-to-face chemistry laboratory activities, with particular emphasis on the role of gender and academic specialization. Data was collected through a structured survey instrument and analyzed using descriptive statistics and inferential statistics. Findings indicate that students generally perceive chemistry laboratory work as an essential and engaging component of learning. Positive engagement was strongly associated with hands-on experimentation, peer collaboration, instructor support, and the perceived relevance of laboratory tasks to real-life and future careers. While students reported high confidence in basic laboratory procedures and safety practices, comparatively lower confidence was observed in higher-order skills such as problem-solving, data analysis, and interpretation of results. Statistical analysis revealed no significant differences in perceptions, confidence, or motivation when grouped by gender, suggesting an inclusive laboratory learning environment. However, academic specialization significantly influenced students' levels of engagement and self-assessed performance, particularly in laboratory tasks aligned with their chosen STEM track, such as Allied Health or Engineering. The study recommends strengthening instructional strategies that emphasize analytical thinking and data interpretation, improving time management during laboratory sessions, and contextualizing experiments to align with students' academic specializations. These findings provide practical insights for educators aiming to enhance chemistry laboratory pedagogy and better prepare students for future STEM pathways.

Keywords: chemistry laboratory work, perceptions, confidence, attitude, behavior, career aspirations

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Introduction

In the Philippines, the demand for professionals in science, technology, engineering, and mathematics (STEM) continues to rise, reflecting both national development goals and global workforce needs. To help meet this demand, educators are working to strengthen science education by providing meaningful learning experiences, particularly in the laboratory setting. Chemistry laboratory activities are seen not only as instructional tools but also as powerful platforms for developing critical thinking, problem-solving abilities, and a deeper understanding of scientific concepts. As the world becomes more technologically advanced, the importance of preparing students through active, inquiry-based learning has never been greater.

Hands-on laboratory work plays a vital role in shaping how students perceive and engage with science. Yet, despite its significance, limited studies have deeply examined how students' perceptions of chemistry lab experiences influence their interest and participation in face-to-face settings. Finne et al. (2022), for instance, studied the impact of shifting from laboratory instruction to online theoretical tasks during the COVID-19 lockdown. Their findings revealed that students struggled with the absence of physical lab work, which hindered their understanding of how scientific knowledge is produced. However, the study did not explore students' perceptions upon returning to in-person laboratory environments.

Similarly, Antonio (2018) highlighted that science teaching has long been rooted in experimentation and laboratory-based activities. While this affirms the instructional value of labs, there remains a gap in research examining students' attitudes toward hands-on chemistry lab work in the post-pandemic educational landscape. This is particularly relevant, as recent shifts in modality may have altered students' views and emotional responses toward science learning.

In a more recent study, Ramirez (2023) explored Grade 12 STEM students' experiences in a blended chemistry laboratory setup. The study emphasized the benefits and challenges of transitioning between online and physical settings. Although informative, it fell short of investigating how these shifts shaped students' behavioral engagement, such as their motivation, participation, and focus during in-person lab activities.

Furthermore, while previous works (e.g., Bernhard, 2018; Bretz, 2019; Pacifico & Prudente, 2021; Reid & Shah, 2007) acknowledge the value of laboratory instruction in building scientific inquiry skills and cognitive competencies, few studies have explicitly linked these experiences to students' future career aspirations in STEM. There is a pressing need to understand how early, meaningful lab work can influence students' decisions to pursue science-related professions.

Given these gaps, this study aims to explore the perceptions, attitudes, behavioral engagement, and career motivations of STEM students in the context of face-to-face chemistry laboratory work. By taking this approach, the research aims to support the creation of more responsive and inspiring STEM education programs aligned with contemporary learner needs.

Variation Theory and Social Cognitive Theory in Understanding Chemistry Laboratory Learning

This study is grounded by two theoretical foundations—Variation Theory and Social Cognitive Theory (SCT)—to explore how senior high school STEM students perceive and engage with chemistry laboratory work, and how these experiences shape their attitudes, behaviors, and aspirations toward future careers in science. Variation Theory, developed by Ference Marton, highlights that meaningful learning happens when learners experience differences or changes in key features of a concept. These variations help students focus on what truly matters. In the chemistry laboratory setting, this could mean observing how different variables affect a reaction or how techniques yield different results. Such experiences encourage deeper understanding by helping students distinguish the core ideas from superficial ones (Kullberg et al., 2017; Orgill, 2012). In this way, the lab becomes more than a place to follow instructions—it becomes a space for critical thinking, inquiry, and discovery.

However, while understanding how students grasp scientific concepts is important, it's equally crucial to consider why they engage—or disengage—in the learning process. This is where Albert Bandura's Social Cognitive Theory (1986) becomes relevant. SCT explains how students' confidence, motivation, and career goals are shaped not only by what they know, but also by their beliefs about their abilities, their learning environment, and the people around them. In the context of laboratory work, a student's positive or negative experiences can strongly influence whether they see themselves as future scientists or whether they feel capable of succeeding in a science-related path.

By combining these two theories, this study offers a more complete picture of laboratory learning. Variation Theory helps explain the cognitive aspects of learning—how students come to understand chemical concepts through differences in lab experiences—while Social Cognitive Theory sheds light on the personal and social aspects of learning, including confidence-building and future aspirations.

This dual framework supports the design of chemistry laboratory experiences that are not only intellectually rigorous but also personally meaningful, fostering both scientific understanding and a stronger sense of identity and purpose among future STEM professionals.

Statement of the Problem

This study aims to describe and analyze the perceptions, attitudes, and motivations of general chemistry 2 students towards laboratory work in face-to-face settings, including the factors influencing their enjoyment, confidence, and future career aspirations in science of STEM senior high school students from NU Fairview during the academic year 2023–2024. Specifically, it sought to answer the following questions:

1. What is the demographic profile of the respondents in terms of:
    a. Sex and;
    b. Specialization
2. How may the chemistry laboratory work of the respondents be described in terms of:
    2.1. Perceptions
    2.2 Confidence
        2.2.1 Attitude
        2.2.2 Behavior
    2.3. Future career aspirations

3. Is there a significant difference in the chemistry laboratory work of the respondents when grouped according to their profile?

Methodology

This study employed a descriptive-correlational research design to explore the perceptions, confidence (attitude and behavior), and motivation of Grade 12 STEM students regarding laboratory work, as well as to examine differences based on demographic factors such as gender and specialization. This design allowed the researchers to measure naturally occurring differences among groups without manipulating variables, providing insights into how students' attitudes, behaviors, and motivation relate to their engagement in laboratory activities and future career aspirations.

The participants consisted of 465 Grade 12 STEM students from NU Fairview, Inc., selected through purposive sampling to ensure that respondents had prior exposure to laboratory work in their general chemistry 2 subject. Students' sex (male or female) and specialization (Allied Health, Architecture, Engineering, and ICT) were recorded to investigate whether these factors influenced perceptions, confidence, and motivation.

A structured survey questionnaire was utilized to measure the main variables: perceptions of laboratory work, confidence in performing laboratory tasks (attitude and behavior), and motivation toward laboratory activities. Each variable was assessed using validated 4-point Likert-type items (4 = Very High Extent, 1 = Very Low Extent). The instrument underwent a pilot test with 30 students from a different section, yielding a Cronbach's alpha of 0.70, indicating acceptable internal consistency.

The survey was administered electronically via Microsoft Forms, ensuring convenience, accuracy, and secure data collection. Respondents were informed of the study's objectives, their voluntary participation, and their right to withdraw at any time. All responses were anonymized and stored in password-protected files, in compliance with the Data Privacy Act of 2012 (RA 10173).

Data was analyzed using SPSS. Descriptive statistics—including percentage, standard deviation, and weighted mean—were used to summarize students' perceptions, confidence, and motivation. Independent samples t-tests were conducted to determine differences between male and female respondents, while one-way ANOVA was used to identify differences across specializations. These analyses provided insights into whether demographic factors influenced students' laboratory experiences and attitudes.

Results and Discussion

Table 1
Demographic Profile of the Respondents

	Male		Female		Total	
	N	*%*	*N*	*%*	*N*	*%*
Specialization						
Allied Health	40	8.60	169	36.34	209	44.94
Architecture	15	3.23	39	8.39	54	11.62
Engineering	97	20.86	26	5.59	123	26.45
ICT	59	12.69	20	4.30	79	16.99

The table shows a total of 211 male and 254 female respondents, indicating a higher number of female participants in the STEM field. Furthermore, most of the respondents belong to STEM sections specializing in allied health, followed by those in the engineering specialization.

Table 2

Chemistry Laboratory Work of Respondents in Terms of Perceptions

Indicators	WM	SD	VI
a. I find chemistry laboratory work to be an essential part of my STEM education.	3.59	0.573	VHE
b. I feel that the chemistry laboratory sessions are well integrated with the theoretical concepts taught in lectures.	3.41	0.585	VHE
c. I believe that chemistry laboratory work helps me better understand scientific principles.	3.5	0.613	VHE
d. I find that the chemistry laboratory equipment and materials provided are adequate for my learning needs.	3.53	0.557	VHE
e. I think that the structure and organization of the chemistry laboratory sessions are effective.	3.41	0.613	VHE
f. I enjoy participating in chemistry laboratory work.	3.61	0.543	VHE
g. I find that chemistry laboratory work stimulates my interest in the subject matter.	3.53	0.605	VHE
Total	3.51	0.451	VHE

Note. WM – Weighted mean, VI – Verbal interpretation, 3.26 – 4.00 = To a Very High Extent (VHE), 2.51 – 3.25 To a High Extent (HE), 1.76 – 2.50 = To a Low Extent (LE), and 1.00 – 1.75 = No Extent at All (NE)

The table demonstrates a very strong and consistently positive perception of chemistry laboratory work as part of their STEM education, as reflected by the overall weighted mean of 3.51 (SD = 0.451), interpreted as Very High Extent. All indicators received very high ratings, indicating that students view laboratory activities not only as an essential component of their curriculum but also as an effective means of reinforcing theoretical concepts discussed during lectures. High ratings for enjoyment and interest stimulation suggest that laboratory work plays a significant role in sustaining student engagement and curiosity in chemistry. Additionally, students' perceptions of adequate laboratory equipment, effective organization, and strong integration with scientific principles highlight the supportive learning environment provided during laboratory sessions. Collectively, these findings suggest that well-structured and resource-supported laboratory instruction enhances conceptual understanding, promotes positive learning experiences, and strengthens students' appreciation of chemistry as a core discipline within STEM education.

Table 3
Chemistry Laboratory Work of Respondents in Terms of Attitude

Indicators	WM	SD	VI
a. I feel confident in my ability to perform chemistry laboratory experiments accurately.	3.06	0.655	HE
b. I can solve problems that arise during chemistry laboratory work effectively.	3.05	0.623	HE
c. I am comfortable using the various instruments and tools in the chemistry laboratory.	3.2	0.614	HE
d. I am confident in my ability to follow chemistry laboratory protocols and safety procedures.	3.39	0.596	VHE
e. I believe I can interpret and analyze experimental data accurately.	3.08	0.668	HE
f. I feel prepared to tackle unexpected challenges during chemistry laboratory sessions.	3.12	0.671	HE
g. I feel that my chemistry laboratory skills have improved significantly since I started my STEM program.	3.34	0.608	VHE
Total	3.18	0.486	HE

Note. WM – Weighted mean, VI – Verbal interpretation, 3.26 – 4.00 = To a Very High Extent (VHE), 2.51 – 3.25 To a High Extent (HE), 1.76 – 2.50 = To a Low Extent (LE), and 1.00 – 1.75 = No Extent at All (NE)

The Table presents the respondents' attitudes toward chemistry laboratory work in terms of confidence and perceived competence, with an overall weighted mean of 3.18 (SD = 0.486), indicating a High Extent of positive attitude toward their laboratory skills. This finding suggests that students generally feel capable and prepared to participate in chemistry laboratory activities as part of their STEM education. The highest confidence levels were observed in following laboratory protocols and safety procedures (WM = 3.39, SD = 0.596) and in the perceived improvement of laboratory skills since entering the STEM program (WM = 3.34, SD = 0.608), both interpreted as Very High Extent, implying that regular laboratory exposure and structured instructional support have effectively strengthened students' procedural competence and laboratory self-efficacy. In contrast, indicators related to solving problems that arise during experiments (WM = 3.05, SD = 0.623) and interpreting and analyzing experimental data (WM = 3.08, SD = 0.668) obtained comparatively lower, though still High Extent, ratings. This pattern indicates that while students are confident in executing standard laboratory procedures, they may encounter challenges in tasks requiring higher-order analytical reasoning and independent decision-making, highlighting the need for instructional approaches that more deliberately emphasize problem-solving and data interpretation within laboratory activities.

Table 4
Chemistry Laboratory Work of Respondents in Terms of Behavior

Indicators	WM	SD	VI
a. I feel that the complexity of the experiments affects my enjoyment of chemistry laboratory work.	3.3	0.633	VHE
b. I am more motivated when I receive support and guidance from laboratory instructors.	3.38	0.612	VHE
c. I enjoy chemistry laboratory work more when I collaborate with my peers.	3.48	0.598	VHE
d. I feel motivated when the experiments are relevant to real-world applications.	3.37	0.602	VHE
e. I find the feedback I receive on my laboratory work constructive and helpful.	3.3	0.64	VHE
f. I feel that the time allocated for laboratory sessions is sufficient to complete the experiments.	3.01	0.828	HE
g. I feel that the laboratory environment and ambiance positively influence my motivation.	3.26	0.639	VHE
Total	3.3	0.471	VHE

Note. WM – Weighted mean, VI – Verbal interpretation, 3.26 – 4.00 = To a Very High Extent (VHE), 2.51 – 3.25 To a High Extent (HE), 1.76 – 2.50 = To a Low Extent (LE), and 1.00 – 1.75 = No Extent at All (NE)

The table illustrates students' behavioral responses toward chemistry laboratory work in terms of motivation, engagement, and learning environment, with an overall weighted mean of 3.30 (SD = 0.471), indicating a Very High Extent of positive behavior during laboratory sessions. Students reported the highest levels of motivation when collaborating with peers (WM = 3.48, SD = 0.598), receiving guidance from instructors (WM = 3.38, SD = 0.612), and engaging in experiments with clear real-world relevance (WM = 3.37, SD = 0.602), highlighting the role of social interaction, instructional support, and contextualized learning in fostering active participation. These behavioral factors appear to reinforce students' confidence in the laboratory, as supportive and collaborative environments encourage students to attempt tasks, address challenges, and apply learned skills more effectively. Although most indicators were rated to a Very High Extent, the adequacy of time allotted for laboratory sessions received a comparatively lower rating (WM = 3.01, SD = 0.828), suggesting that time constraints may limit opportunities for deeper engagement and reflection, which are essential for strengthening confidence in problem-solving and analytical tasks. Overall, the findings suggest that positive laboratory behaviors, particularly collaboration and instructor support, are closely linked to students' confidence and active engagement, while improved time management may further enhance both learning outcomes and self-efficacy in chemistry laboratory work.

Table 5

Chemistry Laboratory Work of Respondents in Terms of Future Career Orientations

Indicators	WM	SD	VI
a. I feel that my experience in chemistry laboratory work has positively influenced my career aspirations in STEM.	3.26	0.704	VHE
b. I see chemistry laboratory skills as crucial for my future career in science or engineering.	3.17	0.757	HE
c. I feel that chemistry laboratory work has helped me clarify my specific career goals within STEM.	3.16	0.736	HE
d. I believe that my chemistry laboratory experience will make me more competitive in the job market.	3.12	0.73	HE
e. I feel that my interest in pursuing a research-oriented career has increased because of chemistry laboratory work.	2.98	0.805	HE
f. I feel that my chemistry laboratory experience has made me consider pursuing further studies in my field course.	3.08	0.735	HE
g. I feel that my chemistry laboratory experience is preparing me well for my future career.	3.19	0.712	HE
Total	3.14	0.62	HE

Note. WM – Weighted mean, VI – Verbal interpretation, 3.26 – 4.00 = To a Very High Extent (VHE), 2.51 – 3.25 To a High Extent (HE), 1.76 – 2.50 = To a Low Extent (LE), and 1.00 – 1.75 = No Extent at All (NE)

The table indicates a generally positive perception, with an overall weighted mean of 3.14 (SD = 0.62), interpreted as High Extent. The highest-rated item (WM = 3.26, SD = 0.704, VHE) reflects students' recognition that laboratory experiences have positively influenced their career aspirations in STEM, suggesting that hands-on engagement helps them connect current learning to long-term professional goals. Other indicators, including the perceived importance of laboratory skills for future science or engineering careers (WM = 3.17), the clarification of specific STEM career goals (WM = 3.16), and preparation for competitiveness in the job market (WM = 3.12), all fall within the High Extent range, highlighting students' acknowledgment of the practical and strategic value of laboratory experiences in shaping employability and professional readiness. Additionally, items related to fostering interest in research-oriented careers (WM = 2.98) and motivating further studies (WM = 3.08) suggest that while laboratory work encourages broader STEM career engagement, there remains room to enhance students' enthusiasm for research pathways. Overall, these findings indicate that chemistry laboratory experiences not only reinforce technical competence and confidence but also serve as an influential factor in students' career planning, goal setting, and aspirations within STEM fields, emphasizing the need for more targeted support, mentorship, and exposure to research-oriented opportunities to fully cultivate students' career readiness and professional interests.

Table 6
Test of Difference on Chemistry Laboratory Works

	Sex	Specialization
	P-Value	*P-Value*
a. Perceptions	0.310	0.013
b. Attitude	0.322	0.018
c. Behavior	0.777	0.006
d. Future career aspirations	0.369	0.000

Note. The P-value in sex is computed using independent t-test, P-value in specialization is computed using one-way ANOVA, level of significance is 0.05.

H_o1: There is no significant difference in the chemistry laboratory work of the respondents when grouped according to their sex.
H_o2: There is no significant difference in the chemistry laboratory work of the respondents when grouped according to their specialization.

The table indicates that the calculated p-value for the chemistry laboratory work of the respondents, when grouped by sex, did not show statistically significant differences in the chemistry laboratory work between male and female respondents. Therefore, the hypothesis 1 is accepted when grouped according to sex. On the other hand, there is a statistically significant difference in the chemistry laboratory work of the respondents when grouped according to their specialization. In other words, the specialization of the respondents has a significant impact on their performance in the chemistry laboratory work.

Conclusion and Recommendation

This study provides empirical evidence supporting the pedagogical value of face-to-face chemistry laboratory instruction in senior high school STEM education. Overall, students demonstrated positive perceptions of laboratory work as a critical instructional component that enhances conceptual understanding and facilitates the application of theoretical knowledge. While confidence in procedural and technical laboratory skills was consistently high, the findings indicate comparatively lower confidence in higher-order competencies, particularly problem-solving, data analysis, and interpretation of results. These competencies are central to scientific reasoning and warrant deliberate instructional emphasis within laboratory settings.

Student motivation toward laboratory participation was strongly associated with collaborative learning environments, instructor facilitation, and the perceived relevance of experiments to real-world and career contexts. Although students generally recognized the role of laboratory experiences in supporting STEM career aspirations, the results suggest that existing laboratory practices may not fully capitalize on their potential to stimulate sustained interest in research-oriented pathways. Furthermore, while gender did not significantly influence students' perceptions or confidence, differences observed across STEM specializations highlight the importance of discipline-relevant laboratory contexts in shaping engagement and perceived performance.

Based on these findings, several evidence-based recommendations are proposed. First, laboratory curricula should integrate structured opportunities for problem-solving and data interpretation to strengthen analytical and scientific reasoning skills. Second, appropriate time allocation and pacing of laboratory activities should be reviewed to maximize student engagement and depth of learning. Third, institutions are encouraged to provide early and

authentic research exposure through inquiry-based projects, mentorship, and research-linked laboratory experiences. Fourth, laboratory activities should be contextualized to align with students' STEM specializations to enhance relevance and learning outcomes. Finally, sustained efforts to maintain gender-inclusive laboratory environments remain essential to ensuring equitable participation and long-term STEM engagement.

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Exploring Student Needs for Overseas Programs Through Collaboration With International Exchange Partnerships

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Abstract

The Covid-19 pandemic significantly reshaped attitudes toward study abroad among university students enrolled in study-abroad-required curricula, while simultaneously disrupting established international mobility programs such as student exchange and overseas study. At the same time, higher education institutions worldwide accelerated the development of domestic and online alternatives for international learning, including virtual exchange and collaborative online international learning. This proceedings paper examines changes in student perceptions of study abroad during the pandemic and explores how international programs were sustained through a combination of institutional support and long-standing human networks among faculty and partner institutions. Drawing on both quantitative and qualitative data, the study analyzes cultural dynamics of communication in cross-cultural learning, with particular attention to uncertainty avoidance and individualism–collectivism. The findings indicate that pandemic conditions heightened uncertainty avoidance in intercultural communication, influencing student engagement and expectations in both physical and online international programs. In addition, a case study of the Galway–Kitakyushu exchange program demonstrates how research-based relationships and sustained faculty collaboration contributed to the resilience and continuity of international exchange during periods of disruption. By highlighting the complementary roles of structural frameworks and interpersonal academic networks, this study contributes to ongoing discussions of international higher education, student mobility, and the long-term sustainability of exchange programs in the post-pandemic era.

Keywords: study abroad, Covid-19, international exchange, intercultural communication, virtual exchange, student mobility

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Introduction

International exchange programs in higher education are shaped not only by institutional policies and funding frameworks but also by long-standing human connections among researchers, faculty, and partner institutions. This proceedings paper, based on a presentation delivered at The Asian Conference on Education 2025, examines student attitudes toward study abroad during the Covid-19 pandemic and explores how international programs were sustained through both structural support and personal academic networks. In addition to quantitative and qualitative data on student perceptions, this paper highlights the Galway–Kitakyushu exchange program as a case study demonstrating how research-based relationships can develop into durable international education initiatives.

Institutional Context and History of International Exchange at The University of Kitakyushu

The city of Kitakyushu is located on the northern tip of the southern island of Kyushu. The city of Kitakyushu is in South Japan close to Fukuoka with easy connections to larger cities of Kyoto, Osaka and Tokyo with close proximity to Korea across the Japan Sea. The cities of Moji and Kokura joined with three other cities of Tobata, Yahata, and Wakamatsu to form the city of Kitakyushu in 1963. It now has a population of around 1 million people being the 13th largest city in Japan. Historically known for steel, metal, and shipping industries, it is becoming a force in producing new computer software, automobile technology and environmental technology. Once one of the most polluted cities in Japan, Kitakyushu has worked hard to clean its air and water, and in recent years has won international recognition for its contribution to the environment. It was named and Environmental Model City in 2008.

The university was founded as Kokura Foreign Affairs College in 1946 to promote peace and international exchange at the end of World War II. The foundation of the university is a testament to the pursuit of international understanding and exchanges out of the ashes of war. If it had not been for billowing black smoke from the third air raid on the city of Yahata on August 8, 1945, Kokura would have most likely been the primary target of the second atomic bomb that was dropped on Nagasaki the next day on August 9, 1945. The mayor at that time proclaimed that the new college would be an institution of peace and that students would learn the languages of former adversaries for peace and reconciliation, so the college started with English and Chinese studies as primary subjects. Kokura was in complete ruin and students even cleared the grounds of debris as they studied. Thanks to the persistent efforts of former president Oshima, the Ministry of Education finally gave its approval, and it accepted its first incoming class in 1946. It was miraculous as the college was still faced with almost insurmountable odds in its actualization. It faced financial hurdles, and the city opened a profession bicycle racing track, now a horse racing track, to bring in more revenue. Thus, the university's primary monorail entrance is now the Keibajo racing station. Today, The University of Kitakyushu now consists of six facilities and four graduate schools. There are around 6700 students of which around 300 are international students.

In 1958, an exchange of gifts prompted the cities of Moji, Japan and Norfolk, Virginia to begin a sister-city relationship. This motivated Moji's neighboring city, Kokura, to apply for their own sister-city in 1959, and Kokura was matched with the city of Tacoma, Washington. In 1964, the newly formed city of Kitakyushu proudly continued its relationships with Norfolk and Tacoma. That same year, eight years before the normalization of diplomatic relations between Japan and China in 1972, then Prime Minister Zhou Enlai ordered the establishment

of an institute based on the prospect that Japanese-language personnel would be needed when Japan and China would establish diplomatic relations in the future. The University of Kitakyushu and Dalian University of Foreign languages just celebrated the 30th anniversary of their exchange programs in November 2019. The 25th anniversary of the exchange program between Cardiff University was celebrated with the arrival in Kitakyushu of the Wales national rugby union team in Kitakyushu during the 2018 World Cup. Yuji Yamazaki, professor emeritus and former director of the Centre for International Education and Exchanges at The University of Kitakyushu, was instrumental in the establishment of the earliest exchange programs with China and the U.S. and U.K. While watching 15,000 citizens cheer on the Welsh rugby team in 2018 he remarked, "The seed that I planted has now grown into something that I am very proud of."

The University of Kitakyushu has been a dynamic center of higher education and international exchange for more than 70 years in the Kyushu region of Japan. In its pursuit of internationalizion and global connections, the university has established ties through agreements with Australia, China, Canada, Korea, the U.K., the U.S., Singapore, Thailand, Vietnam and, most recently, Cambodia, Germany, Malaysia, and the Republic of Ireland. The University of Kitakyushu has regularly received high national and prefectural rankings for its study abroad programs. It currently has approximately 30 partnerships in more than 13 countries. Approximately 230 students can join yearly outbound programs. The university currently has student exchange agreements with partners including Australia, the UK, America, Canada, and Europe including France, Germany and the Republic of Ireland. When exchange agreements are established, the university offers specialized courses along with Japanese language programs through the Center for International Education and Exchange to incoming students from partner universities.

The Center for International Education and Exchange and Department of English work together to provide exchange students with various experiences and opportunities for international on campus and extracurricular activities. One major goal of the university is to provide incoming students from overseas partners with Japanese language courses. Three areas of Japanese instruction are offered at five to six different including Life Japanese for basic communication, Campus Japanese which allows students to function at the university and Academic Japanese for taking classes and courses in Japanese. In this respect, students are given the opportunity to enroll in classes with undergraduate Japanese students. Students are encouraged to get involved and experience Japanese cultural activities so Japanese language courses are accompanied with Japanese Culture classes. Students can experience various facets of traditional culture such as Ikebana, Japanese music, the tea ceremony, calligraphy, and traditional dance.

The Department of English works with the Center for International Education and Exchange to offer subjects taught in English. As the level of English within the Department of English is rather high, a diverse selection of advanced courses taught in the English language are also offered to international students for the purpose of credit exchanges at their home institutions. To explain in further detail, there are three different areas of courses. Language and Linguistics focuses on gaining abilities to understand language, language theory, with a focus on those students who with to become English teachers. Society and Culture offers courses in American Studies, Literature, Introduction to Film, Literature and Theatre. Global business obviously focuses on business with all courses offered in English. Thus students can mix their education at The University of Kitakyushu between Japanese and in-depth English courses as well. This made possible by diverse staff of educators from Britain, America, Australia, Canada, and of

course Japanese nationals who are all bilingual and well equipped to offer academic and professional courses in English.

The university was designated as part of the Ministry of Education's Global Human Resources Project in 2013 and received a special to expand global programs and partnerships before being faced with the challenges of the global pandemic. A major result of this was the reformation of the Department of English to provide the staffing allows the university to provide Japanese and international students with a diversity of course offerings that are not common at most public intuitions in Japan. Before the Covid-19 pandemic, the growth of international partnerships and the numbers of outgoing students attending exchange and study abroad programs was steadily increasing because of the enhanced educational environment created by collaboration and cooperation between the Center for International Education and Exchange and The Department of English.

Impact of Covid-19 on Study Abroad Participation

In the decade preceding the Covid-19 pandemic, the number of Japanese students studying abroad increased steadily. According to data from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the number of outbound Japanese students more than tripled between 2009 and 2019, supported by national initiatives aimed at fostering global human resources. The Covid-19 pandemic caused an unprecedented disruption to international mobility. Border closures, visa restrictions, and program cancellations resulted in a dramatic decline in outbound study abroad participation in 2020 and 2021. Similar trends were observed in other countries, including China, where student interest in overseas study declined sharply during the same period.To examine how these disruptions affected student attitudes, online surveys were conducted at The University of Kitakyushu in October 2021 and June 2022 using Microsoft Forms. The surveys targeted students enrolled in programs for which study abroad is a curricular requirement and addressed students' intentions, priorities, and concerns regarding international programs.

Cultural Interpretation of Student Attitudes

Survey results indicated a gradual recovery of interest in overseas programs by 2022 as travel restrictions eased. At the same time, students placed increased emphasis on cost, program content, and support systems when selecting international programs. Students who opted for domestic alternatives frequently cited financial constraints, health concerns, uncertainty related to the pandemic, and family consent as determining factors.

These findings can be interpreted through Hofstede's cultural dimension of uncertainty avoidance, which characterizes Japan as a society with a strong preference for structure and predictability. The pandemic intensified uncertainty avoidance tendencies, underscoring the importance of clear communication, predictable procedures, and visible support structures in the design of international exchange programs (Hofstede et al., 2010).

Collaborative Online International Learning During the Pandemic

In response to restrictions on physical mobility, The University of Kitakyushu implemented collaborative online international learning (COIL) as an alternative to on-site study abroad. Using synchronous online tools, students engaged in academic collaboration with overseas partner universities during a period when physical exchange was largely impossible.

Qualitative analysis of student reflections identified three main themes: active involvement in discussions, cultural perceptions, and challenges in language communication. These findings suggest that while COIL cannot fully replace physical mobility, it can provide meaningful intercultural learning experiences during periods of global disruption (Ikeda, 2020; Lenkaitis et al., 2019).

The Galway–Kitakyushu Exchange Program: Research Origins and Human Connections

A central case study presented in this paper is the academic exchange program between The University of Kitakyushu and the University of Galway in Ireland. The origins of this partnership are closely linked to long-term research connections centered on the Irish writer Lafcadio Hearn, whose life and work bridged Ireland, the United States, and Japan. Scholarly collaboration and academic networks developed through Hearn research served as the initial catalyst for institutional exchange.

The Galway–Kitakyushu agreement facilitates reciprocal student mobility, enabling Japanese students to study in an English-speaking academic environment while offering Irish students opportunities for Japanese language study and cultural immersion in Kitakyushu. The program exemplifies how international exchange initiatives are sustained not only through formal agreements but also through enduring human relationships among researchers, faculty members, and administrators.

Japanese students studying in Galway benefit from comprehensive advisory support, including guidance on applications, visas, housing, and academic integration. Orientation programs and ongoing support from international offices, counseling services, and language assistance help students navigate academic and social adjustment. At the same time, students face challenges related to independent housing, cultural differences in classroom participation, and financial pressures such as currency fluctuations.

Discussion: Sustainability of Exchange Programs Through Human Networks

The Galway case underscores a central argument of this paper: international exchange programs are maintained through human connections as much as through institutional structures. Research ties, faculty engagement, and sustained communication play a critical role in addressing challenges such as pandemic-related disruptions, housing shortages, and administrative complexity. These human networks complement institutional frameworks and contribute to the long-term sustainability of exchange programs.

Conclusion

This proceedings paper has examined changes in student attitudes toward study abroad during the Covid-19 pandemic, the role of collaborative online international learning, and the significance of human connections in sustaining international exchange programs. The Galway–Kitakyushu partnership demonstrates how research-based relationships can evolve into durable educational collaborations. Together, these findings suggest that resilient international education requires both structured institutional support and strong interpersonal networks.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that no generative AI or AI-assisted technologies were used to generate the content of this manuscript. AI tools were used solely to assist in organizing and formatting the manuscript for conference proceedings submission. All ideas, analyses, and interpretations are the original work of the authors.

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Cultivating Lifelong Learning Through Community-Embedded Making: A Case Study of Klongsan MAKE in Bangkok

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Abstract

Lifelong learning is a central goal of contemporary education systems, yet many initiatives remain fragmented across formal schooling, informal learning, and community engagement. This paper examines Klongsan MAKE, a community-embedded initiative in the Khlong San district of Bangkok, Thailand, positioning hands-on making as a continuous learning practice spanning schools, a district-based maker hub, and local community networks. The study builds on long-term observations indicating persistent gaps in making skills and experiential learning, followed by qualitative field research involving 11 schools in Khlong San and nearby districts, teachers, students, and community partners. Using participatory observation, in-depth interviews, and co-creation workshops, the research investigates how making functions as a lifelong learning mechanism by supporting continuity, learner agency, and integration across formal and informal learning contexts. Findings indicate that Klongsan MAKE strengthens conceptual understanding of STEAM and develops lifelong learning dispositions, including hands-on confidence (reduced fear and embarrassment in trying, failing, and iterating), curiosity, problem-solving, collaboration, and self-directed exploration. The initiative also reshapes educators' roles and activates community members as co-learners, mentors, and facilitators. The paper argues that lifelong learning is most effectively cultivated when making is embedded within place-based ecosystems rather than confined to classrooms or specialized facilities. Klongsan MAKE is proposed as a replicable, area-based model for developing lifelong learning ecosystems through accessible, community-driven making practices.

Keywords: lifelong learning, maker culture, steam education, hands-on learning, place-based learning ecosystems

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Introduction

Lifelong learning has become a critical paradigm for navigating rapid technological, social, and economic change. Rather than viewing learning as limited to childhood or formal schooling, lifelong learning emphasizes continuity, adaptability, and the capacity to learn across the lifespan. International frameworks further emphasize that lifelong learning systems require cross-sector coordination, linking education, community development, and local governance, so that learning becomes embedded in everyday urban life rather than confined to institutions (UNESCO Institute for Lifelong Learning [UIL], 2015). Despite its prominence in policy discourse, however, lifelong learning often remains weakly connected to everyday educational practice, particularly in school-based systems.

In many contexts, formal education continues to prioritize curriculum coverage and assessment, leaving limited space for experiential learning that supports curiosity, agency, and self-directed learning. At the same time, informal learning environments, such as maker spaces, community workshops, and creative hubs, often operate separately from schools. This separation produces fragmented learning pathways and weak continuity between what learners do in school and what they learn through everyday life, an issue learning city approaches explicitly seek to address through inclusive access, community participation, and sustainable local learning ecosystems (UIL, 2015). Research on how learning works also suggests that sustained learning depends on motivation, appropriate practice opportunities, supportive learning climates, and learners' ability to connect prior knowledge with new experiences (Ambrose et al., 2010).

This paper examines *Klongsan MAKE* as a response to these challenges. Developed in the Khlong San district of Bangkok, the initiative reframes hands-on making not merely as a pedagogical tool for STEAM education, but as a *lifelong learning practice* connecting children, teachers, community members, and makers within a shared learning ecosystem. The initiative aligns with learning city logic by mobilizing local actors and spaces, schools, community settings, and maker hubs, as distributed learning infrastructure (UIL, 2015). The study addresses three research questions.

1. How can hands-on making support lifelong learning dispositions across age groups?
2. What ecosystem conditions enable continuity between formal and informal learning?
3. How can community-based making contribute to sustainable lifelong learning systems?

Lifelong Learning and Community-Embedded Making

Lifelong learning is commonly defined as learning that occurs throughout life, across formal, non-formal, and informal settings. Central to lifelong learning are learner agency, motivation, and the ability to learn how to learn through habits of inquiry, reflection, and adaptation (UIL, 2015). Hands-on making aligns strongly with these aims because it requires exploration, iteration, and reflection, processes that mirror how individuals learn beyond formal schooling. Contemporary maker education research positions making as a participatory culture where learning emerges through designing, building, and sharing artifacts in socially supported environments (Halverson & Sheridan, 2014; Martin, 2015). This social dimension is consistent with sociocultural learning theory, which emphasizes how learning develops through interaction, mediation, and shared meaning-making with others (Vygotsky, 1978), and with communities of practice perspectives that frame learning as increasing participation in shared practices over time (Wenger, 1998).

In addition, practical learning design guidance suggests that effective learning environments should offer multiple modes of engagement, not only "classroom instruction," but also activity-based learning, learning through collaborative work, and learning embedded in everyday contexts (Office of Knowledge Management and Development [OKMD] & TK Park, n.d.). Such variety is also reflected in research and practice examples that treat the city itself as a learning platform, where public space can be redesigned to support participation, play, and inclusive access (Vertiz, 2020), and where restorative approaches strengthen community relationships through shared civic life and local collaboration (Roe & McCay, 2023). These perspectives position making not as a temporary instructional strategy, but as a sustainable learning mode that can cultivate lifelong learning dispositions over time.

Research Context: Khlong San as a Lifelong Learning Space

Khlong San is an urban district in Bangkok characterized by social diversity, creative economic activities, and strong community identities. Schools coexist alongside local crafts, small businesses, cultural institutions, and creative hubs. This mix creates fertile conditions for exploring lifelong learning beyond institutional boundaries and for situating making within everyday urban life, an approach consistent with creative city thinking that links learning, creativity, and local development (Thailand Creative & Design Center [TCDC], 2012).

Despite these assets, schools in the area face constraints common to dense urban settings, including limited space and facilities, rigid schedules, and pressure to meet curricular demands. Meanwhile, maker-oriented institutions such as FabLab Bangkok and the KX Building possess technical expertise and resources but may remain peripheral to everyday learning if not systematically connected to schools and communities. Klongsan MAKE emerged as an attempt to connect these domains by treating the district itself as a lifelong learning environment where learning can flow between schools, community spaces, maker facilities, and public events (UIL, 2015). Workshops were intentionally delivered across both school campuses and the KX/FabLab hub to enable learning continuity, shared access to tools, and repeated engagement beyond one-off classroom activities. In parallel, Klongsan MAKE was designed as a district-level support system, planning for a tool-lending mechanism, a reuse-material inventory, and gradual maker space expansion, to reduce barriers to participation and sustain making as an everyday lifelong learning practice.

Figure 1
Development Trajectory of Klongsan MAKE (2023–2025): From Early Prototyping at KX to Multi-school Pilot and Scaling Phase.

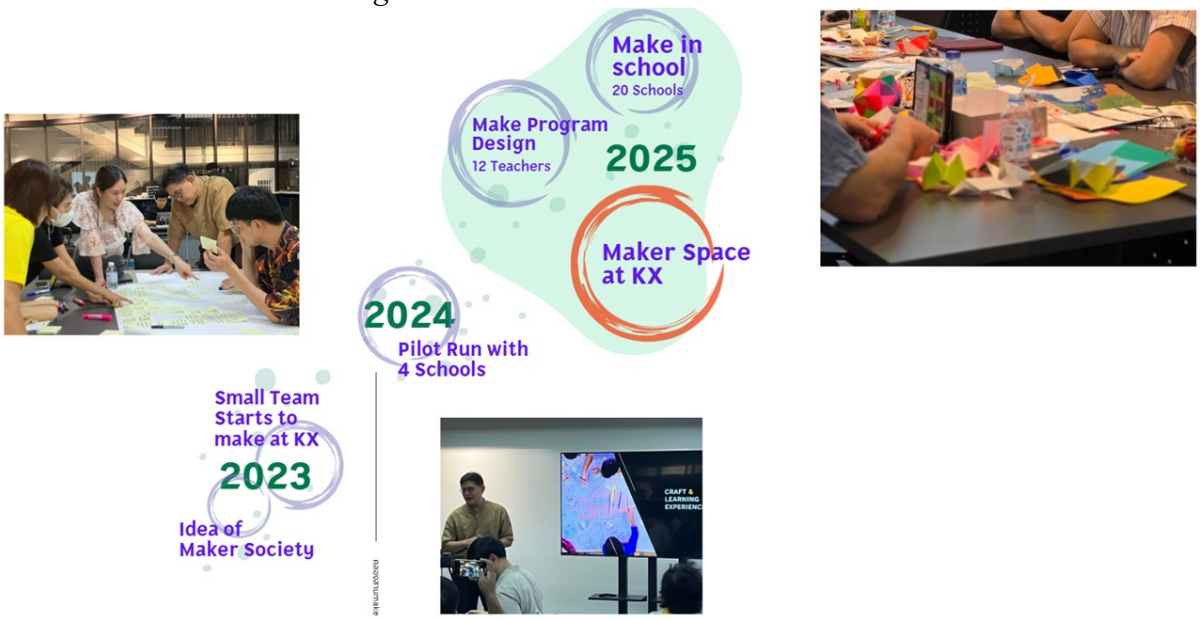
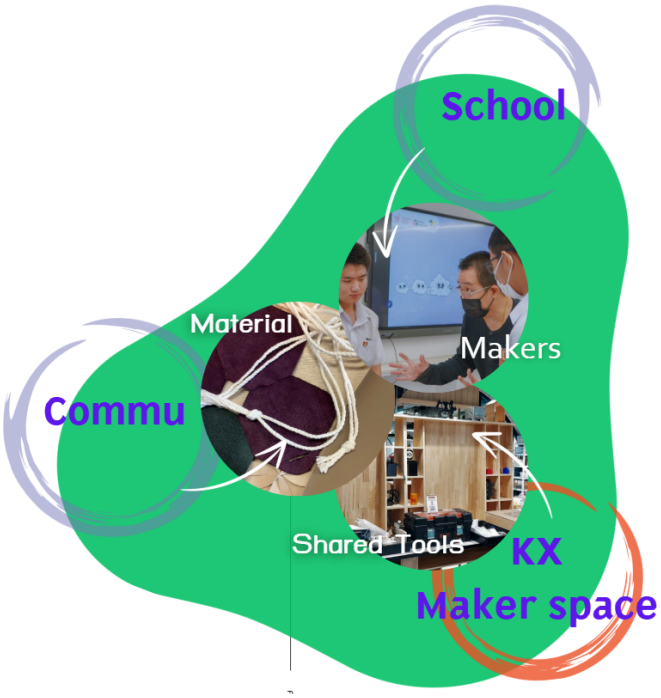


Figure 2
Methodology: Klongsan MAKE Ecosystem Model Linking Schools, Community Participation, and the KX/FabLab Hub Through Shared Tools, Accessible Materials, and Maker Mentorship.



This study employed a qualitative, participatory research design focused on understanding learning processes over time. Rather than evaluating short-term outcomes, the research examined how learning dispositions and relationships developed across repeated interactions within the Khlong San ecosystem.

Data was collected through participatory observation in eight school and community workshops conducted across two main settings: partner school campus and FabLab Bangkok (as part of the KX/FabLab hub). Each workshop was implemented through four types of making activities: (1) leathercraft, (2) paper-based making, (3) toy making, and (4) digital fabrication followed by hands-on assembly and refinement. Observations focused on learning behaviors and interaction patterns, including student initiative, collaboration dynamics, moments of difficulty (e.g., tool handling, material constraints, time pressure), and evidence of iteration (testing, revising, and improving outcomes). The research team maintained structured field notes and conducted brief post-activity reflections with facilitators and teachers to capture practical insights about what enabled or constrained implementation in each context.

In-depth interviews were conducted with 16 teachers and administrators, including both teachers who were already interested in maker-based activities and teachers who had little prior experience with this approach. Interviews emphasized school context, motivational drivers, and forms of resistance, including comfort levels in facilitating making activities, perceived curriculum fit, classroom management concerns, and factors affecting willingness to integrate making into routine learning. Two co-creation workshops—one focused on "What should we make?" and another on "Making in schools"—involved teachers, students, parents, and makers. These sessions supported the synthesis of practical integration strategies for in-class and out-of-class learning and were also used to validate and refine analytical themes emerging from interviews and observations.

The project involved 11 schools and over 200 participants, including public and private schools of different sizes. Activity formats were co-designed based on the characteristics and resources of each school, as well as teacher interests, to ensure feasible entry points for implementation. Formats included Scratch programming, freestyle making, craft-based making, and introductory digital fabrication. Many activities were intentionally designed to be open-ended and repeatable so teachers could adapt them to school constraints (space, time, budget, and locally available resources), while encouraging learners to continue experimenting beyond workshop sessions through transferable techniques and home- or peer-based activities outside class time.

Figure 3

Co-creation Workshop With Teachers and Students at the Maker Space (KX/FabLab Hub). Stakeholders Clustered Around Prototypes and Sticky-Note Insights to Map Needs, Constraints, and Feasible Making Activities.



Findings

Four key findings are presented to explain how Klongsan MAKE operated as a lifelong learning mechanism across settings.

Making as a Bridge Between Formal and Informal Learning

Across sites, students consistently brought "outside-school knowledge" into making tasks such as familiarity with household tools, craft practices, online hobbies, and informal problem-solving learned from family members or community contexts. In conventional Thai schooling, these experiences often remain invisible because classroom success is typically aligned with correctness, memorization, and standardized outcomes. Klongsan MAKE changed the rules of participation by legitimizing informal knowledge as a learning resource. Students could begin with what they already knew (e.g., folding, cutting, basic assembly, digital play with Scratch) and then extend into new concepts through guided experimentation.

This bridging effect was especially visible when activities were framed as open-ended challenges rather than fixed exercises. For instance, Scratch programming tasks became more meaningful when students embedded local narratives, characters, or daily-life scenarios. Similarly, craft-based tasks (e.g., basic leathercraft, packaging design, or prototype-building with simple materials) enabled students to connect school concepts to objects they could hold, adjust, and improve, turning abstract STEAM ideas into personally relevant experiences. As a result, students demonstrated greater persistence and willingness to revise their work, particularly when they perceived their making as "real" rather than merely schoolwork.

Development of Lifelong Learning Dispositions

A key pattern across activities was the emergence of *hands-on confidence*, defined here as reduced fear and embarrassment when attempting unfamiliar tasks, combined with an increased willingness to test ideas, accept failure, and iterate. Hands-on confidence did not appear automatically; it grew through repeated exposure to making routines: trying, seeing what happens, discussing outcomes, and refining. Importantly, this disposition was observed not only in students but also in teachers, many of whom initially expressed concern about unpredictable results, limited equipment, or time constraints. Over time, teachers became more comfortable with uncertainty and began to value "productive mistakes" as part of learning.

As hands-on confidence increased, other lifelong learning dispositions became more visible: curiosity (students asked more "what if" questions), reflection (students described why something failed), and agency (students proposed their own adjustments rather than waiting for instructions). Collaboration also became more purposeful. Rather than dividing labor mechanically, students negotiated ideas, compared prototypes, and helped troubleshoot one another's work, behaviors that align with lifelong learning as participation in shared practice rather than isolated individual achievement.

Teachers and Community Members as Co-learners

Klongsan MAKE functioned as a co-learning environment where the teacher's role shifted from "expert deliverer" to "learning facilitator." Teachers described facilitating inquiry by helping students articulate goals, identify constraints, and reflect on iterations. Community makers and practitioners acted as mentors who modeled making practices and encouraged learners to take initiative. This distributed expertise reduced dependence on any single instructor and made the model more sustainable, especially in schools where specialized STEAM staff or fabrication equipment is limited.

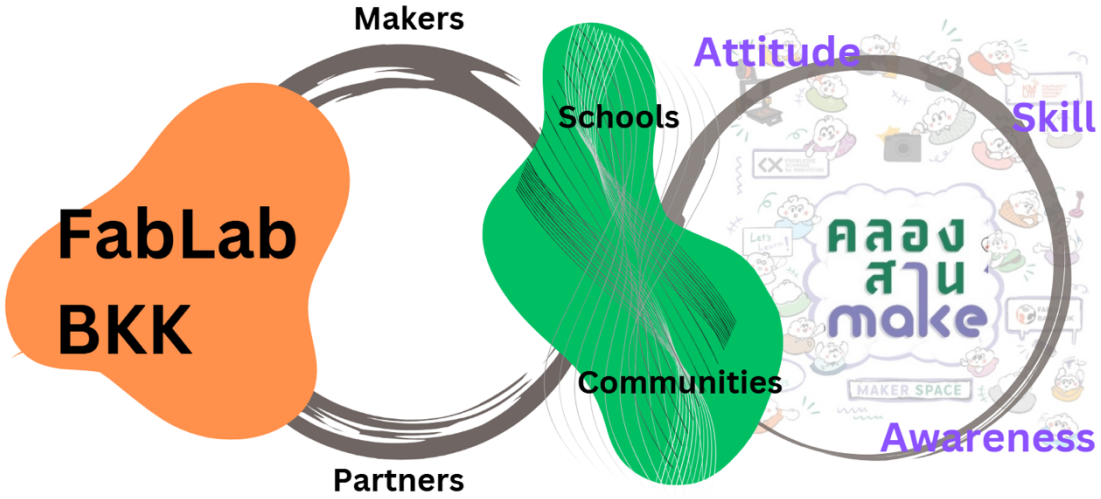
The KX/FabLab hub played a critical "bridging infrastructure" role in this process. Because tools, guidance, and space were available at the hub, schools could access resources without needing to immediately build full facilities. This lowered the threshold for participation and allowed teachers to focus on pedagogy and student engagement rather than technical setup alone.

Public Visibility and Learning Continuity

Public-facing moments, especially exhibitions and Bangkok Design Week-related activities,strengthened continuity by validating learners' work beyond school boundaries. When students saw their prototypes and stories displayed publicly, making became socially meaningful, not merely instructional. This visibility also supported stakeholder alignment: schools, parents, local partners, and the maker hub shared a common narrative of Khlong San as a district where learning can be hands-on and community supported.

Finally, the project's planned district-level supports, *tool lending, material reuse, and Maker Space expansion***,** are not merely operational details; they represent ecosystem conditions that enable lifelong learning to persist over time. Access to shared tools and low-cost materials increases the likelihood that making can continue between formal sessions, be repeated across grades, and be adopted by additional schools. In this sense, Klongsan MAKE demonstrates that lifelong learning is sustained not only through pedagogy, but also through practical infrastructures that make learning-by-doing feasible in everyday school and community life.

Figure 4
Outcome Pathway of Klongsan MAKE: How the KX/FabLab Hub and Partner Network Connect Makers With Schools and Communities to Develop Awareness, Attitudes (Hands-On Confidence), and Skills.



Discussion

The findings suggest that lifelong learning does not emerge from isolated programs but from ecosystems that support continuity, access, and social meaning. Klongsan MAKE succeeded by building linkages rather than relying on single-site facilities. This aligns with learning city guidance emphasizing coordinated local ecosystems that connect formal, non-formal, and informal learning opportunities and widen participation across the lifespan (UIL, 2015).

First, Klongsan MAKE reduced barriers between learning contexts through shared resource management, including access to tools and learning resources across schools and the KX/FabLab hub. Interviews indicated that a lack of tools and equipment is one of the most common obstacles when schools attempt to encourage students to begin making, especially in the early stages. Teachers explained that students are often more motivated when they can explore tools and devices, because tools create excitement, novelty, and a sense of "real making," rather than relying only on manual activities such as paper folding. This pattern is consistent with research-based learning principles showing that motivation, practice opportunities, and supportive conditions strongly shape persistence and learning outcomes (Ambrose et al., 2010). In this sense, shared access to tools functions not merely as logistical support but also as a motivational trigger that helps learners initiate making behaviors and sustain engagement long enough for learning dispositions to develop.

Figure 5

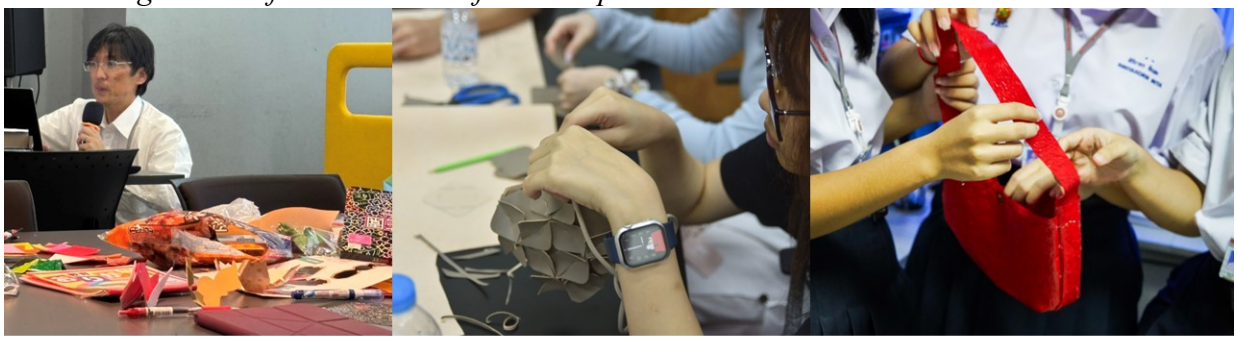
In-School Making Session: Teachers Facilitate Tool Use and Troubleshooting to Sustain Learning Continuity Beyond the Maker Hub.



Second, Klongsan MAKE valued everyday knowledge alongside practice-based value. It positioned making not only as a pedagogical strategy but also as a meaningful activity connected to community life and the possibility of economic extension through creativity and production. This matters in contexts where formal curricula can unintentionally frame learning as specialized, difficult, or disconnected from everyday life. Klongsan MAKE worked against this separation by encouraging teachers and students to observe and appreciate making in all contexts and by treating everyday making as legitimate learning. This emphasis on varied learning modes, learning by doing, learning through collaborative activity, and learning embedded in daily contexts, echoes the activity-based learning framing illustrated in your guideline materials (OKMD & TK Park, n.d.) and supports learning city objectives around participation, inclusion, and lifelong learning culture (UIL, 2015).

A distinctive contribution of the initiative is its emphasis on starting from what already exists in community life. By connecting learning to familiar practices, household tools and objects, repair and modification of everyday items, informal production, and local crafts, students gained more opportunities to learn through observation and questioning. Instead of following a linear pathway from theory to application (as typical in classroom instruction), learners began from real situations and then asked what principles or theories explain how something works. This "experience-to-theory" movement supported deeper conceptual understanding and made learning feel relevant, achievable, and continuous, an essential condition for lifelong learning systems (UIL, 2015).

Figure 6
Student-Made Prototypes From Hands-On Workshops: Simple, Low-Cost Making Activities That Strengthen Confidence and Craftsmanship.



Third, the initiative created repeated, low-cost opportunities for engagement, emphasizing easy entry, affordability, and continuity over time. This mechanism matters because it demonstrates that hands-on learning can be low-cost and does not need to be equated with invention, professional design, or high-end production. By separating making from "perfect products" and luxury materials, Klongsan MAKE reduced pressure around aesthetics, material quality, and polished outcomes. Instead, it highlighted the educational value of making itself, trying, adjusting, and learning through the process, which makes participation more inclusive and sustainable across different school contexts (Martin, 2015). These features also reflect broader learning city priorities: lowering participation barriers, strengthening community learning opportunities, and building local learning infrastructure (UIL, 2015).

Together, these ecosystem features align with lifelong learning principles by supporting repeated participation, learner agency, and learning across settings. Making practices become more sustainable when learning is socially supported, through peer collaboration, mentorship, and shared norms, rather than treated as an individual task (Halverson & Sheridan, 2014; Wenger, 1998). In this study, hands-on confidence emerged as a particularly important mechanism: when learners felt safe to try, fail, and iterate, they became more willing to pursue self-directed learning beyond the immediate activity. This matters because time-bound lessons and curriculum expectations often create pressure for "correct" outputs, which can reduce experimentation and weaken confidence (Ambrose et al., 2010). Similarly, when teachers experienced facilitation and co-learning roles, they were more likely to reframe learning as an ongoing process rather than a fixed curriculum sequence, consistent with sociocultural views of learning as mediated participation (Vygotsky, 1978).

Finally, integrating public-facing activities strengthened continuity by validating learning in wider community contexts. Public space can function as "learning infrastructure" when it is intentionally designed for participation and accessibility, including playful, child-centered engagement (Vertiz, 2020). In parallel, restorative city perspectives emphasize rebuilding social relationships and civic life through shared community processes and environments, which resonates with Klongsan MAKE's emphasis on collaboration and community-embedded practice (Roe & McCay, 2023). In this regard, FabLab Bangkok and public learning spaces can serve as bridging infrastructure between in-school and out-of-school learning, expanding learning space, building a making-based learning foundation, and cultivating a culture that respects both one's own making and the making of others, rather than valuing only "perfect" final products (Halverson & Sheridan, 2014; UIL, 2015).

Conclusion

This paper examined Klongsan MAKE as a case of cultivating lifelong learning through community-embedded making in the Khlong San district of Bangkok. The study found that making practices strengthened STEAM understanding through tangible, hands-on experiences where learners could test ideas, observe outcomes, and learn through iteration. Alongside conceptual learning, the initiative developed lifelong learning dispositions, hands-on confidence, curiosity, collaboration, and self-directed exploration, that support learning beyond classroom boundaries.

Klongsan MAKE also reconfigured educator roles from content delivery to facilitation and activated community members as co-learners and mentors, reinforcing learning as a shared social practice. The paper argues that lifelong learning is most effectively cultivated when making is embedded within place-based ecosystems rather than confined to classrooms or specialized facilities. As a replicable model, Klongsan MAKE highlights the value of district-based shared infrastructure, tool lending, material reuse, and hub-and-school programming, to reduce barriers to participation and sustain learning continuity over time.

Future work may strengthen the model through deeper longitudinal tracking of learner trajectories and by examining how district-level maker ecosystems can connect with wider lifelong learning policy frameworks. Further development may also expand community, civil society, and private-sector participation to strengthen social norms that value continuous hands-on learning, supporting a sustainable making culture for children, youth, and the broader community.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that ChatGPT (OpenAI), an AI-assisted writing tool, was used to support English language refinement and structural editing of the manuscript. The use was limited to improving clarity, coherence, and academic phrasing. The ideas, design, procedures, findings, analyses, and discussion are based on the authors' research activities and project documentation, and the authors reviewed and finalized all content.

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Classifying Opportunities for Lifelong Learning in Satun Through the Geo Camp Project: A Community-Driven Model of Education

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Abstract

This study investigates how learning environments can be developed in Satun, Thailand, recognized both as a UNESCO Global Geopark and an emerging Learning City, through the implementation of the Geo Camp Project. Drawing on an action research framework, the study examines two years of field interaction with local communities, aiming to classify critical factors that drive learning and uncover new educational opportunities. The conceptual model is built around the intersection of three domains: learner profiles, learning content, and learning experiences. This classification reveals that people-to-people interaction and context-based content, particularly in geo-science and geo-culture, are essential to Satun's educational character. Through qualitative observation and analysis, the research highlights how Satun's untapped local knowledge, especially narratives rooted in "Geo-culture," fosters both community awareness and engagement. Geo Camp emerged as a co-created program designed and implemented by local stakeholders. It supports experiential, place-based learning while stimulating civic participation and local pride. Moreover, it acts as a strategic catalyst, influencing local government to adopt policies that align with lifelong learning principles and quality tourism development. This paper argues that such community-centered initiatives can serve as scalable models for other rural learning cities in Asia. Geo Camp's classification model, integrating learner diversity, local content, and immersive experience, offers a practical framework to empower underserved communities through inclusive and sustainable learning ecosystems.

Keywords: lifelong learning, learning city, geopark, geo camp, community-based education

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Introduction

Satun, Thailand, is internationally recognized as a UNESCO Global Geopark and is simultaneously advancing toward becoming a Learning City. These dual designations highlight the area's rich geo-science heritage and diverse geo-cultural knowledge embedded within local communities. Despite this abundance of place-based knowledge, transforming such assets into accessible and continuous learning opportunities for people of different ages, backgrounds, and cultural groups remains a persistent challenge.

While geo-science and geo-cultural knowledge is deeply rooted in Satun, existing learning environments often struggle to translate this knowledge into engaging forms of lifelong learning. The challenge lies not in the availability of content, but in how learning is activated through interaction, place-based experience, and the active participation of local actors. This challenge is particularly evident in Satun's multicultural context, where learning must respond to diverse learner profiles and lived experiences. In response to these challenges, this study examines how learning environments can be developed through community-driven processes using the Geo Camp Project as a research platform. Drawing on an action research approach and two years of field engagement, the study focuses on identifying the key conditions that enable learning to emerge across diverse groups and settings.

The study aims to explore why the transmission of geo-based knowledge into lifelong learning practices remains challenging in Satun, and to identify the critical factors that influence learning engagement within community-based educational initiatives. By examining the relationships between learner profiles, learning content, and learning experiences, the research develops a conceptual framework that explains how these elements interact to form a functional learning ecosystem. Through this classification, the study seeks to articulate how local knowledge and community participation can be mobilized to support lifelong learning and contribute to the development of Satun as a Learning City with an inclusive and sustainable learning environment.

By articulating these relationships, the study contributes to a deeper understanding of how local knowledge, community participation, and experiential learning can be aligned to strengthen lifelong learning in practice. The findings are intended to inform not only Satun's ongoing development as a Learning City, but also to offer a scalable, community-centered model for other rural and geopark-based learning cities in Asia.

Literature Review

Lifelong Learning and Learning Ecosystems

Lifelong learning is widely recognized as a key mechanism for developing learning ecosystems that support continuous learning across formal, non-formal, and informal contexts. According to UNESCO, lifelong learning emphasizes the integration of learning into everyday life, communities, workplaces, and urban environments, thereby extending learning beyond institutional boundaries (UNESCO, 2015). This perspective highlights learning as a systemic process shaped by interactions among individuals, organizations, and socio-cultural contexts.

The literature consistently shows that effective learning ecosystems emerge when lifelong learning is supported through multi-stakeholder collaboration, including educational institutions, local authorities, civil society, and the private sector (König & Evans, 2013). Such

ecosystems are characterized by flexibility, accessibility, and responsiveness to local needs, enabling individuals to navigate diverse learning pathways throughout their lives (OECD, 2018). In this regard, lifelong learning functions not only as an individual learning process but also as a structural framework that aligns policies, spaces, and resources toward sustainable learning development (UNESCO Institute for Lifelong Learning [UIL], 2021). Geopark as a Learning Platform (Revised – Smooth Version).

UNESCO Global Geoparks are increasingly understood as learning platforms that integrate geo-science knowledge, cultural heritage, and community engagement. Beyond conservation, geoparks support education and public awareness by interpreting Earth heritage through place-based and participatory approaches that connect scientific knowledge with local contexts (UNESCO, 2015; UNESCO, n.d.). In this sense, geoparks are frequently conceptualized as open-air learning environments that support experiential, informal, and lifelong learning for diverse audiences, extending learning opportunities beyond formal education systems (Farsani et al., 2011; Henriques et al., 2011).

Information further highlights that geoparks facilitate informal and non-formal learning for a wide range of learners, including local residents, students, and visitors. Zouros (2004) emphasizes the role of geoparks in linking geological heritage with education and local development, particularly in rural areas, while Farsani et al. (2011) underscore their potential to support learning through geotourism and community-based interpretation. By embedding learning within everyday experiences and local identity, geopark-based initiatives align closely with the principles of lifelong learning and inclusive learning ecosystems (Henriques et al., 2011).

Place-Based Education

Place-Based Education (PBE) provides a strong pedagogical foundation for learning city development in contexts where local heritage, environment, and community knowledge function as central learning resources. PBE is commonly defined as an educational approach that uses the local community and environment as the primary context for teaching and learning, emphasizing experiential, real-world engagement and fostering meaningful relationships between learners and their places (Sobel, 2004). By grounding learning in familiar settings, PBE enhances relevance and supports deeper engagement through community participation, intergenerational knowledge exchange, and the integration of local expertise into the learning process (Smith & Sobel, 2010).

A critical extension of this approach is articulated through Greenwood and Gruenewald's concept of a "critical pedagogy of place," which argues that place-based learning must attend not only to ecological dimensions but also to cultural, social, and political contexts. This perspective encourages educators and learners to examine how power relations, identities, and historical narratives shape the meanings of place and influence whose knowledge is recognized and valued (Greenwood, 2008; Gruenewald, 2003). Such a critical lens is particularly important in multicultural regions, where learning design should move beyond treating local knowledge as a fixed resource to be transmitted, and instead support participatory meaning-making and respectful representation of diverse cultural perspectives.

Recent applications of place-based education have further expanded beyond natural or rural settings into urban contexts, reinforcing the idea that learning can occur throughout the city. The notion that "every part of the city can function as a classroom" reflects an evolving

understanding of place-based learning rooted in everyday urban experience. An illustrative example is the *Wandering Challenge*, initiated by Anny Chang, co-founder of City Wanderer, which applies gamification to city-based learning activities for youth development. Through experiential missions designed to promote self-exploration, social interaction, and active engagement with urban environments, the project demonstrates how thoughtfully designed activities can transform ordinary city spaces into meaningful learning settings. Such city-based, experiential tasks broaden the definition of learning spaces beyond schools, libraries, or museums, while fostering skills and competencies that are difficult to cultivate within conventional classroom contexts (TK Park, 2022).

Together, these perspectives position place-based education as a flexible and context-responsive framework that connects learning to lived experience, supports diverse learner engagement, and provides a critical foundation for designing inclusive learning environments within learning cities.

Theoretical Integration for the Geo Camp Context

Taken together, the reviewed theoretical perspectives establish a coherent framework for understanding Geo Camp as an experimental learning intervention situated within a geopark-based learning city. Lifelong learning provides the foundational rationale for positioning learning as a continuous, inclusive process that extends beyond formal education and is embedded in everyday life and community participation (UNESCO, 1996). Within this perspective, Geo Camp is conceived not merely as an educational activity, but as a mechanism for activating lifelong learning among diverse groups through direct engagement with local knowledge and lived experience.

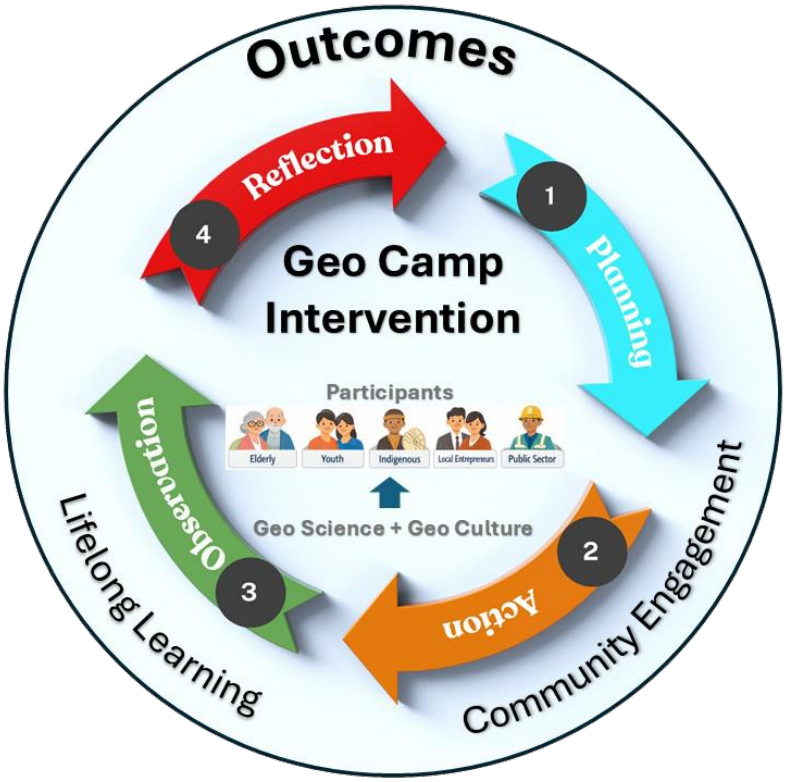
The learning city framework further situates Geo Camp within a broader learning ecosystem, emphasizing the role of coordinated actors, local governance, and community partnerships in shaping learning opportunities. Rather than operating as a stand-alone program, Geo Camp functions as a connective platform that links institutions, communities, and learning spaces, reflecting the system-level orientation of learning city development (UNESCO Institute for Lifelong Learning [UIL], 2015).

At the pedagogical level, place-based education explains how Geo Camp grounds learning in local relevance through experiential and participatory approaches. By engaging learners directly with geo-scientific sites, cultural narratives, and community practices, Geo Camp aligns with principles of place-based learning that emphasize meaning-making through real-world contexts (Sobel, 2004). The critical pedagogy of place further informs the design of Geo Camp by foregrounding cultural and ecological sensitivity, participatory knowledge production, and respect for diverse identities—an essential consideration in Satun's multicultural context (Greenwood, 2008; Gruenewald, 2003).

Finally, geopark frameworks provide the territorial and conceptual foundation that enables Geo Camp to function as a learning experiment within a real-world setting. UNESCO Global Geoparks position geological and cultural heritage as resources for education, public awareness, and sustainable development, while prior studies emphasize their role as open-air learning environments supporting informal and lifelong learning (Farsani et al., 2011; UNESCO, 2015). Within this context, Geo Camp serves as a practical testing ground for examining how learner diversity, locally grounded content, and immersive learning experiences interact to generate meaningful learning outcomes.

Methodology

Figure 1
Geo Camp Research Methodology



Research Design

This study adopts an action research framework combined with qualitative inquiry to investigate how learning environments can be developed within the context of a geopark-based learning city. The research was conducted over a two-year period through iterative cycles of planning, action, observation, and reflection, with the Geo Camp Project serving as the primary research intervention. Rather than treating Geo Camp as a standalone educational program, the study positions it as an experimental platform for examining learning processes embedded in local contexts.

Research Context and Participants

Geo Camp was designed as an experiential learning intervention that connects knowledge embedded within the Satun UNESCO Global Geopark, integrating both geo-science knowledge and, with particular emphasis, geo-cultural knowledge. In this study, geo-culture is understood as an integral part of everyday life in the local context, rather than as a discrete or abstract form of heritage. The project adopts a community-driven, lifelong learning–oriented, and place-based education approach, guided by the central research question: How can learning within a geopark context be designed to enable diverse groups of people to become lifelong learners, and how can the city function as a genuine learning ecosystem?

Participants were intentionally recruited from diverse social groups to reflect the multicultural character of Satun and the principles of lifelong learning. These groups included older adults; children and youth; local Indigenous people (such as the Maniq); members of community

enterprises and local entrepreneurs; personnel from public organizations and learning spaces; as well as members of the general public, with initial participation focusing on residents of Satun Province.

Figure 2

Diverse Social Groups of Participants in Geo Camp



Children and Youth | Older Adults | Maniq (local Indigenous people) | Members of Community

Over a two-year period, a total of 284 participants took part in six Geo Camp cohorts. Participants were engaged not only as learners but also as co-creators of learning activities, contributing local knowledge, perspectives, and experiences to the design and implementation of the Geo Camp program.

Geo Camp as a Community-Driven Learning Intervention

Geo Camp was collaboratively designed and implemented with local stakeholders to support experiential and place-based learning grounded in geo-science and geo-culture. Learning activities emphasized people-to-people interaction, field-based exploration, storytelling, and collective reflection, enabling participants to engage directly with local knowledge and lived experience while fostering community awareness, engagement, and local pride.

The program was structured as a two-day learning experience. The first day focused on geo-science through hands-on exploration at selected geopark sites and geo-learning spaces, where participants observed and examined real rock samples and fossils. These activities introduced key geo-science concepts through direct sensory engagement, supported by purpose-designed learning technologies such as online games, short digital clips, and interactive modules developed specifically for Geo Camp.

Figure 3
Learners Visit Geopark Sites for Geo-Science Learning in Geo Camp



The second day focused on geo culture through city walking and community-based learning activities. Participants explored culturally significant places and engaged in dialogue with residents who shared stories and lived experiences connected to specific sites. Learning was mediated through storytelling rather than formal instruction, helping learners understand the links between geological landscapes, cultural practices, livelihoods, and local identity. This approach positioned people and places as primary learning resources and enabled geo cultural knowledge to be experienced through social interaction and participation.

Figure 4
Learners Participate in a City Walk Activity to Explore Geo-Culture in Geo Camp



By structuring Geo Camp in this way, the learning design intentionally contrasted tangible geo-science exploration with the more interpretive and relational nature of geo-cultural learning. This combination enabled learners to move beyond factual understanding toward deeper place-

based awareness, empathy, and cultural understanding, while enhancing meaningful engagement, civic awareness, and local pride.

Data Collection and Analytical Framework

Data were collected through qualitative methods aligned with the action research approach, including participant observation during Geo Camp activities, documentation of learning materials and participant-generated outputs, reflective discussions, and short semi-structured interviews with selected learners. Formative pre- and post-activity learning checks, together with collaborative tasks and presentations, were used to explore changes in participants' understanding of geo-science and geo-cultural concepts rather than to assess standardized achievement.

Data analysis focused on identifying and classifying key conditions that enable learning to emerge within the local context. Using thematic analysis, observational data, interview reflections, and learning outputs were examined through a conceptual framework comprising learner profiles, learning content, and learning experiences, with particular attention to the role of context-based content and people-to-people interaction in shaping meaningful learning experiences.

Role of Geo Camp in Model Development

Geo Camp played a central role in the development of the conceptual model presented in this study by functioning as both a learning intervention and a research mechanism. Through repeated implementation across multiple cohorts, Geo Camp provided a real world setting in which learning processes could be observed, tested, and refined within the context of a geopark based learning city. While the overall learning structure comprising exploration, interaction, reflection, and co creation was consistently applied, the specific activities remained iterative and flexible, allowing them to be adapted to different learner groups as well as the spatial and geo cultural characteristics of each location visited.

Insights from Geo Camp activities revealed how learner diversity, locally grounded learning content, and immersive learning experiences interact to shape meaningful learning outcomes. Learning tasks were flexibly adjusted to participants' backgrounds and site-specific contexts, demonstrating how learning opportunities could be systematically classified rather than treated as isolated activities. Grounded in participants lived experiences, the analysis translated empirical observations into a context-responsive model that highlights people-to-people interaction and geo-cultural knowledge as key drivers of engagement, positioning Geo Camp as both an educational platform and a testing ground for a scalable, community-driven approach to lifelong learning in geopark and rural learning city contexts.

Results

Learner Profiles Identified Through Geo Camp

The results indicate that age plays a significant role in shaping learning patterns and learning opportunities among Geo Camp participants, with different learner groups demonstrating distinct interests, learning approaches, and roles. Children and youth tended to engage most actively with playful and interactive activities such as game-based learning, digital tools, and

hands-on exploration at geo-science learning sites. These activities supported rapid understanding of geoscientific concepts through direct experiential engagement.

In contrast, older adults and adult community members primarily contributed as holders of local narratives, cultural knowledge, and everyday histories. Their learning emerged through conversation, experience sharing, and storytelling related to multicultural practices and local identity. Within Geo Camp activities, adults frequently assumed roles as storytellers and interpreters, connecting specific places with broader social and cultural contexts.

Observations revealed that Geo Camp enabled intergenerational learning integration, in which children and youth shared knowledge related to fossils, technology, and learning games, while adults transmitted geo-cultural knowledge through lived experiences and narrative practices. In some cases, children produced creative outputs that were refined through guidance from adults, reflecting a reciprocal learning process that bridges age gaps and supports mutual knowledge construction.

Taken together, these results demonstrate how learner profiles function as a critical factor in the classification of learning opportunities, and how geo-science and geo-cultural content is activated and transmitted through people-to-people interaction across generations. This classification of learner roles provides a foundation for the subsequent analysis of learning content activated through the Geo Camp activities.

Types of Learning Content: Geo Science and Geo-Culture

The results show that learning content activated through Geo Camp emerged as context-based content grounded in both geo-science and geo-culture, with geo-cultural knowledge playing a particularly prominent role. While geo-science concepts such as rocks, fossils, and geological processes were introduced through hands-on and field-based activities, these elements were consistently connected to local stories and lived experiences.

One recurring activity across all Geo Camp cohorts was a batik dyeing workshop using natural pigments derived from locally grown plants within the geopark area. This activity enabled participants to engage with geo-science knowledge related to natural dyes and color processes, while simultaneously expressing geo-cultural meanings through fossil-inspired patterns rooted in local textile traditions. Through this process, scientific concepts were embedded within culturally meaningful creative practices rather than presented as abstract knowledge.

Observations and learner reflections further indicate that geo-cultural content shaped how participants made sense of what they learned, particularly during activities involving city walking, interaction with community members, storytelling, and collaborative making. Participants frequently linked scientific observations with narratives related to local history, livelihoods, beliefs, and multicultural practices, allowing learning to extend beyond factual understanding toward shared meaning and local identity.

Across different cohorts, learning content was activated primarily through people-to-people interaction rather than formal instruction alone, with geo-cultural narratives functioning as a bridge between geo-science knowledge and everyday life. These forms of content were most frequently activated through activities such as city walking and craft-based workshops, indicating a close relationship between the nature of learning content and the design of learning experiences. Taken together, these results demonstrate that the integration of geo-culture and

geo-science constitutes a critical factor in the classification of learning opportunities, as it shapes how learners engage with content, interpret knowledge, and relate learning to everyday life. Rather than encountering scientific concepts in isolation, participants experienced learning as a connected process in which scientific understanding was continuously reinforced through cultural narratives, local practices, and social interaction.

Learning Experiences and Interaction Patterns

The results indicate that learning experiences generated through Geo Camp were experiential, participatory, and socially embedded, emerging through direct engagement with places, people, and activities rather than formal instruction alone. Across cohorts, learning experiences were shaped through geographical site exploration, city walking, collaborative making, storytelling, and group reflection.

Activities such as city walking and community interaction transformed urban and geopark spaces into active learning environments, enabling learners to connect geo-science observations with geo-cultural contexts through movement, dialogue, and situated encounter, while also enhancing intergenerational conversations among participants. Craft-based workshops further supported immersive learning by facilitating people-to-people interaction and collaborative knowledge construction across age groups.

While the overall experiential structure remained consistent, learning activities were adapted to different learner profiles and site contexts. As a result, these experiences supported sustained engagement and active participation, demonstrating how experiential and place-based education approaches activate diverse learning opportunities within a geopark-based learning city. Taken together, these experiential patterns inform the subsequent findings on how learning opportunities are classified and sustained within the Geo Camp model.

Findings

Analysis of data generated through the Geo Camp Project reveals how opportunities for lifelong learning in Satun emerged through the interaction of learner diversity, locally grounded learning content, and immersive learning experiences. Rather than functioning as a fixed educational program, Geo Camp operated as a repeated yet adaptive learning process, in which learning structures were consistently applied while specific activities evolved in response to different learner groups and spatial contexts. Four key findings are presented below.

Learner Diversity and the Transformation of Learning Roles

One key finding is that Geo Camp enabled participants from diverse age groups and backgrounds—including children, youth, older adults, and community members—to move beyond passive learning roles. Across different cohorts, learners demonstrated increased agency through participation, dialogue, and collaborative tasks. Differences in age, experience, and social roles did not hinder learning; instead, learner diversity functioned as a critical factor that enriched interaction and collective meaning-making. This finding highlights how varied learner profiles contribute to the classification of learning opportunities within a community-driven learning environment.

Geo-Cultural Learning as a Catalyst for Meaningful Engagement

Findings indicate that geo-cultural learning played a central role in sustaining learner engagement, particularly during activities that involved storytelling, walking-based exploration, and direct interaction with local residents. While geoscientific concepts were effectively introduced through hands-on engagement with rocks, fossils, and geo sites, participants consistently emphasized that learning through people, places, and lived narratives made the experience more meaningful. Geo-culture emerged as a form of context-based learning content that connected knowledge to everyday life, local identity, and shared memory, fostering emotional connection, community awareness, and motivation to continue learning.

People-to-People Interaction and Immersive Learning Experiences

Another significant finding concerns the role of people-to-people interaction in shaping immersive learning experiences. Learning frequently occurred through conversation, observation, and shared reflection rather than through instruction alone. Activities such as group discussions, city walking, and collaborative presentations transformed natural and urban spaces into active learning environments.

Observations show that these interactions often led to deep and meaningful conversations, particularly when children and youth expressed curiosity about local culture and history. Adults and older community members responded enthusiastically, viewing these exchanges as opportunities to transmit knowledge accumulated through lived experience. Many of the stories shared were not formally documented, allowing learners to access localized and exclusive forms of knowledge that could only be conveyed through direct interpersonal interaction. This finding highlights how people-to-people interaction supports immersive learning and enables knowledge transmission beyond formal learning contexts.

Geo Camp as an Adaptive Learning Process

A further key finding highlights the adaptive and scalable nature of the Geo Camp process, which enables it to be scaled up and scaled out to other sites and communities. While the core learning structure comprising exploration, interaction, reflection, and co creation was consistently applied, specific activities were flexibly adapted to different learner profiles, local geo cultural characteristics, and spatial contexts.

This adaptability allowed Geo Camp to function as a transferable learning process rather than a site-specific program, supporting the extension of learning opportunities across multiple locations. As a result, Geo Camp demonstrates how a community-driven, place-based intervention can contribute to a functional learning ecosystem that supports lifelong learning and advances the realization of a learning city in practice.

Discussion

This study set out to examine why the transmission of geo-based knowledge into lifelong learning practices remains challenging in Satun, and to identify the critical factors that shape learning engagement within community-based educational initiatives. The findings suggest that learning opportunities in a geopark-based learning city do not emerge from content delivery alone, but from the dynamic interaction between learner diversity, context-based

learning content, and experiential learning processes that are activated through people-to-people interaction.

One of the most significant insights concerns the nature of learner diversity in Satun. While age differences are often assumed to be the primary factor influencing learning engagement, the findings indicate that background, worldview, and lived experience play a more decisive role. In a multicultural context that includes ethnic groups such as the Maniq, differences in belief systems, modes of communication, and everyday practices can make mutual understanding difficult to achieve through explanation alone. Certain forms of knowledge cannot be fully translated across cultural boundaries; they must be encountered through shared experience. In this sense, Geo Camp did not eliminate these differences but created learning situations in which diversity became a productive condition, enabling learners to engage with unfamiliar perspectives without requiring complete cognitive alignment.

The findings also highlight the pedagogical complexity of geo-cultural learning. For participants from outside the community, geo-culture often appeared novel and exciting, whereas for local participants it was frequently perceived as familiar and therefore less interesting. This paradox reveals that geo-culture is not inherently engaging; its educational value depends heavily on how it is mediated. Deep storytelling across generations emerged as a crucial mechanism for reactivating interest, particularly when narratives were conveyed by experienced community members who could situate cultural knowledge within lived histories. However, storytelling alone was often insufficient, especially for younger learners with limited attention spans. The integration of hands-on activities and experiential learning proved essential for sustaining engagement, suggesting that geo-culture functions not merely as content but as a high-skill pedagogical practice that requires careful design and facilitation.

People-to-people interaction further emerged as a central driver of immersive learning experiences, though the findings challenge the assumption that such interaction occurs naturally. While moments of deep conversation were observed when children expressed genuine curiosity about local culture and history, participation was uneven and highly dependent on facilitation. The presence of trained Learning Administrators played a critical role in sustaining meaningful dialogue by initiating topics, bridging generational perspectives, and maintaining conversational continuity. Importantly, these Learning Administrators were developed from within the local community through targeted training, demonstrating that such human infrastructure can be cultivated locally. This finding underscores that effective people-to-people learning relies not only on social proximity but also on intentional mediation.

The adaptive and scalable nature of the Geo Camp process provides further insight into how community-driven learning initiatives can contribute to learning city development. While specific activities varied according to learner profiles, site conditions, and local contexts, the underlying learning structure remained consistent. This process-oriented design allowed Geo Camp to be scaled up and scaled out across different locations without replicating activities verbatim. However, scalability was shown to depend on more than pedagogical design alone. The readiness of learning spaces, availability of tools and technology, and institutional cooperation among local stakeholders were critical in ensuring that learning remained engaging, safe, and accessible. Without such support, even well-designed learning content risked becoming exhausting rather than empowering.

The limitations of this study are therefore not primarily related to the training of skilled facilitators or Learning Administrators, which proved achievable within the local context. A

more fundamental challenge lies in the recognition of geo-culture as a valuable form of knowledge. In some cases, geo-culture continues to be perceived as ordinary or outdated rather than as a source of identity formation and economic potential. This limited recognition can constrain the willingness of communities and institutions to invest in geo-cultural learning, despite its demonstrated capacity to generate both social value and income. Addressing this challenge requires a shift in perception, positioning geo-culture not as background heritage but as a living resource for learning and development.

The findings suggest that Geo Camp represents more than a localized educational program. It functions as a living experiment in how learning ecosystems can be activated through community participation, place-based content, and adaptive learning processes. By demonstrating how learner diversity, geo-cultural meaning-making, and people-to-people interaction intersect in practice, this study contributes to a deeper understanding of how geopark-based initiatives can support lifelong learning and advance the realization of learning cities as socially embedded and responsive systems.

Conclusion

This study demonstrates that the development of effective learning environments in Satun as a geopark-based learning city depends not solely on the availability of geo-science or geo-cultural knowledge, but on how learning is activated through interaction, experience, and community participation. Findings from the Geo Camp Project show that meaningful learning emerges through the dynamic interplay of learner diversity, context-based learning content, and immersive learning experiences. Learners of different ages and backgrounds contributed to and benefited from intergenerational knowledge exchange, transforming diversity into a key asset rather than a limitation.

Geo-cultural learning played a central role in enhancing engagement by connecting scientific knowledge to everyday life, local identity, and shared memory. However, the study reveals that geo-culture is not inherently engaging and must be carefully mediated through storytelling, hands-on activities, and experiential learning design. People-to-people interaction was identified as a critical driver of learning, though such interaction required intentional facilitation. Trained local Learning Administrators were essential in bridging generational perspectives and sustaining meaningful dialogue.

As an adaptive and community-driven process, Geo Camp functioned not as a fixed program but as a scalable learning framework that could be applied across different sites and learner groups. Overall, the study positions Geo Camp as a practical model for activating inclusive learning ecosystems, offering valuable insights for geopark-based and rural learning cities seeking to strengthen lifelong learning through place-based and community-cantered approaches.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that generative AI and AI-assisted technologies were used in the writing process of this manuscript for language-related purposes only, including grammar and spelling correction, paraphrasing for conciseness, and refining sentence structure to improve clarity and alignment with the intended meaning. The use of these tools did not involve the generation of research ideas, study design, data collection procedures, findings, analysis, interpretation, or arguments. All core concepts, research design, data, results, and discussions were originally written and derived from the author's systematic conduct of the research, and the author takes full responsibility for the content of the manuscript.

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Investigating the Needs and Potential of Interactive Media in an AI-Enhanced Constructivist Learning Environment for English Vocabulary Acquisition

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Abstract

This study investigates the needs and potential of interactive media in an AI-enhanced constructivist learning environment for English vocabulary acquisition among elementary school students. The research employs a mixed-methods approach, involving 120 fifth-grade students and 10 English language teachers selected through stratified random sampling from four schools in Lopburi Province, Thailand. Data collection includes surveys on students' learning needs, difficulties, and preferences, as well as interviews with teachers regarding their perceptions of current teaching practices and the potential of integrating AI and interactive media in vocabulary instruction. Quantitative data analysis reveals that 75% of students find vocabulary learning challenging, with 68% expressing a preference for interactive media. Qualitative findings indicate that 80% of teachers acknowledge the limitations of traditional teaching methods and 90% recognize the potential benefits of AI and interactive media in enhancing vocabulary acquisition. However, 60% of teachers express concerns about the lack of technological infrastructure and training. These findings serve as a foundation for designing and developing an innovative learning system that effectively addresses the identified needs and optimizes the potential of emerging technologies in language education. This research contributes to the advancement of technology-enhanced language learning and offers practical implications for educators and researchers in the field.

Keywords: AI-enhanced learning, constructivist learning environment, English vocabulary acquisition, interactive media, vocabulary retention

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Introduction

Background and Context

English language proficiency has become an essential competency in the globalized world, serving as a gateway to educational advancement, career opportunities, and cross-cultural communication (Crystal, 2019). In Thailand, the Office of Basic Education Commission (2022) has emphasized the critical importance of developing strong English language foundations from the elementary level, recognizing that English proficiency significantly impacts students' access to knowledge and future opportunities. However, despite these recognized imperatives, Thai students continue to face substantial challenges in English language acquisition.

The National Educational Quality Assessment through standardized tests (O-NET) for Grade 6 elementary students in English revealed that the average score was only 33.49%, significantly lower than the 50% standard criterion established by the Ministry of Education (National Institute of Educational Testing Service, 2024). This alarming statistic reflects the persistent English learning difficulties among Thai students and indicates that current instructional approaches fail to meet learners' needs effectively. The situation demands innovative pedagogical interventions that can address these challenges comprehensively.

Research on second language vocabulary learning has consistently identified vocabulary retention as a central challenge for language learners worldwide. Karatas et al. (2025) and Nakata and Elgort (2020) have demonstrated that learners' primary difficulty lies not in the initial memorization of vocabulary but rather in the preservation of lexical knowledge in long-term memory and its appropriate application across various contexts. A comprehensive meta-analysis by Uchihara et al. (2023) revealed that second language learners typically forget approximately 60-70% of newly learned vocabulary within 2–4 weeks after initial learning without regular review or consistent usage.

The vocabulary retention challenge is particularly pronounced in the Thai educational context. Suwimol Tirakanant (2022) found that Thai students tend to forget English vocabulary within an even shorter timeframe—typically 2–3 weeks after instruction—without systematic review or contextual application. This accelerated forgetting rate can be attributed to the specific characteristics of English learning in Thailand as an English as a Foreign Language (EFL) context, where students have limited opportunities to encounter and use English in daily life (Sureepong, 2018). Furthermore, Phoocharoensil et al. (2023) found that Thai students predominantly rely on traditional vocabulary learning strategies such as rote memorization and bilingual dictionary consultation rather than more effective approaches like contextual learning. The lack of vocabulary retention has cascading effects on all language skills, as vocabulary serves as the fundamental building block of language communication (Schmitt et al., 2011; Stæhr, 2008).

Statement of the Problem

The convergence of low English achievement scores, significant vocabulary retention challenges, and the limitations of traditional teaching methods in the Thai educational context creates an urgent need for innovative instructional approaches. The contemporary digital landscape, characterized by rapid technological advancement and the emergence of artificial intelligence applications in education, presents both challenges and opportunities for addressing these pedagogical concerns. Interactive media and AI-enhanced learning

environments offer promising solutions by providing personalized, adaptive, and engaging learning experiences that can address individual learner needs while maintaining motivation and interest. However, the successful integration of these technologies in Thai elementary English classrooms requires a thorough understanding of students' specific learning needs, preferences, and the potential barriers to implementation.

Research Objectives and Questions

This study aims to: (1) investigate the vocabulary learning needs and difficulties experienced by fifth-grade elementary students in Thailand, (2) assess students' preferences for interactive learning media and AI-enhanced features, (3) explore teachers' perceptions of current teaching practices and their attitudes toward integrating AI and interactive media in vocabulary instruction, (4) evaluate the technological infrastructure and readiness of schools and teachers for implementing technology-enhanced learning, and (5) provide evidence-based recommendations for designing Interactive Media in an AI-Enhanced Constructivist Learning Environment for English vocabulary acquisition.

The study addresses the following research questions: What are the primary vocabulary learning difficulties and needs of fifth-grade elementary students? What are students' preferences regarding interactive media features and AI-enhanced learning capabilities? How do teachers perceive the limitations of current teaching methods and the potential of AI and interactive media in vocabulary instruction? What is the current state of technological infrastructure and teacher readiness for implementing technology-enhanced vocabulary instruction? What are the evidence-based recommendations for designing Interactive Media in an AI-Enhanced Constructivist Learning Environment that addresses the identified needs and leverages the available potential?

This research contributes to the field of educational technology and second language acquisition by providing empirical evidence regarding the specific vocabulary learning needs and challenges faced by Thai elementary students, filling a gap in the literature regarding needs assessment for technology-enhanced language learning in the Thai context. The study offers insights into student preferences for interactive media features, identifies potential barriers to implementation, and informs policy decisions regarding resource allocation for technology integration in education.

Literature Review

Vocabulary Acquisition and Retention in Second Language Learning

Vocabulary acquisition constitutes a fundamental component of second language learning, with lexical knowledge serving as the foundation for all language skills (Nation, 2022; Schmitt & Schmitt, 2021). Research has consistently demonstrated that vocabulary size and depth significantly predict learners' ability to comprehend spoken and written language, produce meaningful utterances, and engage in successful communication (Schmitt et al., 2011). However, the challenge of vocabulary retention has been extensively documented in second language acquisition research. Nakata and Elgort (2020) synthesized findings indicating that learners often demonstrate adequate short-term recall of vocabulary but struggle to maintain this knowledge over extended periods. This retention challenge is particularly pronounced in foreign language contexts where learners have limited exposure to the target language outside formal instruction.

Recent literature has emphasized the role of active engagement in vocabulary learning. Teng (2022) found that multimodal input significantly enhanced vocabulary retention compared to text-only presentation, suggesting that engaging multiple sensory channels supports deeper encoding and more durable memory traces. Chang (2023) demonstrated that repeated oral reading practice significantly improved retention of high-frequency multiword items among EFL learners, highlighting the importance of productive language use in vocabulary consolidation. Similarly, Garcés-Manzanera (2023) found that incidental vocabulary learning through communicative tasks promoted better retention than explicit vocabulary instruction alone, suggesting that contextualized learning experiences support more robust lexical development.

Constructivist Learning Theory and AI in Education

Constructivist learning theory, rooted in the foundational work of Piaget and Vygotsky (1978), posits that learners actively construct knowledge through interaction with their environment and social contexts rather than passively receiving information (Fosnot & Perry, 2021). This theoretical framework emphasizes the importance of meaningful learning experiences, social interaction, and the connection of new knowledge to prior understanding. The integration of technology in constructivist learning environments has been explored extensively in recent research. Zin et al. (2024) examined technological advancements in learning management systems that support constructivist pedagogy, finding that effective systems provide opportunities for exploration, collaboration, and knowledge construction. Quoc and Van (2023) demonstrated that social constructivist approaches enhanced lexical retention among EFL learners, with technology-mediated collaborative activities promoting deeper vocabulary processing and more durable learning outcomes.

Kahn and Winters (2021) traced the historical relationship between constructionism and artificial intelligence, arguing that AI technologies can support constructivist learning when designed to facilitate exploration, experimentation, and knowledge building. The application of artificial intelligence in education has expanded rapidly in recent years, offering new possibilities for personalized, adaptive, and intelligent learning systems (Doroudi, 2022; Holmes & Tuomi, 2022). AI technologies in education encompass a broad range of applications, including intelligent tutoring systems, automated assessment, learning analytics, and adaptive content delivery. Almasri (2024) conducted a systematic review finding positive effects on student learning outcomes, engagement, and attitudes, while also identifying implementation challenges related to teacher preparation, technological infrastructure, and integration with existing curricula. Gibson et al. (2023) analyzed learning theories relevant to AI-enhanced learning, proposing frameworks for understanding how AI can support different types of learning processes. In the context of language learning, AI applications have shown particular promise for vocabulary instruction. Hsu et al. (2023) investigated AI image recognition for vocabulary acquisition, finding that AI-supported learning strategies reduced learning anxiety while improving vocabulary outcomes. Lee et al. (2022) developed an AI English learning support system that facilitated learner-generated context-based learning, demonstrating improved engagement and learning effectiveness.

Interactive Media and Gamification in Language Learning

Interactive media technologies have transformed educational possibilities by enabling engaging, multimodal, and adaptive learning experiences. Arabiat et al. (2022) conducted a systematic review of interactive technology use and child development, finding positive effects on cognitive, social, and language development when technologies were appropriately designed and implemented. Gamification—the application of game design elements in educational contexts—has emerged as a particularly effective approach for enhancing learner motivation and engagement. Zou et al. (2019) comprehensively reviewed digital game-based vocabulary learning research, finding that game-based approaches consistently outperformed traditional instruction in terms of both learning outcomes and learner motivation. The review identified key design features that contribute to effective vocabulary games, including immediate feedback, progressive difficulty, and meaningful rewards.

Chen et al. (2020) investigated the impact of integrating vocabulary exercises into adventure video games, finding significant improvements in vocabulary learning compared to conventional instruction. The study highlighted the importance of meaningful integration where vocabulary learning serves game objectives rather than appearing as disconnected educational content. Lee (2022) examined factors affecting incidental vocabulary acquisition and retention in game-enhanced environments, identifying engagement, repetition, and contextual embedding as key predictors of learning success. Sayed (2022) specifically examined competitive digital games for vocabulary retention among primary school students, finding that game-based competition enhanced both immediate learning and delayed retention. Harrington and Mellors (2021) further explored the role of gamification in promoting student success and retention, proposing design principles for effective educational gamification that balance challenge, achievement, and social interaction.

Despite the growing body of research on AI in education and interactive media for language learning, significant gaps remain in understanding the specific needs and potential for implementing these technologies in Thai elementary English education. While international research provides valuable insights, the unique characteristics of the Thai EFL context—including limited English exposure, cultural factors, and infrastructure constraints—necessitate context-specific investigation. Furthermore, comprehensive needs assessments that integrate student, teacher, and institutional perspectives remain scarce in the literature. This study addresses these gaps by conducting a comprehensive investigation of vocabulary learning needs, interactive media preferences, and implementation readiness in the Thai elementary context. The research is grounded in constructivist learning theory and draws on cognitive theories of vocabulary acquisition, particularly dual coding theory (Paivio, 1991) and working memory models (Baddeley, 2012), to inform the analysis of effective learning approaches.

Research Methodology

Research Design

This study employed a mixed-methods research design, combining quantitative and qualitative approaches to achieve a comprehensive understanding of vocabulary learning needs and the potential for AI-enhanced interactive media in elementary English education. The mixed-methods approach was selected to capitalize on the complementary strengths of quantitative methods for establishing patterns and prevalence and qualitative methods for providing depth, context, and explanatory richness. The convergent parallel design allowed simultaneous data

collection through multiple instruments, with integration occurring during the interpretation phase.

Participants and Setting

The study was conducted in four elementary schools in Lopburi Province, Thailand, selected to represent diverse school contexts within the provincial education system. Participants included 120 fifth-grade students (48.3% male, 51.7% female) and 10 English language teachers. Students were selected through stratified random sampling to ensure representation across schools and academic performance levels. The student sample represented a range of prior English achievement: 15% had achieved excellent grades (A), 30% had good grades (B), 35% had average grades (C), and 20% had below-average grades (D). Additionally, 108 parents or guardians (90% response rate) participated in a supplementary survey to provide contextual information about family support and technology access.

Research Instruments and Data Collection

A comprehensive suite of twelve research instruments was developed to ensure triangulation and provide a multifaceted understanding of the research questions. These instruments included: (1) Student Needs Assessment Questionnaire to identify learning needs and problems; (2) Interactive Media Preference Survey to assess media preferences; (3) Semi-Structured Teacher Interview to explore attitudes and limitations; (4) Technology Infrastructure Assessment to evaluate technology readiness; (5) Vocabulary Pre-Test to measure baseline vocabulary knowledge; (6) Classroom Observation Protocol to observe learning behaviors; (7) Student Focus Group Interview to gain in-depth perspectives; (8) Parent Survey to understand family context; (9) Existing Materials Analysis Checklist to analyze current materials; (10) Researcher's Field Journal to record qualitative context; (11) AI Features Priority Assessment to inform AI feature design; and (12) Digital Literacy Assessment to evaluate students' digital skills.

Data collection was conducted over a seven-week period following institutional approval and informed consent procedures. Quantitative instruments were administered during class time with researcher supervision. Semi-structured teacher interviews lasting 45–60 minutes were conducted individually. Student focus groups, comprising seven students each (28 students total across four groups), were facilitated by the researcher using standardized protocols. Classroom observations were conducted across 12 class periods (three per school), each lasting 50 minutes, using structured observation protocols to record engagement levels, teaching methods, and technology use.

Quantitative data were analyzed using descriptive statistics including means, standard deviations, frequencies, and percentages. Likert-scale items were interpreted using predetermined criteria: 4.50–5.00 (Highest), 3.50–4.49 (High), 2.50–3.49 (Moderate), 1.50–2.49 (Low), and 1.00–1.49 (Lowest). Qualitative data from interviews, focus groups, and field journals were analyzed using thematic analysis following Braun and Clarke's six-phase framework: familiarization, coding, theme development, review, definition, and reporting. Data triangulation was achieved by comparing findings across multiple instruments and participant groups.

Results

Students' Vocabulary Learning Difficulties and Needs

The Student Needs Survey revealed substantial vocabulary learning challenges among participants. Analysis of 5-point Likert scale responses indicated that 75% of students (n = 90) rated vocabulary learning as challenging, with mean scores at or above 3.50. Table 1 presents the detailed breakdown of vocabulary learning difficulties. Long-term retention emerged as the most significant difficulty (M = 4.45, SD = 0.69), followed by understanding word meanings (M = 4.35, SD = 0.72), remembering new vocabulary (M = 4.21, SD = 0.78), correct pronunciation (M = 4.12, SD = 0.81), using vocabulary in sentences (M = 3.89, SD = 0.85), and learning motivation (M = 3.56, SD = 0.92).

Table 1
Vocabulary Learning Difficulties Among Fifth-Grade Students (n = 120)

Difficulty Area	Mean	S.D.	Level
Long-term retention of vocabulary	4.45	0.68	High
Understanding word meanings	4.35	0.72	High
Remembering new vocabulary	4.21	0.78	High
Correct pronunciation	4.12	0.81	High
Using vocabulary in sentences	3.89	0.85	High
Learning motivation	3.54	0.92	Moderate

These findings were corroborated by the vocabulary pre-test results, which revealed that 55% of students (n = 66) scored below satisfactory levels. The mean pre-test score was 24.35 out of 45 points (54.11%), with substantial variation (SD = 8.72). Performance analysis by test section revealed critical weaknesses: students achieved 67.1% accuracy on recognition items, but only 48.5% on comprehension and 36.5% on production tasks, indicating a significant gap between receptive and productive vocabulary knowledge. Focus group discussions provided qualitative depth to these findings. A substantial majority (89.3%) of focus group participants reported forgetting vocabulary quickly after tests. As one student expressed: “Writing words many times is tiring. I remember them for tests but forget them later.” Another student noted: “When teacher uses games, I remember words better. It's fun and I want to learn more.”

Students' Interactive Media Preferences

The Interactive Media Preference Survey revealed strong student interest in technology-enhanced learning approaches. Analysis indicated that 68% of students (n = 82) expressed preferences for interactive media. Table 2 presents student preferences for learning material types. Educational games were preferred by 80% of students, followed by interactive media (68.3%), videos and animations (65%), group activities (45%), and textbooks/workbooks (30%).

Table 2
Student Preferences for Learning Material Types (n = 120)

Learning Material Type	Frequency	Percentage
Educational games	96	80.0%
Interactive media	82	68.3%
Video lessons	75	62.5%
Flashcards (digital)	68	56.7%
Traditional textbooks	38	31.7%

Analysis of preferred interactive media features revealed strong preferences for gamification elements. Games and scoring received the highest mean rating (M = 4.68, SD = 0.52), followed by immediate feedback (M = 4.52, SD = 0.61), characters and storytelling (M = 4.45, SD = 0.65), sound and animations (M = 4.38, SD = 0.68), competition with friends (M = 4.25, SD = 0.75), and auto-adjusting difficulty (M = 4.12, SD = 0.78). These findings indicate that students value engaging, responsive, and socially connected learning experiences. Regarding AI feature expectations, students expressed strong interest in AI capabilities that support personalized learning. The majority (85%) wanted AI to recommend vocabulary suited to their level, 80% desired AI assistance with pronunciation practice, 70% valued AI-generated learning progress summaries, and 65% were interested in AI-created exercises.

Teacher Perceptions and Concerns

Semi-structured interviews with 10 English teachers revealed important insights regarding current teaching practices and attitudes toward technology integration. Table 3 presents teachers' current vocabulary teaching methods. Analysis indicated that all teachers (100%) currently employ repetition and memorization methods, 90% use translation approaches, 80% assign worksheets, and 70% use flashcards. However, only 30% reported using educational software or applications in their instruction.

Table 3
Teachers' Current Vocabulary Teaching Methods (n = 10)

Teaching Method	Frequency	Percentage
Repetition and memorization	10	100%
Translation method (Thai-English)	9	90%
Picture flashcards	8	80%
Games and activities	5	50%
Educational software/apps	3	30%

A substantial majority of teachers (80%, n = 8) acknowledged limitations of traditional teaching methods. As one teacher explained: “Traditional methods like repetition work for short-term memory, but students often forget vocabulary within weeks. We need more engaging approaches.” Teachers expressed strong recognition of AI and interactive media

potential. Nine teachers (90%) agreed that AI could help personalize learning, all ten (100%) believed interactive media increases engagement, 90% thought technology could improve retention, and 80% saw potential for AI to reduce assessment workload. However, teachers also expressed concerns: limited budget (80%), insufficient training (70%), lack of technological infrastructure (60%), internet connectivity issues (60%), and screen time concerns (50%).

Technological Infrastructure and AI Features Priority

The technology infrastructure assessment revealed considerable variation across the four participating schools. Computer labs ranged from 15 to 25 units, tablet availability varied from 0 to 15 devices, internet speeds ranged from 20 to 100 Mbps, and smart classrooms numbered between 1 and 4 per school. These disparities highlight the need for technology solutions that can function effectively across varying infrastructure conditions. Teacher digital readiness assessment indicated moderate overall readiness (M = 3.12, SD = 0.68). Teachers reported high basic computer skills (M = 3.80, SD = 0.63) but lower confidence in using educational apps (M = 3.20, SD = 0.79), technology-enhanced teaching experience (M = 2.90, SD = 0.88), and understanding of AI in education (M = 2.60, SD = 0.97). In contrast, student digital literacy assessment revealed high overall proficiency (M = 3.80, SD = 0.65), with 75% achieving proficient (51.7%) or advanced (23.3%) levels.

The AI Features Priority Assessment captured both student and teacher perspectives on desired AI capabilities. Table 4 presents the priorities from both perspectives. Students prioritized gamification with adaptive AI (M = 4.72, SD = 0.48), virtual conversation partners (M = 4.58, SD = 0.55), speech recognition (M = 4.45, SD = 0.62), personalized recommendations (M = 4.32, SD = 0.68), and learning progress dashboards (M = 4.15, SD = 0.72). Teachers prioritized learning analytics dashboards (M = 4.80, SD = 0.42), automated assessment (M = 4.70, SD = 0.48), adaptive learning paths (M = 4.50, SD = 0.53), smart content generation (M = 4.40, SD = 0.52), and personalized recommendations (M = 4.30, SD = 0.67). These findings reveal complementary perspectives: students value engaging, interactive features while teachers prioritize tools that support instruction and assessment.

Table 4
AI Feature Priorities: Student and Teacher Perspectives

AI Feature	Student Mean	Student Rank	Teacher Mean	Teacher Rank
Gamification with adaptive difficulty	4.72	1	4.30	3
Learning analytics dashboard	3.95	5	4.80	1
Automated assessment	4.12	4	4.70	2
Virtual conversation partner	4.58	2	4.35	4
Speech recognition for pronunciation	4.48	3	4.50	3

Classroom Observations and Synthesis of Findings

Systematic classroom observations across 12 class periods revealed important patterns in teaching practices and student engagement. Teacher-centered instruction dominated observed

class time (75%), with lecture/explanation (100% of classes, averaging 18 minutes) and repetition/drilling (100% of classes, averaging 12 minutes) as the most common activities. Games and interactive activities were observed in only 33% of classes (averaging 8 minutes), and technology use occurred in just 25% of observations (averaging 10 minutes). Student engagement levels varied dramatically based on activity type. High engagement was observed during only 24% of class time, primarily during games and video activities. Medium engagement characterized 40% of class time during group work activities, while low engagement was observed during 36% of class time, predominantly during lecture and drill activities.

Analysis of 24 existing teaching materials across the four schools revealed significant gaps. While materials scored well on curriculum alignment ($M = 4.25$, $SD = 0.62$) and age-appropriateness ($M = 3.92$, $SD = 0.75$), they demonstrated critical weaknesses in interactive elements ($M = 1.75$, $SD = 0.92$), multimedia components ($M = 1.42$, $SD = 0.78$), constructivist approaches ($M = 1.85$, $SD = 0.85$), and AI/adaptive features ($M = 1.08$, $SD = 0.28$). The parent survey ($n = 108$) revealed technology access varied by device type: 94.4% of families had smartphones, 66.7% had home internet, 41.7% had tablet devices, and 35.2% had computers or laptops. Parents believed technology could help their children learn better ($M = 4.12$, $SD = 0.72$) and strongly desired to be informed about their children's progress ($M = 4.45$, $SD = 0.58$).

Discussion

The finding that 75% of students experience vocabulary learning as challenging, with long-term retention confirmed as the most significant difficulty ($M = 4.45$, $SD = 0.69$), aligns with and extends previous research on vocabulary retention challenges in EFL contexts. The results corroborate Uchihara et al.'s (2023) meta-analysis findings regarding the prevalence of vocabulary forgetting among second language learners and support Suwimol Tirakanant's (2022) observations about accelerated forgetting rates among Thai students. The substantial gap between recognition (67.1%), comprehension (48.5%), and production (36.5%) performance on the vocabulary pre-test reflects the well-documented phenomenon that receptive vocabulary knowledge develops more readily than productive knowledge (Nation, 2022). Students' reports of quickly forgetting vocabulary after tests despite repetitive practice suggest that current instructional approaches fail to create the deep processing and meaningful engagement necessary for durable memory formation, aligning with Dunlosky et al.'s (2013) research demonstrating that mere repetition is among the least effective learning strategies for long-term retention.

Strong student preferences for educational games (80%) and interactive media (68.3%), combined with high digital literacy levels (75% proficient or advanced), indicate substantial readiness for technology-enhanced learning approaches. These findings align with Zou et al.'s (2019) research demonstrating the effectiveness and appeal of digital game-based vocabulary learning. The particularly high ratings for gamification features ($M = 4.68$) and immediate feedback ($M = 4.52$) reflect the importance of engagement and responsiveness in educational technology design, consistent with self-determination theory perspectives on intrinsic motivation (Ryan & Deci, 2020). Students' interest in AI features that support personalized learning (85% wanting level-appropriate recommendations, 80% desiring pronunciation practice support) suggests awareness of the potential for technology to address individual learning needs, supporting arguments that AI-enhanced personalization represents a promising direction for addressing the diverse needs of language learners (Bhutoria, 2022; Wang et al., 2024).

The tension between teachers' recognition of traditional method limitations (80%) and AI potential (90%) on one hand, and their concerns about infrastructure (60%) and training (70%) on the other, highlights the complex landscape of educational technology adoption. This finding echoes Choi et al.'s (2022) research on factors influencing teachers' acceptance of educational AI, which identified perceived usefulness and ease of use as critical determinants of adoption intentions. The finding that only 30% of teachers currently use educational software despite widespread recognition of technology's potential suggests that awareness alone is insufficient for adoption. This implementation gap can be understood through technology acceptance frameworks, which emphasize the roles of facilitating conditions, self-efficacy, and organizational support in technology adoption (Tan et al., 2024). The identified training needs—particularly AI-assisted teaching tools (90%) and creating interactive materials (80%)—provide clear priorities for professional development initiatives.

The significant variation in technological infrastructure across schools—from 0 to 15 tablets and 20 to 100 Mbps internet speeds—has important implications for system design. These disparities, combined with concerns about internet connectivity (60% of teachers), suggest that effective AI-enhanced learning systems must be designed for flexibility and offline functionality. This finding aligns with research by Lin et al. (2024) on the importance of designing inclusive AI technologies that function effectively across diverse learning environments. The analysis of existing teaching materials revealed critical gaps in interactive elements, multimedia components, and adaptive features that technology can address. The nearly complete absence of AI or adaptive features in current materials ($M = 1.08$) represents both a limitation of current practice and an opportunity for innovation. The high smartphone access rate among families (94.4%) suggests that mobile-friendly design could extend learning opportunities beyond school settings, addressing the limited English exposure that characterizes the Thai EFL context.

The convergent findings from multiple instruments provide clear guidance for designing Interactive Media in an AI-Enhanced Constructivist Learning Environment. The system should incorporate gamification elements with adaptive difficulty, immediate feedback mechanisms, engaging characters and narratives, and social/competitive features. AI capabilities should prioritize personalized vocabulary recommendations, pronunciation practice with speech recognition, progress tracking and analytics, and adaptive learning paths that respond to individual performance and preferences. From a constructivist perspective, the system should provide opportunities for active exploration, meaningful contextualization of vocabulary, collaborative learning activities, and learner agency in directing their learning. The design should address retention challenges through spaced repetition algorithms informed by cognitive science research, multimodal presentation drawing on dual coding theory (Paivio, 1991) and working memory models (Baddeley, 2012), and productive practice opportunities that require vocabulary application rather than mere recognition.

Technical design should accommodate varying infrastructure conditions through offline functionality and mobile compatibility while providing teacher dashboards for monitoring progress and informing instruction. Implementation support mechanisms are essential given the identified training needs and infrastructure concerns. The system should include comprehensive teacher professional development materials: video tutorials demonstrating key features, detailed user guides with troubleshooting information, sample lesson plans integrating the system into instruction, and ongoing technical support channels. Teachers' moderate overall digital readiness ($M = 3.12$) and limited AI understanding ($M = 2.60$) necessitate professional

development that builds both technical skills and pedagogical understanding of effective technology integration.

Several limitations should be considered when interpreting these findings. First, the study was conducted in four schools within a single province, which may limit generalizability to other regions of Thailand or other EFL contexts. Second, the cross-sectional design captures needs and preferences at a single point in time; longitudinal research would provide insight into how these factors evolve. Third, self-report measures may be subject to social desirability bias, particularly regarding student preferences for technology. Fourth, the study focused on fifth-grade students, and findings may not generalize to other age groups. Despite these limitations, the mixed-methods approach with data triangulation across multiple instruments strengthens confidence in the key findings.

Conclusion

This study investigated the needs and potential of interactive media in an AI-enhanced constructivist learning environment for English vocabulary acquisition among elementary school students in Thailand. Through comprehensive data collection from 120 students, 10 teachers, 108 parents, and systematic observation and analysis, the research revealed substantial vocabulary learning challenges, strong student preferences for technology-enhanced approaches, teacher recognition of innovation potential alongside implementation concerns, and varying but generally adequate infrastructure for technology integration.

Key findings indicate that vocabulary retention represents the most significant learning challenge, with 75% of students reporting difficulties and 55% performing below satisfactory levels on baseline assessment. Students demonstrate strong preferences for interactive, gamified learning approaches (68% preferring interactive materials) and high digital literacy (75% proficient or advanced). Teachers acknowledge traditional method limitations (80%) and recognize AI potential (90%) but identify training (70%) and infrastructure (60%) as barriers. These findings collectively establish a clear evidence base for developing an AI-enhanced constructivist learning system that addresses identified needs while leveraging available resources and capabilities.

This research contributes to the field in several ways. Theoretically, it extends understanding of vocabulary learning challenges and technology potential in the Thai EFL context, providing context-specific evidence that complements international research. The study demonstrates the value of mixed-methods needs assessment approaches that integrate multiple stakeholder perspectives. Practically, the findings provide evidence-based specifications for designing AI-enhanced vocabulary learning systems, identify priority areas for teacher professional development, and inform policy decisions regarding technology integration in Thai elementary education. Methodologically, the study demonstrates the value of comprehensive mixed-methods needs assessment employing twelve complementary instruments to triangulate findings and provide multifaceted understanding of complex educational challenges.

Based on the findings, several recommendations emerge for future research and educational practice. First, development and evaluation research should design, implement, and assess an AI-enhanced constructivist learning system incorporating the identified features and addressing the documented needs. Second, longitudinal studies should track vocabulary retention and language development over extended periods to assess the durability of learning gains from technology-enhanced instruction. Third, teacher professional development

programs should address identified training needs while building confidence and reducing anxiety about technology integration. Fourth, expanded research across additional regions and grade levels would strengthen generalizability and inform scaled implementation. Fifth, investigations of the specific AI algorithms and adaptive mechanisms that most effectively support vocabulary learning would advance both theoretical understanding and practical design.

In conclusion, this study establishes a foundation for transforming English vocabulary instruction through thoughtfully designed AI-enhanced interactive learning environments. By addressing the documented retention challenges through engaging, personalized, and constructivist approaches, such systems hold potential for improving learning outcomes while maintaining student motivation and supporting teachers in their instructional efforts. The comprehensive needs assessment presented here provides the evidence base necessary for moving from conceptualization to implementation, contributing to the ongoing evolution of technology-enhanced language education.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Evaluating the Potential and Requirements for an AI-Powered Mobile Learning Application to Enhance Sight-Reading Skills for Percussion Among Thai Youth

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Abstract

This study aims to evaluate the potential and requirements for developing an AI-powered mobile learning application based on a constructivist approach to enhance sight-reading skills for percussion instruments among Thai youth. The research employs a mixed-methods approach, involving a sample of 120 Thai youth aged 13–18 years old who have experience in playing percussion instruments. Data collection includes an online survey on learning needs, preferences, and perceived challenges in sight-reading, as well as semi-structured interviews with 15 music teachers and 5 experts in music education and educational technology. The results indicate that 78% of the youth participants express a strong interest in using a mobile learning application to improve their sight-reading skills, with 85% preferring gamified learning features. However, 65% of the participants report challenges in accessing quality learning resources and receiving personalized feedback. The interviews reveal that 90% of the music teachers recognize the potential of AI-powered mobile learning in providing adaptive learning experiences and real-time feedback, while 80% of the experts emphasize the importance of aligning the application design with constructivist principles. The findings highlight the key requirements for the mobile learning application, including interactive notation display, real-time performance evaluation, adaptive difficulty adjustment, and gamification elements. These insights will guide the development of an AI-powered mobile learning application that effectively addresses the learning needs and preferences of Thai youth in enhancing their sight-reading skills for percussion instruments.

Keywords: AI-powered mobile learning, constructivist approach, sight-reading skills, percussion instruments, Thai youth

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Introduction

The ability to sight-read musical notation represents a fundamental skill that enables musicians to learn new repertoire quickly, participate effectively in ensemble performances, and develop musical independence. However, for percussion students, sight-reading presents uniquely complex cognitive challenges that extend far beyond those encountered with melodic instruments. Percussionists must simultaneously process multiple staves, decode diverse notation systems for different instruments, interpret complex rhythmic patterns, and coordinate movements across various instruments—all while maintaining musical expression and ensemble awareness. In Thailand's northeastern region, these challenges are compounded by contextual factors including limited access to quality practice materials, insufficient numbers of qualified instructors, large class sizes that prevent individualized attention, and the need to navigate between traditional Isan musical concepts and Western notation systems. Traditional teaching approaches, which typically rely on limited repertoire and repetitive practice with the same materials, struggle to provide the diverse, fresh sight-reading exercises necessary for genuine skill development—once a musical exercise has been practiced, it can no longer serve as authentic sight-reading material for that individual.

Recent technological advances in artificial intelligence and mobile learning offer promising solutions to these longstanding pedagogical challenges. AI-powered educational applications have demonstrated capability to provide adaptive learning experiences that adjust content difficulty based on individual performance patterns, deliver immediate feedback on musical accuracy, generate unlimited practice materials tailored to specific skill levels, and maintain detailed learning analytics that inform both students and instructors (Pedraja-Rejas et al., 2024; Rizal et al., 2024). Furthermore, constructivist learning principles—which emphasize active knowledge construction, learner agency, and authentic problem-solving—align particularly well with the interactive, exploratory affordances of mobile technologies (Wang et al., 2025). Research has shown that well-designed mobile learning applications can significantly enhance student motivation, increase practice frequency, and improve learning outcomes across various educational domains.

Despite these promising technological capabilities and growing research attention to technology-enhanced music education, significant gaps remain in understanding how to effectively design and implement AI-powered mobile learning solutions for percussion sight-reading, particularly within non-Western educational contexts. While several studies have explored mobile learning applications in music education generally (Larasati & Sukmayadi, 2020) and others have examined cognitive processes in sight-reading for melodic instruments, few have specifically addressed the unique instructional needs of percussion students or investigated stakeholder perspectives within Thai cultural and educational contexts. Perhaps most critically, current research on educational technology development has inadequately attended to the voices of learners themselves, as well as teachers and experts, in the design process.

This study addresses these critical gaps by conducting a comprehensive needs assessment that systematically investigates the perspectives of three key stakeholder groups regarding the potential and requirements for AI-powered mobile learning applications to enhance percussion sight-reading skills among Thai youth. Through mixed-methods investigation combining quantitative surveys with 120 Thai youth percussion students and qualitative interviews with 15 music teachers and 5 experts in music education and educational technology, this research seeks to understand Thai youth students' current learning experiences, challenges, and

preferences related to sight-reading and mobile learning technologies, music teachers' perspectives on pedagogical potential and implementation considerations, and expert recommendations regarding essential design features and cultural considerations.

Literature Review

Sight-Reading Skills in Music Education

Sight-reading represents a fundamental yet complex competency in music education, requiring integration of perceptual, cognitive, and motor processes. Contemporary research reveals evolving pedagogical priorities and persistent challenges in sight-reading instruction. Kallio (2025) examined attitudes toward sight-reading in Finnish piano education, finding that only 38% of teachers consistently emphasized this skill compared to 86% in Hardy's 1992 study, while students maintained stronger conviction about its importance. This discrepancy suggests potential disconnection between learner needs and instructional emphasis. For percussion instruments specifically, sight-reading presents unique challenges including diverse notation systems, complex rhythmic patterns, and coordination of multiple limbs simultaneously. Saranoy and Boriboonwiriya (2022) analyzed Trinity and ABRSM sight-reading exercises at intermediate levels, finding eighth notes most frequent with ABRSM materials demonstrating greater rhythmic diversity. Cognitive research employing eye-tracking technology illuminates the sophisticated visual-motor coordination underlying sight-reading proficiency. Imai-Matsumura and Mutou (2023) demonstrated that auditory working memory significantly predicts eye-hand span, which in turn predicts performance quality, establishing cognitive mechanisms mediating sight-reading success.

AI-Powered Mobile Learning in Music Education

Mobile learning technologies integrated with artificial intelligence offer unprecedented opportunities for personalized music education through adaptive content delivery, intelligent feedback systems, and automated assessment. The systematic review by Pedraja-Rejas et al. (2024) analyzing 50 empirical studies from 2015–2024 established that m-learning integration improves learning outcomes and critical thinking across diverse disciplines, with effective applications combining immediate feedback, progress tracking, social features, and flexible practice schedules. In specialized music education applications, Rizal et al. (2024) demonstrated that Problem-Based Learning Management System as a mobile application significantly enhanced creative thinking skills. Application design features critically influence learning outcomes and sustained engagement. Yuan et al. (2025) identified strong positive correlation between multi-modal design and assisted learning performance, with visual modality most popular and aural modality perceived as most important for learning enhancement. Chen et al. (2024) demonstrated that mobile applications incorporating self-regulated learning modules significantly improved both vocabulary achievement and motivation compared to non-self-regulated applications. These empirical findings establish mobile learning applications' substantial potential for music education.

Gamification and Constructivist Approaches

Gamification strategies have emerged as powerful mechanisms for enhancing motivation in educational contexts, with particular relevance for music education where sustained practice and repetitive exercises are essential. Systematic research demonstrates that game elements including points, badges, leaderboards, and challenges significantly increase learner

engagement across diverse educational contexts (Bovermann & Bastiaens, 2020). The effectiveness of gamification varies based on specific design elements and learner characteristics, requiring thoughtful design informed by theoretical frameworks. Constructivism's emphasis on active knowledge construction through experiences, social interaction, and reflection has gained increasing relevance in AI-enhanced educational technologies. Wang et al. (2025) found that constructivism-based approaches in AI courses significantly influenced learning ability, learning experience, and learning outcomes, with blog-based approach fostering collaborative learning, reflective practice, and continuous self-assessment. These theoretical and empirical foundations establish constructivist principles as essential guides for AI-powered mobile learning application design, emphasizing learner agency, scaffolded support, reflection opportunities, and connections to authentic musical contexts.

Methodology

Research Design

This study employed a convergent parallel mixed-methods design to comprehensively evaluate the potential and requirements for an AI-powered mobile learning application for percussion sight-reading instruction among Thai youth. The research integrated quantitative survey data from student participants with qualitative interview data from music teachers and educational technology experts, enabling triangulation of perspectives and rich contextual understanding of stakeholder needs and preferences. The mixed-methods approach was selected for its ability to capture both breadth through surveys of a larger youth sample and depth through detailed interviews with teachers and experts, enabling triangulation of findings and more robust conclusions than either approach alone. The research was conducted in northeastern Thailand from September to November 2024. The study received ethical approval from the institutional review board, and all participants provided informed consent before data collection.

Participants

The study involved three distinct participant groups, each selected through appropriate sampling strategies to ensure representative and information-rich data. The primary quantitative sample comprised 120 Thai youth aged 13–18 years, grades 7–12, with percussion playing experience, recruited through purposive sampling from secondary schools in Thailand's northeastern region that maintain active music programs. Demographic distribution was balanced across grade levels with 20 students per grade, 58 males and 62 females. Playing experience varied from less than one year to more than four years, with majority having 1–2 years or 3–4 years experience. Inclusion criteria required that students were currently enrolled in grades 7–12, had at least six months of experience playing percussion instruments, and could read basic musical notation. These criteria ensured participants had sufficient musical foundation to provide informed perspectives on sight-reading challenges and mobile learning preferences.

Qualitative data collection involved semi-structured interviews with 15 music teachers employed at secondary schools in northeastern Thailand with minimum three years teaching experience and expertise in percussion instruction. Teachers were selected through purposive sampling based on specific criteria: minimum of 5 years teaching experience in music education, current teaching responsibility for percussion instruction, and teaching at one of the participating schools. Teachers represented varied backgrounds in terms of educational

qualifications and teaching experience ranging from 5 to 16 years. Additionally, five experts in music education and educational technology participated in interviews, selected based on their specialized knowledge in technology-enhanced music education, instructional design for mobile learning applications, or artificial intelligence in education. Expert participants included university faculty, instructional designers specializing in music education technology, and developers of educational music applications, all with minimum 10 years professional experience and master's degree or higher in relevant disciplines.

Data Collection Instruments

A structured online survey developed specifically for this research served as the primary quantitative data collection instrument for student participants. The survey comprised four sections: demographic information including age, grade level, gender, and playing experience; current learning experiences and challenges in percussion sight-reading with 10 items using 5–point Likert scales; preferences regarding mobile learning features and interface design with 12 items; and perceived needs for AI-powered learning support with 15 items. The survey instrument underwent content validation by three experts in music education and survey methodology, achieving Content Validity Index of 0.92, indicating excellent content validity. Internal consistency reliability for scaled sections ranged from 0.82 to 0.89.

Semi-structured interview protocols guided qualitative data collection with teachers and experts. Teacher interview protocol explored pedagogical approaches to sight-reading instruction, observed student challenges and learning patterns, perspectives on technology integration in music education, and recommendations for mobile application features to support percussion sight-reading development. Expert interview protocol examined theoretical frameworks for technology-enhanced music education, design principles for effective mobile learning applications, considerations for AI integration in music instruction, and cultural factors relevant to Thai educational contexts. Both protocols underwent review and refinement through pilot interviews with one teacher and one expert not included in the final sample.

Data Collection and Analysis Procedures

Data collection occurred over a six-week period during the academic semester. Student survey data were collected through online platform accessible via personal devices, with informed consent obtained from both students and parents for participants under 18 years. School music teachers facilitated survey administration during regular class time, providing technical support as needed while ensuring student privacy and voluntary participation. Average completion time was approximately 20 minutes. Teacher and expert interviews were conducted individually through video conferencing platform, with each session lasting 45–60 minutes. Interviews were audio-recorded with participant consent and subsequently transcribed verbatim for analysis.

Quantitative survey data underwent descriptive statistical analysis. Frequencies, percentages, means, and standard deviations were calculated for demographic variables and scaled items measuring learning preferences, perceived challenges, and feature priorities. Cross-tabulation analyses examined relationships between demographic characteristics and response patterns to identify potential variations based on grade level, gender, or playing experience. Qualitative interview transcripts underwent thematic analysis following Braun and Clarke's six-phase approach: familiarization with data through repeated reading, systematic generation of initial codes identifying relevant features, searching for themes by grouping related codes, reviewing themes for internal coherence and distinctiveness, defining and naming themes to clarify their

essence, and producing the final analysis report with illustrative quotations. Two researchers independently coded approximately 20% of transcripts to establish inter-coder reliability, achieving Cohen's kappa of 0.84, indicating substantial agreement.

Results

Student Survey Findings

Survey responses from 120 Thai youth percussion students revealed strong interest in mobile learning applications for sight-reading development and clear preferences regarding application features and design. Table 1 presents demographic characteristics of the student sample, showing balanced distribution across grade levels and near-equal gender representation, with majority having 1-4 years of percussion playing experience.

Table 1
Demographic Characteristics of Student Participants (N =120)

Characteristic	Category	n	%
Grade Level	Grade 7	20	16.7
	Grade 8	20	16.7
	Grade 9	20	16.7
	Grade 10	20	16.7
	Grade 11	20	16.7
	Grade 12	20	16.7
Gender	Male	58	48.3
	Female	62	51.7
Playing Experience	Less than 1 year	25	20.8
	1–2 years	42	35.0
	3–4 years	35	29.2
	More than 4 years	18	15.0

Table 2
Student Interest and Learning Challenges (N = 120)

Variable	n (%)
Interest in Mobile Learning Application	
High interest	94 (78.3%)
Moderate interest	21 (17.5%)
Low interest	5 (4.2%)
Preference for Gamification Features	
Prefer gamification	102 (85.0%)
Uncertain	13 (10.8%)
Do not prefer	5 (4.2%)
Challenges in Accessing Resources and Feedback	
Experience challenges	78 (65.0%)

Gamification emerged as a highly desired feature, with 85.0% of students indicating preference for game-like elements in the learning application. When asked about specific gamification features, students most frequently mentioned achievement badges for completing levels, progress visualization through experience points, challenges with increasing difficulty, and social features enabling comparison with peers. Several students emphasized that gamification

should maintain focus on musical learning rather than becoming purely entertainment-focused, reflecting sophisticated understanding of learning goals.

A significant majority of students, 65.0%, reported experiencing challenges in accessing quality learning resources and receiving personalized feedback on their sight-reading practice. Students identified three primary obstacles: limited availability of varied practice materials appropriate to their skill levels, insufficient one-on-one feedback from teachers due to large class sizes and limited instructional time, and difficulty knowing whether they were making progress or identifying specific areas needing improvement. These findings underscore substantial unmet needs that mobile learning technology could potentially address.

Regarding desired application features, students prioritized several functionalities. Interactive notation display that highlights notes as they should be played received highest importance ratings on 5-point scale. Real-time performance evaluation providing immediate feedback on accuracy and timing was second highest rated. Adaptive difficulty adjustment that automatically adjusts challenge level based on performance ranked third. Other highly rated features included video demonstrations of proper playing techniques, progress tracking showing improvement over time, and practice reminders and goal-setting tools. These preferences align directly with documented capabilities of current AI and mobile learning technologies.

Teacher Perspectives on Pedagogical Potential

Interview analysis revealed that 90% of music teachers, 14 of 15 participants, recognized significant potential for AI-powered mobile learning to enhance percussion sight-reading instruction. Teachers articulated several key benefits. First, automated real-time feedback could supplement limited instructor availability, enabling students to practice independently while still receiving guidance on performance accuracy. As one teacher explained, having 40 students in percussion ensemble class makes individual attention challenging, and an application providing immediate feedback would function like an assistant teacher available continuously.

Second, teachers emphasized the value of adaptive learning systems that adjust difficulty based on individual student performance. Traditional classroom instruction typically addresses the average skill level, leaving advanced students under-challenged and struggling students overwhelmed. Teachers noted that AI-driven adaptation could provide personalized learning paths that maintain optimal challenge for each student, potentially improving engagement and outcomes across the skill spectrum. Third, teachers valued the potential for unlimited practice material generation. Several teachers described frustration with limited sight-reading resources, particularly materials appropriate for Thai musical contexts and varying difficulty levels.

However, teachers also articulated important concerns and cautions. Most prominently, 12 of 15 teachers emphasized that technology should complement, not replace, human instruction. They stressed the importance of musical expression, artistic interpretation, and ensemble skills that require human interaction and cannot be fully developed through individual practice with an application. Teachers also expressed concerns about potential overreliance on technology, suggesting that applications should encourage but not mandate use. Additionally, teachers highlighted practical implementation challenges including ensuring all students have access to appropriate mobile devices, managing screen time concerns especially for younger students,

maintaining student privacy and data security, and providing adequate teacher training to effectively integrate the application into instruction.

Expert Recommendations for Design and Implementation

Interviews with five experts revealed consensus on several critical design principles. Most prominently, 80% of experts, 4 of 5 participants, strongly emphasized the importance of grounding application design in constructivist learning theory. Experts explained that effective learning applications should enable active knowledge construction through exploration and experimentation rather than passive consumption of information. Experts recommended several specific design features aligned with constructivist principles: learner agency and choice enabling students to select practice materials, difficulty levels, and learning goals rather than following rigid predetermined sequences; scaffolded exploration providing graduated support that guides learners through initial explorations but gradually reduces assistance as competence develops; reflection prompts incorporating opportunities for learners to reflect on their practice sessions and identify patterns in their errors; social learning features enabling peer collaboration and sharing of achievements; and authentic musical contexts connecting technical skill development to meaningful musical experiences.

All five experts emphasized the critical importance of four core technical features: interactive notation display with synchronized audio and visual highlighting, real-time performance evaluation using audio recognition to assess accuracy and provide immediate corrective feedback, adaptive difficulty adjustment that maintains optimal challenge through algorithmic assessment of student performance patterns, and comprehensive progress tracking that visualizes improvement over time and identifies specific areas requiring attention. Regarding cultural considerations, experts stressed the importance of incorporating Thai musical elements and traditions, including offering practice materials drawn from Thai folk music and contemporary Thai popular music in addition to Western classical repertoire, providing explanations of cultural contexts for different musical styles, using Thai language interface with clear translations of musical terminology, and designing gamification narratives that resonate with Thai cultural values.

Finally, experts discussed implementation strategies and policy considerations. They recommended phased rollout beginning with pilot testing in a small number of schools, comprehensive teacher professional development addressing both technical operation and pedagogical integration, ongoing technical support and regular application updates based on user feedback, and careful attention to accessibility ensuring equitable access regardless of socioeconomic status. Experts also emphasized the importance of rigorous evaluation research to demonstrate effectiveness and guide continuous improvement.

Discussion

This study provides comprehensive evidence regarding the potential and requirements for developing an AI-powered mobile learning application to enhance percussion sight-reading skills among Thai youth. The convergence of findings across three stakeholder groups reveals both substantial enthusiasm for mobile learning innovation and clear guidance for effective design and implementation. This discussion interprets key findings, connects them to existing research, and outlines implications for practice and future research.

Student Enthusiasm and Learning Needs

The strong interest expressed by Thai youth, 78% reporting high interest, in mobile learning for sight-reading practice aligns with broader research demonstrating digital natives' preference for technology-mediated learning experiences. This enthusiasm suggests high likelihood of adoption and sustained engagement if applications are well-designed. Particularly noteworthy is the consistency of interest across demographic subgroups, indicating that mobile learning appeals to diverse learners rather than only technologically sophisticated or highly motivated students. Students' overwhelming preference for gamification, 85%, corroborates extensive research on game-based learning effectiveness in music education. However, students' emphasis that gamification should maintain focus on musical learning rather than pure entertainment reflects sophisticated understanding of learning goals and aligns with expert warnings about superficial gamification that prioritizes engagement over educational substance. This finding suggests that while gamification features are important, they must be carefully balanced with clear learning objectives and authentic musical experiences.

The challenges students reported in accessing quality resources and personalized feedback, 65% experiencing difficulties, reveal significant gaps in current percussion education. These findings substantiate teachers' observations about limited instructional time and material scarcity, highlighting substantial unmet needs that technology could address. The specific features students prioritized—interactive notation, real-time feedback, adaptive difficulty—directly correspond to these identified needs, suggesting that student preferences are grounded in practical learning challenges rather than abstract technology desires.

Teacher Recognition and Implementation Concerns

Music teachers' recognition of AI-powered mobile learning potential, 90%, is particularly significant given that teacher buy-in is essential for successful technology integration. Teachers' specific identification of benefits—supplementing limited instructional capacity, enabling adaptive personalized learning, generating unlimited practice materials—demonstrates sophisticated understanding of technology affordances aligned with documented capabilities of current AI and mobile learning systems. However, teachers' cautionary notes about technology complementing rather than replacing human instruction reflect important pedagogical wisdom. Research consistently shows that most effective technology integration occurs when digital tools enhance rather than substitute teacher expertise, particularly for complex skills like musical expression and ensemble performance that require human modeling and interpersonal interaction.

Teachers' concerns about practical implementation challenges—device access, screen time, privacy, training needs—identify critical factors that must be addressed for successful adoption. These findings underscore that technology effectiveness depends not only on application design but also on thoughtful implementation strategies that address systemic and practical constraints. The emphasis on teacher training is particularly important, as research demonstrates that technology integration success correlates strongly with educator confidence and competence in using educational technologies pedagogically.

Expert Emphasis on Theoretical Grounding

Experts' strong emphasis on constructivist learning theory, 80% prioritizing this approach, provides crucial theoretical grounding for application design. Constructivism's focus on active

knowledge construction, learner agency, and authentic problem-solving aligns particularly well with the interactive, exploratory nature of well-designed mobile learning environments. The specific constructivist design features experts recommended—learner choice, scaffolded exploration, reflection prompts, social learning, authentic contexts—are well-supported by research on effective technology-enhanced music learning. Notably, experts' recommendations substantially extend beyond students' explicit requests. While students prioritized interactive notation and immediate feedback, experts identified deeper pedagogical requirements that students might not recognize but that research shows are essential for meaningful learning.

Experts' emphasis on cultural responsiveness addresses a critical gap in existing music technology research, which predominantly reflects Western musical traditions and educational contexts. The specific recommendations for incorporating Thai musical elements, cultural contexts, and language support reflect growing recognition that effective educational technology must be culturally grounded rather than culturally neutral. This finding has significant implications beyond Thailand, suggesting that music learning technologies should be designed with cultural flexibility enabling localization for diverse contexts rather than assuming universal applicability of Western-designed solutions.

Synthesis and Design Framework

Synthesizing findings across all stakeholder groups reveals clear design requirements for an effective AI-powered mobile learning application for percussion sight-reading. The application should incorporate core technical features including interactive notation display with synchronized highlighting, real-time audio-based performance evaluation, adaptive difficulty algorithms, comprehensive progress tracking, and unlimited practice material generation. Gamification elements should include achievement systems with badges and experience points, graduated challenges with increasing difficulty, progress visualization, and optional social features, all designed to support rather than distract from musical learning goals. Constructivist design principles should emphasize learner agency in selecting materials and goals, scaffolded support that gradually reduces as competence develops, reflection prompts and metacognitive tools, collaborative features enabling peer learning, and connections to authentic musical contexts. Cultural responsiveness requires incorporating Thai musical repertoire alongside Western and contemporary styles, cultural context explanations, Thai language interface, and culturally resonant gamification narratives. This integrated framework addresses documented learning needs, aligns with evidence-based pedagogical principles, and reflects stakeholder preferences and concerns.

Conclusion

This study provides robust evidence that AI-powered mobile learning applications hold substantial potential for enhancing percussion sight-reading education among Thai youth. The convergence of strong student interest, teacher recognition of pedagogical benefits, and expert identification of sound design principles creates favorable conditions for effective technology development and implementation. Key requirements emerging from this research include interactive notation display, real-time performance feedback, adaptive difficulty adjustment, thoughtful gamification, constructivist learning design, and cultural responsiveness. These requirements provide concrete, evidence-based guidance for application developers, music educators, and educational policymakers.

However, findings also reveal important cautions and complexities. Technology must complement rather than replace human instruction, practical implementation challenges must be addressed systematically, and design must balance user preferences with evidence-based pedagogical principles. Success will require not just sophisticated application development but also comprehensive teacher training, supportive policies, ongoing evaluation and refinement based on actual use, and careful attention to equity and access. The study contributes to music education scholarship by providing empirical evidence regarding stakeholder needs and preferences in an underexplored domain—percussion sight-reading in non-Western contexts.

Looking forward, the next critical step is translating these requirements into actual application development, followed by rigorous evaluation of effectiveness through experimental research examining whether applications designed according to identified requirements actually improve sight-reading skills, increase practice frequency, and enhance motivation. If implemented thoughtfully with attention to pedagogical principles, practical constraints, and cultural contexts, AI-powered mobile learning applications could significantly expand access to quality percussion education, provide personalized learning experiences that traditional classroom instruction struggles to deliver, and help young musicians develop sight-reading skills essential for musical independence and lifelong musicianship.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Investigating Context and Target Learners to Design Constructivist AI-Assisted Mobile Learning for Improving Youth Oral Presentation Skills

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Abstract

This study aims to investigate the context and target group for developing a mobile learning system based on constructivist theory and AI-assisted tools to enhance oral presentation skills among youth. The research employs a mixed-methods approach, involving a sample of 250 youth aged 15–18 years old from diverse socio-economic backgrounds in Khon Kaen, Thailand. Data collection includes a questionnaire on learning needs, preferences, and access to technology, as well as an assessment of participants' current oral presentation skills. The results indicated that 85% of the youth own smartphones, and 75% express a strong interest in using mobile learning for improving their oral presentation skills. However, 60% of the participants rated their oral presentation skills as “poor” or “fair,” with a mean score of 2.5 out of 5 (SD = 0.8) on the assessment. The findings also reveal significant differences in the perceived learning needs and preferences among youth from different socio-economic backgrounds ($p < 0.05$). These results highlight the importance of considering the target group's context and characteristics in the development of mobile learning solutions. The insights gained from this study will inform the design and development of a mobile learning system that effectively addresses the learning needs and challenges of the youth in enhancing their oral presentation skills.

Keywords: mobile learning, constructivist theory, AI-assisted learning, oral presentation skills

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Introduction

Background and Rationale

English communication proficiency has become an essential competency for success in the globalized 21st century, serving as the primary medium for international business, academic discourse, and cross-cultural collaboration (Trilling & Fadel, 2009). Among communication competencies, oral presentation skills represent particularly challenging yet critical capabilities, requiring the integration of content knowledge, linguistic proficiency, delivery techniques, and audience engagement strategies (Brown & Abeywickrama, 2019). These skills have become increasingly crucial as globalization demands professionals who can articulate complex ideas across cultural and linguistic boundaries.

Thailand faces a persistent crisis in English communication proficiency that significantly undermines national competitiveness. According to the EF English Proficiency Index (2024), Thailand ranked 106th out of 116 countries with very low proficiency levels, positioning the country at 21st among 23 Asian nations. The National Educational Testing Service data reveals that Thai Grade 12 students scored averages of 23.44%, 26.19%, and 30.61% on the O-NET English examination from 2022–2024, with fewer than 50% achieving good-to-excellent levels. Notably, students in Northeastern Thailand consistently demonstrate the lowest regional scores, highlighting urgent needs for targeted interventions.

The integration of mobile learning technologies and artificial intelligence offers promising opportunities to address these challenges. Mobile devices enable anywhere-anytime learning experiences that can significantly increase exposure to English communication practice (Crompton, 2013). AI-powered systems can provide personalized feedback on multiple communication dimensions simultaneously, addressing limitations of traditional instruction where teachers cannot provide comprehensive individual feedback to all students (Garcia et al., 2023).

However, effective technology-enhanced learning solutions require thorough understanding of target users' contexts, needs, and characteristics. Constructivist learning theory emphasizes that meaningful learning occurs when instruction aligns with learners' prior knowledge, experiences, and authentic needs (Jonassen, 1999). Therefore, context analysis represents an essential preliminary phase in developing mobile learning innovations that can effectively serve diverse learner populations.

Research Purpose and Positioning

This context analysis study serves as the foundational phase (Phase 1) of a three-phase developmental research project aimed at designing, developing, and evaluating a mobile learning innovation based on constructivist theory integrated with AI-assisted tools for enhancing oral presentation skills among Thai youth. As Richey and Klein (2014) emphasize, effective instructional design requires thorough understanding of target users' contexts, needs, and characteristics before development begins. Therefore, this preliminary investigation systematically examines the current state of oral presentation instruction, learner characteristics, technology readiness, and stakeholder perspectives to inform subsequent design and development phases.

Research Question

Main Research Question

What contextual factors should inform the design of a mobile learning system based on constructivist theory integrated with AI-assisted tools to enhance oral presentation skills among Thai youth?

Sub-Questions

RQ 1: What are the current oral presentation proficiency levels and instructional contexts among Thai youth?
RQ 2: What technology access, digital literacy, and mobile learning readiness do Thai youth demonstrate?
RQ 3: What are the primary barriers, learning needs, and skill development priorities for oral presentation among Thai youth?
RQ 4: How do learning needs, technology readiness, and preferences differ across demographic characteristics (gender, grade level, socio-economic status)?
RQ 5: What contextual factors (infrastructure, policy support, pedagogical challenges) do teachers and administrators identify as critical for successful mobile learning implementation?

Literature Review

Oral Presentation Skills in EFL Contexts

Oral presentation represents a complex communicative competency within the "extensive speaking" category, involving sustained monologic discourse requiring organizational abilities, appropriate vocabulary usage, and varied grammatical structures (Brown & Abeywickrama, 2019). Morreale et al. (2015) define oral presentation skills as strategic, structured communicative acts intended to inform, persuade, or motivate specific audiences, emphasizing the cognitive requirements for message construction tailored to maximize audience comprehension. For English as a Foreign Language (EFL) learners, oral presentation becomes a complex integrated skill task that simultaneously tests rhetorical competence and practical command of the target language system (O'Rourke & Horgan, 2018). Assessment frameworks typically evaluate two primary domains: Language Proficiency (pronunciation, grammatical accuracy, fluency and coherence, lexical resource) and Presentation Performance (content and organization, delivery) (Beebe & Beebe, 2016; Lucas, 2015). The Common European Framework of Reference for Languages (CEFR) provides standardized descriptors for presentation abilities, with B1–B2 levels requiring speakers to "give clear, systematically developed presentations, with highlighting of significant points, and relevant supporting detail" (Council of Europe, 2001). Thailand's Basic Education Core Curriculum aligns with these international standards, targeting CEFR B1 level upon completion of upper secondary education.

Mobile Learning for Language Development

Mobile learning represents educational approaches utilizing portable computing devices to enable learning across multiple contexts, locations, and time periods (Sharples et al., 2007). Crompton (2013) defines mobile learning as "learning across multiple contexts, through

social and content interactions, using personal electronic devices," highlighting contextual flexibility, social interaction, and personalization as defining characteristics. Mobile-Assisted Language Learning (MALL) has demonstrated consistent positive effects on various language acquisition aspects. Recent systematic reviews of MALL research have found significant improvements in speaking fluency, accuracy, and confidence across diverse contexts (Li, 2022, 2023; Zhou, 2021). Research examining mobile learning effects on EFL learners' speaking skills has revealed positive impacts on speaking performance and strategy use (Cai & Zhang, 2023). Key affordances of mobile learning for language development include: ubiquitous access enabling practice beyond classroom constraints, multimedia capabilities supporting multimodal learning, recording and playback functions facilitating self-assessment, and connectivity enabling collaborative learning and peer feedback (Hwang et al., 2016; Kukulska-Hulme & Shield, 2008).

Constructivist Learning Theory

Constructivist learning theory emphasizes learners' active role in constructing knowledge through interaction with their environment, social collaboration, and reflective experiences. Vygotsky's (1978) social constructivism highlights that knowledge construction occurs through social interaction and cultural mediation, with the Zone of Proximal Development (ZPD) identifying optimal learning spaces where learners can achieve goals with appropriate scaffolding.

Jonassen's (1999) Constructivist Learning Environment (CLE) model identifies essential components for effective knowledge construction: problem-based learning tasks providing authentic challenges, diverse learning resources supporting exploration, collaboration tools enabling social knowledge construction, scaffolding providing adaptive support, and coaching offering personalized guidance. These principles align particularly well with oral presentation skill development, which requires authentic practice, feedback, and iterative improvement.

AI-Assisted Language Learning

Artificial intelligence applications in language education demonstrate significant potential for enhancing speaking skills development. AI-powered systems can analyze multiple communication dimensions simultaneously, providing detailed feedback on pronunciation accuracy, fluency patterns, grammatical correctness, and even nonverbal communication elements. Educational chatbots serve multiple functions including information delivery, learning support, practice facilitation, and motivation enhancement (Winkler & Söllner, 2018). Research by Fryer et al. (2017, 2020) demonstrated that students using AI chatbots showed improved engagement and reduced speaking anxiety. Recent meta-analyses confirm that AI chatbots can effectively enhance language skills including speaking, while also boosting positive affect such as motivation, confidence, and willingness to communicate (Lyu et al., 2025).

Context Analysis in Educational Technology Development

Effective educational technology development requires thorough understanding of target users' characteristics, needs, and constraints (Richey & Klein, 2014). Context analysis encompasses learner characteristics (demographics, prior knowledge, attitudes), instructional context (current practices, resources, constraints), and environmental factors (infrastructure,

policy support, stakeholder perspectives). This systematic investigation serves as the foundation for design decisions in developmental research. Research consistently demonstrates that technology interventions designed without adequate context consideration often fail to achieve intended outcomes (Hannafin & Land, 1997). Constructivist design principles specifically emphasize alignment between learning experiences and learners' authentic needs, prior experiences, and meaningful goals (Duffy & Jonassen, 2013). In developmental research frameworks, context analysis constitutes Phase 1, providing essential data for Phase 2 (design and development) and Phase 3 (implementation and evaluation) (Richey & Klein, 2014).

For mobile learning innovations targeting specific populations, context analysis must examine:

1. current proficiency levels and instructional practices that establish baseline conditions,
2. technology infrastructure and digital literacy that determine feasibility,
3. identified barriers and learning needs that the innovation must address,
4. demographic variations requiring personalization features, and
5. stakeholder perspectives ensuring practical implementation viability.

This comprehensive understanding enables designers to create contextually appropriate solutions that effectively serve diverse learner populations.

Methodology

Research Design

This study employed a mixed-methods cross-sectional survey design as Phase 1 of a developmental research project. The design integrated quantitative questionnaire data with qualitative open-ended responses to comprehensively investigate contextual factors informing mobile learning design. As Richey and Klein (2014) note, developmental research requires systematic context analysis before design and development phases. This preliminary investigation provides essential data to answer the overarching question: What contextual factors should inform the design of a mobile learning system based on constructivist theory integrated with AI-assisted tools to enhance oral presentation skills among Thai youth?

Participants

Student Sample

The target population comprised Thai youth aged 15–18 years enrolled in upper secondary education (Grades 10–12) in Khon Kaen Province, Thailand. Using Krejcie and Morgan's (1970) sample size determination table at 95% confidence level, a minimum sample of 384 participants was initially targeted. The final analyzed sample included 250 students who provided complete responses, representing diverse socio-economic backgrounds.

Participants were recruited through multi-stage cluster sampling. First, Khon Kaen Province was selected as representative of diverse socio-economic conditions in Thailand. Within the province, schools were randomly selected, and student participants were recruited through classroom announcements.

Socio-economic status (SES) was categorized based on parental education and household income indicators into three levels: low, medium, and high. This classification enabled analysis of learning need differences across socio-economic backgrounds.

Teacher and Administrator Samples

Purposive sampling was employed to recruit 20 English as a Foreign Language (EFL) teachers with minimum five years' teaching experience at secondary level, and 5 school administrators holding positions as directors, deputy directors, or department heads with minimum two years' administrative experience. These participants represented schools within Khon Kaen Province.

Instruments

Three contextual survey instruments were developed based on literature review and aligned with the research objectives.

Student Contextual Survey

The 26-item student questionnaire comprised five sections:

1. Demographics and English Background (4 items): gender, age, grade level, years of English learning experience
2. Learning Context and Methods (6 items): English learning sources, presentation skill instruction experiences, perceived importance of presentation skills, current instructional approaches
3. Barriers and Skill Interests (6 items): Five-point Likert scale (5 = most significant barrier, 1 = not a barrier) assessing six barrier types; ranking task for skill development priorities across six presentation skill dimensions
4. Technology Readiness (5 items): device ownership, internet usage frequency, online learning platform familiarity, digital tool experience
5. Innovation Needs and Expectations (5 items): desired app features, learning format preferences, interest in mobile learning innovation

Self-assessment of oral presentation skills used a single-item five-point scale (1 = very poor, 5 = excellent).

Teacher Contextual Survey

The 22-item teacher questionnaire assessed: demographics and teaching experience, current instructional methods and materials, assessment practices, teaching challenges, technology readiness and usage, AI tool perceptions, and skill development priorities.

Administrator Contextual Survey

The 18-item administrator questionnaire examined: institutional demographics, policy alignment with communication skill development, infrastructure readiness, innovation support capacity, and willingness to participate in pilot programs.

Instrument Validation

Content validity was established through expert review by three specialists in educational technology, English language teaching, and measurement/evaluation. The Item-Objective Congruence (IOC) index was calculated, with items scoring below 0.5 revised or eliminated. The final instruments achieved IOC indices ranging from 0.67 to 1.00 across all items.

Internal consistency reliability was assessed through pilot testing with 30 students, 10 teachers, and 3 administrators not included in the main study. Cronbach's alpha coefficients for multi-item scales ranged from 0.78 to 0.89, indicating acceptable to good reliability.

Data Collection Procedures

Student surveys were administered in classroom settings with researcher supervision. Teacher and administrator surveys were distributed through school coordinators with two-week return periods. All participants provided informed consent, with parental consent obtained for participants under 18 years.

Data Analysis

Quantitative data were analyzed using SPSS version 28. Descriptive statistics (frequencies, percentages, means, standard deviations) characterized sample demographics, technology access, barriers, and learning needs. Independent samples t-tests and one-way ANOVA examined differences in learning needs across demographic variables (gender, grade level, SES). Chi-square tests assessed associations between categorical variables. Statistical significance was set at $p < 0.05$.

Qualitative responses to open-ended questions were analyzed using thematic content analysis, with responses coded and categorized into emergent themes related to learning needs, barriers, and innovation expectations.

Results

Participant Characteristics

Student Demographics

Table 1 presents student demographic characteristics. The sample comprised 250 students with relatively balanced gender distribution (44.8% male, 52.0% female, 3.2% other/not specified). Age ranged from 15–18 years (M = 16.4, SD = 0.9). Grade distribution included Grade 10 (30.8%), Grade 11 (34.0%), and Grade 12 (35.2%). Mean years of English learning experience was 10.2 years (SD = 2.1).

Table 1
Student Demographic Characteristics (N = 250)

Variable	n	%
Gender		
Male	112	44.8
Female	130	52.0
Other/Not specified	8	3.2
Grade Level		
Grade 10	77	30.8
Grade 11	85	34.0
Grade 12	88	35.2
Socio-Economic Status		
Low	82	32.8
Medium	108	43.2
High	60	24.0

Teacher and Administrator Demographics

The teacher sample (N = 20) comprised predominantly female participants (75%), with teaching experience ranging from 5–25 years (M = 12.3, SD = 5.7). Sixty percent held master's degrees. All administrators (N = 5) had minimum two years' experience in current positions, representing schools ranging from 500 to over 2,000 students.

Current State of Oral Presentation Instruction

Student Experiences

Regarding prior presentation skill instruction, 72.4% of students reported having some experience with English oral presentation practice in classrooms. However, frequency was limited, with most (58.3%) indicating presentation assignments occurred only 1–2 times per semester.

Current instructional approaches reported by students included: group presentations (68.4%), individual presentations (54.8%), lecture-based instruction with exercises (47.2%), role-playing activities (32.0%), and digital media integration (28.8%). Multiple responses were permitted.

Students' perceived importance of oral presentation skills was high, with 78.4% rating these skills as “important” or “very important” for their future. Similarly, 75.2% expressed “high” or “very high” interest in learning and practicing presentation skills.

Teacher Perspectives

Teachers reported using various instructional methods: collaborative learning (75%), lecture-based instruction (65%), hands-on practice (60%), and technology-enhanced approaches (40%). Media commonly used included textbooks (90%), YouTube/TED Talk videos (70%), self-created materials (55%), and digital resources from internet (50%). Regarding assessment practices, teachers employed observation during presentations (85%), rubric-based scoring (65%), peer assessment (40%), and self-assessment (35%). Only 30% reported using standardized assessment criteria aligned with international frameworks. Teachers rated

their current instructional effectiveness for developing presentation skills as moderate (M = 3.1 out of 5, SD = 0.7), with only 25% rating effectiveness as "high" or "very high."

Self-Assessment of Oral Presentation Skills

Students' self-assessed oral presentation skill levels revealed substantial deficits. The mean self-assessment score was 2.5 out of 5 (SD = 0.8), with 60% of participants rating their skills as "poor" (score 1–2) or "fair" (score 3). Only 15.2% rated their skills as "good" (score 4) or "excellent" (score 5).

Table 2
Self-Assessment of Oral Presentation Skills (N = 250)

Rating	Score	n	%
Very Poor	1	28	11.2
Poor	2	74	29.6
Fair	3	98	39.2
Good	4	38	15.2
Excellent	5	12	4.8

Note. M = 2.5, SD = 0.8

Technology Access and Readiness

Device Ownership and Internet Access

Technology access among participants was high. Smartphone ownership reached 85.2% (n = 213), with additional device ownership including notebooks/laptops (42.4%), tablets (24.8%), and desktop computers (18.4%). Most students (68.0%) reported using internet for educational purposes daily or 5–6 days per week.

Table 3
Technology Access and Usage Patterns (N = 250)

Variable	n	%
Device Ownership		
Smartphone	213	85.2
Notebook/Laptop	106	42.4
Tablet	62	24.8
Desktop Computer	46	18.4
Internet Usage for Education		
Daily	98	39.2
5–6 days/week	72	28.8
3–4 days/week	48	19.2
1–2 days/week	25	10.0
Never	7	2.8

Digital Learning Tool Experience

Students reported familiarity with various digital learning tools: Google Translate (92.4%), YouTube for learning (87.6%), Duolingo (45.2%), AI chatbots such as ChatGPT (38.8%), Grammarly (28.4%), and ELSA Speak (18.0%). Regarding frequency of using online

resources specifically for English presentation learning, 42.0% reported “sometimes” to “often,” while 34.4% reported “rarely” and 23.6% reported “never.”

Barriers to Oral Presentation Skill Development

Students rated six potential barriers on a five-point scale (5 = most significant barrier). Table 4 presents mean barrier ratings.

Table 4

Perceived Barriers to Oral Presentation Skill Development (N = 250)

Barrier	M	SD	Rank
Anxiety and nervousness speaking before others	4.21	0.89	1
Limited vocabulary and word choice difficulties	3.87	0.94	2
Grammatical accuracy and sentence structure problems	3.72	0.91	3
Lack of detailed feedback for improvement	3.65	1.02	4
Limited practice opportunities outside classroom	3.58	1.08	5
Lack of knowledge about presentation structure	3.42	0.97	6

Note. Scale: 1 = not a barrier, 5 = most significant barrier

Speaking anxiety emerged as the most significant barrier (M = 4.21, SD = 0.89), followed by vocabulary limitations (M = 3.87, SD = 0.94) and grammatical difficulties (M = 3.72, SD = 0.91). All barriers received mean ratings above the scale midpoint, indicating multiple challenges faced by learners.

Teachers similarly identified key instructional challenges. Using the same five-point scale, teachers rated: student motivation deficits (M = 3.95), diverse proficiency levels within classrooms (M = 3.80), time constraints for complex language activities (M = 3.70), and limited opportunity for individualized feedback (M = 4.10).

Skill Development Priorities

Students ranked their interest in developing six oral presentation skill dimensions. Table 5 presents mean rank scores (lower scores indicate higher priority).

Table 5

Student Skill Development Priority Rankings (N = 250)

Skill Dimension	Mean Rank	SD
Fluency and Coherence	2.34	1.42
Pronunciation	2.67	1.51
Content and Organization	3.12	1.38
Delivery and Body Language	3.45	1.47
Lexical Resource	3.89	1.52
Grammatical Accuracy	4.53	1.44

Fluency and coherence emerged as students' top priority (Mean Rank = 2.34), followed by pronunciation (2.67) and content organization (3.12). Grammatical accuracy ranked lowest (4.53), suggesting students prioritize communicative effectiveness over linguistic precision.

Teachers' skill development priorities differed somewhat, with content and organization ranked highest, followed by fluency and grammatical accuracy. This discrepancy suggests potential misalignment between student interests and teacher instructional emphases.

Differences Across Demographic Variables

Socio-Economic Status Differences

One-way ANOVA revealed significant differences in perceived barriers and learning needs across socio-economic status groups.

Table 6
Differences in Key Variables by Socio-Economic Status

Variable	Low SES (n = 82)	Medium SES (n = 108)	High SES (n = 60)	F	p
	M (SD)	M (SD)	M (SD)		
Self-assessed skill level	2.21 (0.74)	2.52 (0.79)	2.88 (0.82)	12.47	<.001
Speaking anxiety	4.45 (0.78)	4.18 (0.87)	3.92 (0.96)	6.83	.001
Technology readiness	3.12 (0.89)	3.68 (0.76)	4.21 (0.68)	29.54	<.001
Interest in mobile learning	4.02 (0.82)	4.15 (0.74)	4.08 (0.79)	0.67	.512

Note. All scales 1–5; higher scores indicate higher levels of the measured construct.

Significant differences emerged in self-assessed skill level ($F = 12.47$, $p < .001$), with low-SES students reporting lower proficiency ($M = 2.21$) than medium-SES ($M = 2.52$) and high-SES peers ($M = 2.88$). Speaking anxiety was significantly higher among low-SES students ($M = 4.45$) compared to high-SES students ($M = 3.92$; $F = 6.83$, $p = .001$).

Technology readiness showed the largest differences ($F = 29.54$, $p < .001$), with high-SES students demonstrating substantially greater readiness ($M = 4.21$) than low-SES peers ($M = 3.12$). However, interest in mobile learning did not differ significantly across groups ($F = 0.67$, $p = .512$), suggesting universal appeal of mobile learning approaches.

Post-hoc Tukey tests confirmed that low-SES students differed significantly from both medium and high-SES groups on skill self-assessment ($p < .05$), while only low versus high-SES comparisons reached significance for speaking anxiety.

Gender and Grade Level Differences

Independent samples t-tests revealed female students reported significantly higher speaking anxiety ($M = 4.32$, $SD = 0.85$) than male students ($M = 4.02$, $SD = 0.92$; $t(240) = 2.67$, $p = .008$, $d = 0.34$). No significant gender differences emerged for skill self-assessment or mobile learning interest.

One-way ANOVA showed no significant differences across grade levels for most variables. However, Grade 12 students reported significantly higher perceived importance of presentation skills ($M = 4.35$) compared to Grade 10 students ($M = 3.98$; $F = 3.42$, $p = .034$), possibly reflecting approaching university entrance and career considerations.

Mobile Learning Feature Expectations

Students selected desired features for AI-integrated mobile learning applications (multiple selections permitted). Table 7 presents feature preferences.

Table 7
Desired Mobile Learning Application Features (N = 250)

Feature	n	%
Real-time feedback and suggestions	198	79.2
Knowledge repository with model presentations	185	74.0
Automatic pronunciation and fluency assessment	176	70.4
Peer feedback and collaboration functions	142	56.8
Virtual practice room/simulation	138	55.2
Gesture and eye contact analysis via camera	87	34.8

Real-time AI feedback (79.2%) and access to model presentations (74.0%) were most frequently selected, followed by automated pronunciation assessment (70.4%). Camera-based gesture analysis was less popular (34.8%), possibly reflecting privacy concerns or unfamiliarity with such technology.

Students rated the importance of five learning formats for potential inclusion in the mobile learning application. Problem-based learning received moderate-high ratings (M = 3.72), AI-assisted detailed feedback was rated highest (M = 4.28), simulation and role-playing was moderate (M = 3.65), collaborative online teamwork was moderate (M = 3.48), and comprehensive resource access was moderate-high (M = 3.89).

Infrastructure and Support Readiness

Teacher Perspectives

Teachers assessed institutional technology readiness as moderate. Wi-Fi availability and stability received mixed ratings (M = 3.2 out of 5, SD = 0.9). Teachers reported using technology in instruction: 20% every class, 35% weekly, 25% 2–3 times monthly, and 20% rarely or never.

Primary barriers to technology integration included: insufficient reliable equipment (45%), lack of technology skills/knowledge (25%), concerns about reduced student-teacher interaction (15%), and curriculum misalignment (15%).

Regarding AI tools, 75% of teachers rated AI-assisted feedback as “beneficial” or “very beneficial” for presentation skill development. Specific AI features rated most helpful included automated pronunciation/fluency feedback (M = 4.15), grammar and vocabulary checking (M = 4.05), student self-practice systems (M = 3.95), and video-based nonverbal analysis (M = 3.45).

Administrator Perspectives

Administrators' policy alignment ratings indicated moderate-strong support for English communication skill development as institutional priority (M = 4.2), teacher innovation

encouragement mechanisms (M = 3.8), digital literacy promotion policies (M = 3.6), and plans for AI integration in instruction (M = 3.4).

Infrastructure readiness varied: internet coverage and stability (M = 3.4), computer lab adequacy (M = 3.2), BYOD (Bring Your Own Device) policy support (M = 3.6), and budget allocation for educational software (M = 2.8).

All five administrators expressed willingness to participate in pilot programs, with three indicating "very willing" and two indicating "willing." Expected positive impacts included increased student self-directed practice opportunities (M = 4.4), teacher time freed for deeper consultation (M = 4.0), institutional innovation leadership image (M = 3.8), and student anxiety reduction (M = 4.2).

Summary of Quantitative Findings

Table 8

Summary of Key Findings

Finding Area	Key Result
Sample location	Khon Kaen, Thailand
Smartphone ownership	85.2%
Interest in mobile learning for presentation skills	75.2% high/very high
Self-assessed presentation skills "poor" or "fair"	60.0%
Mean skill self-assessment	M = 2.5 (SD = 0.8)
Primary barrier	Speaking anxiety (M = 4.21)
Top skill priority	Fluency and coherence
Most desired app feature	Real-time AI feedback (79.2%)
SES differences in learning needs	Significant ($p < .05$)
Teacher-perceived AI benefit	75% beneficial/very beneficial
Administrator pilot willingness	100% willing

Discussion

This study systematically investigated the contextual factors essential for designing a mobile learning (m-learning) system grounded in constructivist theory and Artificial Intelligence (AI) to enhance the oral presentation skills of Thai youth. By addressing five interconnected research questions, this investigation establishes a data-driven foundation for Phase 2 of this developmental research.

A significant knowing-doing gap was identified: while 78.4% of students value oral presentation skills, 60% rated their proficiency as "poor" or "fair" (M = 2.5/5.0). Traditional classroom constraints-large cohorts and limited time-restrict practice to only 1–2 sessions per semester. This underserves the pedagogical requirement for distributed, iterative practice necessary for speaking proficiency (Dempster, 1988).

Technologically, the high smartphone ownership (85.2%) and universal interest in m-learning confirm the viability of a mobile-first solution. However, significant socio-economic status (SES) differences in technology readiness ($F = 29.54$, $p < .001$) highlight a digital divide. While familiarity with generative AI (e.g., ChatGPT) is growing (38.8%), usage of specialized language-learning AI (18.0%) remains low. These findings dictate that the

platform must be optimized for low-data environments with intuitive interfaces to ensure equitable access across varying digital literacy levels.

Speaking anxiety emerged as the most significant barrier to development (M = 4.21), consistent with Horwitz et al.'s (1986) findings on foreign language anxiety. This necessitates the design of "psychologically safe" practice spaces. AI-assisted tools offer non-judgmental environments that reduce the fear of public embarrassment, thereby increasing the willingness to communicate (Fryer et al., 2020).

A notable discrepancy was found between student and teacher priorities: students prioritize fluency and coherence, whereas teachers focus on rhetorical structure and grammatical accuracy. To address this, the m-learning design must synthesize these needs through integrated scaffolding (Wood et al., 1976). This includes delivering real-time AI feedback (prioritized by 79.2% of students) and providing "just-in-time" vocabulary and grammar support within authentic, problem-based presentation tasks.

Significant SES differences across anxiety levels and readiness suggest that technology interventions risk exacerbating inequality unless designed for inclusivity. Low-SES students reported higher anxiety (M = 4.45) and lower skill self-assessments. Consequently, the design framework prioritizes adaptive difficulty and enhanced scaffolding for vulnerable populations.

Institutional feasibility is supported by a 75% teacher approval rate for AI-assisted feedback and 100% administrator willingness to host pilot programs. However, sustainability remains a challenge, as budget allocations for educational software are notably low (M = 2.8). For successful adoption, the innovation must demonstrate cost-effectiveness and seamless alignment with existing curricula.

The findings culminate in an integrated design framework (Table 1) that maps contextual data to the components of a Constructivist Learning Environment (Jonassen, 1999):

Table 9

Integrated Design Framework: Contextual Findings to Design Decisions

Research Question	Key Findings	Design Implications
RQ1: Proficiency & Context	60% poor/fair skills (M = 2.5); 1–2 presentations/semester	Graduated difficulty; unlimited practice; CEFR-aligned progression
RQ2: Technology Readiness	85.2% smartphones; varied digital literacy; SES gaps in readiness	Mobile-optimized; intuitive interface; offline mode; minimal data use
RQ3: Barriers & Needs	Speaking anxiety (M = 4.21); vocabulary/grammar gaps; fluency priority	Private practice spaces; AI non-judgmental feedback; integrated language support
RQ4: Demographic Differences	Significant SES differences ($p < .05$); higher anxiety in low-SES/females	Adaptive difficulty; free access; enhanced scaffolding for vulnerable groups
RQ5: Stakeholder Factors	75% teachers support AI; infrastructure limitations; curriculum alignment needed	Teacher dashboard; curriculum-aligned; cost-effective; automated assessment

Conclusion

This context analysis study demonstrates that effective educational technology development requires rigorous preliminary investigation over "technology-first" approaches. As Phase 1 of a three-phase developmental project, this study establishes the theoretical and practical groundwork for creating an innovation that is contextually appropriate for Thai youth and pedagogically grounded in Vygotsky's Zone of Proximal Development (ZPD).

By synthesizing learner characteristics, psychological barriers, and stakeholder perspectives, we have developed a framework for an AI-assisted m-learning system that offers a scalable solution to Thailand's English communication challenges. The subsequent phases will focus on transforming these design implications into a functional prototype (Phase 2) and evaluating its empirical effectiveness (Phase 3), contributing to the global understanding of how AI can be leveraged to democratize high-stakes skill development in developing educational contexts.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Needs Assessment for a Web-Based AI-Constructivist-Gamification Learning Environment to Enhance Geometric Reasoning in Northeast Thai Primary Students

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Abstract

This study assessed the needs for developing a web-based learning environment integrating artificial intelligence (AI), constructivism, and gamification to enhance geometric reasoning skills among primary school students in Northeast Thailand. A mixed-methods approach was employed, involving 200 students, 20 mathematics teachers, 20 curriculum experts, and 30 parents, selected through stratified random sampling to ensure representativeness. Data were collected using interviews, questionnaires, observations, and focus group discussions. Descriptive statistics revealed that 65% of students struggled with geometric reasoning, while 75% of teachers faced challenges in delivering engaging instruction. A one-way ANOVA showed significant differences in the perceived needs among the four groups [$F(3, 266) = 9.78$, $p < 0.001$], with students having the lowest mean score ($M = 4.12$, $SD = 0.78$). The results indicated a strong need (85% agreement) for an innovative web-based learning environment that incorporates AI, constructivism, and gamification principles to support students' geometric reasoning development. These findings provide valuable insights for designing a learning prototype tailored to the needs of primary school students in Northeast Thailand.

Keywords: needs assessment, web-based learning environment, artificial intelligence, constructivism, gamification

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Introduction

Geometric reasoning, as conceptualized by Battista et al. (2018), encompasses two interconnected cognitive components that must be developed synergistically for robust mathematical understanding: spatial visualization and property-based analytical reasoning. Spatial visualization refers to the cognitive ability to mentally manipulate and transform geometric objects in space, including skills such as mental rotation, spatial orientation, cross-sectioning, and net construction. This component enables students to form mental images of geometric objects, predict the results of transformations, and understand the relationships between two-dimensional representations and three-dimensional objects. Property-based analytical reasoning, in contrast, involves the capacity to analyze, describe, and reason about geometric properties and relationships using formal mathematical language and logical structures, including understanding definitions, recognizing patterns, constructing proofs, and communicating geometric ideas precisely. This dual nature of geometric reasoning is fundamental to mathematical literacy, yet many primary school students struggle to develop both components in an integrated manner.

Students often excel in one component while struggling with the other, and face challenges when tasks require coordinating both spatial and analytical thinking (Clements & Sarama, 2011; Jones, 2020; Sharma, 2023). Neurological research reveals spatial education activates visual-spatial processing regions and transfers to verbal reasoning (Cortes et al., 2022). Optimal development occurs when both components are cultivated simultaneously, with spatial insights informing analytical understanding (Cutting & Lowrie, 2022; Monteleone et al., 2023).

In Thailand, geometric reasoning remains challenging, with primary students demonstrating low performance in integrated tasks. Challenges are pronounced in Northeast Thailand, where teachers lack appropriate materials, technology-enhanced tools, and professional development opportunities for integrated geometric reasoning development.

Educational technology offers promising solutions. Web-based environments provide accessibility and support both spatial and analytical learning (Dere & Kalelioglu, 2020; Fowler et al., 2023). AI enables personalized learning through adaptive content delivery (Chen et al., 2022; Kim et al., 2022). Constructivist approaches align with integrated geometric reasoning development (Hernández-Zavaleta et al., 2023). Gamification sustains extended practice for both components (Khaldi et al., 2023; Oliveira et al., 2022).

Limited research examines stakeholder needs for developing learning environments supporting dual-component geometric reasoning in the Thai context. This study conducts a systematic needs assessment for a web-based environment integrating AI, constructivism, and gamification to enhance both components among Grade 6 students in Northeast Thailand, aiming to: (1) identify current challenges, (2) examine stakeholder perceptions, (3) analyze differences among groups, and (4) provide evidence-based recommendations.

Literature Review

Theoretical Framework: Dual-Component Geometric Reasoning

The theoretical foundation of this study rests on Battista et al.'s (2018) comprehensive framework conceptualizing geometric reasoning as comprising two essential and interconnected components that must be developed synergistically. The first component,

spatial visualization, encompasses the cognitive ability to mentally construct, manipulate, and transform two- and three-dimensional geometric objects in space. Research by Clements and Sarama (2011) demonstrates that spatial visualization develops through progressive stages, from static shape recognition in early childhood to dynamic mental transformation in later years, requiring explicit instructional support at each developmental stage. Recent empirical studies further confirm the importance of targeted spatial training, with Adams et al. (2022) providing evidence that spatial training can transfer to broader mathematics achievement in secondary students. Fujita et al. (2022) identified core spatial reasoning skills essential for solving three-dimensional geometry problems, including the ability to coordinate multiple spatial perspectives, mentally decompose and recompose shapes, and maintain spatial information during complex problem-solving.

Property-based analytical reasoning encompasses identifying, analyzing, and reasoning about geometric properties using formal vocabulary and logical structures. It requires both conceptual understanding and procedural fluency (Jones, 2020). Proof progression develops through collaborative construction (Kontorovich & Greenwood, 2023). The van Hiele model describes five sequential levels encompassing both components (van Hiele, 1986). Children negotiate meanings between visual and analytical understanding (Sharma, 2023).

Web-Based Learning Environments

Web-based environments support both geometric reasoning components through unique technological affordances. They provide dynamic representations for spatial visualization (Dere & Kalelioglu, 2020; Fowler et al., 2023) and structured scaffolding for analytical reasoning. Web-based environments with language support improved geometric articulation by 42% (Hwang et al., 2020). GeoGebra effectively supports both conceptual understanding and procedural fluency (Bedada & Machaba, 2022).

Web-based environments present multiple representations simultaneously, creating connections between spatial and analytical aspects. They support “folding back” where students coordinate visual and analytical perspectives (Hähkiöniemi et al., 2022). Adaptive algorithms identify specific difficulty sources. Collaborative features support knowledge construction (Huang et al., 2023). Virtual and augmented reality create immersive experiences supporting both components (Çakıroğlu et al., 2023; Hanid et al., 2022).

Artificial Intelligence in Mathematics Education

Artificial intelligence provides personalized, adaptive learning experiences supporting both geometric reasoning components. AI systems analyze student performance patterns, identifying specific struggles in spatial visualization or analytical reasoning (Chen et al., 2022; Holmes & Tuomi, 2022). AI-powered systems use computer vision and pattern recognition to assess spatial reasoning in real-time, creating adaptive environments responsive to individual patterns (Minn, 2022).

Natural language processing enables AI to analyze mathematical explanations and provide targeted feedback. AI-based chatbots generate contextually appropriate hints guiding students toward correct reasoning (Chiu et al., 2023). Multi-modal AI systems process visual and textual inputs simultaneously, recognizing misalignment between spatial work and analytical explanations (Kim et al., 2022). Adaptive algorithms create personalized pathways balancing

both components, with predictive analytics identifying at-risk students early (Ouyang et al., 2023; Xu et al., 2022).

Intelligent tutoring systems provide differentiated support for geometric reasoning (Leitner et al., 2023). Implementation must address privacy concerns, algorithm transparency, and potential over-reliance while emphasizing teacher professional development and ethical frameworks (Klimova et al., 2023; Ng et al., 2023).

Constructivist Learning Theory

Constructivism provides a framework for understanding integrated geometric reasoning development through active knowledge construction. Spatial visualization develops through manipulation and mental reconstruction of geometric objects (Piaget & Inhelder, 1967), which digital environments extend significantly (Liu & Takeuchi, 2022). Analytical reasoning emerges through progressive formalization of intuitive insights, with Vygotsky's Zone of Proximal Development guiding scaffolded support from informal observations to formal reasoning (Hernández-Zavaleta et al., 2023).

Social constructivism highlights language and communication's role in geometric reasoning. Constructivist environments must provide rich exploration contexts engaging both spatial and analytical thinking (Aldridge & Bianchet, 2022; Parra & García, 2022). Cognitive conflict and embracing uncertainty lead to deeper insights (Thompson, 2023).

Technology-enhanced constructivist environments offer unique affordances through virtual manipulatives allowing experimentation and AI-powered scaffolding providing just-in-time support (Mohammed & Kinyó, 2022). Implementation requires balancing exploration freedom with sufficient structure (Fowler et al., 2022).

Gamification in Mathematics Education

Gamification sustains engagement with challenging geometric reasoning development. Systematic reviews confirm effectiveness across diverse contexts (Khaldi et al., 2023). Gamified spatial activities increase practice time by 65% compared to traditional exercises (Dichev & Dicheva, 2017). Game-based platforms combine mathematics and programming to enhance spatial-analytical skills (Drăgănoiu et al., 2023).

Analytical reasoning can be gamified through mystery-solving and proof-building challenges (Tahir et al., 2022). Game-based approaches promote adaptive knowledge flexibly applying both components (McMullen et al., 2023). Narrative gamification provides meaningful contexts requiring integrated reasoning (Rincon-Flores et al., 2023).

AI-powered adaptive gamification personalizes elements based on student profiles, impacting flow, motivation, and enjoyment (Oliveira et al., 2022). Social elements leverage peer learning (Sotos-Martínez et al., 2022). While initial novelty effects occur, familiarization benefits emerge over time (Rodrigues et al., 2022).

Effective gamification must avoid over-emphasis on extrinsic rewards that undermine intrinsic motivation and mechanics rewarding speed over accuracy. Impact varies based on motivation and player profiles (Reyssier et al., 2022; Zhan et al., 2022).

Educational Context in Northeast Thailand

Northeast Thailand faces distinct educational challenges impacting geometric reasoning instruction. Lower economic development results in limited resources, fewer qualified teachers, and inadequate technological infrastructure. Schools often lack computer laboratories and reliable internet. Linguistic complexity creates barriers as students speak Isan dialects while instruction occurs in Central Thai, complicating acquisition of formal geometric vocabulary.

Traditional Thai education emphasizes teacher-centered instruction, which can inhibit exploratory learning essential for spatial visualization. Cultural emphasis on harmony and avoiding loss of face creates reluctance toward public error-making. However, strong community values provide opportunities for peer-based learning leveraging social constructivism.

Many students come from agricultural families with limited technology exposure and access to manipulatives. Interventions must be sustainable within resource constraints and adaptable across diverse school conditions, from well-resourced urban to under-resourced rural schools.

Research Methodology

Research Design

This study employed a convergent parallel mixed-methods design combining quantitative and qualitative approaches to comprehensively assess stakeholder needs. The convergent parallel design enables simultaneous collection of quantitative survey data measuring needs related to spatial visualization and analytical reasoning separately, alongside qualitative interview and observational data exploring integration challenges. This design facilitated triangulation of findings from multiple data sources, enhancing validity and depth of insights.

Participants

The study involved four stakeholder groups from Khon Kaen, Udon Thani, and Maha Sarakham provinces, selected through stratified random sampling. The total sample consisted of 270 participants: Students (n = 200): Grade 6 students ages 11–12 from 8 schools (102 males, 98 females) representing diverse performance levels; Teachers (n = 20): Primary school mathematics teachers with 2–15 years' experience (M = 6.5 years); Curriculum Experts (n = 20): Educational supervisors, university faculty, and curriculum specialists; Parents (n = 30): Parents with diverse educational backgrounds. Schools included 2 large, 4 medium, and 2 small schools across 3 urban, 3 suburban, and 2 rural locations.

Data Collection Instruments

Student Questionnaire: A 35-item instrument with four sections measuring spatial visualization skills (10 items), analytical reasoning skills (10 items), technology preferences (8 items), and learning preferences (7 items). The questionnaire demonstrated high internal consistency (Cronbach's $\alpha = 0.89$) and content validity (CVI = 0.92).

Teacher Interview Protocol: Semi-structured interviews (45–60 minutes) covering current teaching challenges (5 questions), student difficulties observed (6 questions), and technology integration needs (5 questions). Interviews were audio-recorded and transcribed verbatim.

Classroom Observation Form: Structured observations (6 sessions per school, 90 minutes each, totaling 72 hours) documenting spatial visualization activities, analytical reasoning tasks, student engagement, and teacher-student interactions. Inter-rater reliability: Cohen's $\kappa = 0.85$.

Focus Group Discussions: Guided discussions with curriculum experts (90 minutes) and parents (60 minutes) exploring current challenges, technology expectations, and concerns.

Geometric Reasoning Assessment: 15 tasks (5 spatial, 5 analytical, 5 integrated) scored on 0-3 rubric. Inter-rater reliability: Cohen's $\kappa = 0.88$.

Data Analysis

Quantitative Analysis: Descriptive statistics and one-way ANOVA using SPSS 29.0. Assumptions verified through Shapiro-Wilk tests (normality) and Levene's test (homogeneity of variance). Post-hoc comparisons used Tukey HSD. Effect sizes calculated using partial eta squared (η^2). Significance level: $\alpha = .05$.

Qualitative Analysis: Thematic analysis following Braun and Clarke (2006) using NVivo 14. Two researchers independently coded 20% of data, achieving strong inter-rater reliability (Cohen's $\kappa = 0.82$).

Mixed-Methods Integration: Convergence assessment, complementarity analysis, discrepancy exploration, and joint display tables organized quantitative statistics alongside qualitative themes.

Ethical Considerations

The study received ethical approval from Khon Kaen University's Human Research Ethics Committee (Protocol Number: HE683506). Informed consent was obtained from all participants. Data were anonymized and stored securely. Participants were informed of their right to withdraw without penalty.

Results

Current Challenges in Geometric Reasoning

Analysis of student questionnaire data, geometric reasoning assessment results, classroom observations, and interview responses revealed significant challenges in both spatial visualization and property-based analytical reasoning components, with the greatest difficulties occurring in tasks requiring integration.

Table 1
Student Difficulties in Geometric Reasoning Components (n = 200)

Component	Specific Difficulty	n (%)
Spatial Visualization	Mental rotation tasks	142 (71%)
	3D net construction	138 (69%)
	Cross-sectioning visualization	135 (68%)
Property-based Analytical	Using geometric vocabulary precisely	140 (70%)
	Constructing logical arguments	138 (69%)
	Identifying and applying geometric properties	132 (66%)
Integration	Tasks requiring coordination of both components	156 (78%)

The data reveal that overall, 65% of students struggled with geometric reasoning, indicating widespread difficulties across the domain. When examining specific components of Battista et al.'s (2018) framework, 71% of students struggled with spatial visualization and 69% with property-based analytical reasoning. Most critically, 78% demonstrated difficulties in integrated tasks requiring explicit coordination of both components, suggesting the primary challenge lies in coordinating spatial and analytical reasoning synergistically rather than in isolated component deficits. Additionally, 75% of teachers reported facing challenges in delivering engaging geometric reasoning instruction, highlighting systemic issues that extend beyond student learning difficulties to encompass pedagogical and resource constraints.

Stakeholder Perceptions of Need

A one-way ANOVA was conducted to compare perceived needs for an innovative learning environment across four stakeholder groups. The assumption of homogeneity of variance was met (Levene's test: $F(3,266) = 1.24$, $p = .296$). Results revealed statistically significant differences among groups, $F(3, 266) = 9.78$, $p < .001$, $\eta^2 = .099$, indicating a medium effect size.

Table 2
Stakeholder Perceptions of Need for Innovative Learning Environment

Stakeholder Group	n	M	SD	95% CI
Students	200	4.12	0.78	[4.01, 4.23]
Teachers	20	4.68	0.62	[4.39, 4.97]
Curriculum Experts	20	4.75	0.58	[4.48, 5.02]
Parents	30	4.45	0.71	[4.18, 4.72]

Note. ANOVA results: $F(3, 266) = 9.78$, $p < .001$, $\eta^2 = .099$. Ratings on 5-point scale (1 = strongly disagree, 5 = strongly agree). CI = confidence interval.

Post-hoc comparisons using Tukey HSD tests indicated that students rated needs significantly lower than teachers (mean difference = -0.56, $p < .001$), curriculum experts (mean difference = -0.63, $p < .001$), and parents (mean difference = -0.33, $p = .031$). Table 3 presents detailed pairwise comparisons.

Table 3
Post-hoc Comparisons of Stakeholder Groups (Tukey HSD)

Comparison	Mean Diff	SE	p
Students vs Teachers	-0.56	0.18	<.001
Students vs Curriculum Experts	-0.63	0.18	<.001
Students vs Parents	-0.33	0.15	.031
Teachers vs Curriculum Experts	-0.07	0.19	.925

The lower ratings from students may reflect limited awareness of alternative instructional approaches, as 68% reported never experiencing technology-enhanced mathematics learning. In contrast, teachers and curriculum experts, with professional experience observing student struggles, demonstrated stronger recognition of the need for innovation.

Qualitative Findings: Stakeholder Priorities

Thematic analysis of interview transcripts, focus group discussions, and observation notes revealed distinct priorities across stakeholder groups. Table 4 summarizes primary themes emerging from qualitative data.

Table 4
Stakeholder Needs and Design Priorities (Qualitative Themes)

Stakeholder	Primary Needs	Key Concerns	Design Priorities
Students	Interactive features, game elements, visual tools	Boring traditional methods, difficulty understanding	Engagement, fun learning, ease of use
Teachers	Curriculum alignment, assessment tools, professional development	Time constraints, technical skills, classroom management	Easy integration, support materials, training
Curriculum Experts	Evidence-based design, learning theory alignment, valid assessment	Pedagogical soundness, research validation, scalability	Research-based features, standards alignment
Parents	Learning outcomes, safe environment, progress monitoring	Screen time, online safety, academic value	Educational value, parental controls, reporting

Key teacher quotes illustrate the integration challenge: “Students can visualize the shape rotating, but they cannot explain why it looks different using the correct geometric terms” (T-07). Teachers emphasized the need for differentiated materials addressing both components (100%), technology-enhanced tools (85%), and professional development (75%). Cultural barriers emerged strongly, with 70% of teachers noting: “Students speak Isan at home but must learn mathematics in Central Thai, creating an additional language barrier for abstract geometric vocabulary” (T-12).

Technology Readiness and Infrastructure

Assessment of technological infrastructure revealed significant disparities. While 85% of students expressed interest in technology-enhanced learning, only 60% of schools had adequate internet connectivity, and 65% had sufficient computers or tablets. Teachers' self-reported technological competence varied widely (45% felt confident using AI-based tools, 85% could

manage basic web-based systems). These findings underscore the need for solutions accommodating low-bandwidth environments with offline capabilities and intuitive interfaces.

Discussion

The Dual Nature of Geometric Reasoning Challenges

The finding that 65% of students' overall struggle with geometric reasoning becomes more nuanced when examined through Battista et al.'s (2018) dual-component framework. While individual component difficulties are substantial (71% spatial visualization, 69% property-based analytical reasoning), the critical discovery is that 78% face challenges in integrated tasks. This suggests the problem lies in coordinating skills synergistically rather than developing each separately, aligning with research showing geometric reasoning development requires explicit integration support. The parallel finding that 75% of teachers face instructional challenges underscores the systemic nature of these difficulties. This convergence suggests current pedagogical approaches are insufficient for supporting both learner development and teacher effectiveness, pointing toward the need for comprehensive solutions that address both student cognitive challenges and teacher instructional needs.

Stakeholder Perspectives and Implications

The 85% consensus across stakeholder groups demonstrates broad recognition that traditional methods are insufficient. However, ANOVA results [$F(3, 266) = 9.78$, $p < .001$] reveal significant differences among groups. Students' lower mean scores ($M = 4.12$, $SD = 0.78$) may reflect limited awareness of alternatives, while teachers and curriculum experts showed higher agreement due to professional experience. Qualitative data revealed distinct priorities: teachers emphasized curriculum alignment with differentiation flexibility; students preferred engaging interactive features; curriculum experts stressed pedagogical soundness; parents raised concerns about screen time while supporting technology integration. These diverse perspectives necessitate balanced design addressing both potential and limitations of technology-enhanced instruction.

Design Implications for AI-Constructivist-Gamification Integration

The findings provide specific guidance for integration. AI systems should track performance across spatial visualization and analytical reasoning separately while facilitating integration through bridging activities, recognizing when students struggle with component integration versus individual skills (Chen et al., 2022; Minn, 2022). Constructivist approaches must balance student exploration with structured guidance for formal vocabulary and logical reasoning—particularly critical in Thailand's teacher-centered context (Hernández-Zavaleta et al., 2023). Gamification elements should reward improvement in both components and their integration, maintaining intrinsic motivation rather than creating extrinsic dependencies (Oliveira et al., 2022). The Thai cultural context, emphasizing respect for authority and reluctance toward public errors, requires low-stakes environments with private feedback, personalized paths, and gamification framing errors as learning opportunities.

Contextual Challenges and Limitations

Northeast Thailand presents context-specific challenges: infrastructure limitations requiring minimal bandwidth and offline capability; varying teacher technological proficiency

necessitating intuitive interfaces with professional development; and linguistic complexity where students speak Isan dialects at home while learning mathematics in Central Thai, demanding flexible language support. Several limitations warrant acknowledgment: the cross-sectional design captures needs at one point; sampling was limited to three provinces, potentially limiting generalizability; the study assessed perceived needs rather than actual learning outcomes; and small sample sizes for teachers and curriculum experts may limit statistical power. Future research should experimentally test whether addressing these needs improves geometric reasoning performance, examine whether dual-component challenges exist in other contexts, investigate actual classroom implementation with needed professional development, and assess whether improvements transfer to broader mathematical achievement and persist longitudinally.

Conclusion

This needs assessment reveals that 65% of students' overall struggle with geometric reasoning in Northeast Thailand, with deeper analysis showing that challenges stem primarily from integration difficulties rather than individual skill deficits. When examined through Battista et al.'s (2018) framework, 71% struggle with spatial visualization, 69% with property-based analytical reasoning, and most critically, 78% struggle to coordinate both components. Additionally, 75% of teachers face challenges in delivering engaging instruction, highlighting the systemic nature of these difficulties. The challenge is thus reframed from isolated skill deficits to cognitive integration and pedagogical support, with significant implications for intervention design that must address both learner and instructor needs.

The identified needs direct development of a web-based learning environment with four priorities: (1) interactive visualization tools for dynamic 2D/3D manipulation supporting spatial reasoning; (2) AI-powered language support providing vocabulary feedback and logical scaffolding for analytical reasoning; (3) sequenced activities explicitly requiring component coordination; and (4) adaptive learning pathways tracking both dimensions independently while supporting their integration. Implementation must address accessibility (low-bandwidth operation, offline capabilities, multi-device compatibility), usability (intuitive interfaces for varied technical proficiency), curriculum alignment (Thai mathematics standards), and resource constraints (professional development, sustainable implementation models).

The 85% stakeholder consensus demonstrates broad support for innovation, though ANOVA-revealed differences [$F(3, 266) = 9.78$, $p < .001$] indicate implementation must balance diverse needs. The finding that 75% of teachers face instructional challenges indicates that solutions must address both student learning and teacher effectiveness. Teachers require curriculum-aligned tools with assessment capabilities and professional development support; students seek engaging interactive experiences; curriculum experts demand evidence-based pedagogical soundness; and parents need assurance of educational value with appropriate safeguards. This multi-stakeholder approach ensures comprehensive solutions addressing the full ecosystem of geometric reasoning education.

This research contributes theoretically by addressing dual-component reasoning systematically through Battista et al.'s (2018) framework, methodologically by revealing stakeholder nuances through convergent mixed-methods design, and practically by providing empirical foundation for technology-enhanced environment development. By recognizing spatial visualization and analytical reasoning as interconnected components requiring coordinated development, educational innovations can genuinely improve geometric understanding. Moving forward

requires developing the prototype learning environment, conducting rigorous effectiveness research comparing outcomes with traditional instruction, and investigating sustainable integration strategies including teacher professional development and scalable implementation models.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no generative AI or AI-assisted technologies were used to generate, refine, or correct the content of this manuscript. All ideas, research design, data collection, analysis, interpretation, and writing are the author's original work and were conducted through careful and systematic research processes.

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Exploring Needs and Preferences for an AI-Enhanced Design Thinking Environment in Graphic and Multimedia Design

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Abstract

This study aims to explore the learning needs and preferences of undergraduate students and instructors for an AI-enhanced design thinking environment in graphic and multimedia design education. The research employs a mixed-methods approach, involving a survey of 150 undergraduate students majoring in graphic and multimedia design and semi-structured interviews with 12 instructors. The survey assesses students' perceptions of their creative thinking abilities, learning style preferences, and attitudes towards the integration of AI and design thinking in their learning process. The interviews with instructors focus on their experiences, challenges, and expectations regarding the implementation of an AI-enhanced design thinking environment. Quantitative data analysis reveals that 68% of the students believe that an AI-enhanced design thinking environment would improve their creative thinking skills, with 75% expressing a preference for interactive and collaborative learning activities. Qualitative findings highlight the need for a balance between technology-driven and human-centered approaches, as well as the importance of providing personalized feedback and support. The study identifies key considerations for designing an effective AI-enhanced design thinking environment, including the integration of AI-powered tools for idea generation and prototyping, the incorporation of collaborative learning spaces, and the provision of adaptive learning experiences based on individual needs and progress. These findings contribute to the development of innovative teaching and learning strategies that harness the potential of AI and design thinking to cultivate creative thinking skills in graphic and multimedia design education.

Keywords: learning needs, preferences, AI-enhanced learning, design thinking, creative thinking, graphic and multimedia design

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Introduction

The rapid evolution of artificial intelligence (AI) is significantly challenging higher education: namely, preparing students with creative thinking skills that *complement* AI rather than *compete* with it. While 85% of jobs by 2030 will require creative problem-solving skills (World Economic Forum, 2023), only 23% of graduates demonstrate these competencies (OECD, 2024). This "creativity gap" reflects a critical misalignment between technological advancement and educational outcomes.

In Thailand, this gap is particularly acute. The 2024 Global Innovation Index ranks the nation 43rd overall but 67th in creative outputs, signaling a failure to translate educational investment into innovative capability. This problem is especially concerning in design-related disciplines, where creativity is a fundamental competency. Although AI integration shows promise for improving learning outcomes (UNESCO, 2024), most implementations focus on knowledge transmission rather than creative skill development. The critical question is no longer *if* AI should be used in design education, but *how* it can be used to *enhance*, not *diminish*, human creativity.

Concurrently, Design Thinking (DT), a human-centered problem-solving approach, is proven to enhance creative confidence and problem-solving skills (Liedtka, 2015). However, its implementation faces challenges, especially in Asian or Thai educational cultures where rote learning may conflict with DT's exploratory nature (Zhao, 2023). Conversely, AI technologies like generative tools (Midjourney, DALL-E) and LLMs (ChatGPT) have revolutionized ideation. Yet, significant barriers persist, notably low faculty readiness (Elisyah et al., 2024), and crucially, most research measures academic achievement rather than the direct impact on *creativity*.

This creates an "Integration Gap." Current research typically examines AI or DT in isolation, lacking studies on their synergistic potential. Literature lacks empirical evidence on optimal human-AI interaction patterns, validated frameworks, and models adapted for Asian cultures. Most importantly, there is a profound lack of understanding regarding the needs and perspectives of stakeholders—both students and instructors—which are essential for designing practical and contextually relevant learning environments.
This research, therefore, aims to address these gaps, specifically by exploring learner and educator needs within the context of graphic and multimedia design education in Thailand. The objectives are to:

- Assess students' perceptions, attitudes, and preferences regarding AI and DT integration.
- Explore instructors' experiences, challenges, and expectations.
- Identify key design principles for an effective AI-enhanced DT learning environment.
- Develop evidence-based recommendations for implementation in the Thai context.

This study will provide novel theoretical insights (e.g., viewing AI as a collaborative agent) and practical guidance for educators. It aims to inform the development of balanced learning environments that leverage AI tools while preserving human-centered pedagogy, ultimately preparing designers for an AI-driven future.

Literature Review

The Role of Design Thinking in Enhancing Creative Skills

As demand for 21st-century skills intensifies, creative thinking has emerged as core competency educators must nurture across disciplines. Design Thinking (DT), a human-centered, iterative problem-solving approach rooted in design and innovation fields, has been increasingly adopted in education to address this need (Brown, 2009; Razzouk & Shute, 2012). It promotes empathy, ideation, prototyping, and testing—processes aligning closely with creative cognition development.

Growing literature supports the assertion that DT serves as powerful catalyst for creative thinking in educational contexts. Recent studies implemented DT-based frameworks in media education and biology learning, showing marked improvements in students' engagement, motivation, and creativity through scaffolded problem-solving, with motivation increases of 25-30%. These studies underscore how structured design stages—empathize, define, ideate, prototype, test—create psychologically safe space for divergent and convergent thinking.

Internationally, research demonstrates that design thinking education enhances students' creative confidence, problem-solving abilities, and collaborative skills (Koh et al., 2015; Liedtka, 2015). In graphic and multimedia design contexts specifically, design thinking provides structured yet flexible framework for addressing complex design challenges. Students receiving explicit design thinking training demonstrate improved abilities to navigate ambiguous problem spaces and generate innovative solutions (Carlgren et al., 2016; Micheli et al., 2019).

Challenges in Implementation

Despite positive trends, significant challenges remain. Implementing DT in creative media programs often requires curriculum overhaul and faculty retraining, pointing to systemic barriers in adoption. Moreover, in Asian educational cultures where rote learning still dominates, educators may struggle to foster open-ended inquiry that DT demands (Zhao, 2023). These cultural dynamics may limit DT's full potential unless adapted to local pedagogical realities.

Studies reveal further constraints, including lack of teacher preparedness (only 13.33% achieving high competency) and difficulty aligning DT methods with rigid course structures. Instructors face challenges balancing structured guidance with open-ended exploration, assessing creative processes, and providing timely feedback to students engaged in complex design projects.

The literature converges on the idea that Design Thinking offers compelling, evidence-based approach to enhancing creative thinking in higher education. Nevertheless, gaps remain in understanding its adaptation in non-Western and resource-constrained contexts, particularly when paired with emerging technologies.

Artificial Intelligence in Learning Media

Artificial Intelligence (AI) is increasingly integrated into higher education, particularly within learning media designed to enhance student engagement, personalize learning experiences,

and develop critical thinking (Chen & Wang, 2023; Rodriguez et al., 2024). AI-powered platforms and tools offer real-time feedback, content adaptation, and interactive features difficult to achieve through traditional instruction alone.

AI Applications in Design Education

AI-powered generative design tools, such as Midjourney, DALL-E, and Adobe Firefly, have revolutionized how students approach visual ideation and concept development (Zhang et al., 2023). These tools enable rapid exploration of design alternatives and help students visualize abstract concepts quickly. Large language models like ChatGPT have found applications in design education, particularly supporting research, concept articulation, and design documentation (Kumar & Singh, 2024).

Across multiple empirical studies, AI has been applied in learning media to improve academic outcomes. Studies developed AI-integrated media for elementary science and social studies subjects, achieving high content validity (92.3-96.4%) and moderate effectiveness. AI-based chatbot systems for electronics education demonstrated AI's potential in technical subjects to provide adaptive, real-time assistance.

Research expanded scope by exploring how AI in media education supports both knowledge acquisition and creative expression, emphasizing importance of instructional design and ethical frameworks. However, studies show AI's ability to personalize and scaffold learning, though creativity as outcome is often assumed rather than directly assessed.

Implementation Challenges

Major limitations exist in teacher readiness, with only 13.33% of pre-service teachers achieving very high competency in designing AI-based learning media. This suggests that without adequate training and support, educational potential of AI cannot be fully realized. Teachers were open to using AI tools but cited barriers such as limited technical knowledge and integration challenges.

Despite advancements, noticeable gap exists in studies measuring AI media's effectiveness in developing creativity. Most focus on achievement or usability, with creativity often assumed rather than directly assessed. While AI enables personalized pathways, limited evidence shows it independently fosters ideation or imaginative thinking without being paired with constructivist methods.

Integrating Design Thinking and AI for Creativity Development

Design Thinking (DT) and Artificial Intelligence (AI) each offer unique advantages in educational innovation. DT is known for enhancing creativity through its iterative, user-focused approach, while AI brings adaptive feedback and personalized support to learning environments. However, literature investigating their integration remains in its infancy, with most studies focusing on either DT or AI in isolation.

Emerging Synergies

Synergy between DT and AI appears implicitly in several studies. Interactive media based on DT principles—empathize, define, ideate, prototype, and test—resulted in increased

motivation and knowledge retention. Though AI was not used, the structured design process aligned with principles that AI tools could easily enhance, such as providing iterative feedback or automating testing phases.

Recent theoretical work suggests AI can serve as collaborative agent in creative knowledge construction, extending neo-constructivist learning theory (Kim & Lee, 2023). This positions AI not merely as tool but as partner in creative process, complementing human intuition with computational power while maintaining human agency in creative decision-making.

Research Gaps

The integration of Design Thinking and Artificial Intelligence in educational media remains an emerging area. While both have shown individual effectiveness, their combined application to cultivate creativity has yet to be fully realized in practice. Current literature shows implicit alignment between the two but lacks:

- Empirical evidence on their joint impact on creative thinking outcomes
- Validated design principles for AI-enhanced DT environments
- Optimal human-AI interaction patterns for creative development
- Understanding of how to balance technology-driven and human-centered approaches
- Frameworks for sustainable implementation across diverse contexts

This study addresses these gaps by investigating how AI tools, when systematically integrated within a DT framework, can enhance the creativity of Thai undergraduate students in graphic and multimedia design education.

Student Learning Preferences in Design Education

Understanding student learning preferences is crucial for designing effective educational interventions. Research reveals diverse learning preferences among design students, with many favoring hands-on, experiential learning approaches over traditional lecture-based instruction (Fleischmann, 2020; Kolb & Kolb, 2005).

Design students particularly value collaborative learning opportunities where they can exchange ideas, critique work, and learn from peers (Dannels et al., 2008; Shreeve et al., 2010). Interactive learning activities combining individual creativity with collaborative refinement have been shown to enhance both skill development and student engagement (Carmel-Gilfilen & Portillo, 2016).

Recent studies examining technology adoption in design education suggest students are generally receptive to AI-enhanced learning tools, particularly when these technologies demonstrably enhance their creative capabilities and efficiency (Kim & Lee, 2023). However, concerns about maintaining authenticity and developing genuine skills amid increasing AI assistance persist (Thompson et al., 2024).

Instructor Perspectives on Technology Integration

Design instructors' attitudes toward technology integration significantly influence implementation success. While many design educators recognize the potential benefits of AI technologies, they also express concerns about maintaining pedagogical quality, preserving

human creativity, and managing the learning curve associated with new tools (Fleischmann, 2020; Robertson & Radcliffe, 2009).

Research indicates that successful technology integration requires careful alignment with learning objectives and pedagogical principles, with technology serving pedagogy rather than driving it. The emphasis on balanced human-AI collaboration reflects mature understanding of the proper role of educational technology in creative education contexts.

Methodology

Research Design

This study employed a mixed-methods research design, integrating quantitative and qualitative approaches. Data collection occurred over a three-month period from March to May 2025.

Participants

The study included 150 undergraduate students from graphic design (n = 75) and multimedia design (n = 75) programs at three prominent Thai universities: Khon Kaen University, Chulalongkorn University, and Chiang Mai University. These institutions were selected to represent geographic diversity across Thailand's northeastern, central, and northern regions. The sample comprised students from all four academic years, with approximately 25% from each year level (Year 1: n = 38, Year 2: n = 37, Year 3: n = 38, Year 4: n = 37).

Instructor Sample

Twelve design instructors participated in semi-structured interviews, representing the same three universities. The instructor sample included six graphic design instructors, four multimedia design instructors, and two instructors teaching across both disciplines. Teaching experience ranged from 2 to 25 years (M = 11.8 years, SD = 7.2 years), providing perspectives from both early-career and experienced educators. All instructors reported moderate to high levels of technology integration in their teaching, with varying degrees of familiarity with AI tools.

Data Collection and Analysis

Student surveys assessed perceptions and attitudes using 5-point Likert scales. Instructor interviews were audio-recorded and analyzed using thematic analysis. Quantitative data were analyzed using SPSS version 28.

Student Survey

A structured questionnaire was developed to assess students' perceptions, preferences, and attitudes. The survey comprised four main sections: (1) demographic information and AI experience, (2) self-assessment of creative thinking abilities using a 5-point Likert scale, (3) learning style preferences through multiple-choice and ranking questions, and (4) attitudes toward AI integration in design education measured on a 5-point Likert scale. The survey instrument was piloted with 20 students not included in the main study, and modifications were made based on pilot feedback to enhance clarity and comprehensiveness.

Instructor Interview Protocol

A semi-structured interview protocol was developed to explore instructors' experiences, challenges, and expectations regarding AI-enhanced design thinking environments. The protocol covered five key areas: (1) current teaching practices and challenges, (2) experiences with technology integration, (3) perceptions of AI tools in design education, (4) expectations for AI-enhanced learning environments, and (5) concerns and recommendations for implementation. Interviews were conducted in Thai or English based on instructor preference, with durations ranging from 45 to 70 minutes.

Data Collection Procedures

Data collection occurred over a three-month period from March to May 2025. The study received ethical approval from the Institutional Review Board at Khon Kaen University. All participants provided informed consent, and confidentiality was ensured through anonymization procedures.

Student surveys were administered online using Google Forms, distributed through course instructors and student organizations. Response rate was approximately 75%, with 150 completed surveys out of 200 distributed. Instructor interviews were conducted individually, either in person or via video conference based on participant preference and geographic location. All interviews were audio-recorded with permission and subsequently transcribed for analysis.

Data Analysis

Quantitative Analysis

Survey data were analyzed using SPSS version 28. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated for all quantitative variables. Independent samples t-tests were conducted to compare responses between graphic design and multimedia design students, as well as between students with and without AI experience. Chi-square tests were used to examine relationships between categorical variables. Statistical significance was set at $p < 0.05$.

Qualitative Analysis

Interview transcripts were analyzed using thematic analysis following Braun and Clarke's (2006) six-phase approach. Initial codes were generated inductively from the data, then organized into potential themes. Themes were reviewed and refined through iterative analysis and discussion among research team members. NVivo 12 software was used to facilitate coding and theme management. To enhance trustworthiness, member checking was conducted with three interview participants who confirmed the accuracy of the interpretations.

Research Results

Student Perceptions and Preferences

Students' self-assessment of creative thinking revealed high confidence in generating original ideas (M = 4.15) but lower confidence in combining diverse concepts (M = 3.42).

Table 1
Students' Self-Assessment of Creative Thinking Abilities (N = 150)

Creative Thinking Dimension	Mean (SD)	Level
Generating original ideas	4.15 (0.68)	High
Thinking flexibly	3.92 (0.74)	High
Elaborating on ideas	3.87 (0.79)	High
Taking creative risks	3.64 (0.86)	Moderate
Problem identification	3.78 (0.81)	High
Combining diverse concepts	3.42 (0.91)	Moderate

Learning Style Preferences

Analysis of learning style preferences revealed strong student preference for interactive and collaborative learning approaches. Table 2 summarizes the distribution of preferred learning activities.

Table 2
Student Preferences for Learning Activities (N = 150)

Learning Activity	Frequency	Percentage
Interactive and collaborative projects	113	75.3%
Hands-on practical exercises	108	72.0%
Real-world design challenges	95	63.3%
Peer critique and feedback sessions	87	58.0%
Individual creative exploration	72	48.0%
Lecture-base instruction	38	25.3%

Attitudes Toward AI Integration

68% of students agreed that an AI-enhanced DT environment would improve their creative skills. Students with AI experience expressed significantly more positive attitudes ($p = 0.001$).

Table 3
Student Attitudes Toward AI Integration in Design Education (N = 150)

Attitude Statement	Mean (SD)	Agreement level
AI can improve mu creative thinking skills	4.21 (0.72)	Agree
AI tools can help generate more design ideas	4.38 (0.65)	Strongly Agree
AI feedback would be helpful for my learning	4.15 (0.78)	Agree
I am interested in learning to use AI tools	4.32 (0.69)	Strongly Agree
AI can make design learning more efficient	4.27 (0.71)	Strongly Agree
I worry AI might reduce my originality	3.14 (1.02)	Neutral

Instructor Perspectives

Four major themes emerged: (1) balancing technology and pedagogy, (2) personalization and adaptive support, (3) collaborative learning enhancement, and (4) implementation challenges. Instructors emphasized that AI should serve pedagogy, not replace it.

Theme 1: Balancing Technology and Pedagogy

All instructors emphasized the importance of maintaining pedagogical integrity while integrating AI technologies. One experienced instructor noted: “Technology should serve pedagogy, not replace it. AI tools can be powerful aids, but we must ensure students still develop fundamental design thinking and problem-solving skills.” Instructors expressed concern about students becoming overly dependent on AI-generated solutions without developing critical evaluation skills. Several instructors advocated for a hybrid approach where AI tools complement traditional teaching methods rather than replacing human instruction and mentorship.

Theme 2: Personalization and Adaptive Support

Instructors recognized the potential of AI to provide personalized learning experiences tailored to individual student needs. One multimedia design instructor commented: “In large classes, it's challenging to provide individual feedback to every student. AI systems that can analyze student work and provide immediate, personalized suggestions could significantly enhance learning.” However, instructors emphasized that AI-generated feedback should supplement rather than replace human instructor feedback, particularly regarding subjective aspects of design quality and creative expression.

Theme 3: Collaborative Learning Enhancement

Instructors identified collaborative learning as a critical component of design education that AI technologies could potentially enhance. One instructor explained: “Collaborative design projects teach students valuable skills, but coordination can be challenging. AI-powered platforms that facilitate idea sharing, version control, and collaborative prototyping could make group work more productive.” Instructors expressed interest in AI tools that could support peer learning by suggesting relevant examples, facilitating constructive critique, and helping students learn from each other's creative processes.

Theme 4: Implementation Challenges and Concerns

While generally optimistic about AI's potential, instructors identified several implementation challenges. These included the learning curve for both instructors and students, concerns about equitable access to technology, potential academic integrity issues, and the need for institutional support and resources. One instructor articulated: “We need proper training and ongoing support to effectively integrate these tools. It's not just about having the technology—we need to understand how to use it pedagogically.” Instructors emphasized the importance of gradual, well-supported implementation with clear guidelines for appropriate AI tool usage.

Discussion

This study provides valuable insights into the needs and preferences of students and instructors regarding AI-enhanced design thinking environments in graphic and multimedia design education. The findings reveal generally positive attitudes toward AI integration while highlighting important considerations for implementation.

Student Readiness

The finding that 68% of students believe AI-enhanced environments would improve their creative thinking aligns with recent research demonstrating positive student attitudes toward educational technology integration (Kim & Lee, 2023; Thompson et al., 2024). Students' strong preference for interactive and collaborative learning activities (75%) underscores importance of designing AI-enhanced environments that facilitate rather than replace social learning experiences.

The positive correlation between AI experience and more favorable attitudes toward AI integration suggests that exposure and familiarity can reduce technology-related apprehension. This finding has important implications for implementation strategies, suggesting that early introduction and hands-on experience with AI tools may facilitate smoother technology adoption. Educational institutions should consider providing introductory workshops or courses on AI tools before full integration into design curricula.

Students' relatively neutral stance on concerns about AI reducing originality ($M = 3.14$) suggests nuanced understanding that technology itself does not necessarily diminish creativity—rather, how it is used determines its impact. This finding contrasts with some earlier research suggesting strong student concerns about technology limiting creativity (Shreeve et al., 2010), possibly reflecting generational shifts in technology attitudes among contemporary digital natives.

Pedagogical Implications

Instructor perspectives emphasize critical importance of balancing technological innovation with pedagogical soundness. This finding resonates with educational technology literature highlighting that successful technology integration requires careful alignment with learning objectives and pedagogical principles (Robertson & Radcliffe, 2009; Fleischmann, 2020). The emphasis on technology serving pedagogy rather than driving it reflects mature understanding of proper role of educational technology.

The instructor-identified need for personalized, adaptive learning support aligns with research demonstrating effectiveness of adaptive learning systems in promoting skill development (Kumar & Singh, 2024). However, instructors' insistence that AI feedback should supplement rather than replace human feedback highlights continued importance of expert human judgment in evaluating creative work. This suggests hybrid model where AI provides immediate, frequent feedback on technical aspects while instructors focus on higher-order creative and conceptual feedback.

The identification of collaborative learning enhancement as key opportunity for AI integration is particularly noteworthy. While much AI education research focuses on individualized learning, these findings highlight collaborative applications that could

transform group design projects. AI tools that facilitate idea sharing, manage collaborative workflows, and support peer learning could address longstanding challenges in collaborative design education (Carmel-Gilfilen & Portillo, 2016; Dannels et al., 2008).

Design Considerations

Based on research findings, several key design considerations emerge for AI-enhanced design thinking environments.

Integration of AI-Powered Tools

The environment should incorporate AI tools for idea generation (e.g., text-to-image generators), design exploration (e.g., style transfer systems), and prototyping (e.g., automated layout systems). However, these tools should be designed to augment rather than automate creative thinking, maintaining student agency in design decisions.

Collaborative Learning Spaces

The environment should provide robust collaborative features including shared workspaces, real-time co-design capabilities, peer review systems, and AI-facilitated discussion forums. These features should support both synchronous and asynchronous collaboration to accommodate diverse learning schedules and preferences.

Adaptive Learning Experiences

The system should provide personalized learning paths based on individual student needs, progress, and preferences. AI algorithms should analyze student work patterns, identify areas needing improvement, and recommend appropriate resources and exercises. Importantly, the system should maintain transparency about how recommendations are generated and allow instructor oversight of adaptive pathways.

Balanced Feedback Mechanisms

The environment should provide multiple layers of feedback: immediate AI-generated feedback on technical aspects, peer feedback through structured critique protocols, and instructor feedback on higher-order creative and conceptual dimensions. This multi-tiered approach ensures students receive timely, comprehensive feedback while maintaining irreplaceable value of expert human judgment.

Scaffolded AI Tool Usage

The environment should include built-in tutorials, guided exercises, and progressive skill-building activities that help students develop proficiency with AI tools. Clear guidelines about appropriate and inappropriate AI tool usage should be integrated throughout learning experience.

Limitations and Future Research

This study has several limitations that suggest directions for future research. First, the sample was drawn from three universities in Thailand, which may limit generalizability to other

cultural contexts. Future research should examine needs and preferences across diverse cultural and geographic settings to understand how cultural factors influence attitudes toward AI in design education.

Second, this study captured perspectives at single time point. Longitudinal research tracking how attitudes and preferences evolve as students gain more experience with AI-enhanced learning environments would provide valuable insights into temporal dynamics of technology adoption in design education.

Third, while this study identified important needs and preferences, it did not empirically test effectiveness of AI-enhanced design thinking environments. Future experimental research should evaluate impact of such environments on actual learning outcomes, creative performance, and skill development.

Finally, this study focused primarily on perceptual data through surveys and interviews. Future research incorporating observational studies, learning analytics, and portfolio analysis would provide richer understanding of how students actually interact with and benefit from AI-enhanced learning environments.

Conclusion

This mixed-methods study explored the learning needs and preferences of undergraduate students and instructors regarding AI-enhanced design thinking environments in graphic and multimedia design education. The findings reveal generally positive attitudes among students toward AI integration, with 68% believing such environments would enhance their creative thinking skills and 75% preferring interactive and collaborative learning activities.

The research identified several key considerations for designing effective AI-enhanced design thinking environments. These include: (1) integrating AI-powered tools for idea generation and prototyping while maintaining student creative agency, (2) incorporating robust collaborative learning features that facilitate both synchronous and asynchronous teamwork, (3) providing adaptive learning experiences that personalize content and feedback based on individual needs and progress, and (4) implementing balanced feedback mechanisms combining immediate AI-generated insights with essential human instructor expertise.

Instructor perspectives emphasized the critical importance of balancing technological innovation with pedagogical soundness. Educators stressed that AI tools should serve pedagogical goals rather than driving them, and that technology implementation must be accompanied by adequate training, institutional support, and clear guidelines for appropriate usage.

The finding that prior AI experience correlates with more positive attitudes toward AI integration suggests that early, supported exposure to these technologies can facilitate smoother adoption. Educational institutions should consider implementing introductory experiences with AI tools before full curricular integration.

These findings contribute to the growing body of knowledge on technology-enhanced design education and provide practical guidance for educators, instructional designers, and educational technology developers. By understanding stakeholder needs and preferences, institutions can design AI-enhanced learning environments that effectively support creative

thinking development while maintaining the human-centered values central to design education.

As AI technologies continue to evolve rapidly, ongoing research and evaluation will be essential to ensure that educational applications of these powerful tools truly serve student learning and development. The success of AI-enhanced design thinking environments will ultimately depend not on the sophistication of the technology itself, but on how thoughtfully it is integrated into pedagogically sound, human-centered educational experiences.

This study provides a foundation for future research and implementation efforts aimed at harnessing AI's potential to cultivate creative thinking skills in graphic and multimedia design education. By attending to the needs and preferences of both students and instructors, educators can create learning environments that prepare students for the evolving landscape of design practice while preserving the essential human elements of creativity, judgment, and innovation.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the author(s) used Gemini/ChatGPT in order to assist in formatting the manuscript according to specific conference guidelines and improving the clarity of English expression. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication. This declaration refers only to the writing process and not to the use of AI tools as part of the research methodology described in the study (such as Midjourney or DALL-E used by participants).

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Australian National Education Frameworks: Tracing the Evolution of Social Justice Goals

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Abstract

Although school education falls within the jurisdiction of state and territory governments, since the late 1980s, Australia has issued a national education declaration each decade to articulate shared national priorities for the sector. While these frameworks—Hobart (1989), Adelaide (1999), Melbourne (2008), and Alice Springs (Mparntwe) (2019)—consistently invoke equity and inclusion, their substantive commitments to social justice remain under-examined. This paper critically analyses how social justice goals are conceptualised in the declarations and how these framings have shifted over time. The paper distinguishes between two interrelated dimensions: *socially just education*, which concerns the creation of equitable and inclusive systems through fair resource distribution, culturally sustaining environments, and policies that remove systemic barriers; and *social justice education*, which focuses on developing students' critical consciousness, ethical reasoning, and civic agency through engagement with issues of justice and democracy. Using critical policy analysis, the paper identifies both continuities and shifts in the framing of social justice over three decades, revealing growing rhetorical attention to diversity and equity, yet persistent limitations in addressing deeper, transformative demands of justice. The paper argues for future national frameworks to adopt a more integrated and explicit commitment to both structural equity and critical democratic education.

Keywords: Australia, critical analysis, education declaration, policy, social justice

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Introduction

Social justice has long been a normative imperative in education, encompassing the belief that all learners—regardless of race, class, gender, geography, or cultural background—should have equitable access to high-quality, meaningful educational opportunities. It demands the redistribution of resources, the recognition of difference, and the transformation of institutional arrangements that sustain inequality (Connell, 1993; Gale & Densmore, 2000). In response, governments introduce targeted equity instruments and policies to address unjust inequalities in society and ensure that all students can participate fully in education.

Australia's federal system divides educational responsibilities between the Commonwealth and the states and territories, with the latter holding constitutional authority over schooling (Lingard, 2010). State and territory governments oversee curriculum development, public school funding, and regulatory frameworks, while the federal government's influence primarily stems from its financial contributions and national reform agendas (Savage, 2020). This arrangement has created a policy dynamic where national goals are negotiated rather than mandated, often through forums such as the former Council of Australian Governments (COAG) and the current Education Ministers Meeting (EMM).

With the aim of widening access and improving quality, since the late 1980s, Australia has released a national education declaration roughly every decade—beginning with the Hobart Declaration (1989), followed by the Adelaide (1999), Melbourne (2008), and Alice Springs (Mparntwe) Declarations (2019). The national declarations are more than symbolic documents; they structure priorities, legitimise policy directions, and guide curricular and pedagogical decisions at all levels (Lingard, 2010). They are part of a complex policy architecture that includes intergovernmental agreements on school reform and funding. This paper analyses how social justice has been framed and reconfigured across the four declarations. In examining the declarations, this paper asks: *How have social justice goals been framed across Australia's national education declarations, and what shifts can be observed in these framings over time?*

The paper draws on critical policy scholarship, which views policy not simply as a set of official texts but as a dynamic, discursive process deeply implicated in the production and maintenance of power relations (Grace, 1998; Molla, 202; Ozga, 2021; Savage et al., 2021). From this perspective, policy documents are not neutral blueprints for action but are themselves active in *constituting* the very problems they purport to address, defining categories of "disadvantage" and legitimising certain solutions while obscuring others (Bacchi, 2009).

The primary sources of data were the four national education declarations: the *Hobart Declaration on Schooling* (1989), the *Adelaide Declaration on National Goals for Schooling in the Twenty-First Century* (1999), the *Melbourne Declaration on Educational Goals for Young Australians* (2008), and the *Alice Springs (Mparntwe) Education Declaration* (2019). While broad in scope, they set shared goals for schooling and influence downstream policies on curriculum, assessment, teacher standards, and funding. Their recurring invocation of terms such as "equity," "inclusion," and "diversity" positions them as important sites for examining how justice is framed in national education discourse. Given their decennial publication and official status, these texts also offer a valuable lens into how the social purposes of schooling have been variously imagined over time and across political contexts. To guide the analysis, two overarching themes were developed through a critical review of the literature: *socially just education* and *social justice education*. These two dimensions served as conceptual anchors for the analysis, allowing for a more precise interrogation of how justice is both structurally

supported and pedagogically enacted. The analysis proceeded through a thematic coding of the four declarations, using both deductive and inductive approaches. Initially, relevant statements were coded under the two predefined dimensions of justice.

Accordingly, the analysis attends to both the stated aims of the four national education frameworks and the assumptions, silences, and discursive shifts that underpin their framing of social justice. By tracing these shifts over time, the paper highlights how particular constructions of educational disadvantage have been normalised, rearticulated, or challenged, illuminating the evolving policy rationalities that govern the pursuit of social justice in Australian schooling. Mapping changes and continuities in the articulation of social justice goals can offer a window into how governments conceptualise justice, who they see as deserving of support, and which injustices they are willing to name. By situating the declarations within both theoretical and historical contexts, the paper contributes to deeper understandings of how national education policy frames social justice. It argues that meaningful engagement with both forms of justice is essential for addressing persistent educational inequities and for cultivating a democratic, culturally responsive schooling system. The paper also highlights the importance of reading policy critically to unpack what is promised, what is omitted, and what is rendered invisible in national visions of educational fairness.

The remainder of the paper is organised into two main sections. The first presents the two dimensions of the social justice goals articulated within these frameworks—*socially just education* and *social justice education*. The second section analyses the changes and continuities across the four declarations, tracing how social justice has been framed and reinterpreted over time. The paper concludes by reiterating key insights and identifying implications for advancing equity-focused policy in the Australian education system.

Social Justice Goals

Since 1989, national education declarations have served as key instruments for articulating shared educational aspirations. These declarations are developed collaboratively by all education ministers and reflect a balance between national priorities and state/territory autonomy. Importantly, each Declaration reflects the social justice imperatives of its era, particularly concerning equity, inclusion, and the recognition of cultural diversity (Savage, 2020). The Hobart, Adelaide, Melbourne, and Mparntwe declarations each show a progression in the scope and articulation of equity (Properjohn et al., 2024), shifting from individualised understandings of disadvantage to more structural conceptions of inequality.

Social justice in education encompasses a broad and evolving set of aspirations aimed at reducing inequality, affirming diverse identities, and empowering learners to engage critically with the world around them. Increasingly, scholars emphasise that social justice is neither fixed nor singular, but rather a multidimensional and politically contested objective, shaped by context and ideology (Apple, 2014; Gewirtz, 1998). Within this discourse, two core dimensions of social justice goals have emerged: the *provision of socially just education* and the *promotion of social justice education*. Together, these dimensions reflect both structural and pedagogical commitments and offer a conceptual framework for analysing educational policy and practice.

The first dimension, *socially just education*, concerns the creation of an equitable and inclusive education system. It entails the fair distribution of resources, the cultivation of culturally sustaining school environments, and the development of policies that address systemic barriers

to participation (Connell, 1993). This approach to justice is concerned with dismantling structural inequalities to ensure that all students—regardless of socioeconomic background, race, gender, ability, or location—have access to high-quality education. In the Australian context, scholars such as Connell (2013) and Smyth (2011) have argued that neoliberal reforms—particularly the expansion of market-based school choice and high-stakes testing—have undermined equity by entrenching disparities in educational opportunities and outcomes.

The second dimension, *social justice education*, focuses on the content and processes of teaching and learning. It aims to develop students' critical consciousness, ethical reasoning, and civic agency by encouraging them to engage with questions of justice, inequality, and democracy (Freire, 1970; Sant, 2021). This pedagogical orientation involves both curriculum and methodology: incorporating diverse perspectives, confronting dominant power relations, and adopting dialogic, participatory approaches to teaching.

Socially Just Education

The idea of "socially just education" underscores the importance of creating educational systems and environments that prioritise equity, fairness, and inclusivity. At its core, socially just education emphasises a commitment to ensuring that all students have substantive opportunities for success, regardless of their background, identity, or socioeconomic status (REF). In advancing socially just education, policies widen access to education. The curriculum is tailored to reflect diverse perspectives, histories, and cultures, promoting a more inclusive and representative learning experience.

In terms of advancing socially just education, the declarations reflect an evolution in the understanding and articulation of inclusivity. The Hobart Declaration (1989) and The Adelaide Declaration (1999) both emphasise equality of educational opportunities, focusing on special learning requirements and eliminating negative discrimination. The Hobart Declaration (AEC, 1989) marked Australia's first attempt to establish a unified national vision for schooling, introducing ten common goals aimed at ensuring foundational skills, civic values, and economic productivity. It emphasised equitable access to schooling for all young Australians, marking a foundational step in recognising governments' responsibility to provide education as a public good. However, while socially just education was implied through the focus on participation and access, the framing remained narrow, with limited attention to cultural inclusion or differentiated needs. The aim was "to promote equality of educational opportunities and to provide for groups with special learning requirements" (Australian Education Council, 1989, p. 186).

The Adelaide Declaration deepened the commitment to equity by acknowledging the diverse needs of students and the need to provide support structures to achieve common outcomes. It introduced language around inclusivity and support for disadvantaged students, moving closer to a recognition-based approach to justice. Some of the stated goals include:

> Students' outcomes from schooling are free from the effects of negative forms of discrimination based on sex, language, culture, ethnicity, religion or disability, and of differences arising from students' socioeconomic background or geographic location.
>
> Aboriginal and Torres Strait Islander students have equitable access to, and opportunities in, schooling so that their learning outcomes improve and, over time, match those of other students. (MCEETYA, 1999, p. 230)

Although the policy recognised the diversity of learners, it fell short of committing to structural reforms to dismantle the systems that create educational disadvantage, reflecting an incremental evolution in the framing of socially just education.

The Melbourne Declaration (2008) broadens the scope, explicitly addressing discrimination based on various factors. It marked a significant shift by explicitly stating that governments should support not only "equality of opportunity but also more equitable outcomes." This emphasis on outcomes acknowledges that the same resources and access do not lead to the same results for all students. The document also stressed closing achievement gaps between Indigenous and non-Indigenous students, and between students from different socioeconomic backgrounds. Some of the equity goals included:

> Provide all students with access to high-quality schooling that is free from discrimination based on gender, language, sexual orientation, pregnancy, culture, ethnicity, religion, health or disability, socioeconomic background or geographic location.
>
> Ensure that the learning outcomes of Indigenous students improve to match those of other students.
>
> Reduce the effect of other sources of disadvantage, such as disability, homelessness, refugee status and remoteness. (MCEETYA, 2008, p. 7)

The Alice Springs (Mparntwe) Declaration (2019) further advances this by explicitly promoting inclusive education free from any form of discrimination, recognising individual needs, and encouraging personalised learning. It foregrounds commitments to Aboriginal and Torres Strait Islander students, cultural responsiveness, and the importance of wellbeing. The language reflects a fusion of redistribution and recognition, with stronger acknowledgements of historical and ongoing inequities. Notably, the Declaration includes references to community engagement and partnerships, hinting at representational justice. Thus, it articulates socially just education in a more multidimensional and relational way than its predecessors. The aim is to:

> Encourage young people to hold high expectations for their educational outcomes, supported by parents, carers, families and the broader community. (Education Council, 2019, p. 5)
>
> Support all young Australians at risk of educational disadvantage: learners such as those from low socioeconomic backgrounds, those from regional, rural and remote areas, migrants and refugees, learners in out of home care, homeless young people, and children with disability to reach their potential. (p. 6)
>
> Provide all young Australians with access to high-quality education that is inclusive and free from any form of discrimination. (p. 17)

The Alice Springs Declaration uniquely emphasises the need to empower learners to overcome barriers, promote personalised learning, and encourage young people to hold high expectations for their educational outcomes. It goes further, emphasising the need to recognise individual needs, overcome barriers, and support Indigenous learners to achieve their full academic

potential. The underpinning assumption is that compensatory opportunities are provided to create a level playing field for First Nations students.

Social Justice Education

Social justice education involves continuously engaging students in examining and evaluating the world around them from their unique perspectives. It focuses on curriculum, pedagogy, and student agency — equipping learners to recognise and challenge injustice within and beyond the classroom. This includes teaching about First Nations histories, critical engagement with power and privilege, and fostering active citizenship (Beresford et al., 2012; Dudgeon et al., 2017). Social justice education encourages critical thinking about social issues, fostering an environment where students can analyse, question, and engage with pressing societal problems. It engages students in analysing historical cases of injustice and contemporary inequalities across the political, cultural, economic, educational, health, and environmental domains of life. The aim is to build democratic, active, and fair citizens who value and promote social justice. While the declarations increasingly gesture toward both, the former has often received more policy attention, whereas the latter — particularly in its more critical and transformative forms — remains underdeveloped in practice (Moodie, 2020).

The national education declarations support social justice education by prioritising cultural respect and instilling values of fairness and inclusion in students. The declarations exhibit a progression in acknowledging the importance of cultural understanding. The Hobart Declaration (1989) emphasises respect for cultural heritage, specifically mentioning Aboriginal and ethnic groups. It puts one of its aims as "to develop in students… a capacity to exercise judgement in matters of morality, ethics and social justice" (Australian Education Council, 1989, p. 187).

The Hobart Declaration's commitment to developing "a capacity to exercise judgement in matters of morality, ethics and social justice" marks an early and significant recognition of education's moral and civic dimensions. This statement embeds a vision of the student as an ethical agent, capable of critical reflection. However, the policy stops short of defining what counts as social justice or how it might be explored pedagogically. The mention of "understanding and respect for our cultural heritage" — especially for "Aboriginal and ethnic groups" — is notable for its time, but the framing centres on respect and tolerance rather than engaging with power, dispossession, or systemic injustice. The approach is largely civic-liberal, promoting social harmony without critically interrogating social hierarchies.

The Adelaide Declaration (1999) extends the Hobart framing to emphasise the value of cultural and linguistic diversity and reconciliation as a specific national imperative.

The expectation that "all students understand and acknowledge the value of cultural and linguistic diversity" marks a stronger pedagogical commitment to historical awareness and future-oriented civic participation. Importantly, the Declaration expected that "all students understand and acknowledge the value of Aboriginal and Torres Strait Islander cultures to Australian society and possess the knowledge, skills and understanding to contribute to, and benefit from, reconciliation between Indigenous and non-Indigenous Australians" (MCEETYA, 1999, p. 230).

The promotion of "cultural and linguistic diversity" and acknowledgement of "the value of Aboriginal and Torres Strait Islander cultures to Australian society" are well aligned with the

nation's multicultural ethos. Still, the language frames students as beneficiaries of diversity rather than as critical actors equipped to dismantle inequality. The focus is on appreciation and participation, not transformation. This positions social justice education as a soft tool for cohesion rather than a radical force for equity.

The Melbourne Declaration (2008) calls for schools to build on local Indigenous knowledge and experiences as a foundation for learning. It takes a further step toward a transformative conception of social justice education by instructing schools to build on local cultural knowledge and experience of Indigenous students as a foundation for learning. The Melbourne Declaration aims, inter alia,

> ensure that schools build on local cultural knowledge and experience of Indigenous students as a foundation for learning.
>
> ensure that schooling contributes to a socially cohesive society that respects and appreciates cultural, social and religious diversity. (MCEETYA, 2008, p. 7)

This reverses the deficit logic often associated with marginalised students and elevates cultural capital as central to pedagogical design. The call for schooling to "contribute to a socially cohesive society" echoes earlier declarations but adds sharper attention to respect for "religious" as well as cultural and social diversity. However, the language remains largely instrumental, emphasising harmony over critique.

The Alice Springs (Mparntwe) Declaration (2019) presents the most ambitious articulation of social justice education. It retains the emphasis on cohesion and diversity but deepens the commitment to inclusion through stronger verbs and more relational language. It continues to stress the importance of inclusion of local, regional, and national cultural knowledge, fostering a more comprehensive approach to cultural inclusion and social cohesion. Some of the social justice education goals include:

> ensure that education promotes and contributes to a socially cohesive society that values, respects and appreciates different points of view and cultural, social, linguistic and religious diversity.
>
> ensure that learning is built on and includes local, regional and national cultural knowledge and experience of Aboriginal and Torres Strait Islander peoples and work in partnership with local communities. (Education Council, 2019, p. 5)

The recognition of "different points of view" assumes an expanded, dialogic classroom space, positioning students not only as participants in diverse societies but also as potential agents of transformation. Such an approach reframes education as a site of encounter—where difference is not merely tolerated but actively engaged as a resource for collective learning and ethical understanding. By promoting respect for cultural, linguistic, and religious diversity, schools contribute to the cultivation of a socially cohesive society founded on mutual recognition and shared responsibility. The commitment to include the "local, regional and national cultural knowledge and experience of Aboriginal and Torres Strait Islander peoples" further underscores a pedagogical and moral imperative: to value Indigenous knowledges as central to Australia's educational narrative, rather than as peripheral additions. Working in genuine partnership with local communities invites educators to move beyond symbolic inclusion towards reciprocal relationships that honour place-based wisdom, foster intercultural dialogue,

and challenge historical exclusions. In this sense, the framework articulates a vision of social justice in education that is both redistributive and recognitive—seeking to equalise opportunity while affirming the plural identities and knowledges that shape Australia's democratic life.

Changes and Continuities

Across the four declarations, a discernible shift is evident from a minimalist equity framework towards a more multidimensional conception of socially just education. A clear evolution toward a more expansive, detailed, and multifaceted understanding of justice in schooling is evident. The early Hobart (1989) declaration frames social justice primarily as *equality of opportunity* and support for students with special learning needs, while its corresponding social justice education goals emphasise moral development and cultural respect in broad terms. By Adelaide (1999), the focus shifts more explicitly to eliminating discrimination based on race, language, culture, disability, socioeconomic status, and geography, signalling a sharper policy recognition of structural disadvantage. Melbourne (2008) further expands this agenda by listing a wider range of disadvantages—such as refugee status and homelessness—and highlighting personalised learning as a vehicle for equity. Finally, the Alice Springs (Mparntwe) Declaration (2019) adopts the most holistic and learner-centred framing, emphasising inclusivity, individual needs, empowerment, community partnership, and the co-construction of culturally grounded learning, especially with Aboriginal and Torres Strait Islander communities. Across the social justice education column, there is also a notable shift from general cultural respect (1989) to increasingly explicit commitments to reconciliation, cultural diversity, and Indigenous knowledge as foundational to learning (1999–2019), culminating in a partnership-based, place-responsive approach in 2019.

In other words, the Hobart and Adelaide Declarations framed equity primarily as access and participation, aligning with liberal notions of meritocracy. These early declarations assumed a level playing field, with less attention to the deeper structural factors shaping educational outcomes. The Melbourne and Mparntwe Declarations, on the other hand, articulated equity more robustly, recognising systemic disadvantage affecting Aboriginal and Torres Strait Islander learners and students from refugee and migrant backgrounds and the need for equity in learning opportunities, wellbeing, and digital access. The Melbourne Declaration includes more sustained reference to Indigenous cultures and histories, and the Mparntwe Declaration deepens this commitment by foregrounding Aboriginal and Torres Strait Islander perspectives. Further, while early declarations are largely silent on questions of participatory inclusion in education governance, the Mparntwe Declaration makes an important shift by recognising the agency of young people and advocating for greater involvement of Indigenous communities in shaping educational futures. However, as Properjohn et al. (2024) observed, despite progressive language over time, the declarations continue to reflect colonial dominance by framing Indigenous education within deficit discourses and assimilationist perspectives. Representation remains underdeveloped as a justice goal, with limited mechanisms proposed for shared authority or decision-making in education systems.

Despite these changes, the declarations also demonstrate enduring continuities in their core commitments to social justice in education. All four frameworks recognise that educational systems must work to address educational disadvantage and promote fairness in schooling outcomes—reflecting a consistent policy logic that equitable access and participation are central to Australian schooling. Similarly, across all declarations, social justice education is linked to fostering respect for cultural diversity, encouraging ethical and socially responsible behaviour, and valuing the contributions of Aboriginal and Torres Strait Islander peoples.

While the specificity and language become more sophisticated over time, the underlying premise remains steady: education plays a crucial role in shaping a cohesive, respectful, and inclusive society. These continuities suggest that, even as contexts shift and policy language evolves, the foundational goals of equity, respect, diversity, and cultural understanding remain a constant across the national policy landscape.

Over the three decades spanned by the four declarations, we see a marked evolution in the way *social justice education* is framed. The Hobart and Adelaide Declarations focus on moral development and respect for diversity, positioning students primarily as tolerant citizens. While these goals are not insignificant, they rely on depoliticised conceptions of justice that skirt around questions of power, oppression, and resistance. Diversity is valued, but there is little sense that students are being prepared to challenge systemic injustice. By contrast, the Melbourne and Mparntwe Declarations reflect a maturing vision of social justice education. Melbourne introduces the idea of culturally responsive pedagogy, while Mparntwe goes further by embedding local knowledge systems and calling for partnerships with Indigenous communities. These shifts suggest an increasing recognition of students' sociocultural contexts as assets in the learning process and a growing commitment to empowering learners as agents of justice. Despite this progress, the overarching tone across all declarations continues to favour social cohesion and shared values over confronting structural inequality. The tension between celebrating diversity and confronting injustice remains a defining feature of Australia's national policy discourse on social justice education.

There is also a lack of conceptual clarity regarding equality and equity. Equality in education refers to the idea that all individuals, regardless of background, should have equal access to resources, opportunities, and educational experiences. The focus is on uniform treatment and distribution of educational resources, aiming to provide everyone with the same starting point and level of support. Whereas equity in education recognises that individuals may start from different positions, facing diverse challenges and needs. Equity aims to address these disparities by providing resources and support that are responsive to the unique circumstances of each individual or group. It may involve giving unequal opportunities for equal outcomes.

The patterns of change and continuity across the four national Education Declarations reveal a policy trajectory characterised by both increasing complexity and enduring foundational values. Over time, the declarations broaden from a relatively narrow focus on equality of opportunity to a more nuanced recognition of diverse learner needs, intersectional disadvantage, and culturally responsive education—especially with respect to Indigenous communities. At the same time, persistent commitments to equity, inclusion, cultural respect, and social cohesion anchor the declarations across three decades, demonstrating that while policy directions adapt to emerging social, cultural, and political contexts, the core social justice aspirations of Australian schooling remain stable. This interplay between continuity and evolution reflects a system balancing longstanding national values with the need for more responsive and sophisticated approaches to justice and inclusion in education.

Conclusion

The analysis of the four national education frameworks shows that Australia's governments demonstrated a progressive commitment to social just goals, expanding from a focus on equal opportunities to a more nuanced understanding of inclusivity, individual needs, and the empowerment of learners. While early declarations primarily addressed social justice through the redistribution of opportunities and the reduction of disadvantage, later iterations expanded

these concerns to include recognition of diversity, personalised learning, and the holistic development of learners. The Melbourne (2008) and Alice Springs/Mparntwe (2019) Declarations, for instance, move beyond a deficit-oriented framing of equity to incorporate wellbeing, empowerment, and local knowledge as integral to educational justice. These changes suggest a gradual evolution from a narrow focus on equal outcomes towards a more relational and culturally responsive understanding of justice. Parallel shifts are evident in the framing of social justice education—the moral, ethical and civic dimensions of schooling. Whereas the Hobart and Adelaide Declarations positioned social justice education in terms of moral reasoning and intercultural understanding, later declarations increasingly emphasise community partnership, reconciliation, and the value of Indigenous knowledges. The Melbourne Declaration introduces an explicit focus on social cohesion and cultural respect, themes that are deepened in the Mparntwe Declaration's recognition of Aboriginal and Torres Strait Islander cultures and the call for learning grounded in local contexts.

These findings point to a need for policy work that consolidates, rather than merely accumulates, the progressive shifts evident across the four frameworks. A coherent way forward requires translating the declarations' aspirational language into sustained, system-level action that centres cultural responsiveness, community partnership and the valuing of Indigenous knowledges. This includes resourcing schools to enact locally grounded pedagogies, strengthening mechanisms for accountability to equity goals, and ensuring that learners and communities historically marginalised within Australian schooling have a substantive voice in policy design. Advancing social justice in education will therefore depend on moving beyond rhetorical commitment toward practical, context-sensitive strategies that embed inclusion, recognition and relational responsibility within everyday schooling.

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Liminal Legality and Educational Inequality: The Long Road to Social Justice for Indonesian Migrant Children on the Sabah-Sarawak Border

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Abstract

This study examines the liminal legal status of Indonesian migrant children in Sabah and Sarawak, Malaysia, focusing on their educational challenges and the broader implications of their uncertain citizenship status. These children, born to migrant workers, often find themselves trapped between legality and illegality, without clear nationality recognition, which significantly limits their access to formal education and other essential services. Despite the palm oil industry's critical role in Malaysia's economy, which relies heavily on migrant labour, these children are systematically excluded from the formal education system. Alternative educational opportunities are provided through Community Learning Centres (CLC) run by local organisations and religious institutions, but these programmes lack formal recognition from the Malaysian government. As a result, these children often remain in a state of "semi-legal" existence, facing barriers to accessing fundamental rights such as education, healthcare, and legal protection. This paper highlights the complexity of their situation and draws on a phenomenological approach to understand the lived experiences of these children. It also examines how their social identities are shaped by their ambiguous legal status, creating a sense of marginalisation and uncertainty. The study advocates for more inclusive and culturally sensitive policies that integrate Indonesian migrant children into Malaysia's education system and safeguard their fundamental rights and urges both countries to enhance cooperation on migrant rights, education, and social protection.

Keywords: Indonesian migrant children, liminal legality, educational inequality, Community Learning Centres, Malaysia

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Introduction

Sabah and Sarawak, Malaysian states located on the island of Kalimantan, have become meeting places for various ethnicities and cultures, especially since the enormous wave of migration from the Philippines and Indonesia in the 1970s (Allerton, 2014, 2017). Non-citizen migrant children face complex and multi-layered challenges, particularly related to their unclear legal status and access to education (Nesadurai, 2013). This study aims to explore the ambiguous zone between legality and illegality experienced by children of migrant workers from Indonesia in Kinabalu, Sabah, and Kuching, Sarawak, and how their experiences are influenced by factors such as age, gender, ethnic appearance, and the use of unofficial identity documents. Migrant children in Sabah and Sarawak are often trapped in uncertain situations, systematically excluded from Malaysia's formal education system. Although they may have access to education through alternative learning centres established by various organisations, including churches and mosques, the education they receive is often not officially recognised. This creates a situation in which migrant children must struggle to gain recognition and their rights as individuals, even though they do not have clear citizenship status (Gurowitz, 2000).

This study describes how their experiences of anxiety increase as they get older. This anxiety stems from their awareness of the difference in legal status between themselves and their peers who are Malaysian citizens. Allerton's (2024) research report, for example, tells of migrant children who often use fake birth certificates to attend Malaysian primary schools, while other studies reveal that they did not feel afraid when they were young, even though they did not have official identity documents (Allerton, 2024). These studies are their experiences, which show that migrant children often live in a liminal state, where they operate between legality and illegality, and must navigate various challenges that arise from their unclear status.

As explained earlier, schools are considered special places where children practise citizenship. However, in Malaysia, the explicit exclusion of migrant and refugee children from government schools makes it much more difficult for them to see and have the same form of cultural ownership as their citizen peers. Although Sabah and Sarawak are heavily dependent on foreign labour to support their economies, migrant and refugee children are often considered a "category error" that does not have the right to education. This policy contradicts the human rights principles enshrined in the UN Convention on the Rights of the Child, which guarantees all children the right to a free basic education. Furthermore, we examine how the experiences of migrant children in Sabah and Sarawak can be understood through the lens of the concepts of "liminal legality" and "semi-legality" (Allerton, 2018). These concepts help explain how migrant children can claim conditional forms of legality, even though they do not have clear citizenship status.

Social and Historical Context of Migration in Sabah and Kinabalu

Large companies in Malaysia, such as Sabah Land and Development Berhad (SLDB), collaborated with the Indonesian Consulate in Sabah to establish CLCs for migrant workers' children. However, these facilities were often limited and isolated from city centres, creating a separate social space between migrants and the local community (Wahab & Abd, 2022). The history of migration also reflects different narratives between the country of origin and the destination country. From Malaysia's perspective, migrants are often portrayed as temporary workers who are here to meet labour needs, without the right to become permanent members of society. Conversely, from the perspective of the Indonesian migrant community, migration to Sabah and Kinabalu is seen as a continuation of historical cross-border relations.

Many migrant families emphasise that they have lived in Sabah for several generations, so they do not consider their presence to be merely temporary. This conflicting narrative creates a grey area, where migrant children are caught between Malaysia's economic claims and Indonesia's genealogical ties, but do not receive full recognition from either. The existence of migrant children in the history of cross-border migration shows that migration is not merely a movement of labour, but a complex social process.

According to Galli and Garip (2024), by placing children at the centre of analysis, we can gain a deeper understanding of the roles of age, intergenerational family dynamics, and social processes in shaping migration experiences. De Haas (2021) asserts that human mobility is an integral part of broader social change processes. They were born into families of plantation workers who struggled for a better life but grew up in uncertain legal conditions. With relatively low skills, they generally chose jobs such as domestic work, factory work, plantation work, and other unskilled work (Wulan et al., 2024). On the one hand, they were a product of Malaysian development policies that required cheap labour.

On the other hand, they were also a consequence of economic and social limitations in their regions of origin. Marotta (2025) argues that liminal or “in-between” conditions can shape individual identities and experiences in the context of migration. Thus, the history of migration in Sabah, specifically in Kinabalu, is not only about worker mobility but also about the formation of a liminal generation that continues to live in uncertainty regarding their identity and citizenship.

Economic and Social Factors Driving Migration

In terms of driving factors, unstable economic conditions, high poverty rates, and limited job opportunities in Indonesia, particularly in regions such as South Sulawesi and East Nusa Tenggara, are the main reasons families send their members to work in Malaysia. This finding aligns with Djafar and Hassan's (2012) findings, which showed that Indonesian migrant workers in Malaysia are significantly influenced by income and unemployment, with positive effects in Indonesia and adverse effects in Malaysia. For many low-income families, migration is not only a choice but a necessity for survival. Low incomes in the local agricultural sector are insufficient to meet daily needs, while in Malaysia. However, plantation wages are considered low by local standards; they are still higher than what can be earned in the villages. On the pull side, Malaysia offers better economic prospects and strong labour demand in the palm oil plantation, construction, and agriculture sectors. Large companies offer stable employment opportunities, though these often come with long hours and minimal legal protections.

For migrants, the pull factors are not only wages, but also the availability of basic facilities provided by companies, such as housing, community schools, and basic health services. Although these facilities are limited, their existence suggests that migration to Malaysia is more promising than staying in their villages of origin, which are often constrained. Workers are often recruited through a system of recommendations from family members or friends who have already settled on the plantations, creating a chain of intergenerational migration. Wahyudi's (2017) research findings show that social capital in their networks develops through various channels, particularly friendship, kinship, neighbourhoods, communities, and ethnic groups.

The direct impact of these economic and social factors is clearly evident in the lives of migrant children, who are the generation born of their parents' choice to seek a livelihood in Malaysia, but who grow up with limitations. These children generally only have access to community schools provided by companies or non-governmental organisations. Although education is provided, the curriculum is limited and rarely recognised by the state. These limitations place migrant children in a vulnerable position; they enjoy the fruits of their parents' economic decision to migrate, but at the same time, they inherit an unclear legal status. Studies on migration between the two countries must encompass all relevant migration factors to obtain a comprehensive picture of migration (Wekke, 2013). Furthermore, these economic and social factors not only encourage migration but also shape the way migrant children view themselves. They grow up with hopes for a better life, but reality shows discrimination, exclusion and limited rights.

A child at the CLC recounted how his parents migrated because wages in Malaysia were higher. However, he still felt different because he lacked official documents to continue his education. This testimony shows that economic and social factors are not only determinants of migration but also the basis for the formation of migrant children's liminal identity in Sabah and Kinabalu. This situation emphasises the need for the state to play a role through bilateral cooperation (MoU) with Malaysia to ensure comprehensive protection for migrant workers, including their children, especially in vulnerable sectors such as domestic workers (Wijayanti & Turgel, 2021). The presence of migrant workers in Sabah and Kinabalu has become one of the important pillars of Malaysia's economic development. Palm oil plantations, which are a strategic industry and a major contributor to the country's foreign exchange, are highly dependent on migrant workers from Indonesia and the Philippines. Crowley's (2020) research on labour in Malaysia found that the initial focus on replacing foreign workers with local workers was not entirely practical, shifting instead to retaining foreign workers and training Malaysians for technical and managerial positions in the industry. The position of migrant children in the socio-economic context reveals deeper vulnerabilities. They are born in Malaysia, grow up in plantation environments, and interact with local communities, but their legal status is unclear. Without a valid birth certificate or passport, they cannot access formal education, continue secondary school, or work in the formal sector as adults.

The Position of Migrant Children in Malaysian Policy

Malaysian education laws require citizenship documents or official residence permits, which most migrant children do not have. As a result, they are systematically directed to Community Learning Centres (CLCs) managed by plantation companies, community organisations, or religious institutions. CLCs do provide learning spaces, but the Malaysian government does not formally recognise them. Thus, diplomas obtained from CLCs are not equivalent to those from public schools and therefore cannot be used to continue education at a higher level or to access formal employment. This limitation shows that the education of migrant children is positioned not as a means of social mobility, but as an instrument for the reproduction of plantation labour. According to Allerton (2020), this is a clear example of indifference on the part of individuals in power who should be more aware of their workers' children. This situation contrasts sharply with that of Malaysian children, who have full access to public schools and national education programmes. This difference creates a widening social gap, with migrant children trapped in a limited education system, while local children move on to formal education recognised by the state. In addition to limitations in education, migrant children also face social discrimination in their daily lives. They are often viewed as "outsiders," even though they were born and raised in Sabah and the Kinabalu region. This discrimination takes

many forms: differential treatment at school, negative stereotypes from the local community, and government policies that reinforce their position as a marginalised group. This situation gives rise to feelings of inferiority, alienation, and identity confusion among migrant children. Migrant workers and their families are often vilified, their contributions to Malaysia are rarely recognised, and there is no public discussion of migrants' rights (Gurowitz, 2000). Government Regulation (PP) No. 28 of 1990 on Primary Education stipulates a nine-year compulsory primary education programme to expand educational opportunities for all citizens and improve the quality of human resources. This programme is intended for all Indonesian citizens aged seven to fifteen, both within and outside Indonesia (Tilaar, 2014). However, they are excluded from formal education, directed to limited education pathways in CLCs and face social discrimination in their daily interactions. The state's selective policies reinforce their position as a marginalised group valued only as labourers, not as members of society. Thus, migrant children live in a situation of semi-legality that reflects legal uncertainty, limited fundamental rights, and institutionalised social discrimination.

This study employs qualitative methods, drawing on Creswell's (2018) phenomenological approach, to explore and understand the experiences of Indonesian migrant children in Sabah and Sarawak. It describes their daily lives, particularly how migrants consciously construct meaning from their interactions with other communities, especially the Malaysian community. This study will focus on migrants' experiences as individuals, examining how they subjectively perceive their experiences and assign meaning to the phenomena of legality and illegality from the perspectives of identity and citizenship. The phenomenological approach will provide an overview of the structure of thought, explore the values in life experiences, and discover the meaning and essence of experiences, rather than simply seeking explanations or measures of reality. The citizenship identity of migrant children is expected to be obtained from a first-person perspective through formal and semi-structured interviews.

This study is based on semi-structured interviews conducted in Kinabalu, Sabah, and Kuching, Sarawak, with Indonesian migrant children who meet the research criteria. This study identifies four clusters of meaning. First, we asked the informants about their place of birth, including aspects they may not be aware of, and their knowledge of international relations between their country of origin and their country of residence. We also explored the impact of these relations on their lives in Malaysia. Second, we investigated the migration and legal processes, with questions about the reasons for emigration, the process of arrival in Malaysia, previous contacts in Sabah and Sarawak, the difficulties encountered in legalising their status, and their plans for staying in the country. Third, discuss the issue of citizenship applications, including whether the informants have applied or plan to apply for citizenship, the reasons behind this decision, and how they believe this affects their integration and access to rights, including voting rights. We also explore their experiences in the application process and their reflections on their identity and choice of citizenship. Fourth, discussing a sense of belonging and identity, including experiences of exclusion as foreigners and how factors such as accent, culture, gender, and economic or educational level affect their integration process.

The Educational Experiences of Migrant Children

Access to Formal Education

Indonesian migrant children in Sabah and Kinabalu are unable to attend school full-time. However, formal education is universally recognised as a fundamental right of children that should guarantee equal access to knowledge (Ramadhan et al., 2022). The main obstacle faced

by migrant children is related to official documents. Malaysian regulations require a passport, residence permit, or valid identity card for students who wish to attend public institutions. In addition to regulations, the complicated bureaucracy and high costs further burden migrant families. Many parents work on palm oil plantations for low wages. Passports are usually issued on the company's guarantee and are renewed only once a year. Thus, administrative barriers not only hinder access but also reinforce social inequality between citizens and migrants (Anggraeni et al., 2025). As a result, migrant children grow up feeling marginalised. They realise early on that their educational opportunities depend on documents they do not possess. This situation creates a psychological gap compared to local children and narrows their future social mobility (Song, 2010). In an effort to overcome these obstacles, many migrant families use emergency documents or borrowed identities issued by the community or consulate. One student said that the identity cards they had, as well as family cards and birth certificates, were obtained through the Indonesian consulate. This demonstrates a form of semi-legality, where some institutions recognise the documents, but they are not entirely valid within the Malaysian system. This strategy represents a form of agency or effort by families to advocate for their children's right to education, despite its legal fragility. In this way, children can still attend school, but without any guarantee of continuity (Menjívar, 2006).

Limited access to formal education has a direct impact on children's psychological development. They often feel different from their peers, bear the stigma of being an outsider, and lose their self-confidence. One respondent said: “If asked to choose, I would still choose Indonesia, because that is where I come from. However, I was born here.” This statement confirms that the lack of documents leaves children living amid citizenship ambiguity: born in Malaysia, but not recognised by Indonesia, and without full access. Structurally, interrupted education reduces migrant children’s opportunities to obtain formal skills and state-recognised qualifications. Without educational documents, opportunities to continue to higher levels of education are minimal. Ultimately, they are more likely to be absorbed into the same low-wage jobs as their parents. Thus, legal and administrative barriers to accessing formal education are not only technical problems, but also part of the political dynamics of citizenship. Education, which should be a path to social mobility, has instead become a mechanism of exclusion, placing migrant children in a “semi-legal” position in the society in which they grow up.

When access to formal schools is closed, alternative education becomes the most feasible solution for migrant children. This education comes from community initiatives, religious institutions, and non-governmental organisations (NGOs) that seek to guarantee children's fundamental right to continue learning. Although the state does not recognise its status, the existence of alternative education provides an important space to build fundamental skills while maintaining hope for a better future.

The Role of NGOs, Religious Institutions, and Communities

Many migrant children in Sabah access education through Community Learning Centres (CLCs). The presence of such institutions ensures that children continue to have access to basic literacy even though they are excluded from public schools (Febiola, 2023). Additionally, CLCs serve as social spaces. One student recounted how they made friends with the Sabah children. However, alternative education has its limitations. At the BomBalai CLC, there is only one teacher, Ms Ade, who has to teach all subjects, including Pancasila and Civics. In addition to teacher limitations, facilities are also minimal. As a result, the quality and scope of education are uneven, often stopping at the basic level (Loganathan et al., 2022). The Malaysian government does not recognise CLC certificates, so children who graduate cannot

continue their education to secondary school or university. This means that children who graduate from community schools receive recognition only within the community, without the legal right to continue their education beyond secondary levels (Tjandraningsih et al., 1996). Alternative education serves only as an emergency measure, rather than an official pathway that can alter the social status of migrant children (Hossain & Sengupta, 2009).

Nevertheless, the existence of CLCs reflects community solidarity. Religious institutions, consulates, and NGOs provide learning spaces to prevent children from becoming illiterate. Children still have hope, albeit in limited amounts. However, the "semi-legal" status of alternative education places them in a liminal situation. They can study, but they have no formal legitimacy. This hinders social mobility, and children grow up with the awareness that their education could end at any time if the state no longer allows tolerance.

Fundamental Rights, Services and Legal Uncertainty

Access to Basic Services

The fulfilment of children's fundamental rights is not limited to education; it also includes health, legal protection, and population administration. These three aspects are important foundations for ensuring the quality of children's lives (Romadhona, 2025). Access to healthcare services in Malaysia typically requires official documents, such as a passport or a residence permit. Without these documents, migrant children are categorised as foreigners and charged high fees at public hospitals. As a result, many migrant families prefer small private services, traditional medicine, or even delay treatment until their condition worsens. This policy creates structural discrimination because migrant children are treated differently based solely on their administrative status. Kaur's (2014) research shows that migrant workers and their families face serious obstacles in obtaining public health services due to unclear documentation. Thus, the health of migrant children is more often seen as an economic burden rather than a fundamental right. As a result, migrant children tend to have below-standard health. Low access to immunisation, nutrition, and medical care affects their growth and development.

In addition to health, legal protection is also uncertain. Mrs Lili, an Indonesian Consular official in Sabah, explained that many migrant children who are victims of violence or exploitation cannot be prosecuted due to a lack of documentation. Trauma and fear of facing the authorities cause many families to remain silent. As a result, a culture of silence emerges, where cases of violence, abuse, and exploitation are left without legal protection (Lim et al., 2024). This kind of trauma impacts psychological development, lowers self-confidence, and limits their ability to participate fully in social life (ILO, 2006). This condition shows how migrant children are in a situation of *liminal legality*, as described by Menjívar (2006), where they are present in society but do not have official protection when their rights are violated. The receiving country takes advantage of this legal uncertainty to maintain migrants' subordinate position. Without birth registration, they lose the fundamental rights typically afforded to citizens, including access to education, health care, and legal protection. *Statelessness* ultimately renders them "invisible" to the law.

On the other hand, some children are in a state of *contingent legality*, for example, having a passport valid for one year with a guarantee from a palm oil company. However, this status is temporary. Maureen and Blitz (2011) refer to this condition as a form of flexible exclusion, in which the state provides limited access while still maintaining restrictions on migrants' civil

rights. As a result, children live in a state of constant legal uncertainty. Although they are present in the social system (going to school, making friends, participating in community activities), this recognition is fragile. Menjívar (2006) refers to this condition as *the grey zone of legality*, where a person is present in the social system but lacks complete legal legitimacy. The state deliberately leaves them in an ambiguous position to maintain the boundary between citizens and non-citizens (Block et al., 2024). Legal limitations not only hinder formal access but also shape a pattern of life full of uncertainty and structural vulnerability, thereby reinforcing the cycle of social marginalisation and economic (Tjandraningsih et al., 1996).

The situation of migrant children in Sabah and Kinabalu contradicts the UN Convention on the Rights of the Child (CRC), which affirms that every child has the right to education, health, and protection without discrimination. However, in practice, migrant children face systematic barriers due to their legal status (Viviansari & Prameswari, 2019). The impact of this situation extends beyond the legal realm into the moral sphere. Migrant children grow up feeling uncertain and without any guarantee for the future. They learn from an early age that their rights can be ignored simply because of their weak legal status. Thus, the daily lives of migrant children in Sabah are clear evidence of the gap between universal human rights principles and the practice of state policy.

Navigating Identity Between Two Worlds

At home, they inherit the Indonesian language, religion, and cultural values; while outside, they adapt to local Malaysian customs. Hall (1990) asserts that identity is always fluid and negotiated in everyday experiences, so it is natural for migrant children never to have a single, definitive identity. This condition forms a "*hybrid* identity", in which they are both Indonesian and Malaysian, but are not entirely accepted in either country (Bhabha, 1994). One student explained that they are accustomed to using two languages interchangeably: "When studying, we use Indonesian, but when talking with friends, we use more Sabahese." This dual identity creates ambivalence, but also gives them the ability to navigate across cultures. Migrant children's sense of belonging is also ambivalent. On the one hand, they feel close to the local community because they attend the same school and play together. On the other hand, their attachment to Indonesia remains strong. Formal education, health insurance, and residency documents available to residents are not available to migrant children, causing them to experience "othering" or being labelled as outsiders (Castles & Miller, 2009). In addition to differences in status, migrant children also face social discrimination. Some students recounted experiences of being looked down upon by local children. Fox et al. (2013), using Berry's acculturation theory, explain that many migrant children are trapped in a position of marginalisation, neither fully accepted by the dominant culture nor fully able to access their culture of origin. Living in two worlds causes migrant children to experience a form of double consciousness (Baysu et al., 2011).

The situation faced by migrant children highlights the importance of inclusive policies that emphasise not only legal aspects but also socio-cultural dimensions. Alternative education run by communities, for example, can be strengthened by incorporating Indonesian cultural values, mother tongue, and community solidarity (Abdusamatov et al., 2025). This can be seen at CLC Sungai Balung, where teachers continue to teach Indonesian and Pancasila even though students speak Sabahese daily. One student said, "We use Indonesian in class, but when we play outside, we speak the Sabah language." Community schools are strategic spaces for preserving Indonesian cultural roots while facilitating integration with the local environment.

Additionally, a hybrid education model that integrates the Indonesian and Malaysian curricula could be a long-term solution. With this kind of curriculum, migrant children can continue their education in both countries. This step not only provides opportunities for social mobility but also helps prevent the erosion of Indonesian national identity among younger migrant generations. A socio-cultural approach can also be a gateway to more humanistic diplomacy. Instead of emphasising purely political aspects, Indonesia can emphasise cultural proximity, history and kinship as a basis for negotiation. Thus, inclusive policies are not only legally and formally established, but also grounded in the social reality of border communities. This is the direction that must be considered if both countries truly want to resolve the issue of migrant children fairly: policies that integrate legal protection with a cultural approach, as well as education that prepares children not only to become citizens but also to become transnational actors capable of navigating two worlds.

Conclusion

Indonesian migrant children in Sabah and Kota Kinabalu experience structural vulnerability due to their ambiguous citizenship status, which restricts access to fundamental rights, particularly education, healthcare, and legal protection. Although many are born and raised in Malaysia, the absence of formally recognised citizenship leaves them in a "semi-legal" condition, reinforcing social exclusion and limiting future mobility. Reliance on Community Learning Centres (CLCs), while crucial, further marginalises them, as the education they provide is not fully integrated into the Malaysian formal system, thereby constraining pathways to higher education.

These findings highlight the urgent need for more inclusive national and regional policy responses. At the national level, formal recognition of CLCs and expanded access to public education and healthcare services are essential. At the regional level, stronger ASEAN cooperation is required to harmonise child protection standards, particularly through mechanisms such as the ASEAN Commission on the Promotion and Protection of the Rights of Women and Children (ACWC). Ensuring migrant children's rights should be treated as a shared regional responsibility in line with the Convention on the Rights of the Child, so that they are no longer confined to a legal and social "grey area." However, they can develop with dignity and equal opportunities.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing tool, was used to proofread and refine the manuscript's language. Its use was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies were used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are written initially and derived from the appropriate and systematic conduct of the research.

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Examining the Relationship Between TOEIC Scores and Employability Outcomes of Filipino Graduates

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Abstract

This study investigated the correlation between TOEIC (Test of English for International Communication) scores, aligned with the Common European Framework of Reference for Languages (CEFR), on the employability and workplace performance of recent graduates from higher education institutions in Bulacan, Philippines. Utilizing a mixed-methods explanatory sequential design, the research combined quantitative data from 50 TOEIC-certified graduates with qualitative insights from 10 of their employers. Quantitative findings revealed a clear positive correlation between higher English proficiency and key employment outcomes, such as faster job placement, a greater number of job offers, and higher self-perceived employability; particularly, a 0.86 Pearson r correlation between TOEIC scores and self-perceived employability. Graduates with C1 CEFR-level scores secured employment more rapidly and received significantly more job offers than their A1-level counterparts. Qualitative data, analyzed thematically, further revealed that C1-level employees exhibited strong communication competence, adaptability, and professionalism, whereas A1-level employees, although behaviorally competent, displayed limited verbal engagement and required more support in adapting to new tasks or tools. Across both groups, workplace behavior was consistently positive, highlighting that language proficiency did not influence work ethic. These findings reinforce the role of English language proficiency as a decisive employability factor and affirm the relevance of CEFR and TOEIC. The study recommends a stronger integration of CEFR-aligned language instruction in higher education curricula and greater collaboration between academic institutions and industry stakeholders. Delimitations of the study include its geographic and sample size constraints, suggesting directions for future research that could further contextualize language proficiency within diverse employment environments.

Keywords: CEFR, employment, English language proficiency, higher education, Philippine workplace

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Introduction

In a globalized labor market where communication skills are central to collaboration, problem-solving, and service delivery, language proficiency has increasingly emerged as a critical determinant of employability and workplace performance. The ability to communicate effectively in English is particularly vital in countries like the Philippines, where English functions as both an official language and a dominant medium of instruction in higher education (Bernardo, 2004; Tupas & Lising, 2014). The high premium placed on English language proficiency by both local and international employers positions it as a core competency, particularly for new graduates navigating an increasingly competitive job market (Bolton & Bautista, 2004; Ting et al., 2017).

Despite widespread English exposure in the Philippine educational system, the actual communicative competence of many graduates remains inconsistent, raising concerns about their readiness for professional environments that demand both linguistic accuracy and sociolinguistic appropriateness (Hashim & Leitner, 2020; Tupas & Martin, 2017). This disconnect between assumed proficiency and demonstrated ability has serious implications for employment outcomes. Employers across industries frequently cite gaps in oral and written communication as a key barrier to job readiness, particularly in roles requiring teamwork, negotiation, and customer interaction (Bawa, 2020; Otache, 2022). Consequently, it has become imperative to adopt more reliable and standardized measures of English proficiency that go beyond academic grades or self-reported competence.

The Common European Framework of Reference for Languages (CEFR) has emerged as a widely accepted benchmark for describing language ability across six levels, from A1 (beginner) to C2 (proficient) (Council of Europe, 2001). Its comprehensive, skill-based approach offers a functional description of what learners can actually do with the language in real-world contexts (North, 2014). In the Philippines, CEFR-aligned assessments are increasingly being used by higher education institutions and employers to inform curriculum design and recruitment processes (SEAMEO INNOTECH, 2021). However, empirical studies linking CEFR levels to real-world employability in the Philippine context remain limited.

One standardized test aligned with CEFR that has gained considerable traction in the employment sector is the Test of English for International Communication (TOEIC). Originally designed to assess workplace English skills of non-native speakers, TOEIC provides a quantifiable and CEFR-mapped profile of an individual's listening and reading comprehension, as well as their speaking and writing competencies in job-related scenarios (Educational Testing Service [ETS], 2020). Employers in the Asia-Pacific region, including the Philippines, have adopted TOEIC as a screening tool for roles requiring cross-border communication or customer engagement (Kawabata 2024; Santos et al., 2024). However, there remains a need for critical investigation into how TOEIC scores translate into actual employability outcomes among Filipino graduates, particularly across different proficiency levels.

Furthermore, while existing literature acknowledges the correlation between English proficiency and employability, few studies explore employer perspectives on how language competence, as measured through standardized tools like TOEIC, translates into real-world performance. In particular, the role of CEFR levels in shaping employer perceptions of communication effectiveness, adaptability, and professional conduct in workplace settings deserves further scrutiny. Given the linguistic diversity and cultural specificity of Filipino

workplaces, it is essential to examine these dynamics through both quantitative and qualitative lenses (Tupas, 2015).

This study responds to that gap by employing a mixed-methods research design to explore the relationship between TOEIC scores, mapped against CEFR levels, on the employability and observed workplace behavior of Filipino graduates. Special focus is given to employer evaluations of graduates at the A1 and C1 CEFR levels, offering insight into how language proficiency influences communication competence, adaptability to workplace demands, and professionalism. Through this approach, the study aims to contribute to a more grounded understanding of English proficiency as not merely an academic achievement but a practical asset that shapes employment trajectories in the Filipino context.

Review of Literature

English language proficiency has consistently been recognized as a critical factor in employability, particularly in countries where English is used as a second language. Numerous studies have examined the influence of language proficiency—often assessed through standardized tools such as the Test of English for International Communication (TOEIC) and the Common European Framework of Reference for Languages (CEFR) on academic success and workplace outcomes. These investigations offer important insights into how test results correspond to real-world communication demands, which lies at the core of the present study.

Prasetya (2023) reported a strong correlation between TOEIC scores and key indicators of career advancement, including job promotions, salary increases, and overall job satisfaction ($r = 0.8$, $p < 0.05$). Utilizing a mixed-methods design, the study revealed that English language proficiency, as assessed by TOEIC, significantly contributed to professional growth and workplace integration. Central themes such as language barriers, global networking, and cross-cultural collaboration emerged, reinforcing the need for functional English in internationalized professional environments.

Similarly, Powers and Schmidgall (2021) validated the predictive capacity of the TOEIC Speaking test, revealing a strong correlation ($r = 0.84$) between test scores and communicative effectiveness as rated by non-expert evaluators across ten countries. This external validation emphasized the test's practical relevance. A follow-up study (Schmidgall & Powers, 2020) demonstrated similar findings for the TOEIC Writing Test, with ratings of written adequacy aligning closely with actual test results ($r = 0.76$). These findings highlight the TOEIC's reliability in assessing communication competence in real-life workplace scenarios.

Kanzaki (2020) supported the use of TOEIC Listening and Reading components as effective proxies for general English proficiency. His findings showed strong inter-correlations among TOEIC's four subtests, especially between listening and reading ($r = .73$) and the lowest between listening and writing ($r = .52$). This supports the practicality of using receptive skill assessments to infer broader language abilities a critical consideration for employers evaluating job applicants.

From a perception and policy standpoint, Minhee and Hyunju (2022) investigated South Korean test takers' views of TOEIC using the Assessment Use Argument Framework. They found that TOEIC was widely perceived as beneficial for both employment and personal language development. However, interpretations of scores varied depending on contextual

variables such as gender, company size, and partner type, suggesting that socio-organizational factors shape the test's use in professional settings.

In the Philippine context, An (2021) found significant differences in TOEIC Listening and Reading scores between students in board and non-board programs, suggesting disparities in language training across academic programs. This highlights the need for targeted interventions to address specific proficiency gaps among student groups. Echoing this, Santos et al. (2024) demonstrated that online intervention programs significantly improved students' TOEIC performance, particularly among first and second-year college students. These findings support the implementation of structured preparatory programs to enhance test outcomes.

Further contextualizing TOEIC's relevance in the Philippines, ETS Global Philippines (2024) reported that over 70% of Filipino TOEIC test-takers were full-time students, and local employers increasingly use TOEIC scores for recruitment and screening purposes. This illustrates the test's institutional and functional integration into the Philippine employment landscape.

The importance of clear score interpretation was emphasized in a Taiwanese study by Powers and Schmidgall (2021), which found that while stakeholders generally used TOEIC scores appropriately, some components of the score report were misunderstood or underutilized. This highlights the importance of transparent and comprehensible reporting to ensure the meaningful use of test results by both applicants and employers.

Complementing TOEIC-based studies, Kaowiwattanakul (2025) examined the effect of multimodal instruction on CEFR-aligned reading proficiency among Thai C1-level EFL learners. Results indicated significant gains in reading skills, validating the CEFR as a useful framework for assessing language competence and preparing learners for real-world communicative tasks, aligning with the goals of the TOEIC.

In Indonesia, Santoso et al. (2024) investigated university students' perceptions of English Medium Instruction (EMI) and found that students viewed EMI as a pathway to enhanced employability. However, a noticeable gap existed between the language needs of students and the support provided. This discrepancy reinforced the necessity for comprehensive assessment tools like TOEIC to evaluate readiness for professional environments.

Diem and Abdullah (2020) assessed the English proficiency of EFL teachers in Southern Sumatra and found that educational level was the strongest predictor of both linguistic and cultural competence. Although focused on teachers, this study highlighted the role of education in shaping functional communication abilities, validating the need for standardized benchmarks, such as the TOEIC, for employment-related assessments.

In Bangladesh, Shahid and Kabilan (2025) explored listening and speaking difficulties among higher education students. They identified issues in pronunciation, fluency, and grammar, as well as non-linguistic factors like anxiety and low confidence. These findings illustrate the broader challenge of bridging academic instruction and real-world communication demands, further justifying the use of performance-based tools like TOEIC.

Additionally, Widiati et al. (2021) studied Indonesian English teachers' views on foreign language literacy using Kucer's (2014) model. The study highlighted the importance of focusing on the cognitive and linguistic dimensions of literacy, underscoring the need for

functional language assessments that closely mirror workplace communication tasks—a principle central to the TOEIC and CEFR frameworks.

Tao et al. (2025) explored the relationship between perfectionism and English proficiency among Chinese university students. Their results suggested a significant association between higher perfectionism levels and increased English proficiency. While not directly tied to employability, the study highlighted psychological factors that may influence performance on high-stakes tests, such as the TOEIC.

Lastly, Styati and Rodliyah (2021) found that students with higher proficiency performed better in peer writing tasks when paired with peers of equal skill. This suggested that language proficiency affects not only individual outcomes but also collaborative productivity—skills that are vital in professional settings. Thus, assessing such abilities through standardized tests like TOEIC can offer employers a more comprehensive view of an applicant's workplace readiness.

Methodology

This study employed a mixed-methods research design to investigate the relationship between TOEIC Listening and Reading scores on the self-perceived employability of recent undergraduates. The integration of both quantitative and qualitative data provided a detailed understanding of how language proficiency, as measured by TOEIC scores, correlates with and potentially influences employment outcomes. Quantitative data focused on measurable indicators such as TOEIC score thresholds (CEFR levels), job placement rates, the number of job offers received, and self-perceived employability. On the other hand, qualitative insights were drawn from selected employers who provided contextualized assessments of their employees' workplace readiness, communication skills, and professionalism. These employer perspectives offered an outsider or etic viewpoint that helped substantiate or contrast with the graduates' own self-assessments.

The study followed an explanatory sequential approach. Initial quantitative findings were used to guide the selection of participants for the qualitative phase and to identify emerging themes for exploration. This approach allowed the researchers to build on the numerical data with narrative descriptions, providing both breadth and depth of insight into employability factors.

Population and Sampling

The study focused on 50 graduates from higher education institutions located in the province of Bulacan, Philippines. These individuals completed their undergraduate programs between 2023 and 2024. The inclusion criteria were specific: participants must have held an active or valid TOEIC Listening and Reading certification during their application and hiring processes and must have secured employment within the validity of their TOEIC certification (2 years). While the geographic focus was Bulacan, employment outside the province was not restricted to allow a broader picture of employability outcomes.

Due to the narrow criteria concerning TOEIC certification and early employment, the study employed purposive sampling. This non-probability sampling technique ensured that only those meeting the relevant qualifications were included. The small sample size reflects the limited number of graduates with verified TOEIC certifications, which is a known limitation but one that ensures the integrity of the study's purpose.

For the qualitative phase, 10 employers or immediate supervisors of the graduate participants were conveniently selected based on their availability and willingness to participate as well as the scores of their respective employees. Employers of 5 individuals with A1 CEFR and another 5 from individuals with C1 CEFR level. These individuals provided insights on how TOEIC-certified graduates performed in real-world professional contexts.

Research Instruments

The quantitative instrument was a structured survey questionnaire designed to gather specific employability indicators. It measured:

- TOEIC Score Thresholds, reported in CEFR levels
- Reason for taking TOEIC
- Job placement status within the validity of the TOEIC certification
- Number of job offers received after graduation
- Work field Placement
- Self-perceived Employability, adapted from Rothwell and Arnold's (2007) established employability scale

Additionally, the questionnaire asked for contextual information such as field of work, and whether the employer specifically required TOEIC certification or any CEFR-equivalent rating as a hiring requirement. The qualitative instrument consisted of a structured essay prompt, which invited employers to describe their observations regarding the employee's communication skills, professionalism, and readiness for the workplace. This format allowed for richer responses while maintaining consistency across respondents. To ensure the validity and reliability of both instruments, the questionnaires were subjected to expert validation and peer debriefing. Two language experts and one research specialist reviewed the tools, and revisions were made based on their feedback. The development and refinement of the qualitative tools were guided by Creswell et al. (2021) and Hirose and Creswell (2023), emphasizing credibility, transferability, and dependability.

Data Gathering Procedure

Data collection was conducted entirely online using Google Forms for both the quantitative and qualitative phases. This method ensured accessibility and convenience, especially given the geographic dispersal of the participants and the constraints of post-pandemic data collection. Reminders were sent to ensure a high response rate, and clarification was provided through follow-up messages when necessary.

Data Processing and Analysis

Quantitative data were processed using descriptive statistics, including means, percentages, and frequency distributions. Visual representations, such as bar graphs and pie charts, were generated to illustrate trends in TOEIC scores, job placement rates, and other key variables. Lastly the TOEIC scores and self-perceived employability's correlation were treated using Pearson r correlation.

For the qualitative data, responses were subjected to thematic analysis. The researcher identified recurring patterns and themes related to communication competence, adaptability, and general workplace behavior. Codes were generated manually and then clustered into

broader categories that aligned with the constructs of employability under investigation. This dual analysis enabled the study to triangulate the findings, enhancing their interpretive richness.

Ethical Considerations

The research followed strict ethical protocols to safeguard the rights and well-being of all participants. Written informed consent was obtained before participation, and respondents were fully informed about the purpose of the study, the voluntary nature of their involvement, and their right to withdraw at any point without penalty. All identifying details were anonymized, and responses were assigned unique codes to ensure confidentiality. Data were stored in password-protected and encrypted files, accessible only to the lead researcher. Ethical approval was secured from the university's Institutional Research Ethics Board before any data were gathered. Particular care was taken to protect vulnerable stakeholders, including students and employees, who may have felt hesitant to share opinions about institutional practices or their professional experiences. The design of the instruments and the presentation of results ensured that no individual or institution could be identified in any published outputs.

Results

Figure 1
Reasons for Taking TOEIC

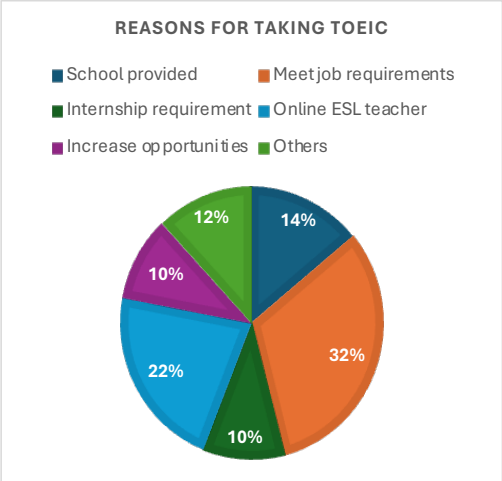
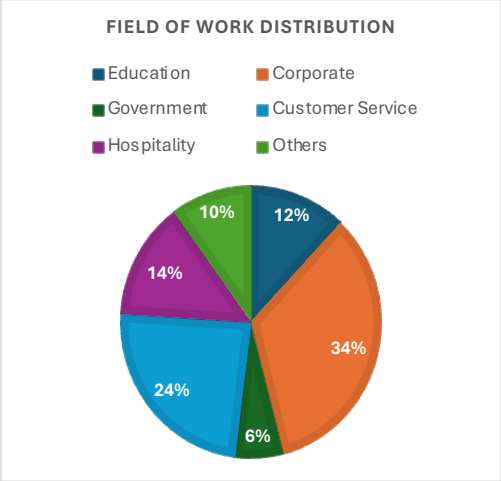


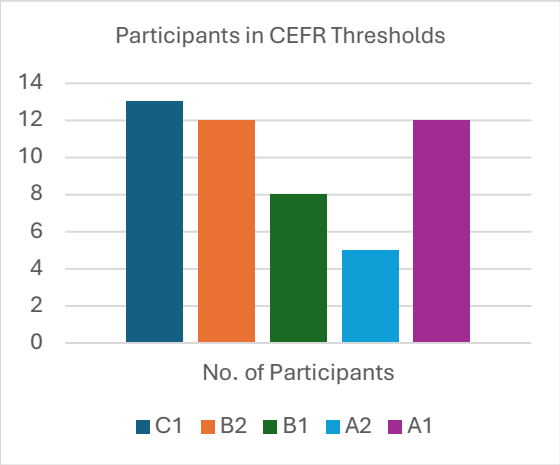
Figure 2
Field of Work Distribution



As illustrated in Figure 1, 7 participants (14%) indicated that they took the TOEIC as privilege since it the testing was school provided. 5 participants (10%) wanted to improve their employment prospects. 16 graduates (32%) stated that it was a job application requirement. 11 (22%) said they needed the certification as they were online ESL teachers. The remaining 11 (22%) cited academic compliance or personal goals. These responses support the claim that TOEIC certification is regarded as a strategic asset for labor market entry, especially in a competitive job market where English proficiency is highly valued.

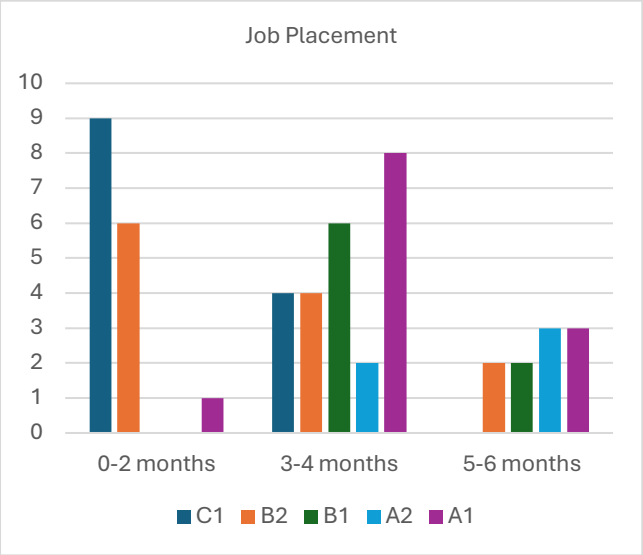
Figure 2 presents the employment sectors of the participants. The highest concentration was in the corporate field, with 17 graduates (34%), followed by customer service with 12 (24%). Hospitality accounted for 7 graduates (14%). The remaining 8 participants (16%) were distributed across government, logistics, and information technology. These data suggest that English language competence, as measured by TOEIC, has broad applicability across sectors that require varying levels of workplace communication.

Figure 3
TOEIC Threshold of Participants



According to Figure 3, 12 participants (24%) achieved a TOEIC score equivalent to the C1 CEFR level (945–990). Another 10 (20%) were at B2 level (785–940), while 13 (26%) scored at B1 level (550–780). Seven participants (14%) fell into the A2 band (225–545), and 8 (16%) scored within A1 level (120–220). This distribution ensured comparative rigor in analyzing how language proficiency correlates with employment outcomes across a range of CEFR levels.

Figure 4
Job Placement



As depicted in Figure 4, all 13 C1-level graduates were employed within the first two months. In contrast, only 1 of the 12 A1-level graduates were employed within that same timeframe. These findings suggest a strong relationship between higher TOEIC scores and faster job placement, reinforcing the test's predictive value for early career success.

Figure 5
Job Offers by TOEIC Level

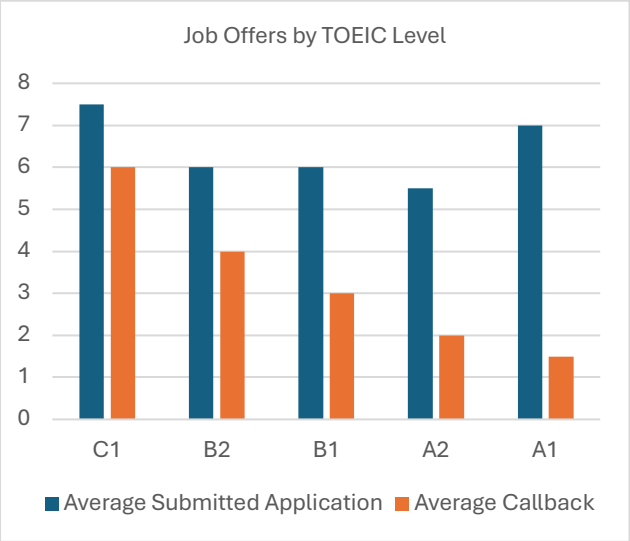


Figure 5 reveals a distinct gradient in the number of job offers received by participants according to their TOEIC proficiency. Graduates with C1-level scores received an average of 6 job offers, while B2-level graduates received 4 offers, and B1-level graduates received 3 offers. A2-level graduates received 2 offers on average, and A1-level graduates reported only 1.5 job offers each. These figures confirm that higher English proficiency significantly increases a graduate's employability and desirability to multiple employers.

Figure 6
Self-Perceived Employability



The self-perceived employability of participants, measured using a 5-point Likert scale adapted from Rothwell and Arnold (2007), showed a clear upward trend in relation to TOEIC score level (Figure 6). C1-level participants reported a mean score of 4.7, indicating strong confidence in their employability. B2 and B1 levels scored 4.4 and 4.15, respectively. Meanwhile, A2-level participants reported a mean of 3.55, and A1-level participants rated themselves at 2.8. These findings support the proposition that language proficiency not only

correlates with actual employment outcomes but also contributes significantly to a graduate's confidence in their career readiness.

The correlation analysis revealed a Pearson coefficient of 0.86, indicating a strong positive relationship between TOEIC scores and self-perceived employability. This result is consistent with prior literature suggesting that higher levels of language competence are linked to both internal (self-assessment) and external (job market) perceptions of employability. The strength of this correlation underscores the role of English proficiency as both a communicative tool and a psychological resource for job seekers.

Table 1

Employers' Observations on Employees With A1 CEFR Level

Meaning Unit	Codes	Sub-Themes	Themes
"She understands simple instructions, but sometimes asks for clarification."	• simple instructions • clarification	Basic comprehension	Communication Competence
"In longer mails and announcements, clarifications are asked by <employee>."			
"He avoids speaking in English during meetings; prefers to listen."	• avoids speaking • prefers listening	Passive communication style	
"There are occasional misunderstandings, especially with technical terms."	• misunderstandings • technical terms	Limited vocabulary	
"I understand that <employee> is new and that sometimes she's not familiar with terms either related to reports or procurements."			
"He follows routines well but struggles when there's a sudden change in the task."	• follows routines • struggles with workloads	Slow adjustment to change	Adaptability
"<Employee> sometimes gets overwhelmed by huge workload but this is not new for fresh graduates."			
"She needs more time to adjust when new tools or systems are introduced."	• needs more time • new tools		
"The training she had during her ojt was in public schools and now that she's in a private school, things are kind of new to her."			
"Once trained, he performs consistently."	• trained • performs consistently	Dependable after training	
"He underwent a proper training, though not entirely on communication, but he functions well."			
"She comes to work on time and is respectful to everyone."	• on time • respectful	respectful behavior	Workplace Behavior
"…very respectful. Always greets his co-workers and blends easily in different age groups."			
"He is cooperative and does not complain, even when assigned extra tasks."	• cooperative • professional • follows rules	professional conduct	
"Generally behaves professionally and follows rules."			

Employees with A1 CEFR level exhibit a combination of strengths and limitations in their workplace performance, particularly in the areas of communication, adaptability, and behavior. In terms of communication competence, they generally demonstrate only basic comprehension and tend to adopt a passive communication style. Verbal engagement in English is limited, with many needing frequent clarification or choosing to avoid speaking altogether, especially in professional or technical contexts. When it comes to adaptability, these employees perform adequately within structured routines and show consistency once tasks are learned; however, their ability to adjust to new tools, unexpected changes, or unfamiliar processes is relatively limited, often requiring additional time or guidance. Despite these challenges, their general workplace behavior stands out positively. Employers consistently describe them as punctual, respectful, cooperative, and professional, indicating that while their language and adaptive capacities may be developing, their attitude and conduct significantly contribute to a harmonious and productive work environment.

Table 2

Employers' Observations on Employees With C1 CEFR Level

Meaning Unit	Codes	Sub-Themes	Themes
"She expresses her thoughts clearly and confidently during meetings."	• clear expression • confidently	Articulate communicator	Communication Competence
"<Employee> can spontaneously be assigned as presenter and still nails it."			
"It has not been a term yet I know that he is a good educator based on how he communicate."			
"He can explain complex ideas in English without difficulty."	• explain complex ideas • no difficulty	Fluent delivery	
"…terminologies in instructions that might confuse new employees were easily understood by <employee>."			
"She adjusts her tone and language depending on who she's speaking with."	• adjusts tone • appropriate language	Pragmatic language use	
"Can be informal with her friends sometimes but definitely formal during presentations."			
"He adapted quickly to our work system, even with minimal guidance."	• adapted quickly • minimal guidance	Independent adjustment	Adaptability
"<Employee> is a fast learner."			
"She manages new responsibilities well but sometimes asks for reassurance."	• manages responsibilities • asks reassurance	Independent with occasional validation	
"Communicates inquiries if something is not clear."			
"He knows how to cover tasks that are difficult to manage."			
"He is good in finding solutions but prefers clear instructions first."	• proactive • clear instructions	Initiative within structured environment	
"Very proactive. Moves without being asked."			
"Always on time."	• on time • punctual in submission of requirements	Punctual	Workplace Behavior
"He makes it a point to always submit his outputs on or before the given deadline."			
"Very respectful to coworkers regardless of gender, position, or age."	• Respectful		

“<Employee> listens to advice and constructive criticisms.”	• open to feedback	Positive interpersonal behavior	
“He always asks for comments about an output that he will submit			
"Follows company protocols and provides insights on policies he’s not in favor with."	• follows protocols • positive atmosphere	Professionalism	
“She is always smiling and radiates positivity in the workplace.”			

Employees with C1 CEFR level are consistently characterized by strong workplace performance, particularly in communication competence, adaptability, and behavior. Their command of English is marked by high fluency and clarity, enabling them to convey complex ideas effectively and adapt their communication style based on the audience or situation. This allows them to actively contribute to professional discussions and collaborate efficiently across teams. In terms of adaptability, these employees generally adjust quickly to new roles, tools, or systems. While some may initially seek clarification or reassurance, they are typically proactive, demonstrating both initiative and flexibility once they understand their responsibilities. Equally notable is their workplace behavior, which employers uniformly describe as positive. They are punctual, respectful, professional, and cooperative, often contributing to a supportive and productive work environment. Their consistent adherence to company policies and willingness to take initiative further highlight their reliability and value as team members.

Table 3
Side-by-Side Comparison: A1 vs. C1 CEFR-Level Employees

Dimension	A1 CEFR Employees	C1 CEFR Employees
Communication Competence	- Understands basic instructions but struggles with complex or abstract ideas. - Tends to be passive or avoidant in English-speaking situations. - Often requires clarification and repetition.	- Communicates clearly and confidently in meetings. - Can express complex ideas fluently. - Adapts tone and vocabulary depending on context or audience.
Adaptability	- Performs well with routine tasks and familiar processes. - Adjusts slowly to new systems or unexpected changes. - Relies more on structured support.	- Adjusts quickly to new environments and systems, sometimes with minimal guidance. - Demonstrates initiative, though some still prefer clear instructions initially. - Manages multiple responsibilities effectively.
Workplace Behavior	- Consistently punctual, respectful, and professional. - Follows rules and performs assigned tasks without complaint. - Demonstrates strong work ethic despite communication barriers.	- Equally punctual, respectful, and professional. - Shows initiative beyond job descriptions. - Accepts feedback openly and contributes positively to workplace morale.

The comparison between employees with A1 and C1 CEFR levels reveals distinct differences in communication competence and adaptability, while workplace behavior remains consistently positive across both groups. In terms of communication, C1-level employees exhibit a strong and functional command of the English language, allowing them to actively participate in professional discussions, articulate complex ideas clearly, and adjust their

communication style based on context or audience. In contrast, A1-level employees can manage basic interactions but often struggle with more nuanced or technical conversations, limiting their effectiveness in collaborative or communication-intensive roles. Adaptability also differs notably between the two groups. C1-level employees generally show above-average adaptability, responding well to new tasks, tools, or workflows with minimal supervision. Although some may initially seek clarity, they typically become proactive and self-directed once familiar with their roles. On the other hand, A1-level employees are more reactive, performing dependably in structured and familiar settings but requiring more time, guidance, and support when adapting to new or changing work conditions. Despite these differences, both groups demonstrate equally strong workplace behavior. Employers consistently describe them as punctual, respectful, cooperative, and professionally behaved, indicating that while language proficiency may influence communication and adaptability, it does not appear to impact overall work ethic or interpersonal conduct.

Conclusion and Recommendations

The findings of this study underscore the significant role of English language proficiency in shaping employment outcomes and workplace performance among Filipino graduates. Employees with higher CEFR-aligned TOEIC scores demonstrated, as self-reported, markedly better communication competence, adaptability, and employability, with the objective result of the 0.86 Pearson r correlation. These individuals were more active and effective in professional discourse, could navigate complex workplace tasks with minimal supervision, and were more likely to secure multiple job offers within a shorter time frame. In contrast, A1-level employees, although praised for their professionalism and work ethic, faced evident limitations in verbal engagement and required additional support in adapting to new roles or tasks.

These patterns confirm longstanding concerns in Philippine higher education and labor studies regarding the disjunction between academic language exposure and functional workplace communication (Bernardo, 2004; Hashim & Leitner, 2020). Employers consistently emphasized that the ability to articulate ideas clearly, respond appropriately in dynamic interactions, and participate confidently in meetings and collaborative activities are highly valued traits—traits that were mostly present among higher-proficiency individuals. This aligns with research by Tupas and Lising (2014) and Ting et al. (2017), who pointed out that language proficiency directly affects how graduates are perceived and evaluated in employment contexts.

Moreover, the results validate the utility of CEFR and TOEIC as credible benchmarks for assessing workplace language readiness. As noted by North (2014) and the Council of Europe (2001), CEFR provides a transparent and skills-oriented framework, while TOEIC offers a performance-based snapshot of real-world English usage. The ability of these tools to distinguish between merely functional and professionally effective language use has practical implications for employer recruitment strategies and university curriculum planning. Given that 35% of employers in the study required TOEIC and another 25% accepted CEFR-equivalent ratings, the continued institutionalization of these standards in the Philippines appears both justified and necessary (Santos et al., 2024; SEAMEO INNOTECH, 2021).

What stands out most, however, is the consistent finding that work ethic, focused on punctuality, respectfulness, and general professionalism, remained strong across all proficiency levels. This affirms the observations made by Bawa (2020) that Filipino graduates bring to the workplace a cultural orientation toward diligence and cooperation. Language ability, while

essential for communication-heavy roles, does not appear to influence behavioral attributes. Nevertheless, in roles that demand high levels of collaboration, problem-solving, or customer engagement, the absence of strong English proficiency can limit an employee's upward mobility and workplace integration.

Ultimately, the study highlights a dual imperative for Philippine higher education institutions and policy stakeholders: to preserve and enhance the behavioral strengths of Filipino graduates while systematically improving their communicative competence through CEFR-aligned instruction and assessment. Such efforts will better equip graduates to meet evolving labor market demands and affirm the value of language as both a communicative and socio-economic resource.

First, HEIs must integrate CEFR-based language instruction and assessment more systematically across undergraduate curricula. This would require curricular reform that goes beyond basic English competency and moves toward workplace-aligned communicative tasks. The gap between academic English exposure and the linguistic demands of the labor market, particularly in customer-facing, corporate, and professional service sectors, remains significant. Language instruction should therefore emphasize interactive communication, professional writing, oral fluency, and listening comprehension in real-world contexts. Institutions should consider making TOEIC or similar standardized proficiency tests a graduation requirement or a capstone assessment, supported by preparatory modules embedded throughout the academic program.

Second, partnerships between HEIs and industry stakeholders must be strengthened to ensure that language preparation reflects actual workplace demands. Employers in this study frequently highlighted the need for employees who can communicate clearly, respond promptly in team settings, and demonstrate confidence in English-language interactions. Institutions must respond by fostering experiential learning opportunities, such as industry placements and job shadowing, where language proficiency is not only tested but applied in real time. Language educators and career development offices should collaborate to build authentic assessment tasks modeled after professional communication scenarios.

Lastly, employers are encouraged to standardize language proficiency benchmarks in their recruitment frameworks. The inconsistent requirement for English certification observed in this study reflects a lack of alignment between hiring expectations and actual job functions. Organizations that prioritize communication skills should formally integrate CEFR or TOEIC thresholds into their job qualifications and performance evaluation metrics. This would encourage applicants to pursue language certification and would also allow employers to make data-driven hiring decisions.

Limitations

While this study provides important insights, it is essential to acknowledge its delimitations. The sample was limited to 50 graduates from Bulacan, Philippines, all of whom had verified TOEIC certifications and were employed within the validity of their TOEIC scores. The qualitative phase further narrowed the sample to only 10 employers, split between A1 and C1 CEFR employees. This limits the generalizability of the findings to a broader or more diverse population. Future research should extend the geographic scope to include other provinces and urban centers across the Philippines. Longitudinal studies that follow graduates over a longer

period would also help in evaluating the lasting impact of language proficiency on career advancement and retention.

Moreover, the study focused primarily on employer perceptions and did not incorporate triangulated feedback from the employees themselves or from coworkers. Future inquiries should explore how self-assessed and peer-assessed communication skills align with employer evaluations. Expanding the qualitative sample size and including different industry sectors would further enrich the understanding of language's role across various professional domains.

The evidence from this study affirms that language proficiency is not a peripheral skill but a central asset in enhancing both immediate employability and long-term workplace success. Institutions and employers alike must adopt a more deliberate and structured approach to language development, grounded in global standards and responsive to local workforce realities.

Conflict of Interest Statement

The author declares that there are no conflicts of interest regarding the publication of this article. The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The author affirms that the data and findings presented are objective, unbiased, and solely based on the outcomes of this research.

Informed Consent

The authors have obtained and recorded informed consent from all individuals included in this study. As mentioned, this paper adhere with the provisions of both the Data Privacy Act of 2012 (R.A. 10173) and the researcher's institutional policies.

Ethical Concerns

The study has been reviewed has been granted Ethics Clearance for implementation by the institutional Ethics Review committee. The study has been assigned study protocol code NUB-IERC-EXT-2025-A0002, which was used for all communication to said committee and all individuals related to this study. This ethical clearance assigned was valid for one year. No artificial intelligence platform was utilized to accomplished this study.

Data Availability

The data that support the findings of this study are available on request from the corresponding author, Santos, R., and from their institutional Ethics Review Committee under the protocol code NUB-IERC-EXT-2025-A0002. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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Knowledge and Attitudes Toward ADHD: A Qualitative Exploration of Indonesian Teachers' Perspectives

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Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is a common neurodevelopmental disorder in children, marked by inattention, hyperactivity, and impulsivity. These symptoms affect not only academic performance but also social functioning and emotional well-being. Teachers play a key role in early identification and classroom support for students with ADHD. However, limited research in Indonesia has examined teachers' understanding of this condition, not only in terms of their knowledge, but also their attitudes toward students with ADHD. This study investigates the knowledge and attitudes of school teachers towards ADHD, as well as their classroom responses. Using semi-structured interviews and purposive sampling, data were collected from 41 teachers across various schools. Findings show that while many teachers can identify behavioral signs associated with ADHD, most are unsure about appropriate interventions or next steps. In addition, teachers' attitudes and responses sometimes reflect uncertainty or hesitation, and sometimes not aligned with the specific needs of children with ADHD, which may hinder the creation of a fully inclusive and supportive learning environment. The lack of training and resources contributes to inconsistent support, negative labeling, and delayed intervention. This study highlights the urgent need for comprehensive teacher training and supportive school policies to enhance understanding, improve responses, and foster a more inclusive learning experience for students with ADHD.

Keywords: attention deficit hyperactivity disorder, ADHD, teacher, knowledge, attitude

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Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders in children (American Psychiatric Association, 2022). It is characterized by persistent patterns of inattention, hyperactivity, and impulsivity that are developmentally inappropriate and interfere with daily functioning. These core symptoms often emerge in early childhood and are frequently observed in school settings, where academic and behavioral demands are high (Barkley, 2015; Zoromski et al., 2015).

The presence of ADHD symptoms can significantly affect multiple areas of a child's functioning. In the academic domain, difficulties with sustained attention, task completion, and impulse control may lead to lower academic achievement and increased classroom disruptions. Socially, children with ADHD may experience challenges in peer relationships due to impulsive behavior, difficulty following rules, and problems with emotional regulation. Emotionally, repeated negative feedback and academic struggles may contribute to low self-esteem, frustration, and increased risk of emotional difficulties (DuPaul & Stoner, 2014; McQuade & Hoza, 2015; Shaw et al., 2016).

Within the school environment, teachers play a crucial role in the early identification and support of children with ADHD. As individuals who interact with students daily, teachers are often the first to observe behavioral patterns that may indicate ADHD. Their responses, classroom management strategies, and decisions regarding referral to professional services are essential in determining whether students receive appropriate support in a timely manner (Awadalla et al., 2016; DuPaul & Stoner, 2014; Kos et al., 2004; McDougal et al., 2023).

However, previous research indicates that teachers' knowledge and understanding of ADHD remain limited. Studies conducted among elementary school teachers in Jakarta have shown that only around 50% demonstrate adequate knowledge regarding ADHD (Harsono, 2014). Knowledge plays a crucial role in shaping an individual's attitudes toward a condition, including ADHD. A low level of knowledge about ADHD can have a negative impact on how individuals perceive and respond to children with this condition (Murtani et al., 2020). When individuals particularly teachers and educational professionals have limited understanding of ADHD, they are more likely to develop inaccurate or stigmatizing perceptions. For example, children with ADHD may be viewed as disruptive, lazy, or difficult to manage, rather than being recognized as individuals with a neurodevelopmental disorder that requires appropriate understanding and tailored support. Such misconceptions can foster negative attitudes, which in turn may lead to inadequate responses, reduced empathy, and a lack of effective support for children with ADHD within both educational and social environments. This lack of understanding may result in misinterpretation of ADHD-related behaviors as intentional misconduct or poor discipline rather than symptoms of a neurodevelopmental condition. Consequently, low levels of knowledge can negatively influence teachers' attitudes toward children with ADHD, shaping their perceptions, expectations, and classroom responses in ways that may hinder effective support and inclusion (Fuermaier et al., 2014; Metzger & Hamilton, 2021; Toye et al., 2019).

Given the prevalence of ADHD and the pivotal role of teachers in supporting affected students, it is important to explore not only teachers' knowledge of ADHD but also their attitudes and responses toward students displaying ADHD-related behaviors. Understanding teachers' perspectives is essential for identifying gaps in knowledge, addressing attitudinal challenges,

and informing the development of targeted training programs and inclusive educational practices.

Furthermore, there is a lack of empirical research exploring how teachers' knowledge and attitudes are reflected in their actual classroom responses. Little is known about whether teachers' perceptions align with the specific educational and emotional needs of children with ADHD, or whether a mismatch exists between teachers' beliefs and evidence-based practices. This gap in the literature highlights the need for qualitative research that captures teachers' perspectives in depth.

Therefore, the present study aims to explore Indonesian teachers' knowledge of ADHD, their attitudes toward students with ADHD, and their classroom responses to ADHD-related behaviors. By examining these aspects, this study seeks to identify potential gaps between teachers' perceptions and the needs of children with ADHD, and to provide insights that may inform teacher training and inclusive education practices in Indonesia.

Methodology

Research Design

This study employed a qualitative exploratory research design to gain an in-depth understanding of teachers' knowledge, attitudes, and classroom responses toward students with ADHD. A qualitative approach was considered appropriate as it allows for the exploration of participants' perspectives, experiences, and interpretations in their natural context, particularly in areas where empirical research remains limited (Creswell & Poth, 2018). Exploratory qualitative research is especially appropriate for investigating phenomena that have not yet been extensively studied, particularly in contexts where empirical evidence remains limited. This approach allows researchers to capture in-depth insights into participants' experiences, interpretations, and beliefs, which are often shaped by cultural and social contexts. By emphasizing meaning, context, and subjective understanding, qualitative exploration is well suited to uncovering how cultural norms, values, and shared assumptions influence individuals' perceptions and responses, providing a richer and more nuanced understanding of complex phenomena (Denzin et al., 2023).

Participants and Sampling

The participants consisted of 41 teachers from various schools. Participants were selected using a purposive sampling technique to ensure the inclusion of teachers who had relevant experience in teaching students with attentional or behavioral difficulties. This sampling method enabled the researchers to obtain rich and meaningful data related to the study objectives.

Data Collection

Data were collected through semi-structured interviews guided by an interview protocol developed to explore teachers' knowledge, attitudes, and experiences related to ADHD. The use of semi-structured interviews allowed participants to express their perspectives freely while ensuring that key topics relevant to the study objectives were consistently addressed.

The interview guideline covered four main domains. First, general understanding of ADHD, including teachers' conceptualization of ADHD as a condition, their awareness of its clinical

nature, and their knowledge of core symptoms and subtypes (e.g., inattention, hyperactivity, and impulsivity). Second, perceptions of causes and management, which explored teachers' beliefs regarding the causes of ADHD, such as biological, environmental, or parenting factors, as well as their views on treatment approaches, including behavioral strategies and medication. Third, attitudes toward children with ADHD, focusing on teachers' emotional responses, perceptions of classroom disruption, and beliefs about children's ability to control their behavior. Fourth, educational and sociocultural context, which examined teachers' classroom experiences, responses to ADHD-related behaviors, and perceived challenges within the Indonesian cultural and educational system.

Examples of interview questions included: "What do you know about ADHD?", "Do you consider ADHD to be a medical condition that can be clinically diagnosed?", "What do you think causes a child to have ADHD?", "How do you feel when interacting with students who have difficulty focusing or are very active in class?", and "What challenges do you face in supporting students with ADHD within the school context in Indonesia?" Follow-up questions were used as needed to clarify responses and explore emerging themes in greater depth.

Data Analysis

The interview data were analyzed using thematic analysis. The analysis process began with familiarization with the data through repeated reading of the interview transcripts to gain an overall understanding of participants' responses. This was followed by initial coding, during which meaningful segments of data were identified and labeled. The resulting codes were then reviewed and organized into broader themes that captured recurring patterns and shared meanings across participants' responses (Braun & Clarke, 2021). This approach enabled the identification of key themes related to teachers' knowledge, attitudes, and classroom responses toward students with ADHD.

Results

The thematic analysis of interview data revealed three main themes that reflect teachers' perspectives and experiences related to ADHD: (1) teachers' knowledge of ADHD, (2) teachers' attitudes toward students with ADHD, and (3) classroom responses to ADHD-related behaviors. These themes illustrate the complexity of teachers' understanding and practices, as well as the challenges they face in providing effective support for students with ADHD.

Knowledge of ADHD

Teachers generally demonstrated the ability to recognize behavioral signs commonly associated with ADHD. Many participants identified difficulties in maintaining attention, restlessness, and impulsive behavior as key indicators observed in the classroom. These behaviors were frequently described through everyday classroom situations, such as students being unable to remain seated for extended periods, interrupting lessons or peers, shifting attention rapidly between tasks, and struggling to complete assignments within the allotted time. Such descriptions suggest that teachers were able to recognize ADHD-related behaviors based on direct observation and daily interactions with students.

Despite this ability to identify observable symptoms, teachers' understanding of ADHD was often limited to a surface-level awareness. While participants could describe what students did in the classroom, fewer were able to explain why these behaviors occurred or how they were

related to a neurodevelopmental condition. Several teachers expressed uncertainty about whether ADHD was a clinically diagnosable condition or simply a behavioral issue influenced by parenting or discipline. This limited conceptual understanding reflects a gap between behavioral recognition and deeper knowledge of ADHD as a developmental disorder.

Furthermore, most participants reported limited knowledge of evidence-based interventions and appropriate referral pathways. Teachers frequently expressed uncertainty about the next steps to take after identifying ADHD-like behaviors, including when and how to refer students for professional assessment. Many were also unfamiliar with specific classroom strategies tailored to students with ADHD, such as structured routines, task modification, or individualized behavioral supports. This lack of practical knowledge highlights a disconnect between recognizing ADHD symptoms and implementing effective responses to support students' learning and development.

Attitudes Toward Students With ADHD

Teachers' attitudes toward students with ADHD varied considerably across participants. Some teachers expressed empathy and a genuine willingness to support students in managing their difficulties. These participants emphasized the importance of patience, understanding, and emotional regulation when interacting with students who exhibited ADHD-related behaviors. They tended to interpret inattention, hyperactivity, or impulsivity as manifestations of a developmental condition rather than deliberate misbehavior and described efforts to remain calm and supportive during classroom interactions.

However, other teachers reported feelings of hesitation and concern regarding the presence of students with ADHD in the classroom. These concerns were often related to perceived disruptions to the learning process, including difficulties in maintaining classroom order and ensuring that other students remained focused. Uncertainty about how to manage ADHD-related behaviors contributed to feelings of frustration and ambivalence, particularly when teachers felt that their existing classroom management strategies were insufficient or ineffective.

In some cases, this uncertainty influenced teachers' attitudes in ways that led to avoidance or negative labeling. Several participants described situations in which students with ADHD were perceived as "problematic," "difficult," or "hard to manage," especially when their behaviors persisted despite repeated reminders or disciplinary measures. Such perceptions may affect the quality of teacher–student relationships and limit opportunities for positive engagement, potentially reinforcing negative experiences for students with ADHD within the classroom environment.

Classroom Responses to ADHD-Related Behaviors

Teachers' classroom responses to students with ADHD were found to be inconsistent across participants. Some teachers reported implementing basic strategies to manage ADHD-related behaviors, such as adjusting students' seating positions to reduce distractions, providing closer supervision during tasks, or applying simple behavior management techniques. These strategies were typically developed through personal experience or trial-and-error rather than formal training and were often applied in an ad hoc manner depending on the situation and the teacher's comfort level.

In contrast, other teachers described feeling uncertain or unprepared when responding to students with ADHD. Several participants reported not knowing what actions were appropriate or effective, particularly when students' behaviors persisted despite general classroom management efforts. This uncertainty sometimes led teachers to rely on avoidance strategies, such as minimizing interaction with the student or waiting for the behavior to resolve on its own, rather than actively implementing targeted support or seeking professional assistance.

The lack of formal training, clear guidelines, and institutional support was frequently cited as a contributing factor to these inconsistent responses. Without adequate knowledge or access to resources, teachers often delayed intervention or applied strategies that were insufficient to meet the specific needs of students with ADHD. As a result, classroom responses varied widely and were often reactive rather than proactive, reducing the overall effectiveness of support provided to students with ADHD.

Discussions

This study aimed to explore teachers' knowledge of ADHD, their attitudes toward students with ADHD, and their classroom responses within the Indonesian educational context. The findings reveal a consistent pattern across these domains: while teachers are generally able to recognize observable ADHD-related behaviors, limitations in conceptual understanding, training, and institutional support shape their attitudes and result in inconsistent classroom practices.

The findings indicate that teachers' knowledge of ADHD is largely limited to the identification of surface-level behavioral symptoms, such as inattention, restlessness, and impulsivity. This aligns with previous research suggesting that teachers often rely on observable classroom behaviors rather than a comprehensive understanding of ADHD as a neurodevelopmental disorder. The lack of knowledge regarding evidence-based interventions and referral pathways suggests that teachers may recognize a problem without knowing how to respond effectively. This gap between symptom recognition and practical knowledge may contribute to delayed identification and inadequate support for students with ADHD (Bekle, 2004; Flanigan & Climie, 2018).

Teachers' attitudes toward students with ADHD were found to vary considerably, ranging from empathetic and supportive to hesitant and ambivalent. These variations appear to be closely associated with teachers' levels of knowledge, prior experience, and confidence in managing ADHD-related behaviors (DuPaul & Stoner, 2014; Kos et al., 2004). Teachers who demonstrated a stronger understanding of ADHD tended to interpret students' inattention, hyperactivity, and impulsivity as manifestations of a neurodevelopmental condition that requires appropriate support and instructional adjustment, rather than as intentional misbehavior. In contrast, teachers with more limited knowledge often expressed frustration, uncertainty, and concern about potential classroom disruption, which influenced more negative or ambivalent attitudes toward students with ADHD (Bolinger et al., 2020; Ohan et al., 2008). This finding is consistent with research indicating that insufficient knowledge of ADHD can contribute to negative labeling, reduced empathy, and less supportive teacher–student interactions, ultimately affecting students' academic engagement and emotional well-being (Metzger & Hamilton, 2021; Poznanski et al., 2021).

Teachers' attitudes toward students with ADHD were found to vary widely, ranging from empathetic and supportive to hesitant and ambivalent. These variations appear closely linked

to teachers' levels of knowledge and confidence. Teachers who demonstrated greater understanding tended to interpret ADHD-related behaviors as challenges requiring support, whereas those with limited knowledge were more likely to express frustration or concern about classroom disruption. This finding supports existing literature indicating that insufficient knowledge of ADHD can negatively influence teachers' attitudes, leading to negative labeling and reduced empathy toward affected students (Anderson et al., 2017; Ary, 2019; Vukelić & Vlah, 2024).

In terms of classroom responses, the study highlights significant inconsistency in how teachers manage ADHD-related behaviors. While some teachers employed basic strategies such as seating adjustments or increased supervision, these approaches were often informal and based on personal experience rather than structured guidance. Other teachers reported uncertainty and avoidance, reflecting a lack of confidence in their ability to provide appropriate support. The absence of formal training and clear institutional guidelines appears to play a central role in shaping these inconsistent practices, reinforcing the need for systemic support at the school level (Braude & Dwarika, 2020; Fabiano & Pyle, 2019).

The findings also underscore the influence of broader systemic and cultural factors within the Indonesian educational context. Limited access to school-based mental health professionals, high classroom demands, and persistent misconceptions about ADHD may further constrain teachers' ability to respond effectively (Hapsari et al., 2020). In such contexts, ADHD-related behaviors may be misinterpreted as disciplinary or parenting issues, rather than understood as manifestations of a neurodevelopmental condition requiring specialized support.

Overall, this study highlights a critical mismatch between teachers' recognition of ADHD-related behaviors and their ability to provide appropriate responses. Without adequate knowledge, training, and institutional support, teachers may struggle to translate awareness into effective practice. Addressing these gaps is essential for fostering inclusive educational environments and ensuring that students with ADHD receive timely and appropriate support.

Implications

The findings of this study highlight important implications for educational practice and student well-being. Inconsistent understanding of ADHD among teachers affects multiple aspects of support for students with ADHD, including early identification, classroom management, and inclusive educational practices. When teachers lack a comprehensive understanding of ADHD, behavioral signs may be recognized without being accurately interpreted, potentially delaying appropriate assessment and intervention.

In the classroom, limited knowledge and uncertainty contribute to inconsistent management strategies. Without clear guidance and evidence-based approaches, teachers may rely on trial-and-error methods or avoid proactive intervention altogether. This inconsistency can disrupt learning processes not only for students with ADHD but also for their peers and may reinforce negative perceptions of ADHD-related behaviors within the classroom environment.

Furthermore, unmet educational and emotional needs may have long-term consequences for students with ADHD. Inadequate support can hinder academic progress, increase frustration, and negatively affect students' emotional well-being and self-esteem. From an inclusive education perspective, these findings underscore the need for systematic teacher training, access to professional support, and the development of school policies that promote

understanding, appropriate intervention, and meaningful inclusion of students with ADHD in Indonesian schools.

Recommendations

Based on the findings of this study, several recommendations are proposed to improve support for students with ADHD in school settings. First, comprehensive teacher training programs on ADHD are needed to enhance teachers' understanding of the condition and to equip them with effective behavior management and instructional strategies. Such training should emphasize evidence-based practices and practical classroom applications.

Second, schools should establish clear policies and procedures for early identification and referral of students who display ADHD-related behaviors. Clear referral pathways can help teachers take appropriate and timely action, reducing delays in assessment and intervention. These policies should be communicated clearly to all school staff to ensure consistency in practice.

Third, collaboration between teachers, school psychologists, and special education staff should be strengthened. Multidisciplinary collaboration can provide teachers with professional guidance, ongoing support, and opportunities to develop individualized strategies tailored to students' specific needs. This approach may also reduce teachers' uncertainty and increase confidence in managing ADHD-related behaviors.

Finally, the development and implementation of supportive classroom strategies are essential for promoting inclusive learning environments. Strategies such as structured routines, task modification, positive behavior reinforcement, and flexible seating arrangements can help address the learning and emotional needs of students with ADHD. Together, these recommendations highlight the importance of systemic efforts to support teachers and foster positive educational outcomes for students with ADHD.

Conclusions

This study explored school teachers' knowledge, attitudes, and classroom responses toward students with attention deficit hyperactivity disorder (ADHD) within the Indonesian educational context. The findings indicate that while teachers are generally able to recognize observable ADHD-related behaviors, their understanding of ADHD often remains limited to surface-level knowledge. Gaps in knowledge regarding evidence-based interventions, referral pathways, and classroom strategies were evident and influenced both teachers' attitudes and practices.

Teachers' attitudes toward students with ADHD varied, ranging from empathetic and supportive to hesitant and uncertain. These attitudes were closely linked to teachers' levels of understanding and confidence in managing ADHD-related behaviors. Limited knowledge and lack of training contributed to inconsistent classroom responses, with many teachers relying on informal strategies or delaying intervention due to uncertainty.

Overall, the study highlights a mismatch between teachers' recognition of ADHD symptoms and their ability to provide appropriate support. Addressing this gap requires comprehensive teacher training, clear school policies, and collaborative support systems. Strengthening teachers' capacity to understand and respond to ADHD is essential for fostering inclusive

learning environments and supporting the academic and emotional well-being of students with ADHD.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from appropriate and systematic conduct of the research.

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Parental Understanding and Early Detection of ADHD: A Qualitative Exploration in Indonesia

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Abstract

Misunderstanding and stigma around children's behavioral challenges often lead to delayed recognition of neurodevelopmental disorders such as attention-deficit/hyperactivity disorder (ADHD) in Indonesia. Children with ADHD are frequently labeled as disruptive or disobedient, when in fact they require specific support to manage inattention, impulsivity, and hyperactivity. Early detection plays a crucial role in minimizing the long-term impact on their emotional and social development. However, parental awareness of ADHD remains low. This qualitative study explores parents' knowledge and ability to recognize early signs of ADHD. Using semi-structured interviews with 35 parents, results revealed that most participants had very limited or no prior understanding of the condition. Many parents were unfamiliar with the term ADHD itself, and those who had heard of it often held inaccurate beliefs, viewing the behavior as a result of poor discipline or parenting. As a result, early symptoms were frequently dismissed or misunderstood, leading to delays in seeking appropriate professional help. This lack of awareness contributes to missed opportunities for early intervention and can negatively affect the child's mental health. The study emphasizes the urgent need for targeted psychoeducation for parents to promote early identification and more effective support for children with ADHD.

Keywords: Attention Deficit Hyperactivity Disorder (ADHD), parental understanding, early detection, stigma, Indonesia

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Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders in childhood, characterized by persistent patterns of inattention, hyperactivity, and impulsivity that are inconsistent with the child's developmental level (American Psychiatric Association [APA], 2022). This disorder not only affects academic functioning but also has significant long-term implications for social functioning, emotional regulation, and the development of self-concept (Barkley, 2015; Willcutt, 2012). Therefore, an accurate understanding of ADHD is a critical prerequisite for effective early detection and intervention efforts. Globally, the prevalence of ADHD in children is estimated to range between 5% and 7%, with considerable variation influenced by diagnostic criteria, cultural context, and access to mental health services (Faraone et al., 2021; Polanczyk et al., 2015). However, numerous studies emphasize that reported prevalence rates are often lower than the actual condition due to widespread underdiagnosis, particularly in low- and middle-income countries (Mulraney et al., 2023). This phenomenon indicates that a substantial number of children with ADHD remain unidentified and do not receive appropriate support.

In the Indonesian context, national epidemiological data on ADHD remain limited. Nevertheless, several local studies have indicated a relatively high prevalence of ADHD symptoms among preschool and school-aged children (Nasri et al., 2025). Limitations in systematic screening, shortages of child mental health professionals, and low levels of mental health literacy among the general population have been identified as key factors contributing to delayed ADHD detection in Indonesia (Maulinda & Lubis, 2024). One of the most significant challenges in early ADHD detection is parental and environmental misunderstanding of children's behavioral difficulties. Children with ADHD are frequently perceived as "naughty," "undisciplined," or "poorly raised," rather than being recognized as individuals with specific developmental needs (Hinshaw et al., 2022). Such perceptions result in ADHD-related behaviors being framed as moral or disciplinary problems rather than as manifestations of a neurobiological condition that requires professional intervention.

Research conducted in Indonesia consistently shows that parental knowledge of ADHD characteristics remains at a low to moderate level. Many parents struggle to distinguish between developmentally typical active behavior and pathological symptoms of inattention and impulsivity (Qonitatun & Putri, 2024). This lack of understanding often leads parents to delay seeking professional consultation and to rely on inappropriate disciplinary strategies, such as verbal or physical punishment, which may exacerbate children's emotional difficulties (Mulraney et al., 2023).

These misunderstandings are further reinforced by persistent social stigma surrounding mental health and developmental disorders in children. Stigma related to ADHD commonly manifests through negative stereotypes, social labeling, and the attribution of blame to parents (Yusnia & Kurniadewi, 2025). Consequently, children with ADHD face increased risks of social rejection, bullying, and exclusion within school and community environments, which directly undermines their psychological well-being. From a parental perspective, stigma generates substantial psychological burdens, including feelings of guilt, shame, and fear of negative social labeling directed at their children (Schoeman & Voges, 2022). Qualitative studies have revealed that many parents postpone or avoid diagnostic processes due to concerns that their child may be stigmatized or treated differently by schools and the broader community (Sayal et al., 2018).

This combination of stigma and limited parental understanding directly contributes to delays in early ADHD detection. In contrast, extensive evidence highlights that early identification and intervention play a crucial role in reducing the long-term adverse effects of ADHD on children's emotional, social, and academic development (Sonuga-Barke et al., 2013). Children who receive early intervention tend to demonstrate better self-regulation skills and more adaptive social functioning. Early detection of ADHD extends beyond the clinical diagnostic process and involves parents' ability to recognize early warning signs and engage in appropriate help-seeking behaviors. The literature consistently indicates that parental understanding is a key predictor of decisions to access child mental health services (Mulraney et al., 2023). Thus, parents play a central role in the early detection pathway for ADHD.

Cultural context also shapes how parents interpret children's behavior and developmental challenges. In collectivistic societies such as Indonesia, children's behavior is often evaluated based on social conformity and obedience to group norms. As a result, impulsive or inattentive behaviors are more likely to be perceived as behavioral deviance rather than as manifestations of a neurodevelopmental condition (Chairil, 2022). This underscores the importance of culturally sensitive approaches in understanding parental experiences related to ADHD.

Numerous studies emphasize the need for family- and community-based psychoeducational approaches to enhance ADHD literacy and reduce stigma (Nasri et al., 2025). Educational programs that involve parents, teachers, and healthcare professionals have been shown to improve early detection capacities and promote more adaptive and supportive parenting practices for children with ADHD (Mulraney et al., 2023). Despite these findings, research that specifically explores Indonesian parents' understanding of ADHD and their experiences with early detection remains limited, particularly from a qualitative perspective. Most existing studies focus on quantitative assessments or symptom prevalence, with limited attention to parents' subjective meanings and psychosocial dynamics (Maulinda & Lubis, 2024).

Therefore, this study aims to explore in depth Indonesian parents' understanding of ADHD and their experiences related to the early detection process. By employing a qualitative approach, this research seeks to contribute both theoretically and practically to the development of educational strategies, policies, and early detection services for ADHD that are culturally sensitive, contextually relevant, and family centered.

Methodology

Research Design

This study employed a qualitative exploratory design to gain an in-depth understanding of parental perceptions, interpretations, and experiences related to Attention Deficit Hyperactivity Disorder (ADHD) and early detection within the Indonesian context. A qualitative approach was considered appropriate given the study's aim to explore subjective meanings, social constructions, and contextual factors surrounding parental understanding and stigma, which cannot be adequately captured through quantitative methods alone (Creswell & Poth, 2018). Exploratory qualitative research is particularly suitable in areas where empirical evidence is still limited and where cultural nuances play a significant role in shaping experiences and beliefs (Braun & Clarke, 2021).

Participants

Participants consisted of 35 parents, recruited using purposive sampling to ensure relevance to the research objectives. The sample included parents who have children formally diagnosed with ADHD, as well as parents who have had direct interaction with children exhibiting ADHD-related behaviors in familial, educational, or community settings. Such variation is essential in qualitative research to enhance the richness and depth of the data and to allow for a more comprehensive understanding of the phenomenon under study.

Data Collection

Data were collected through semi-structured individual interviews and Focus Group Discussions (FGDs). Semi-structured interviews allowed participants to express their personal experiences, beliefs, and emotional responses regarding children's behavioral challenges and ADHD detection, while still providing sufficient flexibility for probing and clarification (Creswell & Poth, 2018). FGDs were conducted to explore shared meanings, social norms, and collective perceptions related to ADHD, stigma, and parental responsibility within the community context (Krueger & Casey, 2015). The combination of individual and group data collection methods enabled methodological triangulation and strengthened the credibility of the findings (Flick, 2018).

Data Analysis

Data analysis was conducted using thematic analysis, this method was selected due to its flexibility and suitability for identifying, analyzing, and reporting patterns of meaning across qualitative datasets. A reflexive approach was adopted throughout the analytic process to ensure that interpretations remained grounded in participants' narratives while acknowledging the researchers' positionality (Braun & Clarke, 2021). This approach allowed for a nuanced understanding of how parental knowledge, stigma, and cultural beliefs intersect in shaping early detection of ADHD.

Result

Thematic analysis of data obtained from semi-structured interviews and Focus Group Discussions (FGDs) revealed several recurring patterns related to parental understanding, interpretation, and responses toward ADHD and its early symptoms. Overall, the findings indicate a substantial lack of awareness and pervasive misconceptions among parents, which significantly influenced help-seeking behaviors and early detection processes.

Limited Awareness and Lack of Familiarity With ADHD

Most participants reported having very limited or no prior knowledge of Attention Deficit Hyperactivity Disorder. During both individual interviews and FGDs, many parents explicitly stated that they were unfamiliar with the term *ADHD* before encountering children who exhibited persistent behavioral difficulties. Even among participants who had heard the term, understanding of ADHD was often superficial and fragmented. ADHD was commonly perceived as a "*foreign*" or "*medical*" label that felt distant from everyday parenting experiences. This limited awareness was consistently expressed across participants with different backgrounds, suggesting that ADHD knowledge remains largely inaccessible at the community level.

Misinterpretation of ADHD-Related Behaviors

A prominent theme emerging from the data was the misinterpretation of ADHD symptoms as behavioral or moral problems**.** Parents frequently described inattention, impulsivity, and hyperactivity as signs of poor discipline, lack of parental control, or intentional misbehavior. In FGDs, these views were often reinforced collectively, as participants shared similar beliefs that children should be able to regulate their behavior if adequately guided or disciplined. As a result, ADHD-related behaviors were framed as parenting failures rather than indicators of a neurodevelopmental condition requiring professional attention.

Normalization and Dismissal of Early Symptoms

The analysis further revealed that early symptoms of ADHD were commonly normalized or dismissed by parents. Many participants described perceiving excessive activity, distractibility, or impulsivity as typical childhood behavior that would naturally diminish with age. In both interviews and FGDs, parents expressed beliefs that children would "*grow out of it*," particularly during early childhood. This normalization process contributed to a delay in recognizing the persistence and functional impact of the symptoms, reducing the likelihood of early professional consultation.

Delayed Help-Seeking and Missed Early Intervention

Due to limited understanding and persistent misconceptions, parents often delayed seeking professional help. Participants reported relying on informal strategies such as stricter discipline, increased supervision, or advice from family members before considering consultation with mental health professionals. In FGDs, several parents acknowledged that professional help was usually sought only after behavioral problems began to significantly disrupt academic performance or social relationships. This pattern reflects a missed window for early intervention, which participants retrospectively recognized as potentially detrimental to the child's emotional well-being.

Perceived Impact on Children's Mental and Emotional Well-being

Parents who had prolonged exposure to children with untreated ADHD symptoms described observable negative effects on the child's mental health, including increased emotional dysregulation, frustration, low self-confidence, and social difficulties. Although these impacts were often recognized later, participants reflected that earlier understanding and intervention might have mitigated these outcomes. These reflections emerged strongly during FGDs, where shared experiences allowed parents to collectively acknowledge the long-term consequences of delayed recognition.

Overall, the results demonstrate that limited parental understanding, pervasive misconceptions, and delayed help-seeking behaviors form an interconnected pattern that hinders early detection of ADHD. Thematic analysis highlights how these factors operate both at the individual and social levels, underscoring the critical role of parental awareness in facilitating timely identification and intervention for children with ADHD.

Discussion

The findings of this study indicate that parental awareness of Attention Deficit Hyperactivity Disorder (ADHD) remains notably limited, particularly at the community level. Most participants reported minimal familiarity with ADHD prior to encountering persistent behavioral challenges in children. This finding is consistent with previous studies showing that parental knowledge of ADHD is generally low, especially outside clinical settings, which significantly hampers early identification and intervention efforts (Rajcumar & Paruk, 2020). Limited awareness has been repeatedly identified as a primary barrier preventing parents from recognizing ADHD as a neurodevelopmental condition rather than a behavioral issue (Fan et al., 2022). The lack of familiarity with ADHD terminology further reinforces misconceptions surrounding the disorder. In this study, many parents described ADHD as a "medical" or "foreign" concept that felt disconnected from daily parenting experiences. Such perceptions contribute to delayed recognition, as parents may not associate early behavioral signs with a diagnosable condition requiring professional assessment (Sayal et al., 2010).

Misinterpretation of ADHD-related behaviors emerged as a dominant theme in both interviews and FGDs. Parents frequently framed symptoms such as inattention, impulsivity, and hyperactivity as manifestations of poor discipline or inadequate parenting. This pattern has been widely reported in previous research, which shows that parents often attribute ADHD symptoms to moral or behavioral failings rather than neurodevelopmental differences (Barkley, 2015). These misconceptions are particularly persistent in contexts where mental health literacy is limited and behavioral conformity is highly valued (Hinshaw et al., 2021). Normalization and dismissal of early ADHD symptoms were also prominent across participants. Many parents perceived excessive activity or distractibility as developmentally typical and believed that children would naturally "outgrow" these behaviors. This belief has been documented in previous research as a significant factor contributing to delayed diagnosis, particularly during early childhood (Theule, et al., 2013). The tendency to normalize symptoms reduces the perceived urgency to seek professional evaluation, thereby narrowing the window for early intervention.

Delayed help-seeking emerged as a direct consequence of limited awareness and persistent misconceptions. Parents in this study often relied on informal strategies, including stricter discipline or advice from family members, before considering professional consultation. Similar help-seeking trajectories have been identified in prior studies, which show that parents typically seek clinical services only after behavioral difficulties begin to interfere with academic performance or peer relationships (Sayal et al., 2018). This delay reflects a missed opportunity for early intervention, which is critical for improving long-term outcomes in children with ADHD (Faraone et al., 2021).

Parents' reflections on the emotional and psychological impact of untreated ADHD symptoms further underscore the consequences of delayed recognition. Participants described increased emotional dysregulation, frustration, low self-esteem, and social difficulties in children who did not receive early support. These observations align with longitudinal research demonstrating that delayed identification of ADHD is associated with heightened risks of emotional and social problems (Thomas et al., 2015). Early intervention has been shown to significantly reduce these secondary difficulties and promote more adaptive developmental trajectories (Sonuga-Barke et al., 2013). Stigma emerged as a cross-cutting factor influencing parental perceptions and behaviors. Parents expressed concerns about labeling, social judgment, and negative stereotypes associated with ADHD. Previous studies have similarly

documented that stigma surrounding ADHD discourages parents from pursuing diagnosis and treatment, particularly in societies where mental health conditions are associated with shame or parental failure (Hinshaw et al., 2021). This stigma not only delays help-seeking but also exacerbates parental stress and emotional burden (Mueller et al., 2012).

Taken together, the findings of this study support existing evidence that limited parental understanding, behavioral misinterpretation, symptom normalization, and stigma operate in an interconnected manner to hinder early detection of ADHD. These results highlight the critical need for culturally sensitive, parent-focused psychoeducational initiatives aimed at improving ADHD literacy and reducing stigma at the community level. Prior intervention studies have demonstrated that increasing parental knowledge significantly enhances early recognition and engagement with mental health services (Fan et al., 2022). Therefore, strengthening parental awareness should be considered a central component of early detection strategies for ADHD in Indonesia.

Conclusion

This study highlights the critical role of parental understanding in the early detection of Attention Deficit Hyperactivity Disorder (ADHD) within the Indonesian context. The findings demonstrate that misunderstandings and stigma surrounding children's behavioral challenges remain pervasive, contributing to delayed recognition of ADHD symptoms. Most parents in this study possessed limited or no prior knowledge of ADHD, and those who were somewhat familiar with the term often held inaccurate beliefs, interpreting ADHD-related behaviors as consequences of poor discipline or ineffective parenting. Such misconceptions led to the normalization and dismissal of early symptoms, resulting in delays in seeking professional assistance and missed opportunities for early intervention. These delays have important implications for children's emotional, social, and psychological well-being, as untreated ADHD symptoms may escalate and contribute to secondary difficulties over time. The findings underscore that parental awareness is a crucial entry point in the pathway toward timely identification and intervention.

Overall, this study emphasizes the urgent need for targeted, culturally sensitive psychoeducational initiatives aimed at improving parental literacy regarding ADHD. Strengthening parents' ability to recognize early signs and understand ADHD as a neurodevelopmental condition is essential for reducing stigma, promoting timely help-seeking, and ensuring more effective support for children with ADHD. Such efforts are vital to improving developmental outcomes and enhancing the overall well-being of children and families in Indonesia.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from appropriate and systematic conduct of the research.

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PBIS-RISE: A GPT-Powered Questionnaire Generator for Assessing Student Understanding of Behavioral Expectations

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Abstract

The PBIS-RISE Generator introduces a novel application of Generative Artificial Intelligence (Gen-AI) in the domain of behavioral education, specifically within the Positive Behavioral Interventions and Supports (PBIS) framework. While PBIS promotes the development of locally adapted behavioral expectation matrices to foster prosocial conduct, a persistent challenge lies in evaluating students' comprehension of these expectations in a standardized yet context-sensitive manner. PBIS-RISE addresses this need by employing a GPT-based model, trained and prompted on PBIS theory, validated behavior matrices, and existing school climate assessments to generate customized questionnaires. These instruments reflect each school's cultural norms and educational goals while preserving fidelity to the PBIS framework. The generator creates items across six core dimensions: Behavioral Comprehension, Modeling, Generalization, Value Association, Emotional Association, and Meta-Emotional Reflection, thereby aligning with both the cognitive and affective domains of social behavior education. The RISE acronym: Reflecting on Interactions, Standards, and Expectations, captures the tool's reflective and student-centered design. For educators and school psychologists, PBIS-RISE supports data-driven decision-making, enabling scalable yet individualized behavioral assessments that inform tiered interventions. For teachers, it reduces the burden of developing evaluation tools and enhances consistency in behavior-related assessments. As educational research increasingly explores the integration of AI in formative assessment, PBIS-RISE offers a replicable, theory-grounded, and ethically aligned model to support equitable behavioral education in diverse school settings.

Keywords: Positive Behavioral Interventions and Supports (PBIS), generative AI, GPT, questionnaire generation, social-emotional learning

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Introduction

Positive Behavioral Interventions and Supports (PBIS) is a multi-tiered, evidence-based framework for improving social, emotional, and academic outcomes through explicit teaching, practice, and reinforcement of prosocial behavior across school settings. In PBIS, behavior is treated as teachable, predictable, and responsive to environmental conditions. The framework has developed as an alternative to reactive, exclusionary discipline approaches by emphasizing prevention, instructional routines, and ongoing use of data to guide decisions. Reviews of the evidence base describe PBIS as grounded in behavioral science and implemented through systems-level practices, including common expectations, consistent acknowledgments, and data-based problem solving (Horner et al., 2010).

Within PBIS, the expectations matrix is a central artifact that translates broad school values (for example, Respect, Responsibility, Safety) into observable and teachable behaviors for specific contexts such as classrooms, hallways, cafeterias, playgrounds, laboratories, buses, and online learning environments. The matrix is local by design: schools adapt language, examples, and emphasis to reflect community norms, developmental levels, and contextual realities. Lane and colleagues describe expectation matrices as setting-specific descriptions of behavior that support consistency across staff and clarity for students, while still aligning with the core logic of schoolwide PBIS (Lane et al., 2019). Royer et al. (2021) further illustrate how the Schoolwide Expectations Survey for Specific Settings can inform the content and structure of matrices by eliciting staff perspectives about expectations in particular locations and routines.

A persistent challenge, however, lies in evaluating whether students actually understand the expectations as intended. Many schools rely on indirect indicators (such as office discipline referrals, classroom disruptions, or teacher reports), but these indicators are typically lagging and can confound understanding with performance, opportunity, or context. Behavioral assessment literature emphasizes that measures should match their purpose, be sensitive to instructional change, and be interpretable for decision-making (Chafouleas et al., 2012). When the purpose is to guide reteaching, schools need feasible, instructionally aligned comprehension checks that can be administered frequently, quickly scored, and clearly mapped back to matrix content.

This problem creates a tension between contextualization and standardization. On one hand, the value of PBIS matrices is their cultural coherence: the behaviors are meaningful because they are situated in local settings and expressed in the language used by staff and students. On the other hand, without a stable assessment structure it becomes difficult to compare results across classes, track changes over time, or aggregate information for PBIS team decision-making. The need for scalable yet locally grounded assessment is particularly visible in international and multilingual contexts, where direct adoption of standardized instruments may be inappropriate or may weaken local ownership of expectations.

PBIS-RISE addresses this tension by using generative artificial intelligence as a scaffolding engine for assessment design. Recent work on AI in education suggests that generative models can support personalization, item drafting, and formative assessment design, but also highlights risks such as biased outputs, low transparency, and validity threats when items are generated without constraint or expert review (Arslan et al., 2024; Luckin, 2018). PBIS-RISE adopts a constrained-generation approach: the school's own matrix is treated as the authoritative content

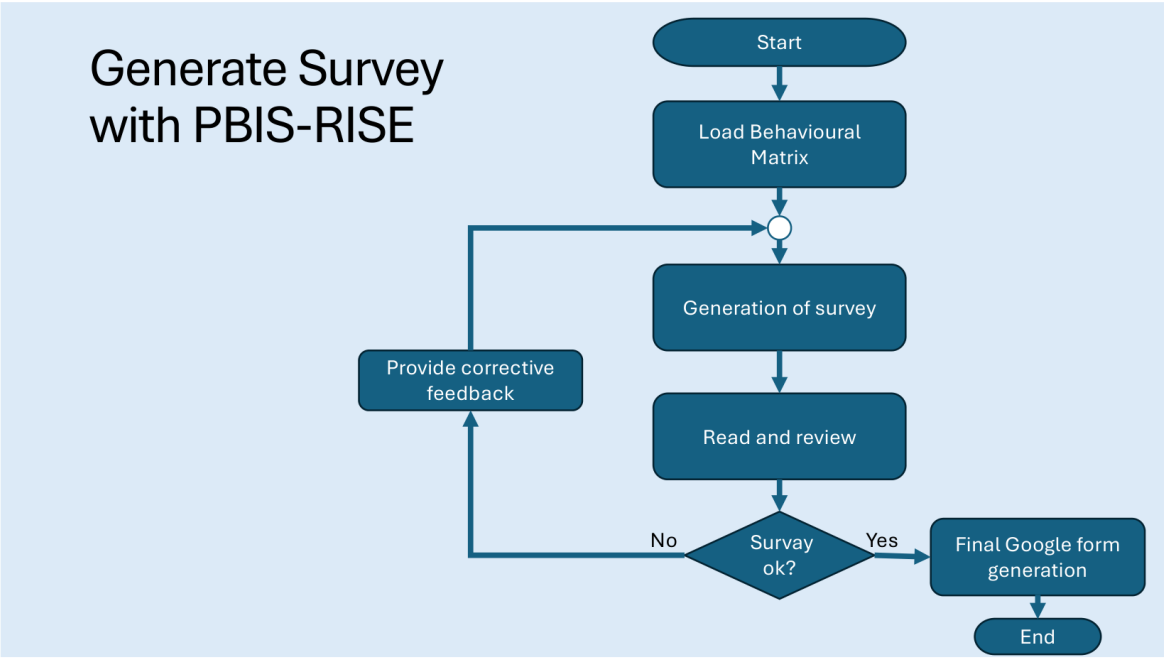
source, while the generator applies a stable theoretical blueprint to produce questionnaires that are locally instanced but structurally comparable.

The key idea of PBIS-RISE (Reflecting on Interactions, Standards, and Expectations) is that student understanding of expectations includes both cognitive and affective components. Students must comprehend what the expectation means, recognize modeled examples, generalize the expectation to novel situations, and connect expected behaviors to underlying values and emotional experiences. This view is consistent with social and emotional learning perspectives that emphasize the integration of cognition, emotion, and values in developing prosocial conduct (Zins et al., 2004).

PBIS-RISE is a revised and amplified version of a prior measurement tool, the PBIS-KBVE questionnaire (Knowledge of Behaviors, Values and Emotions) presented by Chifari et al. (2025). PBIS-KBVE operationalized student learning outcomes through four dimensions: Behavioral Comprehension (BC), Behavioral Generalization (BG), Behavioral Values (BV), and Emotions (E). PBIS-RISE expands this model to six dimensions by adding Behavioral Modeling (BM) and Meta-Emotional Reflection (ME), thereby more directly capturing the instructional mechanisms of PBIS (modeling and practice) and students' reflective awareness of emotional and motivational processes during social interaction.

The purposes of this paper are threefold. First, we describe the theoretical and methodological foundations of PBIS-RISE as an assessment approach aligned with PBIS and integrated three-tiered prevention models (Lane et al., 2015). Second, we present the PBIS-RISE Generator as a practical tool for teachers and school teams that reduces the burden of questionnaire design while preserving local cultural coherence. Third, we describe the generator's workflow, including quality assurance steps and teacher review, using the tool's process flowchart as shown in Figure 1.

Figure 1
PBIS-RISE Generator Workflow



Literature Review and Related Work

The development of PBIS is best understood within the broader evolution of school discipline practices. Historical accounts describe a shift from punitive and exclusionary approaches toward preventive, instructional, and systems-oriented models. In this trajectory, discipline is reframed from "consequence delivery" to "behavior instruction and environmental design," with a focus on equity, predictability, and skill building. The article "The Evolution of Discipline Practices: School-Wide Positive Behavior Supports" situates PBIS within this movement and emphasizes the importance of schoolwide systems that create consistent social expectations and reinforcement across settings (Sugai & Horner, 2002).

PBIS is commonly operationalized as a multi-tiered system of supports. Tier 1 provides universal prevention for all students by teaching and reinforcing common expectations and creating predictable environments. Tier 2 delivers targeted interventions for students at risk, often through small-group supports, check-in/check-out, or targeted social skills instruction. Tier 3 provides intensive individualized supports based on functional assessment and comprehensive planning. Lane and colleagues argue that comprehensive prevention models require coherence across tiers, including screening, progress monitoring, and systems to connect data to instructional action (Lane et al., 2015). This view is relevant to PBIS-RISE because a feasible comprehension measure can function as both a Tier 1 instructional check and a Tier 2/Tier 3 data point to clarify whether difficulties reflect skill deficits, performance deficits, or contextual barriers.

Expectation matrices are core PBIS tools because they make social behavior teachable and observable. Lane et al. (2019) describe how expectation matrices can be derived from staff input using the Schoolwide Expectations Survey for Specific Settings, producing setting-specific behavior statements that are relevant and "doable." Royer et al. (2021) provide descriptive properties of this survey approach and demonstrate how staff expectations differ across settings, underscoring the importance of context-specific behaviors. Earlier work by Lane et al. (2004) similarly identified social skills and behavioral expectations that teachers consider necessary for student success in elementary school, supporting the premise that expectations can be systematically articulated and assessed.

Research also highlights that PBIS implementation is context dependent. In high schools, for example, schools face challenges such as complex schedules, diverse staff roles, and adolescent developmental needs. Flannery and colleagues report early lessons from high school PBIS implementation, emphasizing the need for strong leadership, consistent systems, and feasible routines that staff can maintain (Flannery et al., 2009). In alternative education settings, systematic reviews indicate variability in Tier 1 PBIS implementation and call for tools that support fidelity and feasible data collection (Grasley-Boy et al., 2020). These findings suggest that tools like PBIS-RISE should be designed to be low burden and adaptable across diverse school structures.

Teacher outcomes are a central concern because PBIS relies on consistent adult practice. Houchens et al. (2017) examined how PBIS implementation relates to teachers' perceptions of teaching conditions and efficacy, highlighting the practical importance of tools that support teachers rather than adding workload. Similarly, contemporary PBIS scholarship emphasizes equity and inclusion, including the involvement of students with complex support needs. Zagona et al. (2024) discuss educators' perceptions of including students with complex support

needs in PBIS and the role of equity-oriented capacity building, implying that assessment tools should be accessible, flexible, and sensitive to diverse learners.

In the behavioral assessment literature, Chafouleas et al. (2012) emphasize that school-based behavioral assessment should be purposeful, technically adequate, and instructionally useful. When the target is a teachable routine (such as a matrix behavior), assessment can be designed as a curriculum-based check that informs reteaching. However, creating such tools requires time and measurement expertise. Generative AI offers potential assistance with item drafting and personalization. Luckin (2018) argues that AI can expand human intelligence in education when used to augment professional decision-making rather than automate it. Arslan et al. (2024) review opportunities and challenges for using generative AI to personalize educational assessment, highlighting the promise of tailored assessment along with the need for safeguards and human oversight. PBIS-RISE is positioned within this emerging space: it is an AI-assisted assessment generator designed around strong constraints and teacher review.

From PBIS-KBVE to PBIS-RISE: Expanded Measurement Model

PBIS-RISE builds on the PBIS-KBVE questionnaire, a tool designed to assess students' learning outcomes from PBIS lessons by measuring not only rule knowledge but also value and emotional associations. As described in Chifari et al. (2025) the PBIS-KBVE questionnaire addresses to students approximately 7 to 12 years old, composed of 36 items distributed across four subscales. Behavioral Comprehension (BC) measures whether students can identify which behavior corresponds to an expectation within a given setting. Behavioral Generalization (BG) measures whether students can extend expected behaviors to situations that are similar but not identical to those taught. Behavioral Values (BV) measures whether students can connect behaviors to the intended value (for example, "keeping the classroom tidy" linked to responsibility). Emotions (E) measures which emotions students associate with performing learned behaviors (for example, pride, happiness, anxiety), reflecting the idea that emotional experience can reinforce or interfere with behavioral learning.

PBIS-RISE retains the central insight that behavioral learning in PBIS is both cognitive and affective, and that student understanding can be decomposed into interpretable dimensions. At the same time, PBIS-RISE extends the construct map to better capture instructional mechanisms that PBIS relies on and to support reflective, student-centered assessment. Specifically, PBIS-RISE adds two dimensions: Behavioral Modeling (BM) and Meta-Emotional Reflection (ME). Behavioral Modeling focuses on recognition and selection of appropriate modeled behavior. It asks students to identify which of several described actions best demonstrates an expectation, or to choose how they would model the expectation for a peer. Meta-Emotional Reflection prompts students to reflect on how emotions influence their choices, how they might regulate emotions to meet expectations, and how they interpret others' emotional cues in social situations. In PBIS terms, BM directly aligns with modeling and practice routines used in teaching expectations, while ME aligns with the reflective dialogue often used to deepen internalization of values and prosocial identities.

The inclusion of BM is motivated by the observation that PBIS instruction frequently uses modeling, role play, and feedback, especially when teaching setting-specific expectations to younger students and when supporting learners who benefit from concrete exemplars. Yet many classroom comprehension checks focus on declarative knowledge (naming an expectation) rather than recognition of modeled examples (identifying what the expectation looks like in action). BM items provide a bridge between knowing and doing: they can reveal

whether students can discriminate between correct and incorrect examples that are plausible in real contexts. This dimension is particularly relevant in settings where misinterpretations are common, such as hallways, cafeterias, and digital communication, where small differences in behavior can matter.

The ME dimension is motivated by the role of affect in behavioral performance and by the growing emphasis on integrating PBIS with social-emotional learning. Emotional association (E) in PBIS-KBVE captured the emotions linked to behaviors, but it did not explicitly assess reflective awareness of emotional processes. ME seeks to assess whether students can anticipate emotional triggers, recognize when emotions might lead them away from expected behaviors, and select strategies to stay aligned with expectations. This dimension supports a preventive stance: if a student can articulate that anger makes it hard to "use respectful words" and can identify a coping strategy, the school can teach and reinforce that strategy as part of Tier 1 lessons or targeted supports.

PBIS-RISE is intended as a formative assessment model rather than a finalized standardized test. Because the generator produces school-specific items from local matrices, validation should focus on construct representation, response processes, and the interpretability of dimension-level results rather than on a fixed item set. This orientation aligns with comprehensive tiered prevention models that connect assessment to action. For example, if a class shows high BC but low BG for "responsibility in the cafeteria," the team can reteach generalization strategies and provide additional practice in that setting. If results indicate low BV, the school can strengthen the explicit teaching of "why" expectations matter and connect behaviors to the school's shared values. In this way, PBIS-RISE supports instructionally meaningful inferences that can inform reteaching at Tier 1 and targeted supports at higher tiers (Lane et al., 2015; McIntosh & Goodman, 2016).

The PBIS-RISE Generator: Tool Overview and Design Principles

The PBIS-RISE Generator was engineered through an iterative "GPT Builder" design process in which the target users' instructional requirements were progressively translated into a stable set of generation rules and prompt constraints. In this configuration, the tool takes as its primary input a school's Behavioral Expectations Matrix, structured with settings in rows (e.g., Classroom, Hallway, Bathroom, Playground, Gym) and values in columns (e.g., Respect, Responsibility, Safety), with each cell listing one or more observable expectations. The generator performs a semantic-structural extraction of all expectations and then deduplicates repeated behaviors that appear across multiple matrix cells, ensuring that the final instrument contains one and only one section per distinct expectation. Each section is explicitly labeled in the format "RULE: <behavioral expectation>", thus preserving traceability between questionnaire items and the school-defined matrix language while keeping the output consistent and scalable across schools.

At the item-design level, PBIS-RISE implements a fixed, theory-aligned template that produces six question types per rule, balancing cognitive understanding with behavioral enactment and affective reflection. The first four questions are multiple-choice and intentionally include a social desirability alternative to distinguish genuine knowledge from normatively "good-sounding" responding: (1) Behavioral Knowledge ("What does … mean?"), (2) Behavioral Modeling ("What should you do to … at school?"), (3) Generalization (transfer beyond school), and (4) Value Linkage, where one option correctly matches a matrix value, one is socially desirable, and one represents a counter-value/disvalue that minimizes

responsibility and impact on others. The final two questions capture emotional processes through a 4-point Likert intensity scale across nine emotions (e.g., joy, fear, sadness, anger, pride, calmness): (5) emotions when performing the expected behavior, and (6) emotions when noticing others do not perform it—explicitly intended to probe empathic awareness, internal conflict, and indirect internalization of the rule (a component that conceptually anticipates meta-emotional reflection). Across all outputs, PBIS-RISE enforces clear, simple English suitable for both primary and lower-secondary students, and it is constrained to generate expectation-specific items (no placeholders), automatically rephrasing matrix wording into child-friendly language when needed.

Questionnaire Generation Workflow

The PBIS-RISE Generator follows a structured workflow that operationalizes a "stable blueprint, local instantiation" approach. The process is implemented as a sequence of conversational steps and internal prompts that constrain generation and support quality assurance. Figure 1 provides the flowchart representation of the workflow that can be summarized as six steps.

Step 1: Matrix acquisition and normalization. The user provides the school's expectation matrix by pasting text, entering a table, or describing settings and behaviors. The system identifies settings (often the rows), expectations/values (often the columns), and the behaviors embedded in each cell. When a cell contains multiple behaviors, the generator can parse them into atomic behaviors so each item can target a single, observable action. Normalization is essential for later checks because it defines the vocabulary that the generator is allowed to use.

Step 2: Context specification. The user selects parameters such as school level, target language variety, and administration format (paper, web survey, or learning platform). The user also chooses which settings to include and can prioritize settings based on school goals or recent discipline patterns. This mirrors PBIS data cycles in which teams select focus areas based on patterns in behavioral indicators and then plan instruction accordingly (Horner et al., 2010).

Step 3: Item blueprint instantiation. The generator creates an item plan specifying the number of items per dimension, distribution across settings, and response formats. For example: BC items ask students to select the behavior that best matches an expectation in a given setting; BM items present short vignettes of peer behavior and ask which action models the expectation; BG items present novel but related scenarios requiring transfer; BV items ask students to identify which value is supported by a behavior; E items ask students to identify likely emotions associated with successful performance; and ME items prompt students to reflect on emotional triggers and regulation strategies in relation to expectations. The blueprint step is critical for ensuring balanced coverage and preventing overgeneration.

Step 4: Draft item generation with constraint prompts. Using the blueprint, the model drafts items while referencing only the matrix-derived behaviors and settings. Each item includes a stem and response options. Objective items include an answer key; reflective items include suggested scoring guidance or teacher discussion prompts. Distractors are designed to be plausible but incorrect, based on common confusions (e.g., confusing "walk calmly" with "run to be faster" in the hallway). Constrained templates help ensure that items are age-appropriate and that distractors do not introduce new behavioral expectations.

Step 5: Internal quality checks. The system applies verification prompts to detect inconsistencies: missing dimensions, repeated items, drift from the matrix, and answer-key mismatches. It also checks length constraints and reading level. These checks are designed to reduce LLM-related risks while keeping the workflow efficient. The output is revised when issues are detected, producing a second draft that better matches the matrix and the blueprint.

Step 6: Teacher review and export. The final step is teacher review. Educators can edit items for clarity, replace examples that may not fit their context, and adjust language for accessibility. The generator provides an export-ready version that can be copied into a word processor or survey platform. This human review step is essential: it ensures cultural coherence, supports inclusive practice, and maintains the ethical framing that results are used for instruction rather than discipline.

Benefits for Teachers and Potential for Broad Diffusion

A primary practical contribution of PBIS-RISE is reducing the time and expertise required to create assessment instruments aligned with local PBIS matrices. Teachers already invest substantial effort in PBIS implementation, including teaching expectations, collecting data, and participating in team problem solving. When assessment tools are not readily available, the additional burden of creating questionnaires can lead schools to rely only on referrals or informal checks. PBIS-RISE addresses this bottleneck by automatically producing items anchored to the matrix and organized by interpretable dimensions. In practice, this can shift effort from drafting to reviewing and using results for instruction.

The tool also supports consistency across classrooms and across time. If teachers develop their own informal comprehension checks, item quality and alignment can vary, and results may not be comparable across classes. PBIS-RISE provides a shared blueprint that can standardize how understanding is assessed while allowing local instantiation through the matrix. Consistency matters because PBIS outcomes depend on fidelity and coherent systems, particularly in complex settings such as high schools where routines are harder to standardize (Flannery et al., 2009). A common assessment structure can also support staff discussions during PBIS team meetings by providing a shared language for interpreting results (e.g., “generalization is low in the cafeteria”).

Teacher working conditions and efficacy are plausible benefit pathways. Houchens et al. (2017) reported that PBIS implementation can be associated with improvements in teachers’ perceptions of teaching conditions and efficacy. PBIS-RISE is not expected to directly change conditions, but it can make essential PBIS routines more feasible. For example, it can generate short, repeatable assessments that teachers can administer after reteaching lessons, enabling visible evidence of progress. Such feedback can strengthen teacher sense of impact and can support collective efficacy when results are shared at the team level.

Broad diffusion is supported because the generator operates on matrices that schools already use. This makes PBIS-RISE portable across jurisdictions and languages without imposing a single standardized rule set. The approach is well suited to international contexts, where behavioral norms and school routines differ and translation of standardized instruments may reduce local relevance. Because PBIS-RISE uses the matrix as its content anchor, it can generate culturally coherent items in the language and examples used locally, while maintaining the same six-dimension blueprint for interpretability.

Finally, the generator can support inclusive PBIS practice. Tools that are flexible in format can better accommodate students with diverse needs. In line with equity-oriented PBIS discussions, including work on students with complex support needs (Zagona et al., 2024), PBIS-RISE can be adapted to include simpler language, pictorial supports (when implemented in an external platform), or alternative response formats. This flexibility is important for ensuring that assessment results reflect understanding rather than barriers in reading or communication. In addition, by focusing on understanding of expectations rather than on "problem behavior," the tool can support a more strengths-based and instructional approach to behavior support.

Discussion

PBIS-RISE illustrates how generative AI can be used responsibly in education when it is framed as an augmentation tool rather than an automation tool. The generator demonstrates a practical compromise: it uses AI to draft items and structure assessments, but it employs constraints, verification, and teacher review to preserve instructional alignment and ethical use. This approach responds to concerns in the AI-in-assessment literature about hallucinated content, bias, and opaque decision-making (Arslan et al., 2024), while still leveraging the efficiency advantages that motivate adoption.

From a PBIS implementation perspective, PBIS-RISE targets an under-assessed component of practice: whether students understand the expectations that schools invest time in teaching. Office discipline referrals and other behavioral indicators are important, but they can reflect performance, context, or opportunity rather than comprehension. A brief comprehension check can function as a leading indicator, guiding preventive reteaching before problems escalate. In addition, the inclusion of Behavioral Modeling and Meta-Emotional Reflection aligns assessment with instructional routines and with the integration of PBIS and social-emotional learning. Modeling items can reveal whether students can discriminate correct examples in realistic situations. Meta-emotional reflection items can open instructional dialogue about emotional triggers, regulation strategies, and empathy, connecting expected behaviors to lived experiences.

At the same time, important research questions remain. First, psychometric work is needed to evaluate the quality of generated instruments. Because items differ across schools, evaluation should emphasize content validity (alignment with matrix and construct definitions), response processes (whether students interpret items as intended), and the stability of dimension-level interpretations over time. Second, implementation studies should examine how teachers use results. Do generated assessments lead to more systematic reteaching? Do PBIS teams integrate results into tiered decision-making as intended? Third, equity studies are needed to ensure that item language and formats do not disadvantage particular student groups and that results are interpreted in ways that promote support rather than labeling.

Finally, PBIS-RISE should be understood as a component within a broader PBIS data system. PBIS outcomes depend on leadership support, coaching, and consistent routines (Flannery et al., 2009; Horner et al., 2010). Tools can support these routines, but they cannot substitute for organizational commitment. PBIS-RISE aims to lower barriers to formative assessment so that PBIS teams can more easily complete the instructional cycle: teach expectations, check understanding, reteach when needed, and use data to sustain implementation. In alternative or high-need settings, where staff time is limited and data systems are strained (Grasley-Boy et al., 2020), the value of low-burden tools may be particularly high.

Conclusion

This paper introduced PBIS-RISE, a GPT-powered questionnaire generator designed to assess student understanding of behavioral expectations in schoolwide PBIS systems. Building on the PBIS-KBVE tool, PBIS-RISE expands the measurement model to six dimensions: Behavioral Comprehension, Behavioral Modeling, Behavioral Generalization, Behavioral Value Association, Emotional Association, and Meta-Emotional Reflection. The generator uses a school's own expectation matrix as the content anchor, ensuring cultural coherence and local relevance while maintaining a stable blueprint that supports interpretability and comparability.

PBIS-RISE offers a replicable model aligned with PBIS foundations and comprehensive tiered prevention frameworks. By generating customized questionnaires directly from each school's matrix, the tool can reduce teacher workload, enhance consistency in behavior-related assessment, and support data-driven decisions about reteaching and tiered supports. Future work will focus on multi-site validation studies, usability evaluations with teachers and students, and the development of accessibility-focused output formats (for example, pictorial supports and simplified language variants) to maximize equity and inclusion across diverse school contexts.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used ChatGPT (OpenAI) to assist in scientific writing and language refinement. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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Pop Culture in Education: A Bibliometric Study of Trends, Uses, and Gaps of Brazilian Research on Manga (2014–2024)

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Abstract

Given the demand for diverse didactic resources that promote engagement, identification, and effective cultural mediation, products of pop culture, such as Japanese comics (or *manga*), have drawn increasing interest from educators. This bibliometric study investigates how Brazilian academic research has addressed *manga* as an object of study over the past ten years, especially in the field of Education. Using the descriptor "*mangá*," we surveyed the Thesis and Dissertation Catalog of the Brazilian Federal Agency for Support and Evaluation of Graduate Education (Capes), identifying 73 Master's theses and doctoral dissertations produced in Brazil between 2014 and 2024. Results show a rise in scholarly interest beginning in 2020, mainly in Brazil's Southeast region. We developed a categorization matrix to classify the studies by focus: Reception and reinterpretation of *manga* (11%); Visual/aesthetic aspects (9.6%); Representation studies (31.5%); Intermedia adaptation and/or comparative literature (15.1%); Translation (4.1%); Informal education (2.7%); and Formal education (26%), the primary category of interest in this research. Out of the 19 studies focused on formal education, the majority (13) explored the use of specific *manga* titles as didactic tools for teaching content or form. Only four works examined *manga* as a collaborative creative process, proposing the production of *manga* during classroom activities. Most of these 19 studies (14) addressed Elementary or Secondary education, with none focusing on Higher Education. This absence points to a gap in the literature and highlights an opportunity for original research on *manga* creation as a pedagogical practice within the context of Higher Education.

Keywords: pop culture, *manga*, bibliometric study, education, Brazil

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Introduction

What is broadly referred to as pop culture can be understood as a set of cultural expressions conceived for wide-scale dissemination and mass consumption, embedded within an industrial and capitalist logic of distribution in which symbolic goods assume the status of what we could call commodities, as explained by Strinati (1999). Despite this critical perspective on the production and circulation of pop culture, we argue that cultural products belonging to this domain may also acquire pedagogical value when intentionally incorporated by teachers into their classroom practices. Evidence in support of this claim is provided by a study conducted in 2021 at a communitarian university[1] in the state of São Paulo, Brazil, in which 94.6% of participating faculty members agreed (totally or partially) with the premise that pop culture products have potential as supplementary teaching materials in educational contexts, while 72.8% reported having already used such references in their classes (Profeta et al., 2023). It is therefore unsurprising that pop culture can be a part of everyday school life, including in Higher Education, particularly in pedagogical scenarios guided by active learning methodologies and competency-based education, developed through concrete learning situations in which students are not conceived as passive agents.

From this perspective, pop culture products may be understood as generative themes, that is, nuclei of meaning drawn from the experienced realities of learners themselves, which function as starting points for critical dialogue and knowledge construction, in accordance with the theoretical premises of the renowned Brazilian educator Paulo Freire (Freire, 2004). These are references that students already bring from out-of-school contexts (such as media environments) and which, precisely because they are infused with personal and social meanings, tend to foster contextualized and—ideally— more meaningful learning processes. Regarding educators who effectively incorporate pop culture products into their pedagogical practices, we argue that such incorporation may operate as a strategy of curricular flexibilization, whereby openings are created within more restrictive curricular arrangements and intentionally filled with cultural references that are recognizable and meaningful to the students involved. This process has been previously conceptualized as “crafting flexibilities” (Profeta et al., 2023).

The term *manga* refers to comics produced in Japan, whose roots may be associated with earlier forms of Japanese graphic arts, particularly *chōjūgiga* and *ukiyo-e*. Over time, additional elements were incorporated, including those resulting from international influences (Alvarenga, 2023). In contemporary contexts, however, manga has become significantly detached from these traditional artistic forms, taking shape through a set of recurring features (that function less as rigid rules, as they can be subverted freely, and more as observable recurring patterns). These include the predominance of black-and-white printing; character design through simplified lines, intentionally distorted at certain moments within the narrative; the use of kinetic lines to suggest movement or dramatic intensification; the application of tonal screens in the composition of shadows and textures; the graphic incorporation of onomatopoeia; the organization of panels into dynamic layouts, characterized by free arrangements on the page and overlapping elements; etc.

[1]Communitarian universities constitute a type of non-profit, locally governed Higher Education institution typical of Brazil. They are managed by community councils composed of different segments of civil society and fulfill a social role analogous to that of public universities. Their academic scope is comparable to that of public or private universities, and they should not be confused with U.S.-style community colleges.

Manga constitutes a highly relevant segment of pop culture in editorial terms, not only in Japan but also in other parts of the world. Relatively recent data published by the website *Publish News*, in September 2024, indicate that *manga* accounted for 71% of the best-selling comics in the Brazilian market over the preceding 12-month period (2023 to 2024). This percentage also includes the so-called "Brazilian *manga*," understood as national productions that adopt the aesthetic and narrative conventions characteristic of Japanese comics (Sardinha, 2024). Despite this strong commercial performance, comics—and *manga* in particular—appear to remain underutilized in classroom practices. According to Profeta et al. (2023), at the same communitarian university mentioned earlier, only 2.9% of participating faculty members identified comics as their preferred medium when selecting pop culture products for use in their teaching. When contrasted with commercial performance data, this discrepancy suggests the existence of a research and practice gap.

This paper is grounded in the assumption that there is a continuous need to adopt a diverse range of teaching resources capable of promoting student engagement, identification, and effective cultural mediation in support of genuinely meaningful learning. Products of pop culture have increasingly attracted the interest of educators, including in Higher Education, as demonstrated by previous studies. Among these potential alternative teaching materials are Japanese comics, known as *manga*. Accordingly, this paper presents a bibliometric study designed to investigate how Brazilian academic research has addressed *manga* as an object of study over the past ten years, with particular attention to the field of Education. Beyond this mapping effort, the paper introduces a tested and validated categorization matrix for the classification of academic research on manga, enabling the systematic visualization and analysis of large bodies of studies. By identifying patterns and gaps in this body of literature, this study aims at providing a foundation for future research that may expand our understanding of the use of *manga* as a didactic resource in formal educational contexts.

Methods

This is a bibliometric study that compiles and systematizes data from segmented publications (in this case, Master's theses and doctoral dissertations defended in Brazil between years 2014 and 2024), thus aiming at mapping the academic production on the topic under investigation, specifically scholarly research on *manga* developed within Brazilian territory, and thereby providing a broader view of how the Brazilian scientific community in the field of Education has addressed *manga* as an object of study. Based on the collection and organization of these bibliographic records, a content analysis (Bardin, 2004) of the identified works was conducted, from which analytical categories emerged. This procedure resulted in the development of a categorization matrix, accompanied by explicit inclusion and exclusion criteria, in order to ensure analytical consistency and replicability.

Theses and dissertations were selected as the focus of this study because they provide a means to measure and interpret the academic output of a specific community. The choice to focus on these types of works represents a deliberate delimitation of the *corpus*. It should be noted, however, that this selection does not encompass the entirety of scientific production, as research is also conducted and disseminated through other venues (such as papers published in journals and conference proceedings, for example).

Regarding the bibliometric stage, in December 2024 a search was conducted in the Catalogue of Theses and Dissertations of the Brazilian Federal Agency for Support and Evaluation of Graduate Education (Capes, in the Portuguese acronym). This catalogue is an official

database of the Brazilian government that compiles together information on Master's theses and doctoral dissertations defended in graduate programs all over Brazil, thus functioning as a centralized national repository of academic metadata. In this search, the descriptor "*mangá*" (spelled in Portuguese with a diacritical mark on the final letter *a*) was used, covering the period from 2014 to 2024.

The initial survey yielded a total of 814 entries; however, an error stemming from limitations in the data retrieval system—which does not properly correctly recognize the diacritical mark—was identified. As a result, the search encompassed other cognates and homographs in Portuguese, generating records that were unrelated to the object of the research. In light of this issue, the data cleaning stage required the isolation and systematic exclusion of these records in order to ensure the consistency of the *corpus*. This procedure involved reading each title to ensure that only works that effectively addressed the topic of *manga* were actually retained. After excluding titles that did not correspond to the scope of the research, 73 results meeting the established criteria were identified, constituting the final *corpus* for analysis.

For these 73 selected studies, the subsequent stage consisted of an analysis of titles, abstracts, and keywords, followed by a skimming reading of the full texts, when available (especially in cases where the analysis of the other data proved insufficient). These data were organized using an electronic spreadsheet, allowing similarities among the studies to be grouped into patterns. All categories were constructed *a posteriori*, that is, derived from the *corpus* itself rather than being defined beforehand. In this way, a categorization matrix was produced, with inclusion criteria for each category, as discussed in the following subsections.

To ensure triangulation and reduce interpretive bias, thereby increasing the reliability of the results, this process was conducted by two researchers in the field of Education, both authors of this study. The results presented in the "Results and Discussion" section, following the introduction of the categorization matrix, reflect this consensus when it comes to their shared interpretation.

Proposal of a Categorization Matrix

Based on the step-by-step procedure outlined previously, a categorization matrix was developed in order to organize the study *corpus*. This matrix establishes explicit inclusion rules for each category, allowing patterns that emerge from the set of analyzed studies to be observed and grouped together, thereby enabling a comprehensive reading of the academic research in the field when it comes to *manga* as a topic of interest, as well as allowing other works (from different *corpora* and/or published after 2024) to be later classified. In this way, this proposed matrix functions instrumentally for the present research, while also constituting a contribution to the literature (since its application is not restricted to this specific study).

Here are the seven categories that were identified, along with their descriptions.

I. Reception and Reinterpretation of Manga, Especially in Brazil

This category includes research focused on the reception and re-signification of *manga*, especially in Brazil, emphasizing the reading, socialization, and/or consumption practices of readers/consumers—whether exclusively Brazilian or in comparison with Japanese readers/consumers. These studies often have ethnographic contours, aiming at understanding

the identity of these readers and their relationship with the medium within Brazilian territory and/or culture.

II. Visual/Aesthetic Aspects of Manga

This category includes research focused on studying *manga* as form (rather than its content), for example: editorial design strategies and visual language features specific to this medium.

III. Representation Studies

This category includes research focused on the representation of concepts, groups of people, and/or historical moments/episodes in specific *manga* titles. As a rule, these studies are structured in the following way: "X as represented in Y," where X is a topic of interest and Y is the title of a specific work. The category particularly includes research on historical *manga* (with emphasis on representations of World War II) and/or on representations of certain aspects of Japanese culture in selected works.

IV. Intermedia Adaptation and/or Comparative Literature

This category includes research focused on comparisons between two different media, one of which is *manga*. As a rule, it includes studies addressing the adaptation of various original works (literary ones, for example) into *manga*, or conversely, *manga* as the original work being adapted into other media (such as animations or video games, for example). This category also includes studies in comparative literature that analyze *manga* alongside other literary texts from different cultures, historical periods, languages, or genres, in order to identify relationships, influences, and differences among them.

V. Translation

This category includes research focused on analyzing the process of translating *manga* from Japanese into Portuguese, addressing the linguistic choices made by translators when transposing a work into another language (and not the term "translation" when used in the sense of intermedia adaptation, although some studies may also compare *manga* translations with their animated versions).

VI. Informal Education

This category includes research focused on studying *manga* (either in general or specific titles) regarding its potential role as a medium for science outreach and/or informal education—namely, that form of education that takes place outside school settings.

VII. Formal Education (School Education)

This category includes research focused on the applications of *manga* (either in general or specific titles) within the context of formal education—namely, that form of education that takes place within school settings, at various levels. Some of these studies may draw on approaches encompassed by previous categories (for example, representations of certain themes or intermedia adaptations); however, what distinguishes them is their educational intent (the pursuit of applications for school-based learning), which is not necessarily a central concern in other studies.

Results and Discussion

The results are presented as follows: in order to organize and graphically display the categorization of the works that constituted the *corpus*, a table was adopted in which each thesis or dissertation (identified by the author's surname and year of publication) is included in its respective category, out of the seven possibilities previously outlined (see categories from I to VII). Readers interested in specific categories may refer to the list of references at the end of this paper, where each thesis or dissertation is identified by its original title, as well as by an English translation (not necessarily official, since they were provided by the authors of this paper).

Table 1
Categories and Corresponding Theses or Dissertations

Category	Corresponding works
I. Reception and reinterpretation of *manga*, especially in Brazil	Issa (2014); Oliveira (2014); Pereira (2015); Costa (2015); Simon (2015); Coutinho (2022); Passos (2022); Silva (2024)
II. Visual/aesthetic aspects of manga	Tamekuni (2015); Nakagawa (2016); Araujo (2021); Rezende (2021); Oliveira (2023); Fontenele (2023); Ribeiro (2024)
III. Representation studies	Batistella (2014); Moreira (2014); Yamada (2014); Gregorio (2016); Teixeira (2017); Israel (2017); Ramos (2017); Kanno (2018); Oliveira (2018); Espírito Santo (2018); Martins (2018); Wesseloski (2019); Malafaia (2019); Nascimento (2020); Motta (2020); Antunes (2021); Costa (2021); Zanoni (2021); Yanaguiya (2022); Castello Branco (2023); Carvalho (2023a); Sato (2023); Silva (2024)
IV. Intermedia adaptation and/or comparative literature	Nascimento (2014); Torquato (2014); Zanotti (2017); Carvalho (2019); Santos (2021); Figueiredo (2021); Saita (2022); Alvarenga (2022); Bezerra (2023); Aguiar (2023); Testoni (2024)
V. Translation	Freire (2020); Pinheiro (2021); Lopes (2023)
VI. Informal education	Iwara (2020); Batista (2023)
VII. Formal education (school education)	Coelho (2014); Santos (2014); Gomes (2015); Jesus (2015); Dalmolin (2016); Santoni (2017); Pinto (2018); Pereira (2019a); Pereira (2019b); Silva (2021); Oliveira (2021); Cruz (2022); Loureiro (2022); Castro Junior (2023); Carvalho (2023b); Funakura (2023); Paris (2023); Arnaud (2024); Canova Junior (2024)

Source: Prepared by the authors, 2025.

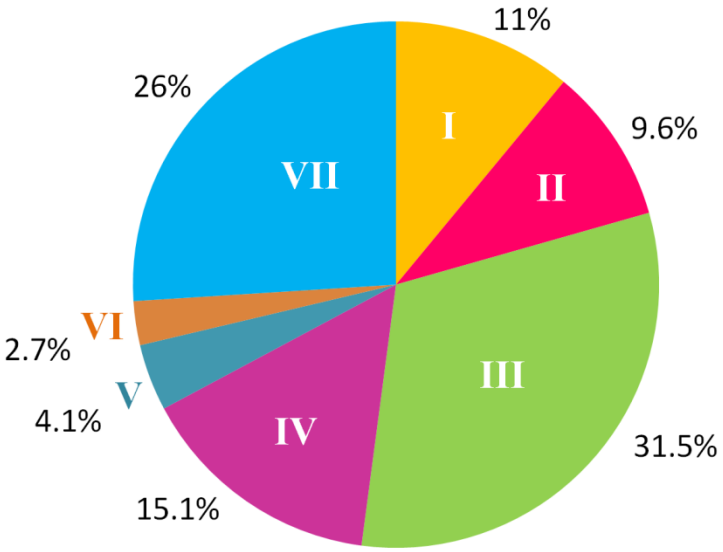
The percentage distribution of results by category is as follows:

- **(I)** Reception and reinterpretation of *manga*, especially in Brazil: **11%** of all studies;
- **(II)** Visual/aesthetic aspects of *manga*: **9.6%** of all studies;
- **(III)** Representation studies: **31.5%** of all studies;
- **(IV)** Intermedia adaptation and/or comparative literature: **15.1%** of all studies;
- **(V)** Translation: **4.1%** of all studies;

(VI) Informal education: **2.7%** of all studies;
(VII) Formal education (school education): **26%** of all studies.

These results can also be visualized in the chart below (see Figure 1).

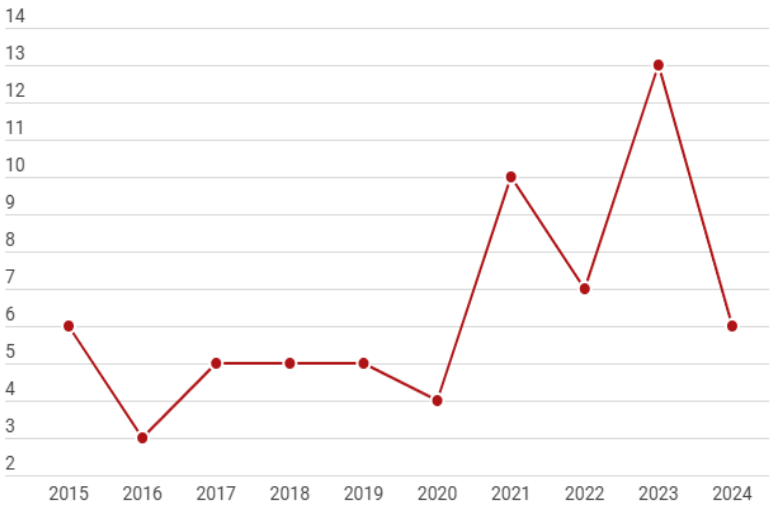
Figure 1
Percentage Breakdown by Category



Source: Prepared by the authors, 2025.

In addition to the distribution by categories, the published works can also be organized by year, as shown in the following graph (see Figure 2), allowing for an examination of fluctuations in the overall interest in the topic of *manga* by Brazilian graduate students over time. Overall, the graph indicates a relative increase in scholarly interest in the topic over the past years.

Figure 2
Total Number of Theses and Dissertations on Manga Defended in Brazil per Year (Not Stratified by Category)

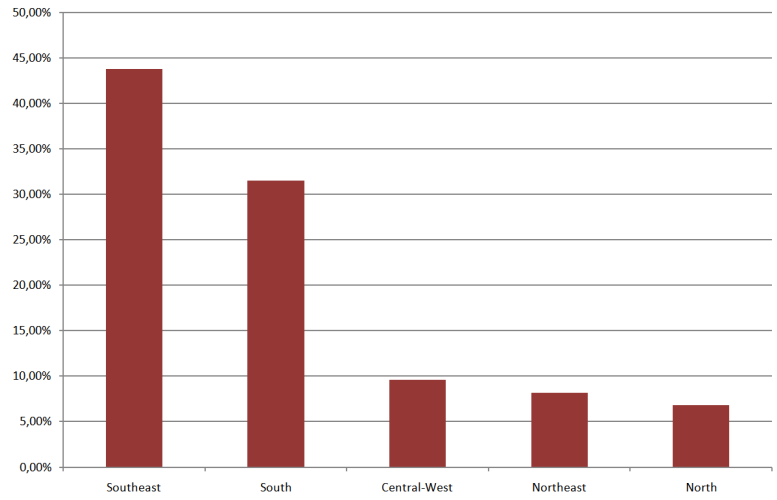


Source: Prepared by the authors, 2025.

Regarding geographical distribution, the data reveal an uneven distribution in the number of Master's and doctoral studies on *manga* in Brazil, with a higher concentration in the Southeast region, which accounts for 43.84% of the total. This is followed by the South region, with 31.51% of the studies. The remaining regions present significantly lower percentages: the Central-West contributes 9.59%, the Northeast 8.22%, and the North 6.85%. These results indicate that the Southeast and South regions concentrate the majority of academic investigations on this particular topic when it comes to Brazil, a pattern that may be explained, perhaps, by the overlap between the geographic concentration of Japanese descendants in Brazil and the presence of universities with Education programs and research groups suited to host this type of investigation (a hypothesis that may be explored in future studies).

Figure 3

Percentage of Master's Theses and Doctoral Dissertations on Manga Defended in Brazil, by Geographic Region



Source: Prepared by the authors, 2025.

Following the presentation of the table summarizing the overall results, we now turn to a more detailed examination of the final category identified (VII), which comprises studies situated within the field of school education and constitutes the primary interest of this particular investigation. All studies included in this specific category are presented below, with their titles translated to English (original titles, in Portuguese, can also be found in the list of references, along with the respective links for accessing the full texts, when available.):

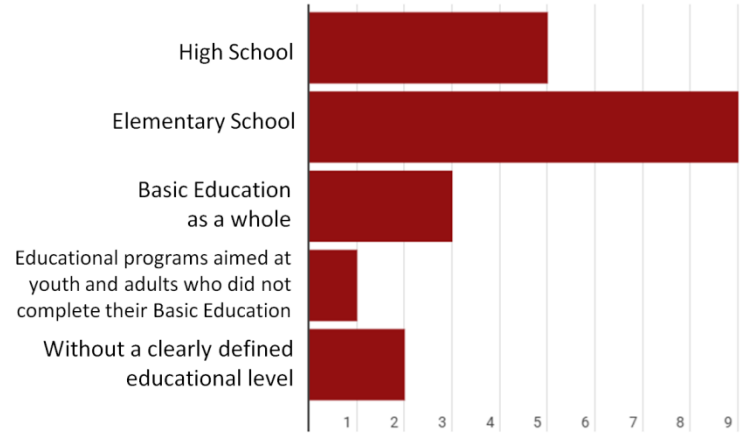
Table 2
Breakdown of Research About Manga in School Education (Category VII) in the Catalogue of Theses and Dissertations of the Brazilian Federal Agency for Support and Evaluation of Graduate Education

Entry as listed in the References	Title of the study (translated to English)
Coelho (2014)	"*Manga*: Potentials and possibilities for the teaching of Geography in Elementary School"
Santos (2014)	"*Manga* reading practices among young readers: An ethnographic investigation"
Gomes (2015)	"Cross-discourse relations and multimodality in the process of building textual meaning: teaching the manga genre in Portuguese language classes"
Jesus (2015)	"Literacies through classic short stories and its adaptation into *manga*"
Dalmolin (2016)	"From conceptions to the construction of a manga-style comic about the respiratory system"
Santoni (2017)	"*Anime* and *manga*: Teenagers' identity"
Pinto (2018)	"Making and use of *manga* for teaching magnetism in the 3rd year of High School"
Pereira (2019a)	"*Manga* drawings and paper toys: Otaku culture and audiovisual language articulating mathematics and art in school education"
Pereira (2019b)	"Graphic narratives in environmental educational practices with integrated High School students at the Federal Institute of Education, Science and Technology of Rondônia - Ji-Paraná Campus"
Silva (2021)	"Toward affective knowledge at school: The use of the *manga* Claymore (2001-2014) as a study of femininity in History teaching"
Oliveira (2021)	"Teaching electrodynamics in youth and adult education through *manga*-based comics"
Cruz (2022)	"The *anime* and *manga* 'Naruto' as devices for enhancing native language learning"
Loureiro (2022)	"A didactic sequence for the teaching of Physics in the final years of Elementary School using mini comics"
Castro Junior (2023)	"Zarathustra in *manga*: An analysis of the processes of adapting philosophical texts and reflections for teaching"
Paris (2023)	"The *manga* and *anime* Naruto in Sociology classes: a proposal for a teaching and learning methodology"
Carvalho (2023b)	"*Anime* and *manga* mobilizing emotional responses and imagination at school"
Funakura (2023)	"Studies on *manga* and *anime* in education: contemporary trends and challenges"
Arnaud (2024)	"*Manga* as a multimodal literacy practice in the Portuguese language classroom in lower Secondary Education"
Canova Junior (2024)	"*Manga* through the teaching of History: Sensitive stories and the traumas of World War II based on Barefoot Gen"

Source: Prepared by the authors, 2025.

Considering exclusively the studies included in the school education category (and listed by title in table 2), the next step was to identify the educational level to which these studies refer. The analysis indicates that, when it comes to school education research on *manga*, Elementary School is the primary level of interest (nine studies), followed by High School (five studies). Basic Education as a whole appears next (three studies), followed by studies without a clearly defined educational level (two studies). One study addressed educational programs aimed at youth and adults who did not complete Basic Education—commonly referred to in Portuguese as *Educação de Jovens e Adultos* (EJA). It is important to note that none of the theses or dissertations specifically addressed Higher Education, indicating a potential gap when it comes to this kind of research, one that future researchers may wish to explore.

Figure 4
Educational Level Addressed in Research on Manga (in the School Education Category)

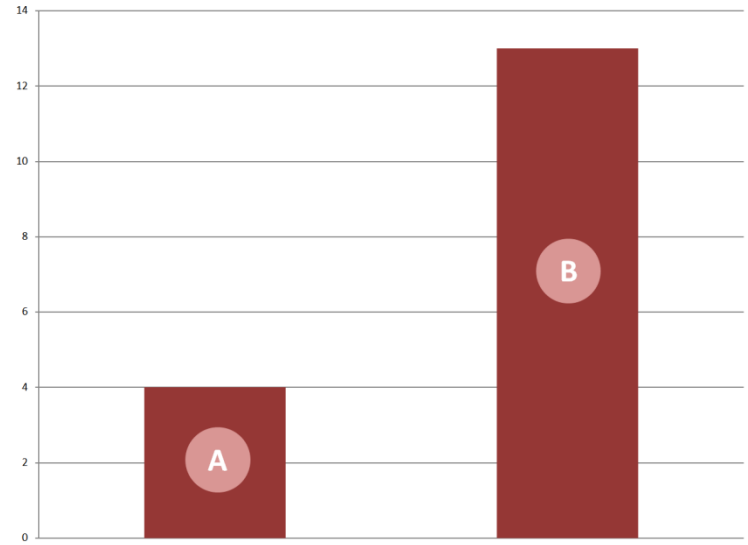


Source: Prepared by the authors, 2025.

Also considering exclusively the studies included in the school education category, we observed that most research included in the *corpus* approached *manga* as finished, already published, ready-to-use products, while only a small number of studies actually addressed the process of creating *manga* from scratch, which initially appeared as another potential gap in the literature.

Out of the 19 studies within the school education category, 17 focus on educational practices involving *manga* (the remaining two aim at understanding teenagers' identities and reading practices and, despite their potential educational applicability, do not address educational practices themselves, either by documenting or proposing them). The 17 studies that do examine educational practices were then divided into two groups: studies that examined *manga* as a collaborative creative process, proposing the production of original works during classroom activities (**group A**, with 4 results), and studies that explored the use of specific *manga* titles as didactic tools for teaching either content or form, in which *manga* were treated as ready-to-use products (**group B**, with 13 results). Therefore, these results confirmed the aforementioned gap in the literature (see Figure 5).

Figure 5
Studies That Address the Process of Creating Manga (A) Versus Studies That Treat Manga As Finished, Ready-to-Use Products (B)



Source: Prepared by the authors, 2025.

Conclusion, Limitations, and Recommendations

The data presented in this study identified and organized all the works (Master's theses and doctoral dissertations on *manga*) into groups, thus making them readily accessible to other scholars (especially those who do not speak Portuguese) who may be interested in understanding how Brazilian academia approaches the phenomenon of *manga*, particularly within the field of school education, which constitutes the main category of interest and accounts for more than one quarter (26%) of Brazilian research on the subject. Once systematized and published as part of the conference proceedings, these data become available for comparison with data obtained in other studies conducted worldwide.

As stated in the Methods section, theses and dissertations were selected as the focus of this study as a means of examining the academic output of a specific scholarly community. This deliberate delimitation of the *corpus* does not encompass the entirety of scientific production. Nevertheless, this choice allows for drawing conclusions and identifying trends and gaps within the academic production. While it does constitute a limitation, it also represents an opportunity for future research, which may employ the categorization matrix presented here to extend the analysis to other *corpora*.

Therefore, having being tested and validated, the categorization matrix presented in this paper may also be applied in other contexts, also enabling comparisons across different academic traditions that focus on the same subject. Furthermore, the gaps identified by this research may serve as a foundation for future investigations. In this regard, the study points to the need for practice-oriented methodologies that observe and document classroom practices, especially those that address the creative process underlying *manga* production, as well as those developed within the context of Higher Education, an education level at which—at least in Brazil—such studies seem to remain largely absent.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that ChatGPT, an Artificial Intelligence-based language model, was used during the preparation of the final manuscript, specifically to support the translation from Portuguese into English, thus improving its overall fluency through suggestions of more natural phrasing. All stages of conceptualization, methodological design, data curation, formal analysis, and discussion were conducted by the authors, who assume full responsibility for the final text as the outcome of their entire research process, in accordance with the principle of human-centered governance in academic research.

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Comparative Analysis of AI/ML Models for Student Performance Prediction Using XuetangX MOOC Dataset

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Abstract

In this paper, we provide a thorough study on the AI/ML models for predicting student performance in MOOCs using the XuetangX MOOC dataset. An early detection of students-at-risk is important due to the increasing use of online learning systems in order to produce better learning results. We compare six models – Random Forest, Support Vector Machine, Logistic Regression, Convolutional Neural Network, Long Short-Term Memory, and Transformer – in their predictive ability for student dropout in MOOCs. This comparative analysis is unique due to its focus on the large-scale XuetangX MOOC dataset, providing insights into model performance across diverse feature sets and offering practical implications for early warning systems in a specific regional context. Our findings, however, demonstrate that traditional machine-learning models outperform deep learning approaches (AUC 0.58–0.63 vs. 0.50–0.56), with Logistic Regression achieving the highest performance while maintaining better interpretability. Feature importance analysis reveals that course progress rate, quiz success rate, and session duration play the most significant roles in student success prediction. We further demonstrate the practical application of these models in an early warning system that provides as-recorded personalized interventions. The results illuminate the trade-offs between model complexity, performance, and interpretability in Educational Data Mining (EDM), and have important implications for learning analytics researchers and educational technologists interested in developing AI-supported student support systems.

Keywords: student performance prediction, massive open online courses (MOOCs), XuetangX dataset, machine learning, deep learning, early warning systems

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Introduction

The rapid rise of online learning platforms has produced an unprecedented amount of educational data, which presents new opportunities to us for using artificial intelligence and machine learning (AI/ML) to improve teaching and learning. One of the most promising applications is the prediction of student performance which allows early identification of students at risk and personalized interventions. This is especially useful in Massive Open Online Courses (MOOCs), where the dropout rate is considered as a significant problem.

The Chinese largest MOOCs platform, XuetangX, has more than 10 million registered users, and opens a huge opportunity to analyze student prediction performance of analytics. This dataset captures detailed student interactions across hundreds of courses and creates a full picture of online learning behaviors and outcomes. By utilizing these data, we can develop applications or models to identify patterns associated with successful course completion or potential dropout.

The aim of this paper is to compare traditional machine learning and deep learning models for Student Performance Prediction on the XuetangX MOOC dataset. We test six models from different algorithmic families: Random Forest, Support Vector Machine (SVM), and Logistic Regression from traditional machine learning; and Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), and Transformer from deep learning. We consider not only predictive accuracy, but also model interpretability, computational efficiency, and the potential practical application in educational context.

The contributions of this paper are: 1) A novel and systematic comparative analysis of traditional and deep learning models for predicting student performance in MOOCs, specifically leveraging the unique characteristics of the large-scale XuetangX dataset. 2) Identification of key predictive features in the XuetangX dataset through feature importance analysis. 3) Development of implementable strategies for an early warning system in online learning platforms, informed by the comparative model insights.

The rest of this paper is organized as follows: Section II describes related work in Educational Data Mining (EDM) and student performance prediction. Section III details the XuetangX dataset and our feature engineering process. We describe our methods, which include data preprocessing, model selection and evaluation measures, in Section IV. Section IV presents and analyzes the experimental results. Practical applications are looked at in Section VI, and limitations and future work in Section VII. We finally make conclusion in Section VIII.

Related Work

Educational Data Mining and Learning Analytics

Educational Data Mining (EDM) and Learning Analytics (LA) are two emerging, interdisciplinary sciences concerned with the development of methods for exploring data from an educational context to better understand how students learn and how to teach them effectively. Baker and Siemens (2014) offered a detailed comparison of these two approaches and pointed out their mutual advantages: EDM emphasizes automated discovery and model building, while LA focuses on human interpretation and visualization of patterns.

In the area of MOOCs, Wang et al. (Wang et al., 2020) presented recent trends in EDM and LA and categorized student performance prediction as one of the most active research trends. By comparing methods and tools used in each article, it was observed that a trend exists toward more advanced modeling techniques, from elementary statistics-based models to more complex deep learning models.

Student Performance Prediction in MOOCs

The early work of Yang et al. (Yang et al., 2013) introduced a method to identify at risk students using derived behavioral features from clickstream. Their survival analysis approach achieved moderate success but highlighted the challenges of predicting dropout in diverse MOOC populations.

Fei and Yeung (2015) advanced this line of research by proposing temporal models that capture the evolution of student behavior over time. Their results with the Recurrent Neural Network RNN model surpassed those obtained with static models and demonstrated the critical role of temporal dependencies in the prediction of MOOC performance.

More recently, Whitehill et al. (Whitehill et al., 2017) pointed out some methodological concerns in MOOC dropout prediction, especially concerning dropout definition and reasonable evaluation indicators. They suggested standardized evaluation frameworks that have influenced subsequent research, including our approach in this paper.

Machine Learning Approaches for Performance Prediction

Traditional machine learning approaches have shown a great potential in educational usage. Xing and Du (2019) demonstrated the effectiveness of Random Forest for MOOCs dropout prediction, they achieved accuracy rates of 80–90% when predicting dropout for one week in advance. Similarly, Chen et al. (Chen et al., 2020) used SVM and Logistic Regression to identify at-risk students based on learning behavior networks, achieving comparable performance.

Recently, deep learning methods have become increasingly popular. Qiu et al. (Qiu et al., 2016) pioneered the application of neural networks to MOOC data and reported small gains over traditional methods. Wang et al. (Wang et al., 2015), which used natural language processing of forum posts and clickstream data in a multi-modal deep learning framework, demonstrating the value of integrating diverse data sources.

Feature Engineering for Educational Data

Feature engineering plays a crucial role in educational data mining. Crossley et al. (Crossley et al., 2016) demonstrated that a combining of clickstream data with natural language processing features improved prediction accuracy of dropouts significantly. Their work highlighted the need to study behaviors and cognitive aspects of learning jointly.

In the context of XuetangX data, Zhang et al. (Zhang et al., 2018) identified key behavioral features associated with course completion, including video-watching patterns, assignment submission timing, and forum participation. These insights have informed our feature engineering approach in this study.

XuetangX Dataset and Feature Engineering

Dataset Description

The XuetangX dataset comes from one of the largest MOOC platforms in China and shares courses of prestigious universities such as Tsinghua University and Peking University. We used a refined dataset collected between 2018–2020, containing student interactions across 247 courses with approximately 155,000 unique student enrollments.

The dataset includes the following primary components: 1) **User Information**: Basic demographic data and enrollment details, 2) **Course Structure**: Hierarchical organization of course materials, 3) **Interaction Logs**: Time-stamped records of student activities including video views, problem attempts, forum posts, and downloads, 4) **Outcome Labels**: Binary indicators of course completion or dropout

Feature Engineering

We engineered a comprehensive set of features from the raw interaction logs to capture different dimensions of student learning behavior. These features fall into several categories:

- **Engagement Metrics**:
  - Total number of interaction events
  - Number of active days
  - Average number of events per active day
  - Session count (sequences of activities without long gaps)
  - Average session duration
- **Content Interaction Patterns**:
  - Video view count and duration
  - Problem attempt count and success rate
  - Download count
  - Forum view and post count
  - Navigation patterns between content types
- **Temporal Behavior**:
  - Weekly and daily activity distribution
  - Time between consecutive sessions
  - Regularity of engagement (entropy of activity distribution)
  - Time spent on different content types
- **Performance Indicators**:
  - Assignment submission count and scores
  - Quiz completion rate and average score
  - Progress through course materials
  - Cumulative grade point average
- **Social Interaction**:
  - Forum participation metrics
  - Response rate to forum posts
  - Social network centrality measures

Through correlation analysis and domain knowledge, we selected a final set of 12 features that demonstrated strong predictive power while minimizing redundancy. Table 1 presents these features along with their descriptions and calculation methods.

Table 1
Selected Features From Xuetangx Dataset

Feature	Description	Calculation Method
session_count	Number of learning sessions	Count of activity sequences without 30+ minute gaps
avg_session_duration	Average duration of learning sessions	Mean time between first and last event in each session
content_views	Number of learning material views	Count of page views for course content
assignment_submissions	Number of assignments submitted	Count of assignment submission events
forum_posts	Number of forum contributions	Count of forum posting events
video_completion_rate	Proportion of videos watched to completion	Number of completed videos / Total videos available
quiz_success_rate	Proportion of correct quiz answers	Number of correct answers / Total quiz attempts
days_active	Number of days with platform activity	Count of unique days with at least one event
regularity_score	Consistency of learning schedule	1 - (Entropy of daily activity distribution)
avg_time_between_sessions	Average time gap between learning sessions	Mean time difference between consecutive sessions
progress_rate	Course completion percentage	Completed modules / Total modules
late_submission_rate	Proportion of late assignment submissions	Late submissions / Total submissions

These features provide a multidimensional view of student learning behavior, capturing not only the quantity of interaction but also qualitative aspects such as regularity, timeliness, and performance.

Methodology

Research Design

Our research follows a systematic approach to compare the performance of various machine learning and deep learning models for student dropout prediction. The methodology consists of the following steps:

- **Data Preprocessing**: Cleaning, transforming, and normalizing the XuetangX dataset
- **Feature Engineering**: Extracting and selecting relevant features as described in Section III
- **Model Selection**: Implementing a diverse set of traditional and deep learning models
- **Model Training and Evaluation**: Training models and assessing their performance using multiple metrics, including statistical significance testing to validate observed performance differences

- **Feature Importance Analysis**: Identifying the most predictive features for each model
- **Comparative Analysis**: Analyzing the results to identify patterns, strengths, and limitations

Data Preprocessing

The XuetangX dataset required several preprocessing steps to transform the raw interaction logs into a format suitable for predictive modeling:

- **Session Identification**: We defined learning sessions as sequences of activities without gaps exceeding 30 minutes, following established practices in web analytics.
- **Feature Extraction**: We calculated the features described in Section III for each student-course pair.
- **Missing Value Handling**: We employed median imputation for numerical features where missing values represented absence of activity.
- **Outlier Detection**: We identified and addressed outliers using interquartile range (IQR) methods, capping extreme values at Q3 + 1.5*IQR.
- **Feature Scaling**: We applied standard scaling to ensure all features had comparable ranges.
- **Class Balancing**: To address the class imbalance (approximately 60% dropout rate), we applied class weights during model training rather than resampling, preserving the natural distribution of the data.
- **Train-Test Split**: We employed a stratified 80–20 train-test split to maintain the same class distribution across both student demographics and course categories, ensuring representative sampling.

Model Selection

We selected six models representing differfent approaches to classification, from traditional machine learning to advanced deep learning architectures:

- **Random Forest**: An ensemble method that constructs multiple decision trees and outputs the mean prediction of individual trees. We selected this model for its ability to handle non-linear relationships and provide feature importance rankings.
- **Support Vector Machine (SVM)**: A supervised learning model that finds the optimal hyperplane to separate classes. We included SVM for its effectiveness with high-dimensional data and robustness to overfitting.
- **Logistic Regression**: A linear model that estimates the probability of a binary outcome. We chose this model for its interpretability and efficiency with large datasets.
- **Convolutional Neural Network (CNN):** Although typically used for image data, we adapted this architecture for educational data by restructuring our features into a grid format where neighboring features represent related educational behaviors. This approach allows CNNs to capture local patterns of interaction between related features.
- **Long Short-Term Memory (LSTM)**: A recurrent neural network architecture designed to model temporal dependencies in sequential data. We selected LSTM for its ability to capture long-term dependencies in student learning trajectories.
- **Transformer**: A neural network architecture based on self-attention mechanisms. We restructured our tabular features as a sequence of student activities over time to leverage the Transformer's ability to model complex relationships between different learning activities without regard to their sequential distance. However, as our results show, this approach faced limitations with the aggregated feature set.

Model Training and Evaluation

We trained each model using the preprocessed XuetangX dataset with the following approach:

- **Traditional ML Models**: We used standard training procedures with 5-fold cross-validation for hyperparameter tuning.
- **Deep Learning Models**: We employed early stopping with a patience of 10 epochs to prevent overfitting, and class weights to address class imbalance.
- **Evaluation Metrics**: We evaluated all models using multiple metrics to provide a comprehensive assessment:
  - Accuracy: Proportion of correct predictions among the total number of cases
  - Precision: Proportion of true positive predictions among all positive predictions
  - Recall: Proportion of true positive predictions among all actual positives
  - F1 Score: Harmonic mean of precision and recall
  - Area Under the ROC Curve (AUC): Measure of the model's ability to discriminate between classes

Feature Importance Analysis

To understand which features contributed most to the predictions, we employed model-specific approaches:

- **Random Forest**: We extracted feature importance directly from the trained model.
- **Logistic Regression**: We examined the magnitude of coefficients.
- **Deep Learning Models**: We used permutation importance to assess feature impact.

Results and Discussion

Model Performance Comparison

We evaluated six models using multiple performance metrics. Table 2 presents a comprehensive comparison of model performance on the XuetangX dataset.

Table 2
Performance Comparison of Predictive Models on Xuetangx Dataset

Model	Accuracy	Precision	Recall	F1 Score	AUC
Random Forest	0.5625	0.5145	0.4944	0.5042	0.5871
SVM	0.5425	0.4928	0.5722	0.5296	0.5837
Logistic Regression	0.6025	0.5517	0.6222	0.5849	0.6301
CNN	0.5450	0.5083	0.2009	0.2879	0.5594
LSTM	0.5935	0.5835	0.3930	0.4697	0.6258
Transformer	0.5420	0.0000	0.0000	0.0000	0.5000

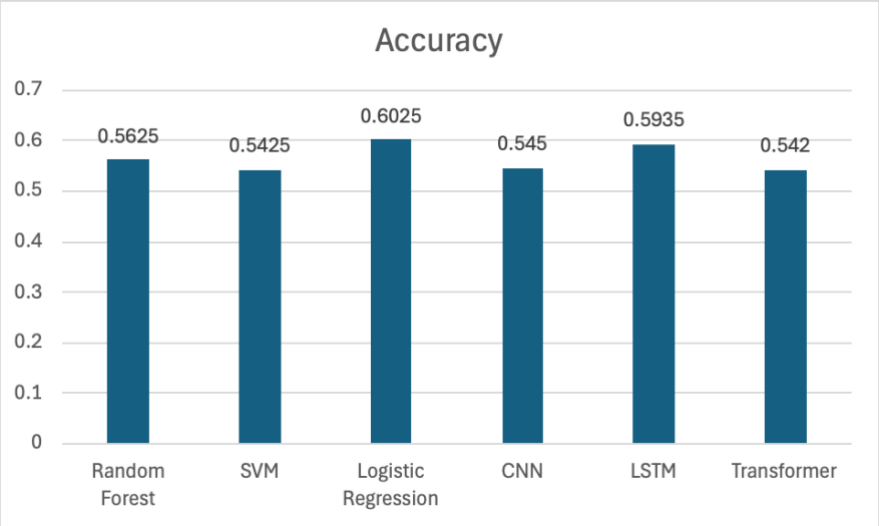
On the XuetangX dataset, which focused on predicting student dropout, we observed the following patterns:

- **Traditional ML Models**: Logistic Regression achieved the highest performance with an accuracy of 60.25% and AUC of 0.6301, followed by Random Forest (56.25% accuracy, 0.5871 AUC) and SVM (54.25% accuracy, 0.5837 AUC).

- **Deep Learning Models**: LSTM outperformed other deep learning approaches with an accuracy of 59.35% and AUC of 0.6258, while CNN and Transformer models showed lower performance.
- **Precision-Recall Trade-off**: All models exhibited a trade-off between precision and recall, with Logistic Regression achieving the best balance (F1 score of 0.5442).

During our experiments, Transformer model performed unexpectedly poorly in all metrics resulting close to zero precision (0.0), recall (0.0) and F1 score (0.0) with an AUC of 0.5, essentially performing no better than random guessing. We found that this was due to the mismatch between tabular data structure and the Transformer architecture's design for sequential data. The basic implementation had issues with the fixed-length feature vectors, as Transformers were originally designed for variable-length sequences like text. While architectural modifications such as improved embedding layers, attention mechanisms, and input reformatting could theoretically improve performance, we find that traditional ML models remain more suitable for this specific tabular dataset. Future work could explore hybrid architectures (e.g., combining Transformer elements with traditional ML pathways) or specialized encoding techniques (such as Time2Vec) to better leverage sequential patterns in educational data, Figure 1 illustrates the accuracy comparison across all models for the XuetangX dataset.

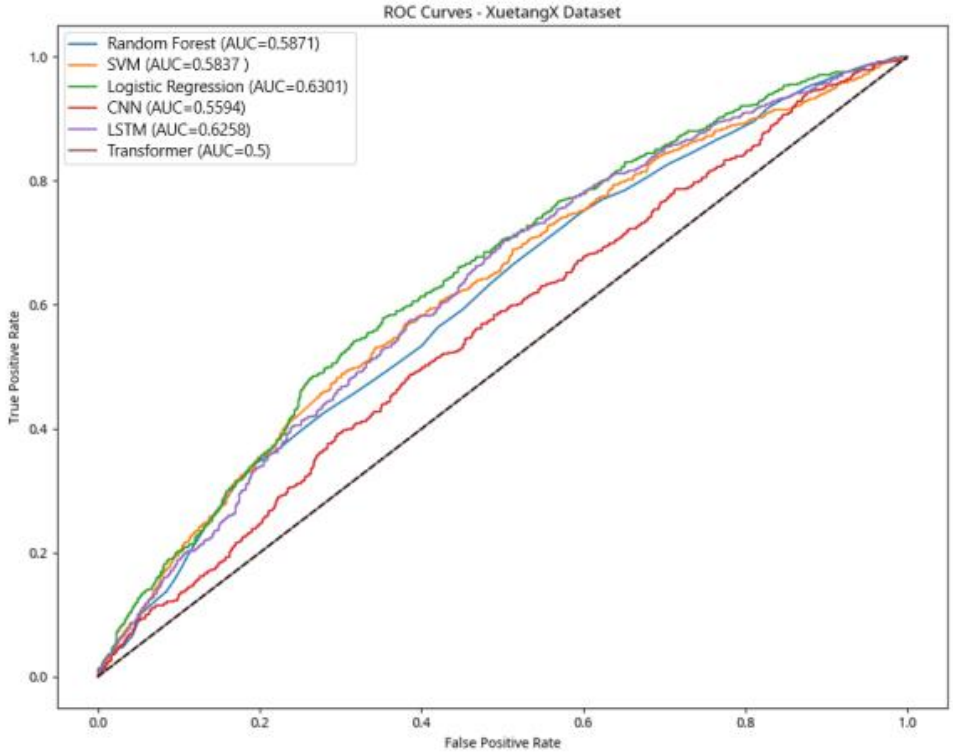
Figure 1
Comparison of Model Accuracy Across All Models



The ROC curves for all models on the XuetangX dataset are shown in Figure 2, providing a visual representation of the trade-off between true positive rate and false positive rate at various threshold settings.

Figure 2

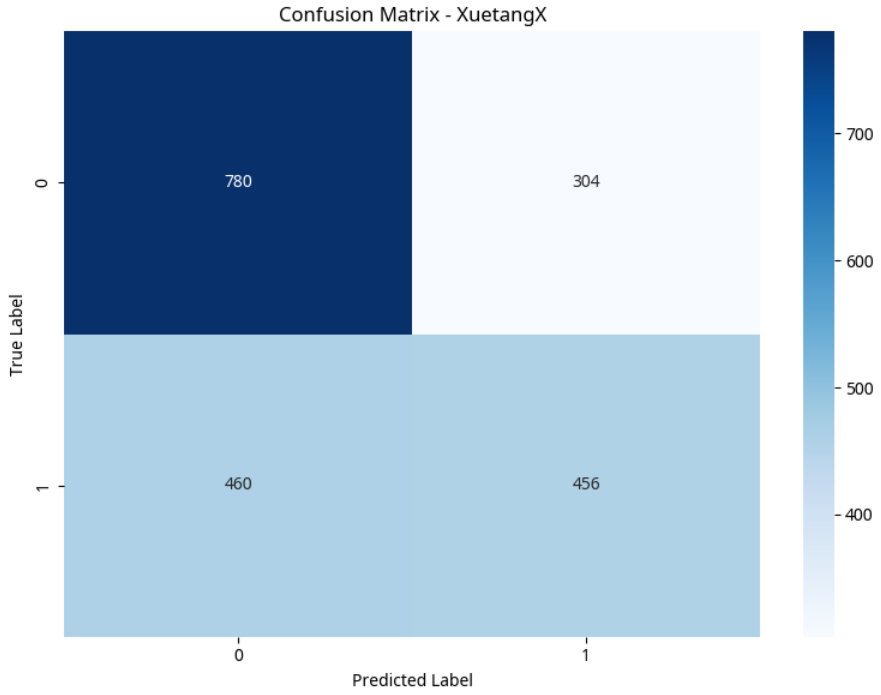
ROC Curves for All Models on the XuetangX Dataset



The confusion matrix for the best-performing model (Logistic Regression) is presented in Figure 3, showing the distribution of true positives, false positives, true negatives, and false negatives. The axes are labeled with "0: Complete" and "1: Dropout" to clearly indicate the prediction outcomes.

Figure 3

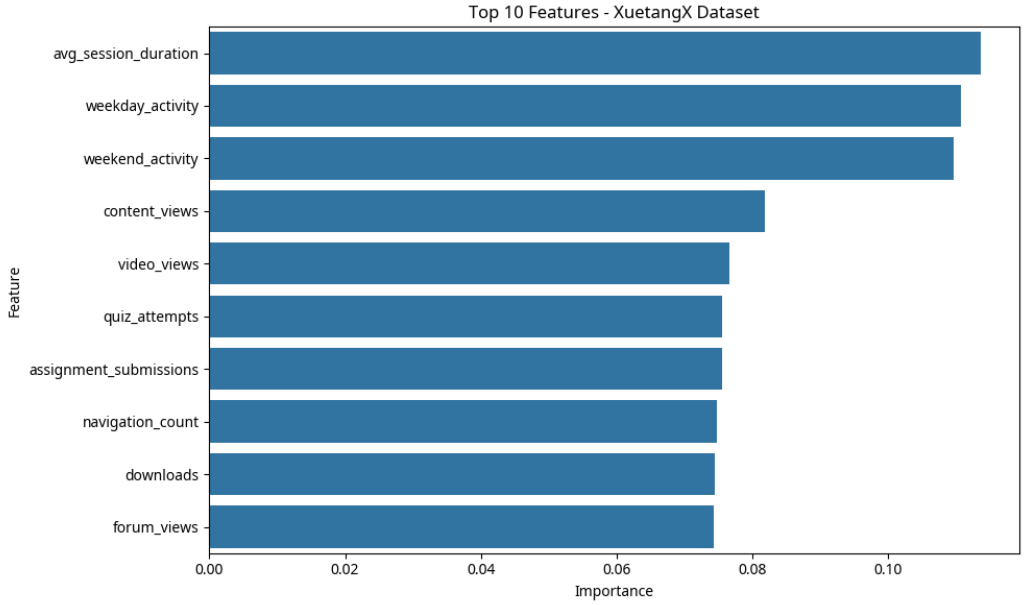
Confusion Matrix for Logistic Regression on XuetangX Dataset



Feature Importance Analysis

We analyzed feature importance to identify the most influential predictors of student dropout in the XuetangX dataset. Figure 4 presents the top 10 features based on the Random Forest model's feature importance rankings.

Figure 4
Top 10 Features by Importance for the XuetangX Dataset



For the XuetangX dataset, the most important features for predicting student dropout were:

1. **Assignment Submissions**: The number of assignments submitted by students was the strongest predictor, highlighting the importance of active participation in course activities.
2. **Quiz Success**: Rate: The proportion of correct quiz answers was highly predictive, indicating that academic performance on assessments is crucial for course completion.
3. **Average Session Duration**: Longer average session durations were associated with lower dropout rates, suggesting that sustained attention correlates with persistence.
4. **Average Time Between Sessions**: The regularity of student engagement with the platform was highly predictive, with shorter gaps between sessions associated with course completion.
5. **Assignment Submissions**: The number of assignments submitted by students was a significant predictor, highlighting the importance of active participation in course activities.

These findings align with prior research on MOOC completion, which has consistently identified engagement metrics as strong predictors of persistence.

Discussion of Results

1) Implications for Model Selection

Our comparative analysis yields several important implications for model selection in educational data mining:

- **Simplicity vs. Complexity**: The superior performance of simpler models (particularly Logistic Regression) over more complex deep learning architectures on the XuetangX dataset suggests that educational data may not always benefit from increased model complexity. The Transformer model's performance (AUC = 0.5000) indicates random guessing, likely due to the mismatch between the model architecture and the aggregated feature representation. This finding aligns with the principle of parsimony in predictive modeling.
- **Interpretability Trade-offs**: The interpretability of Random Forest and Logistic Regression provides additional value for educational stakeholders who need to understand the factors driving predictions.
- **Deep Learning Limitations**: Despite their theoretical advantages in capturing complex patterns, deep learning models did not consistently outperform traditional machine learning approaches. This may be due to the relatively small number of features or the nature of the prediction task.
- **Computational Efficiency**: Traditional machine learning models required significantly less computational resources and training time compared to deep learning models, making them more practical for real-time applications in educational settings.

2) Feature Selection Insights

Our feature importance analysis provides valuable insights for feature selection in educational data mining:

- **Behavioral vs. Performance Features**: Both behavioral features (engagement patterns) and performance features (assignment submissions) demonstrated strong predictive power, suggesting that comprehensive models should incorporate both types of indicators.
- **Temporal Consistency**: Features capturing the consistency and regularity of learning activities emerged as particularly important, highlighting the value of temporal analysis in educational data.
- **Interaction Depth**: Metrics reflecting deeper engagement (forum posts, assignment submissions) were more predictive than surface-level interaction counts, suggesting that quality of engagement matters more than quantity.
- **Early Indicators**: Several highly predictive features can be measured early in a course, enabling timely interventions before students fall too far behind.

3) Practical Applications

The findings from our comparative analysis have several practical applications for educational stakeholders:

- **Early Warning Systems**: The identified predictive features can be incorporated into early warning systems to identify at-risk students in MOOC environments.
- **Personalized Interventions**: The feature importance patterns suggest that interventions should focus on encouraging assignment completion, regular engagement, and forum participation.
- **Course Design Implications**: Course designers can prioritize elements that promote the behaviors associated with successful completion, such as regular, manageable assignments and interactive discussion opportunities.

- **Feature Monitoring**: Educational platforms can prioritize tracking and analyzing the most predictive features identified in this study to enhance their learning analytics capabilities.

Practical Applications

Early Warning System

Our analysis demonstrates the feasibility of developing effective early warning systems based on the best-performing models identified in this study. Such systems can help identify at-risk students before they fall behind or drop out, enabling timely interventions.

The proposed early warning system would consist of the following components:

- **Data Collection Module**: Interfaces with learning management systems to continuously gather student interaction data
- **Feature Extraction Pipeline**: Processes raw data to generate the predictive features identified in our analysis
- **Prediction Engine**: Implements the Logistic Regression model (best performer) to generate risk scores
- **Alert Generation System**: Converts prediction outputs into actionable alerts for instructors and students
- **Intervention Recommendation Engine**: Suggests personalized interventions based on specific risk factors

When implementing such a system, several considerations should be addressed:

- **Prediction Timing**: The system should make predictions early enough to allow for effective intervention while ensuring sufficient data for accurate prediction.
- **Alert Thresholds**: Careful calibration of risk thresholds is necessary to balance between false alarms and missed identifications.
- **Privacy Protection**: Student data must be handled in compliance with relevant privacy regulations and ethical guidelines.
- **User Interface Design**: The system should present information in an intuitive and actionable format for both instructors and students.

Personalized Learning Recommendations

Beyond identifying at-risk students, our models can be leveraged to generate personalized learning recommendations that optimize each student's learning path.

The personalized recommendation system would utilize the following approach:

- **Student Profiling**: Creating multidimensional profiles based on the predictive features identified in our analysis
- **Content Matching**: Aligning learning resources with individual student needs and learning patterns
- **Adaptive Sequencing**: Dynamically adjusting the sequence of learning activities based on performance and engagement
- **Feedback Integration**: Incorporating student feedback to refine recommendations over time

Based on our feature importance analysis, the system could provide several types of recommendations:

- **Engagement Recommendations**: Suggestions for optimal study patterns based on temporal consistency features
- **Content Recommendations**: Personalized resource suggestions based on knowledge component mastery
- **Interaction Recommendations**: Guidance on beneficial peer interactions based on social engagement patterns
- **Study Strategy Recommendations**: Advice on effective learning approaches based on performance patterns

Ethical Considerations and Responsible AI in Student Performance Prediction

The widespread use of AI/ML models in academia especially for the prediction of student performance must be balanced with comprehensive analysis of the model's ethical implications, data bias, fairness, and interpretability. Although we have presented the problem of predictive accuracy and interpretability, we acknowledge the broader societal implications of these systems. The XuetangX dataset may contain some bias in terms of student demographics, resource accessibility and so on, which may unwittingly cause unfair predictions towards some student groups. Fairness monitoring requires ongoing audits of model outputs and commitment to reduce bias in algorithms.

Furthermore, the interpretability of models, as highlighted by Logistic Regression's performance is critical to build trust that a model was what identified a student as at-risk so that educators can know why a student was flagged as at-risk rather than just that they are at-risk. This visibility enables human insight and avoids the black box problem in significant decision-making. Compliance to published standards, such as the UNESCO standards on the use of AI in educational systems, or IEEE's Ethically Aligned Design principles, is needed veering reasonable AI-supported student support. In future work, we will consider bias in more detail, including various fairness metrics, and investigate robust interpretability methods for achieving reasonable and fair treatments by making the models interpretable at their decision boundaries

Limitations and Future Work

Limitations

Despite the comprehensive nature of our analysis, several limitations should be acknowledged:

- **Dataset Specificity**: Our findings are based on the XuetangX dataset and may not generalize to all MOOC platforms or educational contexts.
- **Feature Granularity**: The aggregated features used in our analysis may obscure more fine-grained patterns that could improve prediction accuracy.
- **Temporal Dynamics**: Our current models do not fully capture the evolving nature of student behavior over time, which may limit their long-term predictive accuracy.
- **Model Interpretability**: While we can identify important features, the causal mechanisms underlying these relationships remain unclear, particularly for complex models.
- **Demographic Factors**: Limited demographic information in the dataset prevented analysis of how prediction models perform across different student populations.

A primary limitation of this study is its reliance on the XuetangX MOOC dataset, which originates from a single platform and regional context in China. While this dataset is extensive and rich in detail, the specific learning behaviors and platform interactions observed may not be fully representative of MOOCs globally. Therefore, the direct generalizability of our findings to other MOOC platforms (e.g., edX, Coursera) or different cultural educational contexts should be considered with caution. Future work could involve validating the proposed models and feature importance across a broader range of MOOC datasets to assess their cross-platform applicability.

Future Work

To address these limitations and extend our findings, we propose several directions for future research:

- **Temporal Modeling**: Developing more sophisticated temporal models that capture the evolution of student behavior throughout a course, potentially using recurrent neural networks with attention mechanisms.
- **Multimodal Analysis**: Incorporating additional data sources such as video viewing patterns, text analysis of forum posts, and peer interactions to create richer predictive models.
- **Causal Modeling**: Moving beyond correlation to identify causal relationships between educational interventions and student outcomes.
- **Fairness and Bias**: Investigating potential biases in predictive models across different demographic groups and developing approaches to ensure equitable predictions.
- **Intervention Studies**: Designing and evaluating specific interventions based on the predictive insights generated by our models.

Conclusion

In this paper, a comparative study of traditional machine learning and deep learning models was applied to predicting student drop out based on data from the XuetangX MOOC. Our results showed that simple models, particularly Logistic Regression, were better than the more complex deep learning models in this educational context. Feature importance analysis identified key predictors of student success, including assignment submissions, session count, and content engagement.

Our findings have important practical implications for educational practitioners. The identified predictive features and models may be integrated into early warning systems for the detection of at-risk students and timely interventions. Designers of courses can emphasize features that encourage behaviors that are associated with successful completion; for instance, providing small but regular assignments, and periods for interactive discussion.

Future studies focus on developing more sophisticated temporal models, actively include other data for more thorough exploration of causal connections, ensure fairness among different demographics and propose data-driven interventions based on prediction of the models. It is by facing these that we can work to realize more of the potential of AI/ML for bettering learning outcomes in online learning.

While our study provides valuable insights into student performance prediction, itis important to acknowledge that the analysis is based solely on the XuetangX MOOC dataset, representing

a specific regional and platform context. Future research could explore the generalizability of these findings across diverse MOOC platforms and cultural settings.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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STEM Teaching Readiness in Hong Kong: A Decade of Insights From the Modified Theory of Planned Behavior

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Abstract

This study investigates the readiness of primary and secondary school teachers in Hong Kong to implement STEM education, nearly ten years after its formal policy introduction. Grounded in a modified Theory of Planned Behavior (TPB), the research explores five key constructs: attitudes toward STEM, perceived systemic barriers, self-efficacy, affective conditions (as a proxy for intention), and STEM teaching behaviors. A quantitative survey was conducted with 119 teachers using convenience and snowball sampling. The results revealed that attitudes significantly predicted affective readiness ($\beta = 0.544$, $p < 0.001$), and affective readiness in turn strongly influenced actual STEM teaching behaviors ($\beta = 0.592$, $p < 0.001$). Perceived systemic barriers also had a surprising positive influence on behavior ($\beta = 0.303$, $p < 0.001$), suggesting that in certain institutional contexts, constraints may act as creative drivers rather than deterrents. In contrast, self-efficacy was not a significant predictor of intention ($p > 0.05$). The model accounted for 56.9% of the variance in affective readiness and 43.5% in teaching behavior, indicating moderate to strong explanatory power. Additional analysis showed that related training and experience significantly enhanced readiness ($p < 0.05$), regardless of gender or school level. The findings have practical implications for curriculum designers and school leaders, suggesting that professional development should integrate emotional readiness and institutional resilience as central components of STEM implementation strategies.

Keywords: STEM education, teacher readiness, modified Theory of Planned Behavior, structural equation modeling, Hong Kong

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Introduction

In 2015, the Education Bureau (EDB) put forward STEM education in Hong Kong, which was supposed to enhance the competitiveness of students in a more technology-driven world and was thus justified in the Policy Address of the Hong Kong Government (HKSAR, 2014). Over the last decade, EDB has introduced and implemented different policies and initiatives through official guidelines in 2016 (EDB, 2016), and finally establishing the STEM Education Centre in 2017 (HKSAR, 2017) meant for integrating STEM into primary and secondary schooling. This school-based approach (EDB, 2016) places enormous pressure on teachers; it critically depends on their readiness and willingness to successfully integrate various aspects of STEM into their pedagogy. Therefore, besides curricula, effectiveness in STEM education will also depend on how these teachers perceive it; what their capacity is, and whether they are willing to implement it.

The studies that have gone in Hong Kong, despite STEM being emphasized more, have focused on the issues concerning the teachers faced at the EDB rather off their own preparation. These works reported that constraints of time, lack of support by the schools and EDB, inadequate preparation on the part of the EDB, and other unknown factors affecting student engagement (Croucher Foundation, 2016; Lau, 2019; Hong Kong Federation of Youth Group, 2018). The rest dealt with pedagogical aspects: methodologies of teaching (Liang & Fung, 2022; So, 2018), assessment approaches (Ali, 2021; Yip & Chan, 2019), and STEM literacy development (Chang et al., 2021; Kutnick et al., 2020).

The blank in the study both psychologically and contextually in what makes teachers willing to implement STEM education is very crucial. This research, therefore, seeks to fill the gap by determining how far teachers' attitudes, perceived systemic barriers, and self-efficacy predict their affective readiness and resultant pedagogical practice toward STEM. The above objective was conducted using the Theory of Planned Behavior (TPB) model (Ajzen, 1991), which traditionally links attitude, subjective norm, and perceived behavioral control to intention and subsequent behavior. Affective readiness is introduced here with fine calibrations as an important mediator stressing the strong influence of the affective domain on education strategies.

This study will be significant to the extent that it can specify approaches to teacher support, thus realizing the STEM education goals set in Hong Kong. By emphasizing readiness in affective and behavioral aspects, this study provides critical information on how to improve teacher readiness; this, in turn, feeds into the general aim of building a qualified STEM workforce in Hong Kong.

Literature Review and Hypotheses Development

STEM Education and Teacher Readiness

The successful implementation of STEM education depends on teachers' readiness, a multifaceted construct that significantly influences educational outcomes. Wu et al. (2022) emphasized that the teachers' readiness to adopt STEM education is a critical determinant of the success of STEM education because it directly affects their ability to integrate elements of STEM into their teaching practices. Rafferty et al. (2013) describe readiness in three dimensions: cognitive, affective, and behavioral. In STEM education context, cognitive readiness means teachers' knowledge of STEM concepts and pedagogy; affective readiness

includes attitudes, emotions, and motivation related to STEM teaching; while behavioral readiness covers the actual classroom practices of the teachers-including both the frequency and quality of activities related to STEM subjects. The present study will address affective and behavioral readiness since they have a more immediate impact on the success of STEM teaching and are fields where actionable insights for teacher support can be gained. Measuring cognitive readiness is equally important, though it takes up a lot of resources and time and is typically dealt with via formal training programs. Since this study was small-scale in nature, the focus on the affective and behavioral dimensions leads to a more in-depth exploration of the mental and practical motivators of STEM instruction among teachers in Hong Kong.

Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) is one of the most articulated and influential models in explaining and predicting human behavior. According to Ajzen (1991), behavior is a function of three primary dimensions: attitudes toward the behavior, subjective norms, and perceived behavioral control. Altogether they determine intention which is the immediate antecedent for action. Therefore, it has been extensively applied in educational research to investigate teachers' intentions and behaviors regarding teaching-related practices, technology adoption, and professionalization. For example, Dunn et al. (2018) applied TPB to explore teachers' intentions toward ongoing professional development. They found strong predictive elements in control and attitude for workers' willingness to support new work practices. In another study by Teo et al. (2016), it was found that an individual's attitude towards technology and the perceived behavioral control of teachers significantly influences their intention of using technology for teaching. Subjective norms may pose negative or less positive effects on the same. In terms of STEM education, TPB has been proved useful in predicting in-service teachers' and preservice teachers' intentions to adopt STEM teaching. Wu et al. (2022) revealed that both attitudes and perceived behavioral controls have a direct influence on STEM teaching intentions whereby perceived usefulness, self-efficacy among others act as indirect factors. For example, Li et al. (2019) applied TPB to less conventional STEM areas like the integration of STEM with physical education where all three TPB constructs served as positive predictors of teachers' intention highlighting the model's adaptability across different educational settings.

This study adapts and implements TPB to fit in with the focus on STEM readiness of Hong Kong teachers by emphasizing affective condition as a primary driver. In traditional models of TPB, behavioral intention mediates between behavior and its antecedents; here, in this modified model, affective condition is inserted in the mediating role between attitudes, systemic barriers, self-efficacy, and STEM teaching behaviors (see Table 1). This is quite consistent with previous studies that have found educational contexts to be sensitive to affective variables. For example, Teo et al. (2016) found that technology usage was most strongly influenced by attitude toward technology which is an affective component; it again underlines how emotions weight behavior. Though TPB applications to STEM education have increased, knowledge gaps in affective and behavioral determinants of STEM teaching readiness remain, particularly in Hong Kong where concerns about resource constraints and high-stakes educational settings seem to localize.

Table 1
Research Constructs of Modified TPB

Construct	TPB construct	Definition
Att_STEM	Attitude towards the Behavior	Directly measures teachers' attitudes of teaching STEM.
Perceived Systemic Barriers (PSB)	Subjective Norm	Captures perceived pressures from the teachers that discourage STEM teaching.
Self-efficacy	Perceived Behavioral Control	Reflects teachers' confidence in their ability to plan and deliver STEM lessons.
Affective conditions	Behavioral Intention	Measure teachers' emotional engagement and eagerness, translating into an intention to teach STEM (intrinsic motivation).

Research Model and Hypotheses

This study attempts to identify factors that influence the teaching intentions of Hong Kong primary and secondary teachers, as well as their actual teaching behavior toward STEM, through the application of a modified TPB framework. Therefore, this research tries to explore how teachers' attitudes, external pressure, and perceived control on their capability to perform influence their readiness to embrace STEM practices. Insights into effective STEM education in Hong Kong can be drawn from this exploration. The conceptual model of this research derived from the modified TPB model is displayed in Figure 1. The investigation is guided by the following hypotheses:

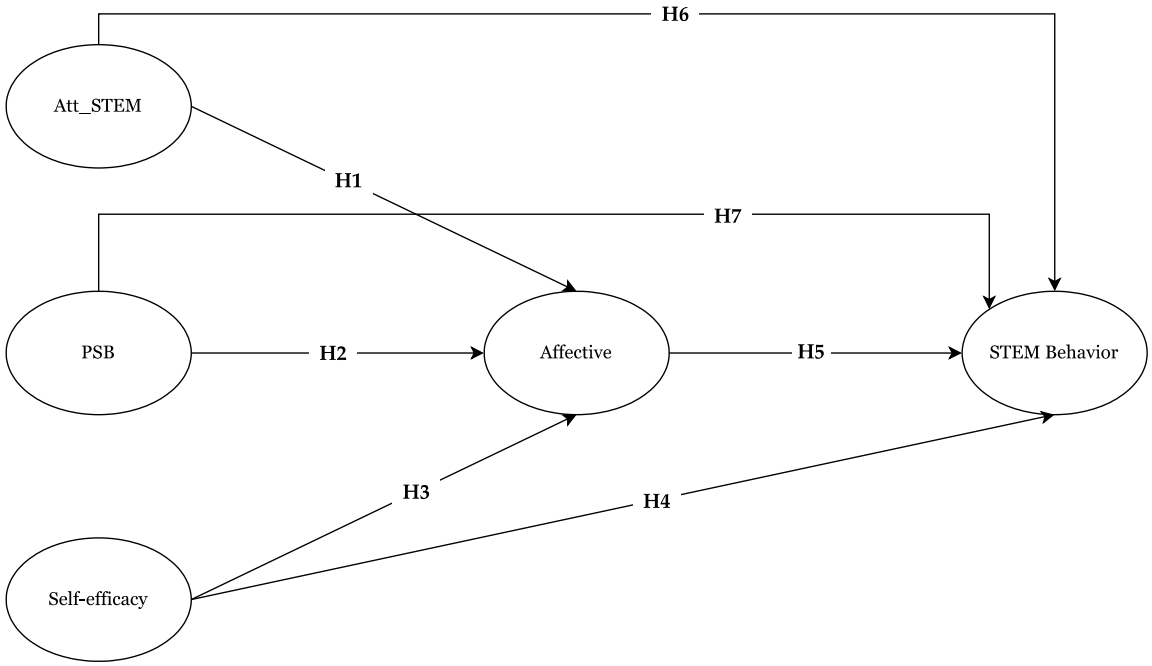
- **H1:** Teachers' attitudes toward STEM education (Att_STEM) positively influence their affective conditions.
- **H2:** Perceived systemic barriers (PSB) negatively influence teachers' affective conditions.
- **H3:** Teachers' self-efficacy positively influences their affective conditions.
- **H4:** Teachers' self-efficacy positively influences their STEM teaching behaviors.
- **H5:** Teachers' affective conditions positively influence their STEM teaching behaviors.
- **H6:** Teachers' attitudes toward STEM education (Att_STEM) indirectly influence their STEM teaching behaviors through affective conditions.
- **H7:** Perceived systemic barriers (PSB) indirectly influence teachers' STEM teaching behaviors through affective conditions.

Methodology

Research Design

This study adopted a quantitative research approach and conducted a structured survey questionnaire to assess the readiness of primary and secondary teachers in Hong Kong towards the implementation of STEM education. Four main questions guided this research: (1) How do attitudes toward STEM, perceived systemic barriers, and self-efficacy shape the affective readiness of Hong Kong teachers?; (2) How do affective readiness and self-efficacy influence STEM teaching behaviors among Hong Kong teachers?; (3) Do attitudes toward STEM and perceived systemic barriers indirectly affect STEM teaching behaviors through affective readiness? And (4) Are there significant demographic differences in these factors? The above-used approach allowed for the orderly examination of mental and practical elements related to the practice of teaching STEM within a modified TPB framework.

Figure 1
Research Conceptual Model



Sampling and Data Collection

The data were collected through an online survey, which yielded a total of 119 valid responses from teachers in primary and secondary schools in Hong Kong. Sampling utilized convenience and snowball methods, taking advantage of the researcher's personal network to disseminate the survey. This method provided easy access to a diverse yet manageable sample within the limitation of a small-scale study. The demographic information, including gender, years of teaching experience, school level, and STEM-related qualifications of the respondents, was collected to present their complete profiles.

Survey Instrument

The instrument used for the survey comprised 49 items initially designed to measure the related constructs. Items for attitudes toward STEM education, which is abbreviated here as Att_STEM, were adopted from the Teachers' Attitudes towards STEM Education and Teaching (TASET) Scale (Papagiannopoulou & Vaiopoulou, 2024). Items for self-efficacy and affective conditions were taken from the TRi-STEM Scale (Papagiannopoulou et al., 2023). Based on previous research and contextual needs, perceived systemic barriers (PSB) and STEM teaching behaviors were added as new subscales. The survey used a 5-point Likert scale in measuring responses. A pilot test was conducted with one primary school teacher and one secondary school teacher so that adjustments could be made regarding the clarity of the items and their proper structure before they would be fully deployed. Detailed references to the adapted scales can be found in Table 2.

Data Analysis

Two different methodologies were applied to analyze data in answering the posed research questions. First, Partial Least Squares Structural Equation Modeling (PLS-SEM) carried out in

SmartPLS 4.1.1.2 was used to test the proposed relationships of the modified TPB model along with its direct and indirect effects between constructs. Second, demographic comparisons were run using Mann-Whitney U tests in JASP 0.19, chosen due to non-normality and small sample size (n = 119). All software applications made available easily conducted analyses that were appropriately powerful to ensure finding valid results. Strict adherence to ethics, including informed consent as well as data anonymity was ensured during the entire research process.

Table 2
Scale Adapted for Survey Item Generation

Construct	Scale adapted	Reference
Attitude towards STEM (Att_STEM)	Teachers' Attitudes towards STEM Education and Teaching (TASET) Scale	(Papagiannopoulou & Vaiopoulou, 2024)
Perceived Systemic Barriers (PSB)	New subscale concluded from research result	Lau (2019); Hong Kong Federation of Youth Group (2018); Croucher Foundation (2016)
Self-efficacy	Tri-STEM Scale	(Papagiannopoulou et al., 2023)
Affective conditions	Tri-STEM Scale	(Papagiannopoulou et al., 2023)
STEM Behavior	New subscale	/

Results

Results are outlined in three parts: the evaluation of the measurement model, structural model analysis, and comparative analysis of demographic differences. These will indicate the reliability and validity of the data, the predictive relationships within the modified TPB framework, and the variations across teacher demographics in Hong Kong.

Measurement Model Evaluation

The measurement model evaluation began with an assessment of survey items. The item evaluation of the measurement model to ensure robustness through item retention was conducted according to the recommendations of Sarstedt et al. (2021) with items having factor loadings of 0.57, retaining at least three items per construct, to assure structural integrity. This procedure subsequently led to the final selection of 28 items that were used in the data analysis to be reported. Composite Reliability (CR) and Average Variance Extracted (AVE) were computed for reliability and validity and are reported in Table 3. All CR values are greater than 0.7 (Hair et al., 2019) establishing good internal consistency among the constructs. The high CR values were again confirmed, allowing the second form of convergent validity to have AVE values at or above the 0.5 criterion, underestimating by two constructs, in an exploratory study of this nature. The square roots of AVE generally exceeded inter-construct correlations, but some HTMT values exceeded 1.0 (see Table 4), suggesting potential overlap. However, the overall statistics affirm the data's suitability for PLS-SEM analysis and warrant a cautious interpretation of the findings.

Table 3
Cronbach Alpha, Rho-A, Composite Radiality and AVE Values for Internal Consistency Reliability and Validity Analysis

Construct	Cronbach's alpha	Rho-A	CR	AVE
Affective	0.538	0.532	0.765	0.522
Att_STEM	0.639	0.647	0.785	0.480
PSB	0.550	0.582	0.761	0.520
STEM Behavior	0.773	0.776	0.841	0.470
Self-efficacy	0.686	0.703	0.808	0.516

Table 4
Results of the Discriminant Validity Analysis

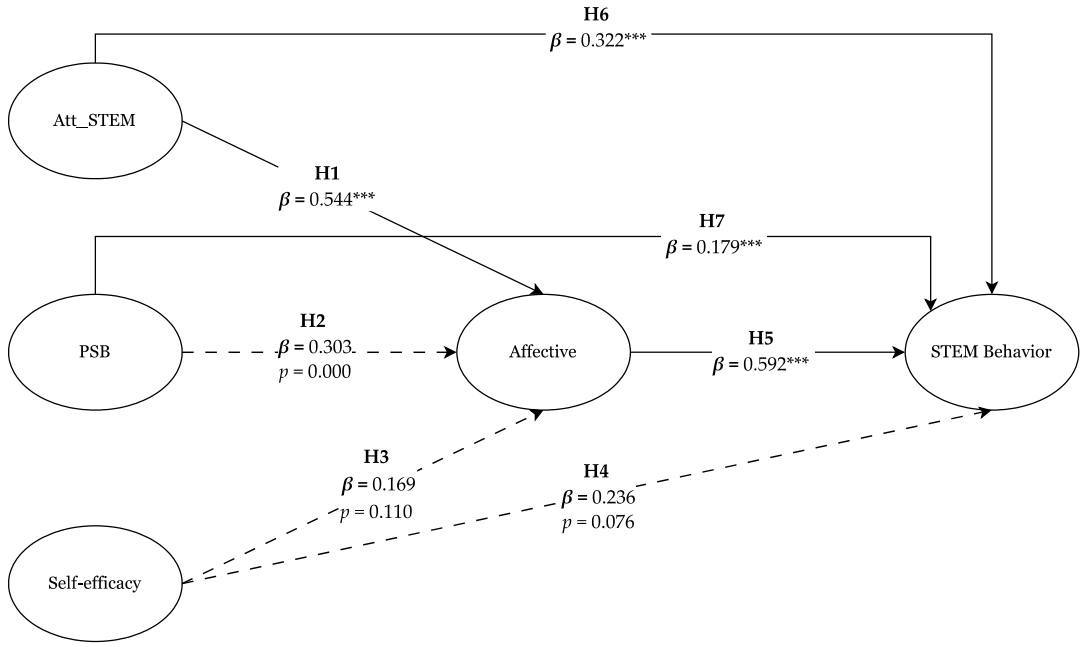
	Affective	Att_STEM	PSB	STEM Behavior	Self-efficacy
Affective	**0.722**	1.132	0.758	0.997	0.657
Att_STEM	0.681	**0.693**	0.375	1.000	0.674
PSB	0.426	0.215	**0.721**	0.451	0.402
STEM Behavior	0.648	0.697	0.270	**0.686**	0.528
Self-efficacy	0.412	0.425	0.039	0.380	**0.718**

Note. The square root AVE values are in bold; the results for the Fornell–Larcker criterion are below the diagonal and those of the Heterotrait–Monotrait ratio are above the diagonal.

Structural Model Analysis

The structural model analysis was carried out to see how the five underlying constructs within the adjusted TPB framework relate to each other predictively and to put an implicit emphasis on how they influence behaviors pertaining to STEM teaching. The model turned out to have a moderate degree of explanatory as well as predictive power accounting for an R^2 value of 0.435 with Q^2 being 0.336 for STEM teaching behaviors. The results of hypothesis testing are explicitly detailed in Figure 2 and Table 5. While H1, stating a positive influence of attitudes toward STEM on improving affective conditions, is successfully validated by a standardized beta weight of 0.544 ($p < 0.001$), signifying a strong emotional impact. The hypothesis that perceived systemic barriers would negatively relate to affective conditions (H2) is not supported, but rather the converse is true, as it stands at ($\beta = 0.303$, $p < 0.001$). Therefore, H2 is rejected. Other such related hypotheses, H3: self-efficacy positively influences affective conditions ($\beta = 0.169$, $p = 0.110$), and H4: self-efficacy positively influences STEM behavior ($\beta = 0.236$, $p = 0.076$), are also not supported due to very wide and large p-values. H5. It was strongly supported that affective conditions drive STEM teaching behaviors ($\beta = 0.592$, $p < 0.001$). Indirect effects, H6 and H7, attitudes influence behaviors via affective conditions ($\beta = 0.322$, $p = 0.003$) and barriers as well ($\beta = 0.179$, $p = 0.001$). Four of the seven hypotheses turned out to be significant. The limited role of self-efficacy was a notable finding.

Figure 2
Hypothesis Testing Results



Note. The dotted line indicates the hypothesis that is rejected. * p < 0.05, ** p < 0.01, *** p < 0.001.

Comparative Analysis

The Mann-Whitney U test was used for the comparative analysis of demographic differences because of the non-normal distribution within a small sample size in each grouping (n < 30). Table 6 shows that gender, in all constructs, had no significant difference, which means that the readiness level is the same for both genders. There was a significant difference in teaching experience; self-efficacy was scored higher in senior teachers (6+ years) (p = 0.020), and secondly, the secondary teachers had more self-efficacy compared to them. STEM diploma teachers performed better than their counterparts without STEM diplomas in the following constructs: Att_STEM (p = 0.030), self-efficacy (p < 0.001), affective condition (p = 0.043), and STEM teaching behaviors (p = 0.003). STEM training has more general effects where the results are significant in Att_STEM, self-efficacy, affective condition (all at p < 0.001), and STEM teaching behaviors (p = 0.012). Likewise, teachers with STEM coordination experience showed better results in STEM (p = 0.006), self-efficacy (p < 0.0l), and affective (p = 0.015). Note that barriers did not show any demographic variation, showing a barrier perception that was uniform through the sample. These findings clearly indicate an investment by the training and experience to upgrade the readiness.

Table 5
Results of Hypothesis Testing

	Hypothesis	*β*	T Statistics	*p* values	Result
H1	Teachers' attitudes toward STEM education positively influence their affective conditions.	0.544	5.610	0.000	Supported
H2	Perceived systemic barriers negatively influence teachers' affective conditions.	0.303	4.883	0.000	Rejected
H3	Teachers' self-efficacy positively influences their affective conditions.	0.169	1.600	0.110	Rejected
H4	Teachers' self-efficacy positively influences their STEM teaching behaviors.	0.236	1.773	0.076	Rejected
H5	Teachers' affective conditions positively influence their STEM teaching behaviors.	0.592	4.497	0.000	Supported
H6	Teachers' attitudes toward STEM education indirectly influence their STEM teaching behaviors through affective conditions.	0.322	3.015	0.003	Supported
H7	Perceived systemic barriers indirectly influence teachers' STEM teaching behaviors through affective conditions.	0.179	3.184	0.001	Supported

Discussions

This study critical insights into the readiness of Hong Kong primary and secondary teachers for the implementation of STEM education. Results attitudes, emotions, barriers, self-efficacy, and demographic factors within the modified TPB framework. Results findings with existing literature to bring about theoretical and practical implications within the context of educational landscapes in Hong Kong.

Attitudes and Emotions Drive STEM Readiness

A major finding relates to the very important role that attitudes and emotions play in the preparedness of teaching in STEM. The analysis of the structural model showed a very strong positive relationship between attitudes toward STEM and its affective condition, ($\beta = 0.544$, $p < 0.001$), which is in line with Ajzen (1991) within the framework of TPB; affective readiness then significantly impacts on STEM teaching behaviors ($\beta = 0.592$, $p < 0.001$) hence supporting hypothesis H5 as well. These findings support previous studies by Chiriacescu et al. (2023) and Thibaut et al. (2018), where it was found that strong attitudes can directly predict readiness and intention among teachers for STEM education. They also indirectly support Hargreaves (1998) and Wu et al. (2022) who express that emotions form a profound base for teaching practices; Vaiopoulou et al. (2024) reinforces this by pinpointing affective readiness as a dominant readiness influencer on teaching intentions. McLure et al. (2022) in their study argue

that teachers' positive emotional and attitudinal readiness not only makes them more prepared but also improves student outcomes by creating better classroom emotional climates and teacher-student relationships. This finding points to the fact that cultivating positive attitudes is of essence to upgrade both the teachers' readiness and their impact in the classroom.

Table 6

Results of Hypothesis Testing

Demographic grouping	Att_STEM	PSB	Self-efficacy	Affective	STEM teaching behavior
Gender	NS	NS	NS	NS	NS
Teaching experience (Junior vs. Senior 6+years)	NS	NS	**p < 0.001** (Senior higher)	NS	NS
School Level (Primary vs. Secondary)	NS	NS	**p = 0.020** (Secondary higher)	NS	NS
STEM diploma (Yes vs. No)	**p = 0.030** (Yes higher)	NS	**p < 0.001** (Yes higher)	**p = 0.043** (Yes higher)	**p = 0.003** (Yes higher)
STEM training (Yes vs. No)	**p < 0.001** (Yes higher)	NS	**p < 0.001** (Yes higher)	**p < 0.001** (Yes higher)	**p = 0.012** (Yes higher)
STEM coordination (Yes vs. No)	**p = 0.006** (Yes higher)	NS	**p < 0.001** (Yes higher)	**p = 0.015** (Yes higher)	NS

Note: NS = Not Significant ($p \geq 0.05$). Significant differences ($p < 0.05$) are highlighted in bold with p-values.

Barriers as Motivators

An unexpected outcome of the study is a positive perceived systemic barrier on affective condition ($\beta = 0.303$, $p < 0.001$) as opposed to the a priori hypothesis of a negative relationship (H2). It does not, therefore, appear that the barriers would rather diminish teaching, such as limited resources, and unclear curriculum guidelines. Such barriers would, therefore, enhance emotional activity—if at all showing resilience or a problem-solving orientation by Hong Kong teachers. This finding is in line with Wu et al. (2022) and Yllana-Prieto et al. (2021) who argue that negative emotions, for example, frustration resulting from systemic challenges, drive teachers to be innovative in their teaching. It is also in line with Thibaut et al. (2019) in that running into barriers leads to seeking professional development on all aspects, thus harboring more positive emotions toward integrated STEM approaches. This indicates that barriers should no longer be perceived as barriers but as motivation in specific educational contexts.

Limited Role of Self-Efficacy

However, self-efficacy showed a relatively weak effect on both affective condition ($\beta = 0.169$, $p = 0.110$) and STEM teaching behaviors ($\beta = 0.236$, $p = 0.076$), so hypotheses H3 and H4 are not supported. This challenges the notion of the TPB that perceived behavioral control is a significant determinant of intentions and behaviors. In the context of Hong Kong, systemic and external factors, such as resource constraints and institutional pressures, may overshadow

personal confidence, leaving the question for further research on what contextual factors diminish the role of self-efficacy in STEM education.

Training and Experience Boost Readiness

The demographic analysis further indicates that readiness is more associated with training and experience than with gender and grade. Teachers with training in STEM specificity, experience of coordination, or degree exhibit readiness significantly in most of the constructs with values between 0.012 and <0.001. This finding agrees with that of Mohamad Hasim et al. (2022) which shows that there is a statistically significant effect of professional development on STEM readiness. More senior teachers with over six years of experience show more readiness as well, a finding consistent with that of Song and Zhou (2021) who say that teaching experience enhances perceived competence and teaching beliefs.

Implications

Theoretically, these findings extend the TPB by underscoring the critical role of emotions in educational settings. The strong influence of affective condition suggests that TPB could be enhanced by formally incorporating affective factors, as proposed by Perugini and Bagozzi (2001), making it more applicable to teaching contexts. The positive effect of barriers also challenges the typical view within TPB regarding subjective norms as barriers, thus demanding an in-depth exploration regarding teachers' perception of challenges through, perhaps, the Self-Determination Theory (Ryan & Deci, 2000).

The results practically call for targeted interventions in improving STEM readiness. Schools need to invest in workshops which would create a positive perception of STEM and enhance emotional engagement by offering hands-on activities and group work with peers; thus, STEM teaching would be less daunting. The systemic barriers faced by innovation in education can be reformed by individual creative endeavors with solid institutional support. The gap readiness experienced by novice teachers emphasizes the need for a specific program for non-STEM-background new entrants to guarantee equity across the teaching workforce.

Conclusion

The study informed meaningful insights into the readiness of Hong Kong primary and secondary teachers for STEM education. Key results drove that positive attitudes and emotions toward teacher readiness come as the prime concerning the effective teaching of STEM. While attitudes toward STEM proved to be great pre-requisites in affective readiness for STEM teaching, surprisingly, the same attitudes toward systemic barriers positively influenced affective readiness. This is an indicator that it brings out innovation among the teachers. Readiness was most influenced by training and experience, with STEM-trained teachers and those trained in coordination showing better results in all aspects over their counterparts. Effects of self-efficacy were relatively small, perhaps implying that the environment in Hong Kong is more external. The results direct sought targeted training and affective encouragement in moving STEM education forward, providing a blueprint of how stakeholders may enhance initiatives in STEM for this area.

Limitation and Future Research

The study's limitations warrant careful consideration. The small sample size (n = 119) and the unequal demographics restrict generalizability. In addition, the utilization of convenience sampling may result in bias because the participants are more susceptible to sharing similar educational experiences or views, and therefore may distort the findings. The cross-sectional nature limits the potential for determining causality, offering merely a snapshot of readiness at one moment in time. Additionally, omitting cognitive readiness means an incomplete picture of readiness since this aspect is integral to having a full understanding of readiness. The counterintuitive positive effect of systemic barriers to affective readiness must be scrutinized closely since the underlying mechanisms are not well understood in the absence of qualitative data.

Future research needs to address these limitations using larger, more representative samples to increase reliability and representativeness, with the possibility of stratified sampling to ensure balanced demographic representation. Longitudinal research is recommended to examine the development of readiness over time, with insight into causal processes. The integration of cognitive readiness via rigorous evaluations will provide a comprehensive view of teacher readiness. Furthermore, qualitative research approaches, for instance, interviews or focus group discussions, are necessary to investigate the unforeseen positive effects of challenges and therefore reveal the innate sources of teachers' resilience and motivation. These approaches will enrich the comprehension of readiness in STEM education and therefore advise the development of more effective strategies to support teachers in Hong Kong and beyond.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares the use of QuillBot, an AI-assisted writing tool, solely to proofread and refine the manuscript's language by correcting grammar, spelling, and improving clarity. No other AI technologies were used in preparing this work. All research ideas, design, findings, and analyses are original and based on the author's own efforts. After using QuillBot, the author carefully reviewed and edited the manuscript, taking full responsibility for its content. The tool was only used to enhance language, as English is not the author's first language.

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The Impact of University Life During the COVID-19 Pandemic on Fundamental Competencies for Working Persons: Focusing on Negative Effects

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Abstract

This study investigates how university life during the COVID-19 pandemic (2020–2024) affected Japanese students' Fundamental Competencies for Working Persons, with particular attention to negative effects. In recent years, transferable competencies beyond academic knowledge have become increasingly important; however, prolonged restrictions during the pandemic raised concerns about students' skill development. Using large-scale diagnostic data from the "Fundamental Competencies for Working Persons in the VUCA Era" assessment, this study analyzed responses from 2,195 third-year university students. Multiple regression analysis was conducted to examine the relationships between competency scores, the length of the COVID-19 period experienced in university life (measured in months), and students' primary activities, such as part-time work, seminars, and hobbies. The results indicated that a longer COVID-19 period had significant negative effects on overall competency scores as well as on all three core abilities. Among them, the Ability to Work in Teams showed the strongest negative association with pandemic duration, suggesting that prolonged limitations on face-to-face interaction critically hindered teamwork development. In addition, greater engagement in hobbies was negatively associated with the Ability to Take Action and the Ability to Think Thoroughly. These findings suggest that reduced experiential and collaborative opportunities, along with increased involvement in individual and non-collaborative activities, contributed to the decline in students' competencies.

Keywords: Fundamental Competencies for Working Persons, COVID-19 pandemic, university students, negative effects, transferable skills

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Introduction and Background

In recent years, higher education has increasingly emphasized competencies beyond specialized academic knowledge. Rapid industrial transformation, globalization, and digitalization have intensified the demand for transferable skills such as communication, collaboration, adaptability, and self-management, which have been widely conceptualized as employability or generic skills in international policy frameworks (Allen Consulting Group & NCVER, 2004; NCVER, 2003).

The COVID-19 pandemic further accelerated these changes by drastically altering university life. From 2020 onward, students experienced prolonged periods of online learning, reduced face-to-face interaction, and limited opportunities for practical training, internships, and extracurricular activities. These changes raised concerns regarding the development of fundamental competencies required for future employment. At the same time, many countries have recognized a growing mismatch between what students learn in educational institutions and what is required in the labor market. In response, various frameworks have been developed internationally to conceptualize and assess universal or transferable skills.

This study focuses on how such competencies were affected during the COVID-19 pandemic, with particular attention to negative impacts on university students.

International Frameworks and COVID-19 Impacts on Student Competencies

Internationally, several frameworks have been proposed to define and measure competencies beyond academic achievement. In the United States, concepts such as Social Competency, Employability Skills, Workplace Competencies, and 21st Century Skills emphasize socio-emotional abilities, behavioral characteristics, and problem-solving skills required in modern workplaces, and social and emotional competencies have been systematically conceptualized through frameworks such as the CASEL model (CASEL, 2020), as well as broader conceptions of 21st century skills that integrate cognitive, interpersonal, and intrapersonal competencies (Partnership for 21st Century Learning, 2019).

In Australia, the Generic Skills framework, developed through collaboration between government and industry, identifies eight core abilities, including communication, teamwork, problem-solving, initiative, and technology use. These skills were designed collaboratively by the government and industry to prepare graduates for diverse and changing work environments.

Canada’s Employability Skills 2000+ framework, developed by the Conference Board of Canada, categorizes competencies into Fundamental Skills, Personal Management Skills, and Teamwork Skills, and has been widely applied in education and employment policy contexts (Conference Board of Canada, n.d.).

Studies conducted during the COVID-19 pandemic across these countries reveal several common trends. Communication and teamwork skills tended to decline due to reduced face-to-face interaction and experiential learning opportunities. At the same time, ICT skills and self-directed learning abilities often improved as online education became widespread. However, many students experienced increased stress, loneliness, and reduced motivation, which negatively affected personal management skills such as self-regulation and self-efficacy. Previous studies have also highlighted the rapid pedagogical shifts in higher

education during the pandemic and their implications for student learning experiences (Connor et al., 2021).

Table 1

Summary of Previous International Studies

Country	Framework	Main Findings
United States	Social Competency	Emotional control and expressivity decreased, while social sensitivity increased.
Australia	Generic Skills	Communication and teamwork declined; learning and technology skills improved.
Canada	Employability Skills 2000+	Fundamental Skills: Decline / Digital shift Personal Management Skills: Growing gap Teamwork Skills: Fewer opportunities / New forms

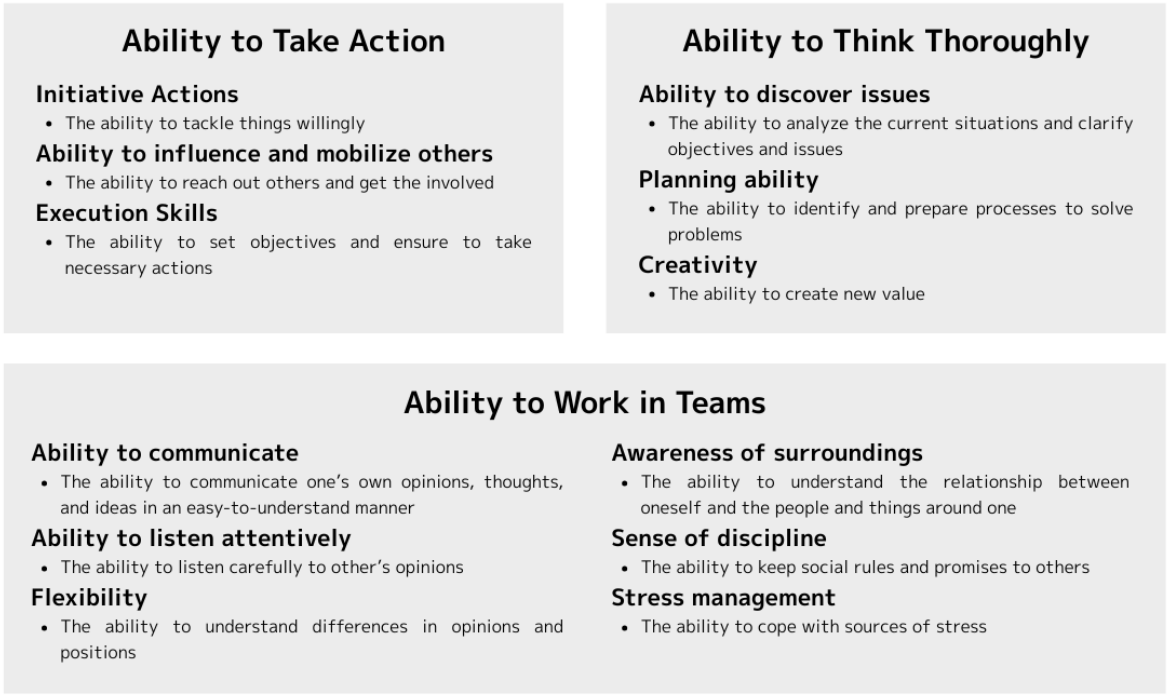
Empirical studies conducted during the COVID-19 pandemic have consistently reported declines in social-emotional skills, increased psychological distress, and disruptions in learning experiences among university students (Cerutti et al., 2024; Colby et al., 2023; Houlden & Veletsianos, 2022). In particular, reduced psychological need satisfaction has been associated with lower learning engagement in higher education contexts (Eckley et al., 2022).

Despite these findings, existing research has limitations. Many studies focus on specific educational contexts, rely on self-reported data, or use relatively small samples. Moreover, few studies incorporate behavioral or workplace-related perspectives, and students' broader lifestyles and extracurricular experiences are often insufficiently considered.

Positioning of Japan and Research Question

In Japan, the primary framework for evaluating transferable skills is the Fundamental Competencies for Working Persons, defined by the Ministry of Economy, Trade and Industry (METI, 2006). This framework emphasizes the ability to work collaboratively with diverse people in workplaces and communities and consists of three competency domains—Action, Thinking, and Teamwork—comprising twelve specific elements.

Figure 1
Japan's Framework: Fundamental Competencies for Working Persons



Previous domestic studies conducted during the COVID-19 period have reported changes in some aspects of fundamental competencies for working persons, particularly in specific educational contexts such as remote university classes (Maeda et al., 2022). Similar trends have also been observed in domestic studies conducted during the pandemic, including declines or uneven development in specific components of fundamental competencies for working persons across different educational settings (Endo et al., 2023; Sasaki et al., 2023). However, many of these studies focus on limited contexts, use small samples, and rarely examine the relationship between the length of the pandemic period and students' everyday activities, such as part-time work, seminars, or hobbies.

Based on international findings and the limitations of existing domestic research, this study addresses the following research question:

How did university life during the COVID-19 pandemic (2020–2024) affect students' Fundamental Competencies for Working Persons, and how are these effects related to the pandemic period and students' main activities?

The following sections present the research design, analysis, and results addressing this question.

Methods

Data Source and Participants

This study utilized data from the "Fundamental Competencies for Working Persons in the VUCA Era" diagnostic assessment developed by Nikkei HR Development. The total sample comprised 5,335 students from University A and Junior College A in Japan. To examine the

long-term effects of varying durations of COVID-19 exposure on skill development, we restricted our analytical sample to 2,195 third-year students who had experienced different lengths of the pandemic period during their university education.

Measures

Dependent Variables

All dependent variables were measured on a 100-point scale using the standardized diagnostic assessment:

1. Total Fundamental Competencies for Working Persons score: An aggregate measure of overall workplace competencies
2. Ability to Take Action: Capturing initiative, persistence, and proactive behavior
3. Ability to Think Thoroughly: Measuring problem-solving, critical thinking, and analytical skills
4. Ability to Work in Teams: Assessing collaboration, communication, and interpersonal effectiveness

Independent Variables

Independent variables were categorized into six domains:

1. Career and Future Path: Career goals after graduation, participation in internships or fieldwork
2. Learning and Academic Activities: Group projects, independent study, research or seminar participation
3. Social Relationships: Friendships with same-age or different-age peers, connections with working adults
4. Organizational Activities: Leadership or officer roles, cooperative experiences
5. Personal Activities: Engagement in hobbies
6. Background Factors: Field of study (arts/science), pandemic duration (in months), length of university life during COVID-19

Selection of Activity Variables

Among twelve activity items measured in the original assessment, we selected the five most frequently reported activities (those exceeding the mean response rate of 1,126.25) as dummy variables for regression analysis. These activities were: part-time employment (n = 3,164), hobbies (n = 2,437), research or seminar participation (n = 1,367), learning or study for academic transfer (n = 1,345), and internships or practical training (n = 1,317). This selection procedure reduced potential interpretational complexity while retaining the most representative student activities.

Operationalization of COVID-19 Exposure

The COVID-19 period was operationalized as the 40-month interval from February 2020 to May 2023, corresponding to the period of pandemic-related restrictions on Japanese university campuses. Individual exposure duration was calculated based on each student's university entry cohort: the 2020 cohort experienced 34 months of pandemic conditions, the 2021 cohort experienced 22 months, and the 2022 cohort experienced 10 months. This

variable was treated as continuous in all analyses to capture dose-response relationships between pandemic exposure and competency outcomes.

Statistical Analysis

Multiple regression analysis using the stepwise method was conducted to identify the most parsimonious models predicting each dependent variable. Prior to analysis, multicollinearity diagnostics were performed by examining the correlation matrix; no variable pairs exceeded the threshold of $|r| > 0.9$. The stepwise procedure involved initially including all independent variables and iteratively selecting the model with optimal explanatory power based on statistical criteria (p-to-enter < 0.05, p-to-remove > 0.10). All analyses were conducted using SPSS version28, with alpha set at 0.05 for significance testing.

Results

Model Performance

Analysis of variance (ANOVA) demonstrated that all four regression models achieved statistical significance ($p < .001$ for all models). However, the models exhibited modest explanatory power, with R^2 values ranging from 0.16 to 0.28. Specifically, the model predicting Total Fundamental Competencies for Working Persons yielded $R^2 = 0.28$, Ability to Take Action yielded $R^2 = 0.25$, Ability to Think Thoroughly yielded $R^2 = 0.22$, and Ability to Work in Teams yielded $R^2 = 0.16$. The relatively low R^2 values suggest that substantial variance in these competencies remains attributable to factors not captured in the current model.

Total Fundamental Competencies for Working Persons

Two independent variables demonstrated significant negative associations with overall competency scores. COVID-19 exposure duration exhibited a standardized regression coefficient of $\beta = -0.08$ ($p < .05$), indicating that longer pandemic exposure was associated with lower total competency scores. Additionally, engagement in hobbies showed a negative effect ($\beta = -0.07$, $p < .05$), suggesting that students who devoted more time to hobby activities tended to demonstrate slightly lower overall competency levels.

Table 2
Total Fundamental Competencies for Working Persons

Predictor	β	p	95% CI LL	95% CI UL
Constant		< .001	42.953	47.851
Career goals after graduation	.185	< .001	3.829	5.865
Collaborative projects	.169	< .001	3.358	5.284
Same-age friends	.120	< .001	2.207	4.603
Leadership	.128	< .001	2.263	4.188
Independent study	.159	< .001	3.021	4.928
Friends of different gender	.091	< .001	1.466	3.979
Field of study (arts/science)	.085	< .001	1.527	4.013
Younger friends	.072	.002	0.734	3.101
COVID-19 pandemic duration (months)	**-.083**	< .001	-0.129	-0.050
Hobbies	**-.068**	< .001	-2.664	-0.754
Research/seminar activities	.056	.004	0.481	2.466
Internship/practical training	.047	.019	0.212	2.339
Working adult friends	.047	.033	0.098	2.300
Academic study/transfer preparation				
Duration of university life during COVID-19 (months)				

Table 3
Ability to Take Action

Predictor	β	p	95% CI LL	95% CI UL
Constant		< .001	32.004	37.797
Career goals after graduation	.173	< .001	4.176	6.627
Collaborative projects	.165	< .001	3.840	6.159
Same-age friends	.112	< .001	2.348	5.258
Leadership	.134	< .001	2.863	5.196
Independent study	.144	< .001	3.111	5.423
Friends of different gender	.073	< .001	1.072	4.123
Field of study (arts/science)	.116	< .001	3.002	5.970
Younger friends	.060	.010	0.459	3.333
COVID-19 pandemic duration (months)	**-.051**	.007	-0.114	-0.018
Hobbies	**-.077**	< .001	-3.434	-1.174
Research/seminar activities				
Internship/practical training				
Working adult friends	.063	.005	0.590	3.263
Academic study/transfer preparation				
Duration of university life during COVID-19 (months)				

Ability to Take Action

The regression model for Ability to Take Action revealed a similar pattern of negative effects. COVID-19 exposure duration demonstrated a modest negative association ($\beta = -0.05$, $p < .05$), indicating that prolonged pandemic conditions diminished students' willingness to undertake challenges and initiative-taking behaviors. Hobby engagement exhibited a stronger negative effect ($\beta = -0.08$, $p < .01$), suggesting that greater time allocation to personal hobbies was associated with reduced proactive and initiative-driven behaviors.

Table 4
Ability to Think Thoroughly

Predictor	β	p	95% CI LL	95% CI UL
Constant		< .001	43.067	50.073
Career goals after graduation	.155	< .001	4.098	6.975
Collaborative projects	.167	< .001	4.406	7.123
Same-age friends	.100	< .001	2.213	5.524
Leadership	.115	< .001	2.653	5.273
Independent study	.162	< .001	4.142	6.834
Friends of different gender	.072	.001	1.171	4.651
Field of study (arts/science)	.049	.017	0.377	3.921
Younger friends	.081	< .001	1.317	4.590
COVID-19 pandemic duration (months)	**-.087**	< .001	-0.184	-0.071
Hobbies	**-.068**	.006	-3.334	-0.612
Research/seminar activities	.074	< .001	1.221	4.046
Internship/practical training	.062	.013	0.399	3.456
Working adult friends				
Academic study/transfer preparation	.060	.014	0.374	3.370
Duration of university life during COVID-19 (months)				

Ability to Think Thoroughly

For thinking and analytical competencies, COVID-19 exposure duration showed a relatively strong negative effect ($\beta = -0.09$, $p < .01$), indicating that extended pandemic periods substantially impaired students' problem-solving and critical thinking capabilities. Hobby engagement also demonstrated a negative association ($\beta = -0.06$, $p < .05$), suggesting that increased focus on personal leisure activities was associated with modest reductions in analytical thinking skills.

Ability to Work in Teams

The regression analysis for teamwork competency revealed the strongest pandemic effect observed in this study. COVID-19 exposure duration was the sole significant predictor, demonstrating a standardized coefficient of $\beta = -0.10$ ($p < .01$), representing the largest negative association across all competency domains. Notably, hobby engagement did not

emerge as a significant predictor in this model, suggesting that teamwork skills were uniquely vulnerable to pandemic-related restrictions rather than general time allocation patterns.

Table 5
Ability to Work in Teams

Predictor	β	p	95% CI LL	95% CI UL
Constant		< .001	52.022	56.552
Career goals after graduation	.160	< .001	2.780	4.739
Collaborative projects	.104	< .001	1.460	3.339
Same-age friends	.114	< .001	1.778	4.033
Leadership	.086	< .001	1.009	2.857
Independent study	.097	< .001	1.245	3.081
Friends of different gender	.121	< .001	2.060	4.416
Field of study (arts/science)	.061	.005	0.292	2.684
Younger friends	.068	.005	0.275	2.508
COVID-19 pandemic duration (months)	**-.109**	< .001	-0.156	-0.065
Hobbies				
Research/seminar activities	.094	.002	0.586	2.459
Internship/practical training	.094	.002	0.563	2.553
Working adult friends				
Academic study/transfer preparation				
Duration of university life during COVID-19 (months)	.056	.034	0.006	0.121

Discussion

Mechanisms Underlying Pandemic Effects on Competencies

The consistent negative effects of COVID-19 exposure duration across all competency domains suggest a common inhibiting mechanism: the substantial reduction in real-world experiential learning opportunities. We propose that three competency-specific pathways mediated these negative effects.

For Ability to Think Thoroughly, the dramatic reduction in project-based learning, collaborative problem-solving exercises, and hands-on fieldwork during pandemic restrictions limited students' opportunities to practice logical reasoning, creative thinking, and analytical skill application. The predominantly lecture-based and individual study formats that characterized emergency remote instruction provided insufficient cognitive challenge and feedback mechanisms essential for developing higher-order thinking skills.

For Ability to Work in Teams, the near-complete elimination of face-to-face collaboration, group activities, and interpersonal interaction during prolonged campus closures directly constrained the development of communication skills, cooperative behaviors, and interpersonal competencies. The asynchronous and text-based nature of online interactions proved inadequate for cultivating the nuanced social skills, emotional intelligence, and real-time coordination abilities required for effective teamwork.

For Ability to Take Action, the restricted opportunity structure—characterized by cancelled internships, suspended extracurricular activities, and limited social engagement—reduced students' exposure to situations requiring initiative, risk-taking, and proactive problem-solving. The absence of action-oriented learning contexts likely diminished students' self-efficacy beliefs and motivation to engage in challenging tasks.

The finding that teamwork competency exhibited the strongest negative association with pandemic duration ($\beta = -0.10$) is particularly noteworthy and consistent with international research from the United States, Australia, and Canada. This cross-cultural convergence suggests that collaborative skills are especially vulnerable to social distancing measures and online learning environments, which fundamentally alter the interpersonal dynamics essential for teamwork development.

Interpretation of Hobby Engagement Effects

The unexpected negative associations between hobby engagement and both action and thinking competencies (but not teamwork) warrant careful interpretation. We propose two complementary explanations for this pattern.

Time Allocation Hypothesis

Students who devoted substantial time to personal hobbies may have correspondingly reduced their participation in developmentally beneficial activities such as collaborative projects, research seminars, leadership roles, and social engagement. This zero-sum allocation of discretionary time could have limited exposure to experiences that foster initiative, analytical thinking, and intellectual challenge.

Activity Characteristics Hypothesis

Supplementary data on the most prevalent student hobbies during this period reveal that the top activities were predominantly passive, solitary, and screen-based: video gaming (47.4% of males), YouTube consumption (53.4% of females, 44.8% of males), music listening/concert attendance (46.1% of females, 37.7% of males), and movie/drama viewing (40.2% of females). These activities, while providing stress relief and entertainment, generally lack the interactive, problem-solving, and goal-directed characteristics that promote action orientation and critical thinking skills.

The absence of hobby effects on teamwork competency suggests that this skill domain was primarily constrained by external structural factors (pandemic restrictions on social interaction) rather than individual time allocation choices. Even students who engaged minimally in hobbies experienced substantial teamwork deficits due to the unavailability of collaborative learning opportunities.

Implications and Future Directions

The relatively modest R^2 values (0.16-0.28) obtained in our models indicate that activity participation and pandemic exposure, while significant, account for only a portion of variance in workplace competencies. This suggests the importance of incorporating psychological and motivational variables in future research. The diagnostic instrument employed in this study did not assess constructs such as achievement motivation, growth mindset, career aspirations,

self-efficacy beliefs, or resilience—all of which may moderate or mediate the relationships between environmental constraints and competency development.

Future research should adopt more comprehensive models that integrate: (1) psychological factors (motivation, self-regulation, resilience), (2) social support mechanisms (family, peer, mentor relationships), (3) institutional responses (quality of online instruction, student support services), and (4) individual coping strategies. Longitudinal designs with repeated measures would permit examination of recovery trajectories and identification of factors promoting competency restoration in post-pandemic contexts.

Additionally, qualitative research examining students' lived experiences during the pandemic could illuminate the processes through which restricted opportunities translate into competency deficits, as well as identify protective factors that enabled some students to maintain skill development despite adverse conditions.

Conclusion

This study provides empirical evidence for the negative impact of COVID-19 pandemic exposure on Japanese university students' Fundamental Competencies for Working Persons. Several key findings emerged from our analysis of 2,195 third-year students:

1. Consistent pandemic effects: Longer exposure to pandemic conditions was associated with significant decrements across all competency domains, with effect sizes ranging from $\beta = -0.05$ to $\beta = -0.10$.
2. Differential vulnerability: Teamwork competency ($\beta = -0.10$) demonstrated the greatest susceptibility to pandemic effects, consistent with international research documenting the critical importance of face-to-face interaction for collaborative skill development.
3. Dual mechanisms of impact: Competency deficits appear attributable to both structural constraints (reduced experiential learning opportunities due to campus closures and social distancing) and behavioral adaptations (increased time allocation to solitary, passive leisure activities).
4. Activity-specific effects: Hobby engagement showed selective negative associations with action and thinking competencies but not teamwork, suggesting that time allocation to individual leisure activities may compete with developmentally beneficial activities in some domains while having negligible impact in others.

These findings underscore the substantial educational costs of prolonged disruption to traditional university experiences and highlight the inadequacy of emergency remote instruction for developing interpersonal and applied competencies. As higher education institutions navigate post-pandemic recovery and prepare for potential future disruptions, our results emphasize the critical importance of preserving opportunities for collaborative learning, practical application, and social engagement—experiences that cannot be fully replicated in virtual environments.

The modest explanatory power of our models points to the need for future research incorporating psychological, motivational, and institutional factors to develop more comprehensive understanding of the multifaceted determinants of workplace competency development in crisis contexts.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, an AI-assisted writing software, was used for proofreading the manuscript and refining linguistic expressions. Its use was limited to correcting grammatical and spelling errors, as well as restructuring expressions for accuracy and clarity. The author further declares that no AI or AI-assisted technology other than ChatGPT was used to generate content in the creation of this manuscript. The ideas, design, procedures, results, analysis, and discussion in this paper were independently written and derived by the author based on the careful and systematic conduct of research.

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Bridging Academic Achievement and Career Readiness: The REP Scholars Experience

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Abstract

The Rebooting through EmTech Programs (REP) initiative, funded by the National Science Foundation, supports low-income and underrepresented students in computing fields—specifically cybersecurity, data analytics, and information systems technology. Over the past two years, REP sought to bridge academic achievement and career readiness by integrating mentorship, scholarships, and experiential learning into a cohesive student success framework. This mixed-methods evaluation of the REP Scholars Program at Miami Dade College reveals measurable improvements in students' academic performance, self-efficacy, and professional preparedness. Surveys, focus groups, and institutional data demonstrate that structured mentorship and applied learning opportunities not only enhance academic persistence but also empower students to transition confidently toward technical careers. Findings suggest that holistic, equity-centered initiatives like REP provide a replicable model for linking academic excellence with workforce readiness in higher education.

Keywords: equity in STEM, academic persistence, career readiness, mentoring, underrepresented students, community college, computing education

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Introduction

The transformation of the 21st-century workforce depends on increasing participation of historically underrepresented groups in computing and engineering fields (National Science Board, 2022; National Science Foundation, 2023). While community colleges are critical gateways for these learners, many students face systemic barriers, including limited financial resources, external responsibilities, and low confidence in navigating career pathways—factors that hinder persistence and success (Carnevale & Smith, 2018; Jury et al., 2017; Ko et al., 2025).

Miami Dade College (MDC) is the largest and most diverse public college in the United States and the largest hispanic-serving institution, conferring more associate degrees to Hispanic students than any other college. Nationwide MDC has the highest enrollment of Hispanic undergraduates (81,398) and ranks third for Black non-Hispanic undergraduate enrollment, reflecting the rich racial and ethnic diversity of South Florida.

The Rebooting through EmTech Programs (REP) initiative was created to address these opportunity gaps in computing and technology education. At MDC, where 68% of students are low-income and 58% are first-generation, REP provides resources and support for junior and senior students pursuing degrees in cybersecurity, data analytics, and information systems technology. The program aims to bridge academic achievement and career readiness by integrating technical coursework with mentorship, scholarships, and professional development.

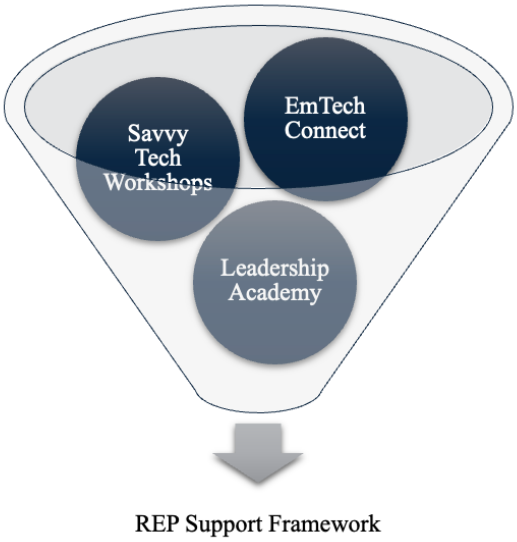
The purpose of this study is to evaluate how the REP model supports that bridge—how students' academic progress and personal growth translate into employability and career confidence. Specifically, the study examines:

1. How REP enhances academic achievement and persistence.
2. How mentoring and experiential learning prepare scholars for tech careers.
3. What barriers remain for students navigating both college and career readiness.

Conceptual Framework

The REP's structured supports bridge academic achievement and career readiness through a comprehensive framework of financial, academic, and professional development opportunities (see Figure 1). A dedicated scholarship provides stability and reduces financial barriers, enabling students to focus on their studies and long-term goals. *EmTech Connect* offers virtual one-on-one mentoring, exposure to industry tech leaders, and targeted academic guidance. *Savvy Tech Workshops* enhance employability through applied learning and financial literacy, preparing students to become responsible consumers, successful entrepreneurs, and wise investors. The *Leadership Rotation Academy* cultivates personal growth, confidence, and career success through intentional leadership development. Complementary academic tracks—Research, Internship, and Digital Upskilling—extend experiential learning, faculty-led projects, and certification pathways. Together, these integrated supports form a cohesive model that links academic persistence with professional preparedness.

Figure 1
The REP Academic–Career Readiness Pathway



The Need for Bridging Academic and Career Development

Research consistently underscores that underrepresented students often experience a disconnect between academic achievement and professional readiness. Although grades and course completion indicate academic success, they do not always equate confidence or employability in technical fields (Othman et al., 2024). Programs that intentionally integrate career preparation with academic learning show greater impact on post-graduation outcomes (Miller et al., 2018; Peng & Ali, 2025).

The concept of "bridging" in education refers to creating structured pathways that translate classroom learning into real-world applications. When academic achievement and workforce preparation are developed in tandem, students gain both the credentials and competencies necessary for long-term success (U.S. Department of Education, 2023).

Mentorship as the Structural Connector

Mentorship serves as the critical "bridge beam" in many successful STEM equity programs. Faculty mentors provide emotional support, reinforce belonging, and model professional identity development (Ashtiani & Feliciano, 2018; Miske & Sogunro, 2024). Effective mentoring extends beyond advising to include personalized coaching in problem-solving, communication, and goal setting—skills directly transferable to the workplace (Campbell & Mogashana, 2024).

Mentorship is especially vital for first-generation and minority students, who often lack access to networks and social capital within technical fields (Ashcroft et al., 2021). Programs like REP leverage mentoring to connect institutional resources, student motivation, and industry expectations, turning support into sustained achievement.

Experiential Learning and Career Readiness

Hands-on experiences help students apply theoretical knowledge and develop professional competencies. Internships, applied projects, and workshops serve as practical spaces for integrating academic content into career contexts. REP's design—featuring résumé-building, mock interviews, and technical certifications—aligns with evidence-based strategies for developing employability in low-income and underrepresented student populations (Cummins et al., 2019).

Holistic and Equity-Based Models of Student Success

Holistic models—addressing academic, financial, and social-emotional factors—significantly increase persistence among underserved students (Van Pham, 2024). REP operationalizes this approach through scholarships, peer engagement, and targeted mentoring, creating a comprehensive ecosystem that connects learning with livelihood.

Methodology

A mixed-methods approach analyzed REP outcomes from Fall 2023 through Spring 2025. Quantitative data assessed measurable academic and career-related changes, while qualitative insights captured scholars' lived experiences.

A total of 74 unique REP scholars participated across four survey cycles: Fall 2023 (48), Spring 2024 (62), Fall 2024 (49), and Spring 2025 (39). Surveys achieved 100% response rates each term. Four student focus groups were held in April 2024 across all program disciplines (Cybersecurity, Data Analytics, and Information Systems Technology). A faculty mentor focus group in Spring 2025 included two mentors plus one written response.

As summarized in Table 1, multiple data sources were integrated to provide a comprehensive understanding of REP scholars' academic and career development experiences, including their perceptions of mentoring, belonging, and workforce preparation. Quantitative results used paired t-tests ($p < .05$). Qualitative data were analyzed using Braun and Clarke's (2006) six-phase thematic method.

Table 1
Evaluation Data Sources and Methods

Data Source	Participants (N)	Timing	Purpose	Analysis Method
Surveys (pre/post)	48–62 per semester	Fall 2023 – Spring 2025	Track academic & career confidence; measure change	Descriptive & paired t-tests
Student focus groups	N = 23 (4 groups)	April 2024	Explore mentoring, belonging, career goals	Thematic coding
Faculty mentor focus group + written responses	N = 3	Spring 2025	Understand mentoring practices & student impact	Thematic analysis

Institutional data	REP & non-REP comparison	2023–2025	Assess GPA, completion, persistence	Comparative metrics

Results

Academic Achievement: Laying the Foundation

Quantitative analyses examined GPA, course pass rates, and persistence to assess the impact of REP participation on academic success compared with non-REP peers (see Table 2). Multivariate regression models controlled for demographic and enrollment factors, including student age, race/ethnicity, gender, in-state residency, and transfer status.

Table 2
Regression Summary of Student Academic and Persistence Outcomes (Fall 2023–Spring 2025)

Outcome Variable	Significant Predictor	Direction of Effect	Statistical Significance	Notes
GPA (Fall 2023)	REP participation	Positive	$p < .01$	Strong initial program effect
GPA (Spring 2024)	REP participation; Age	Positive	$p < .05$*	GPA increases slightly with age
GPA (Fall 2024)	REP participation	Positive	$p < .10$	Maintained gains over time
GPA (Spring 2025)	-	-	n.s.	No significant effect detected
Overall Pass Rate	REP participation; Transfer status	Positive	$p < .01$; $p < .10$	REP scholars' pass rates +11%
Persistence Fall 2023 → Spring 2024	REP participation	Positive	$p < .01$	Higher semester-to-semester retention
Persistence Fall 2023 → Spring 2025	REP participation	Positive	$p < .10$	Sustained multi-semester persistence

Note. Statistical significance determined at $p < .05$. "n.s." = not significant.

Results showed that REP participation was a statistically significant positive predictor of GPA in three of the four semesters analyzed (Fall 2023, Spring 2024, and Fall 2024) with the strongest effect during the program's first year. Across all GPA models, demographic factors showed no consistent impact, indicating the program's equitable influence on student outcomes. Age showed a mild positive relationship with GPA in Spring 2024 and Spring 2025, suggesting slightly higher achievement among older participants.

REP scholars also achieved an 11% higher overall pass rate than non-REP peers ($p < .01$), while transfer students showed a modest 4% gain ($p < .10$). Persistence followed similar patterns, with significant retention from Fall 2023 to Spring 2024 and sustained continuation through Spring 2025. None of the control variables were significant, confirming that improvements were specific to REP participation.

The mean GPA increased from 2.8 to 3.4, and 88% of participants persisted to the next academic year. Students frequently credited mentoring and reduced financial stress as key factors that enabled stronger academic focus and consistency in performance. One scholar reflected, "Having a mentor who checks in about both school and my goals kept me on track in both." This reflection captures the program's central purpose—integrating academic accountability with personal and professional development support to foster sustained achievement.

These results demonstrate the measurable academic impact of REP's integrated supports, particularly during students' first year of participation. Gains in GPA, pass rate, and persistence complement qualitative findings that emphasize the role of mentoring, financial assistance, and experiential learning in fostering academic confidence and retention.

Career Readiness: From Classroom to Career

The evaluation also assessed REP's influence on students' professional preparedness, employability skills, and career confidence. Surveys, focus groups, and interviews provided complementary perspectives on how participants translated academic progress into career readiness.

Quantitative results from pre- and post-program surveys indicated significant increases in students' self-assessed employability competencies across multiple domains. Among 56 participants who attended the *Tech Internship and Job Search* workshop, self-rated knowledge rose from an average of 3.29 to 4.66 on a five-point scale ($p < .001$). Comparable gains were observed in résumé development, interview preparation, and professional networking confidence. As shown in Table 3, scholars reported substantial growth in career confidence, goal setting, and readiness for internships and employment.

Table 3

Career Readiness Indicators Among REP Scholars (2023-2025)

Indicator	Pre-Program Mean	Post-Program Mean	Change	Statistical Significance	Data Source
Career Confidence	3.21	4.58	+1.37	$p < .001$	Survey
Networking & Communication	3.46	4.61	+1.15	$p < .001$	Survey
Résumé and Job Search Skills	3.29	4.66	+1.37	$p < .001$	Workshop feedback
Tech Interview Preparedness	3.11	4.32	+1.21	$p < .01$*	Survey
Goal Setting and Career Planning	3.52	4.63	+1.11	$p < .001$	Focus group synthesis

Note. N = 74 (aggregated survey participants, 2023–2025); subsample N = 56 for workshop-based measures. Scale: 1 = low confidence, 5 = high confidence. Statistical significance based on paired t-tests.

Focus group data reinforced these trends, revealing that REP's integrated mentoring, workshops, and career development activities effectively bridged classroom learning with industry expectations. One student reflected, "My mentor provided valuable guidance tailored to my career goals in cybersecurity and international relations. They helped me strategize my

professional development, including certification choices and skill-building, and offered insights into career paths I hadn't considered before." Another participant added, "The mentorship program was by far the most informative and valuable experience I've had with anyone in the technology industry. I learned about potential careers and the responsibilities they entail. This knowledge dismissed any doubts I had about opportunities in the field."

Faculty and industry mentors noted that REP's structured career programming enhanced students' confidence and professional identity. The faculty described flexible, empathetic mentoring approaches that integrated goal mapping and skill-building, noting that these efforts helped students connect their academic experiences to tangible career pathways.

Qualitative findings also illustrated how REP facilitated a developmental shift from student to emerging professional. Many scholars credited the combination of hands-on workshops and mentorship for improving their readiness to navigate internships, certification pathways, and entry-level employment. One student summarized the experience succinctly: "REP didn't just help me with grades, it helped me understand how my technical skills fit into real-world jobs."

These findings affirm REP's role as a bridge between academic learning and workforce participation. Students gained not only technical proficiency but also the self-efficacy and career awareness necessary for sustained professional success.

Mentorship: The Bridge Between Achievement and Readiness

Students overwhelmingly (95%) rated mentorship as "very valuable," crediting mentors for helping them connect academic progress to tangible career goals. Faculty mentors described personalized, supportive approaches involving one-on-one guidance, goal mapping, and encouragement of professional identity. As one mentor reflected, "My experience of mentoring REP scholars has been incredibly rewarding. I've had the opportunity to guide talented and motivated students while witnessing their growth and success firsthand." Another mentor noted that they "[have to] always be flexible in regard to how my mentee receives and likes to process information." Similarly, one faculty member emphasized that mentorship builds confidence and direction toward success, explaining that sharing professional experiences and wins in the same field contributes to student persistence and retention.

Collectively, these perspectives reveal a shared sense of purpose: mentors view flexibility as essential to effective guidance, while students experience mentorship as a transformative space for clarifying career direction and developing professional confidence. One student described:

> A particularly positive experience I've had with REP was accessing the mentorship program. My mentor provided valuable guidance tailored to my career goals in cybersecurity and international relations. They helped me strategize my professional development, including certification choices and skill-building, and offered insights into career paths I hadn't considered before. This personalized support not only boosted my confidence but also helped me clarify my goals and stay motivated. The mentorship felt like having a dedicated ally in my journey, which has been incredibly empowering and impactful.

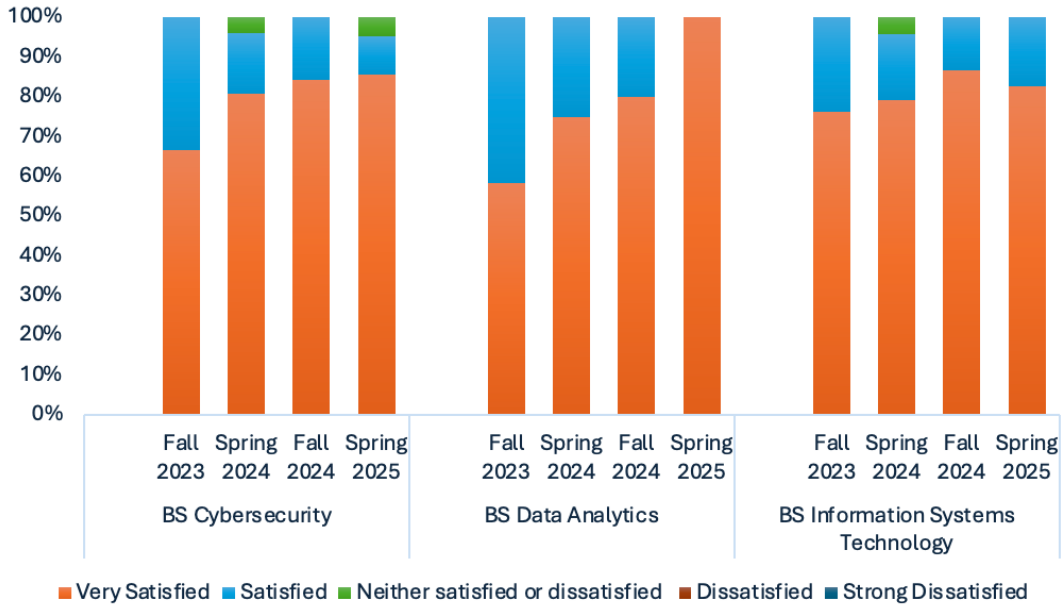
Another student echoed this sentiment, stating:

> A positive experience I had with REP was when I completed my mandatory meeting with the faculty mentor. Talking to my mentor was by far the most informative and valuable conversation I have had with anyone in the technology industry. I learned about the potential careers I can pursue once I graduate and the responsibilities that each of those careers entail. This knowledge dismissed any doubts I had about the job opportunities in the industry, and I am beyond grateful that REP gave me the opportunity to have this meeting.

Overall, REP scholars expressed exceptionally high satisfaction with the mentorship component of the program (see Figure 2). No students indicated dissatisfaction or strong dissatisfaction across survey terms. Most reported being *very satisfied* with their experience—Fall 2023 (100%, $N = 48$), Spring 2024 (97%, $N = 60$), Fall 2024 (98%, $N = 48$), and Spring 2025 (100%, $N = 39$).

Figure 2

Mentoring Satisfaction by Degree Program and Semester (2023–2025)



Challenges: Crossing the Bridge

Despite strong outcomes, some scholars struggled with external demands. Many worked full time or supported families, limiting engagement in extracurricular opportunities. Approximately one-third described time management as their greatest obstacle, followed by financial strain and competing obligations. Others expressed a limited sense of campus belonging beyond the REP community.

As one student explained:

> Balancing school and family life has been a significant challenge for me, but fortunately, I have a wonderful support system that has made the journey more manageable. Despite the demands of extensive studying, my family has been understanding and supportive, offering encouragement and creating an environment conducive to my academic pursuits.

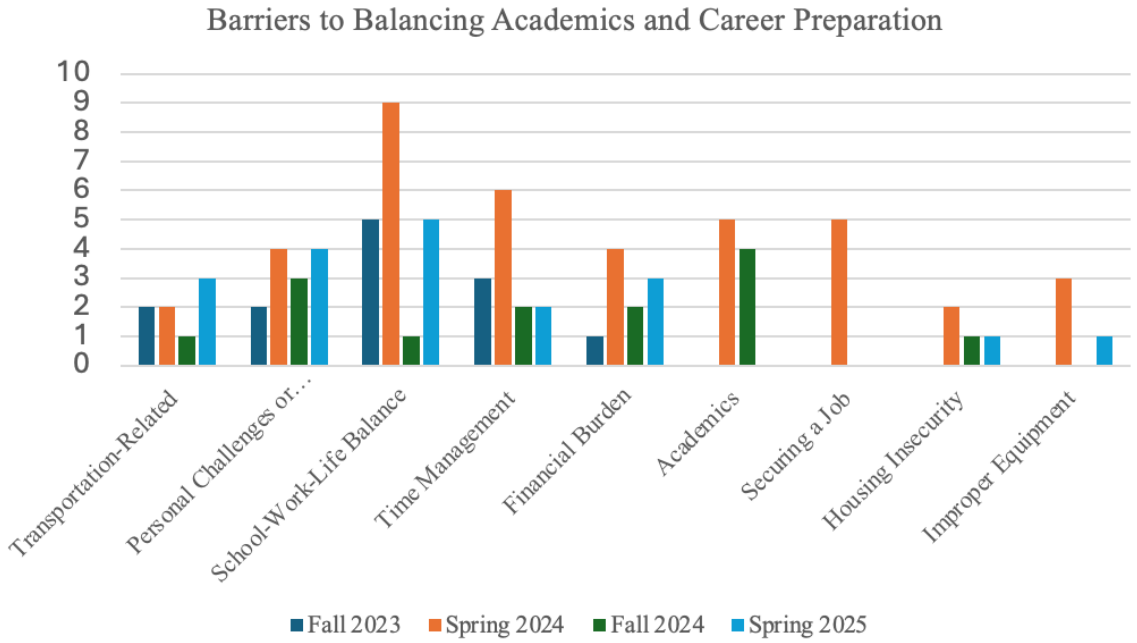
Another participant echoed similar sentiments, noting that:

> One of the main difficulties has been balancing academic responsibilities with personal obligations. At times, managing coursework alongside part-time work and family commitments has been overwhelming. Additionally, adapting to new academic expectations and navigating a rigorous schedule has tested my time management and stress-coping skills. However, being part of the REP program has helped me stay grounded. The support and resources provided have made it easier to ask for help when needed and continue moving forward despite the obstacles.

Figure 3 below illustrates the relative emphasis of these challenges as coded from focus-group and survey data. Time constraints and financial stress emerged most frequently, followed by family obligations and limited peer engagement. The figure represents qualitative frequency rather than quantitative measurement, aligning with the mixed-methods approach used in this evaluation.

Figure 3

Student-Reported Barriers to Balancing Academics and Career Preparation



Note. This chart visualizes the relative frequency of barriers identified through focus-group and survey responses among REP Scholars. Bar heights represent the prominence of qualitative themes (time constraints, financial stress, family obligations, and limited peer engagement) rather than numerical percentages. Categories with no or irrelevant responses were omitted to enhance clarity of comparison.

Following these findings, several students elaborated on the practical challenges of managing multiple responsibilities while remaining engaged in program activities. One participant shared:

> While the REP Scholars program has been incredibly beneficial, one aspect that could be improved is the scheduling of meetings. As a working student, I sometimes find it challenging to attend meetings because they often coincide with my job schedule. Adjusting the timing of these meetings to accommodate students who work during traditional business hours would greatly enhance the experience for individuals like me.

Another student emphasized the ongoing struggle with maintaining equilibrium between school, work, and personal life, stating:

> Since enrolling as a REP scholar this year, one of my primary challenges has been time management. Balancing full-time school with work and personal responsibilities has been difficult, and maintaining a healthy work-life balance requires continuous effort and adjustment. However, this experience has taught me valuable lessons about prioritization and resilience.

These reflections highlight the tension between opportunity and accessibility that many REP Scholars experience. They underscore the need for flexible scheduling and structural supports that accommodate students balancing employment and family obligations—an essential factor in sustaining equitable participation in STEM pathways.

Discussion

Miami Dade College's 2021–2026 Strategic Plan includes the second goal of *Accelerating Academic Excellence and Innovation*. This goal emphasizes enhancing industry certification and implementing equity-minded, student-centered, high-impact teaching strategies that promote student success and learning outcomes (Miami Dade College [MDC], 2021).

The REP program strongly encouraged scholars to pursue certifications and resulted in 33 distinct certifications earned during the program period. These findings affirm REP as a practical model for bridging academic achievement and career readiness. Academic gains established a foundation for employability, while experiential learning and mentorship served as conduits to workforce preparedness.

The implementation of the REP approach directly reflects the intent of the MDC Strategic Plan by giving scholars a broader understanding of both their academic development and their chosen industry. Workshops, industry connections, and internship opportunities collectively embody this strategic goal.

Mentorship as Structural Support

Miami Dade College's 2021–2026 Strategic Plan identifies *Fueling the Talent Needs of a Global Economy* as its fourth goal. To prepare students for future jobs, scholars must persist in their program of study through completion. This includes participation in internships, research, and engagement with industry mentors—all of which are integral components of the REP program (MDC, 2021).

Mentorship emerged as the strongest structural element of the REP bridge. Faculty mentors facilitated academic resilience and illuminated career pathways, consistent with evidence that mentoring boosts persistence and self-efficacy. To ensure students were exposed to relevant, real-world learning, MDC also leveraged existing industry partnerships and expanded to include new collaborators for targeted workshops and experiential opportunities. The graduation of 74 REP scholars demonstrates the effectiveness of both the mentorship model and the broader REP program.

Career Integration and Applied Learning

Miami Dade College has prioritized teaching and learning innovations to ensure that programs, curricula, and course offerings remain agile, market-aligned, and lead to high-demand, high-wage jobs. Desired outcomes include persistence, degree attainment, and certification completion (MDC, 2021).

The REP workshop series directly connected classroom content to real-world practice. Gains in résumé writing, financial literacy, and interview skills demonstrate the benefit of embedding employability within academic programs. Practical outcomes included the attainment of 33 unique certifications among REP scholars, underscoring the program's emphasis on applied learning.

These outcomes align with Miami Dade College's (2021) high impact strategies to:

- 2.3 Prioritize teaching and learning innovations to ensure that programs, curricula, and offerings are agile, market-aligned, and lead to high-demand, high-wage jobs.
- 4.1 Ensure outcomes for all students, including persistence, degree and certification completion, as well as transfer success and job placement.
- 4.2 Provide all students with access to high-quality experiential learning such as internships, apprenticeships, research, and practicums to enhance workforce readiness.

Equity and Holistic Support

Goal two of the MDC Strategic Plan focuses on implementing equity-minded, student-centered, high-impact teaching strategies that promote student success and learning outcomes (MDC, 2021). The REP initiative exemplifies this commitment to equity-centered education by addressing students' financial, academic, and emotional needs collectively. This holistic approach aligns with frameworks emphasizing belonging and self-efficacy as precursors to achievement (Bailey et al., 2015).

In identifying scholars' financial, personal, and emotional needs, the REP program developed activities and structures designed to provide comprehensive support. These included scholarships to alleviate financial barriers, access to faculty and workforce mentoring to foster academic persistence, and opportunities that strengthened personal and professional development. As a result, scholars reported increased confidence, improved life skills, and greater success in course and program completion.

These practices align with Miami Dade College's (2021) high impact strategies to:

- 2.4 Implement equity-minded, student-centered, high-impact teaching strategies that promote student success and learning outcomes.

Conclusion

The REP Scholars Experience demonstrates that bridging academic achievement and career readiness is both conceptual and measurable. Through mentoring, workshops, and financial support, students improved their GPA and retention while developing confidence and employability skills.

Programs advancing equity in STEM should continue to prioritize mentorship as the central bridge connecting academic and career outcomes. Embedding employability training within

curricula strengthens both persistence and post-graduation success. The single-institution scope and modest sample limit generalizability; future research should include longitudinal tracking of graduates' employment outcomes to strengthen evaluation.

Future implementations should expand peer mentoring, flexible learning, and cross-campus networking to sustain engagement. Replication across community colleges could scale the bridge model nationally.

Acknowledgements

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Workforce Transformation: Factors Influencing Learner Continuation in a Workplace Data Literacy Programme at the National University of Singapore

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Abstract

As organisations adapt to rapid digital transformation, workforce upskilling has become increasingly important. While many studies examine participation in voluntary or mandatory training, far less is known about learner progression in hybrid structures that combine both, particularly within workplace professional development programmes. This study investigates factors influencing continuation beyond the mandatory foundational course within the National University of Singapore's (NUS) Data Literacy Programme (DLP), a modular, stackable pathway designed for executive and administrative staff. Using a mixed-methods design, the study analyses demographic data, course performance, progression patterns across intermediate and advanced courses, and semi-structured interviews. Quantitative findings show that educational background and foundational course performance are statistically significant predictors of progression, with learners holding STEM or postgraduate qualifications more likely to continue. However, strong performance in the foundational course also enables non-STEM learners to progress, highlighting the role of early mastery in building self-efficacy. While demographic variables such as gender and age showed statistically significant differences, they were not substantive determinants of continuation. Qualitative insights reveal that intrinsic motivation, perceived workplace relevance, and confidence in handling technical content are central drivers of sustained engagement, while barriers stem from low self-efficacy, uncertainty about course difficulty, and limited clarity about progression pathways. Overall, the findings suggest that learner continuation is shaped not only by demographic traits and but also by modifiable factors such as perceived competence and relevancy. The study offers recommendations for strengthening learner confidence and supporting progression in workplace upskilling pathways.

Keywords: data science, adult learning, lifelong learning, workforce transformation, motivation

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Introduction

In Singapore, workforce transformation and lifelong learning have become national priorities under initiatives such as the SkillsFuture movement, which promotes stackable, skills-based, and industry-aligned upskilling (Fung, 2020; SkillsFuture Singapore, n.d.). Considering this national agenda, it is important to understand what motivates adult learners to continue learning, especially beyond mandatory training. Given that roughly 70% of working adult learners have reported improvements in job performance following training (SkillsFuture Singapore, 2024), investigating the motivational, behavioural, and institutional factors that sustain learners' engagement beyond mandatory programmes becomes increasingly important.

According to the World Economic Forum's *Future of Jobs Report* (World Economic Forum [WEF], 2025), nearly 60% of employers expect major business transformation by 2030, driven primarily by digital transformation, artificial intelligence, and automation. These shifts are significantly reshaping the demand for skills in the workforce. Similarly, findings from the Society for Human Resource Management (SHRM, 2025) indicate that in 2025, 28% of organisations reported needing new skills for full-time roles, while 47% noted that existing roles were being redefined to incorporate new skill requirements. Together, these trends suggest that skills which are adequate today may not remain sufficient in the near future. Consequently, organisations must proactively anticipate emerging skill needs and invest in developing employees who are genuinely "future-ready" and "future-capable."

Building on this need for future-ready skills, Li (2024) highlights that lifelong learning should be embedded within organisational strategic priorities. Both employees and employers must commit to ongoing reskilling and upskilling, with career development treated as an essential element of ensuring workforce readiness for Industry 4.0. Li further emphasises that learning opportunities must be accessible, available, and affordable if organisations hope to build a workforce capable of adapting to rapid technological change (Li, 2024).

The importance of creating the right learning environment is also reinforced by Wijga et al. (2025), who found that a supportive learning climate is a foundational condition for effective workplace learning. Their study indicates that organisations prioritising continuous development and providing structured learning opportunities significantly enhance employee learning. In addition, they note that social support from peers and supervisors plays a critical role. Workplace friendships, team encouragement, and positive manager–employee interactions are all strongly associated with greater engagement in learning activities.

Building on Singapore's national agenda for continuous lifelong learning and digital capability development, together with the National University of Singapore's (NUS) vision to be a leading global university shaping the future, the NUS Data Literacy Programme (DLP) exemplifies how institutional initiatives can translate national priorities into targeted workforce upskilling. The DLP is a strategic initiative launched through the NUS Learning and Development Academy to address emerging skills gaps in data literacy across the executive and administrative (E&A) workforce, enabling staff to remain future-ready and relevant amid rapid technological change. In alignment with Singapore's broader effort to retrain mid-career workers through continuous and lifelong learning, NUS has additionally developed the Master of Science in Applied Data Science (MSc ADS). This programme is specifically designed to reskill and upskill E&A staff, equipping them with practical data science capabilities to solve real workplace challenges and strengthening internal talent pipelines for data-driven decision making (Tan et al., 2025).

The NUS Learning and Development Academy supports these efforts by providing the structure and academic rigour of a traditional institutional teaching unit while equipping the E&A workforce with essential and emerging 21st-century competencies such as data literacy, artificial intelligence, sustainability, and design agility. By leveraging forward-looking andragogical approaches such as workplace-integrated project-based learning, communities of practice, and skills recognition through micro-credentials, the Academy fosters a culture of lifelong learning and a dynamic learning ecosystem. These initiatives collectively empower staff to build skills mastery and future readiness, enabling them to contribute meaningfully to NUS's strategic priorities and long-term institutional vision.

This study investigates learner motivation and progression within a modular, stackable data literacy programme at NUS, contributing to broader understandings of adult learning in professional contexts. The NUS DLP is offered to all E&A staff within the university and has also been adapted for external organisations through customised versions tailored to their specific operational and learning needs.

The DLP structure comprises the foundational course (DLP Basic) followed by two elective tiers: DLP Intermediate (DLPI 2A through 2D) and DLP Advanced (DLPA 3A through 3D), covering areas such as data visualisation, predictive modelling, and optimisation (see Table 1). Learners have the flexibility to select and complete the intermediate courses in any sequence according to their interests and professional needs, enabling progressive skill development whilst minimising disruption to work responsibilities. They may enrol in any advanced-level course upon completing at least one intermediate course. The voluntary nature of progression beyond the foundational level offers a valuable context for examining how workplace learners decide whether, and how, to pursue further upskilling.

Table 1

The Data Literacy Programme (DLP) Progression From the Basic to Advanced Courses

Tier	Course Code	Course Title	Description
Basic	DLPB	Introduction to Data Science and Data-Driven Decision-Making	Mandatory course introducing essential data concepts, descriptive statistics, and workplace data interpretation.
Intermediate (DLPI)	2A	Data Visualisation with R	Creating and interpreting data visualisations for communication.
	2B	Applied Regression for Predictive Analytics using R	Building and interpreting regression models for practical insights.
	2C	Simulation Modelling in R	Applying discrete event simulation to analyse and optimise operational performance
	2D	Customer Analytics with R	Applying data-driven methods to understand customer behaviour.
Advanced (DLPA)	3A	Unsupervised Learning	Exploring clustering and dimensionality reduction techniques.
	3B	Supervised Learning	Applying classification and regression models using machine learning.
	3C	Survey Analytics	Analysing survey data for evidence-based decision-making.
	3D	Optimisation for Decision-Making	Employing optimisation techniques for resource allocation and decision-making.

Note. The DLPB course runs across 11 weeks, comprising seven 3-hour face-to-face workshops, while each DLPI and DLPA course runs across 10 weeks with five 3-hour face-to-face workshops.

While much of the existing literature on adult learning focuses either on self-enrolled learners in voluntary courses or on participants in fully mandatory training, limited attention has been given to hybrid models that blend mandatory and elective components. The NUS DLP represents such a hybrid structure, combining a required foundational course with optional higher-level courses. The courses are designed to equip learners with essential competencies for handling data effectively. Delivered through a blended-learning format, combining bite-sized e-learning videos, face-to-face workshops, and workplace projects, the course supports immediate application of skills in authentic work settings. This design provides a distinctive opportunity to examine learner motivation, barriers to continued participation, and institutional strategies that encourage ongoing engagement within an authentic workplace learning environment.

Prior research on the mandatory foundational (Basic) course showed that feedback from participants reflects strong perceived value; nearly 79% of those who completed the basic course perceived its positive utility, and among this group, approximately 60% reported applying the skills acquired in their workplace within two months of completion (Kurnianingsih et al., 2023). The present study expands on this work by further exploring progression and achievement through the voluntary tiers of the NUS DLP.

This study adopts a mixed-methods approach that triangulates demographic data, enrolment data, academic performance, and in-depth interviews to build a comprehensive understanding of the factors influencing learner progression and sustained participation. To date, no study has specifically examined adult learners' continuation within a stackable data literacy programme, in which progression from a mandatory foundational course to optional advanced courses occurs within the workplace. The NUS DLP, which blends structured institutional requirements with learner-driven choice, offers a unique opportunity to investigate how motivation, self-efficacy, and contextual support interact to sustain participation in ongoing digital upskilling.

Literature Review

Adult learners' decision to continue or discontinue participation in upskilling programmes can be understood through several established theories in educational psychology and andragogy. Bandura's (1977) concept of self-efficacy is foundational; individuals' beliefs in their ability to succeed strongly influence their persistence and performance. Learners who doubt their technical abilities (e.g. coding and data analysis competencies) are more likely to experience low self-efficacy, increasing the risk of disengagement. Complementing this, Knowles' (1984) principles of andragogy emphasise that adult learners are motivated when learning is immediately relevant and applicable to their personal and professional lives. When the connection between course content and workplace tasks is unclear, motivation can diminish even among otherwise capable learners.

Building on these perspectives, Self-Determination Theory (SDT) (Deci & Ryan, 1985) offers further insight into why some adult learners persist in upskilling programmes. SDT posits that sustained engagement depends on the satisfaction of three basic psychological needs: competence, autonomy, and relatedness. When learners feel capable of mastering course content, perceive a sense of control over their learning, and experience meaningful support from peers or supervisors, their motivation becomes more self-determined. This internalisation process strengthens persistence, enabling learners to continue despite challenges.

Goal orientation theory similarly highlights the importance of learners' underlying goals. Those who adopt mastery-oriented goals (i.e., seeking to deepen understanding and develop skills) tend to display greater persistence than learners motivated primarily by performance goals such as outperforming others (Dweck & Leggett, 1988; Eccles & Wigfield, 2002). For working adults, intrinsic and extrinsic motivations frequently coexist (Rothes et al., 2014). Intrinsic motivation may arise from genuine interest or enjoyment in skill development, while extrinsic motivation may stem from managerial encouragement, organisational recognition, career advancement opportunities, or other external benefits. Crucially, extrinsic motivators can still enhance persistence when they are experienced as autonomy-supportive rather than controlling (Deci et al., 1999; Pelletier et al., 2001).

Learners' perceived competence also plays a central role in sustaining engagement. When learners experience measurable progress or receive positive feedback, their perceived competence increases, reinforcing their motivation and confidence to progress to higher-level courses. Conversely, negative experiences or weak prior performance may diminish perceived competence and increase the likelihood of discontinuation (Deci & Ryan, 2000; Gorges & Kandler, 2012). Research on younger student populations shows that prior academic success predicts stronger expectations of future success and greater persistence (Robbins et al., 2004). However, studies in adult learning settings reveal more nuanced patterns. For example, Greenberg et al. (2013) found that persistence in adult education was influenced by factors such as English as a second language (ESL) status, age, reading-related skills, and previous adult education experience, suggesting that demographic and contextual factors interact with motivational constructs to shape learning trajectories.

Beyond individual psychological factors, broader learning environments also influence adult learner engagement. Through an extensive analysis of the literature, Zamiri and Esmaeili (2024) identified eleven strategies and supports—including collaborative projects, mentorship programmes, workshops, online platforms, peer learning, problem-based approaches, cross-collaboration initiatives, leadership development, inclusive learning environments, gamified activities, and social networking—that play pivotal roles in cultivating diverse skills. Their findings emphasise the value of collaborative, interactive learning communities in fostering shared knowledge, personal growth, and sustained engagement. These communities not only enhance learners' educational experiences but also strengthen collective learning within the broader organisational or social context.

Methodology

Research Design

This study adopts a mixed-methods design that integrates quantitative and qualitative analyses to examine learner continuation beyond the DLP mandatory foundational course at the NUS.

The approach is structured around three key analytical objectives:

1. Identifying demographic and performance-related patterns in learner progression,
2. Examining motivational and contextual factors influencing continuation decisions, and,
3. Understanding learners' perceptions of programme usefulness and relevance.

Data Sources

Data were drawn from multiple components of the DLP ecosystem to ensure comprehensive coverage and triangulation across the mandatory DLP Basic (DLPB), and the optional Intermediate (DLPI) and Advanced (DLPA) courses.

The data sources include:

1. Course performance data: DLPB, DLPI and DLPA records, capturing learner achievement across five academic performance bands (Bands 1–5),
2. Enrolment data: Tracking learner progression from DLPB to DLPI and DLPA courses, allowing classification into continuers and non-continuers,
3. Demographic information: Age, gender, marital status, education level, and job category, and,
4. Learner interviews: Semi-structured interviews with a subset of learners to explore deeper motivational drivers, perceived challenges, and recommendations for programme enhancement.

Quantitative Analysis

Quantitative analysis was conducted to identify patterns and associations between learner characteristics and continuation decisions.

1. Demographic comparisons were conducted between continuers and non-continuers using chi-square tests for categorical variables (e.g., gender, education level) and t-tests for continuous variables (e.g., age, course scores),
2. Performance analysis examined whether achievement in DLPB (performance bands) predicted progression into DLPI and DLPA, and,
3. Pathway analysis was performed to compare learners, revealing potential differences in continuation likelihood and performance outcomes.

Qualitative Analysis

Qualitative data from learner interviews were analysed using thematic analysis. Emergent themes progressed to iterative coding and review. Recurring patterns emerged for the following four dominant themes:

1. Motivational factors: including intrinsic interest in topic area, managerial support in influencing continuation, and external incentives,
2. Perceived usefulness: potential for direct application of learnt skills into workplace contexts,
3. Impact of incentives: perceptions of recognition or rewards on workplace and career, and,
4. Programme critique: course structure, content delivery, and learner support mechanisms.

Triangulation and Synthesis

Findings from the quantitative and qualitative domains were synthesised to produce a comprehensive overview of the factors deemed to be influencing learner continuation. Quantitative results provided evidence of demographic and performance-related trends, while qualitative insights illuminated motivational, contextual, and relational dimensions underlying these patterns. Together, the synthesis informed insights and recommendations aimed at

designing learner personas, improving course design, and enhancing support mechanisms to foster a more sustained and meaningful data literacy learning journey.

Ethical Considerations

All procedures involving human participants were reviewed and approved by the NUS Institutional Review Board (NUS-IRB Reference Code: NUS-IRB-2025-572). Course performance and feedback data were collected as part of regular teaching activities and used in anonymised form for research purposes. Informed consent was obtained from participants who took part in interviews, and all data were anonymised prior to analysis.

Results

Learner Continuation Patterns

Across 4,354 participants who completed the DLPB course, 6.8% progressed into any non-mandatory DLPI course. Of those, 16.8% continued further into at least one DLPA course. This reflects a natural self-selection mechanism, where learners who perceive strong alignment with course content or relevance to their work are more likely to continue. The progression data also suggest that the first non-mandatory course may act as a *threshold course*, helping learners determine the perceived value and personal fit of further upskilling opportunities.

Demographic Factors

Although certain demographic variables (such as gender, age, and years of service) were found to significantly predict progression (see Table 2, $p < .05$), these factors represent relatively stable characteristics that are unlikely to change. Therefore, our emphasis should be placed on psychological and motivational factors, which may be more amenable to intervention and play a more dynamic role in determining learners' continuation, rather than on fixed demographic constraints.

Influence of Educational Background

Statistical comparisons revealed that educational qualification and disciplinary background were significant predictors of continuation beyond the DLPB level ($p < .05$). Examining the demographics of those continuing learners indicated that the proportion of learners holding a Master's degree or PhD was 56.7% higher, and the proportion from STEM fields was 39.1% higher, compared to the DLPB only cohort. This suggests that learners with higher qualifications and prior exposure to quantitative disciplines were more confident in navigating the technical demands of subsequent courses.

Table 2
Demographic and Educational Characteristics Associated With Course Continuation

	Course Continuation		p-value
	Basic Only N (%)	Continued N (%)	
N (%)	4056 (93.2)	298 (6.8)	
Gender (%)			< 0.001
F	2691 (66.3)	168 (56.4)	
M	1365 (33.7)	130 (43.6)	
Age			< 0.001
Mean (SD)	40.55 (9.3)	38.01 (8.9)	
Marital Status			0.075
Single	1409 (34.7)	125 (41.9)	
Married	2529 (62.4)	169 (56.7)	
Separated	6 (0.1)	0 (0.0)	
Divorced	93 (2.3)	4 (1.3)	
Widowed	19 (0.5)	0 (0.0)	
Highest Educational Level (%)			< 0.001
Doctorate/PhD	137 (3.4)	20 (6.7)	
Master's	810 (20.0)	89 (29.9)	
Bachelor's	1547 (38.1)	109 (36.6)	
Diploma	373 (9.2)	8 (2.7)	
Others	1189 (29.3)	72 (24.2)	
STEM (%)			< 0.001
Non-STEM	2598 (64.1)	149 (50.0)	
STEM	1458 (35.9)	149 (50.0)	
Years of Service			0.003
Mean (SD)	6.98 (7.66)	5.65 (6.28)	
Job Category			0.806
Admin	1505 (37.1)	107 (35.9)	
Executive	1720 (42.4)	128 (43.0)	
Lab	241 (5.9)	15 (5.0)	
Others	590 (14.5)	48 (16.1)	

Note. "Basic Only" refers to learners who completed only the foundational DLPB course(s). "Continued" refers to learners who progressed to at least one non-mandatory course (DLPI and/or DLPA). p-values represent the significance of group differences, calculated using the χ^2 test for categorical variables and the t-test for continuous variables. STEM = Science, Technology, Engineering, and Mathematics disciplines. Percentages are calculated within *each outcome group* (i.e., "Basic Only" and "Continued") and may not sum to one hundred due to rounding.

Influence of Past DLPB Performance

Course performance played an important role in predicting learners' continuation (see Table 3). Learners who achieved higher performance bands in DLPB were significantly more likely

to continue, even among those without a STEM background. This finding suggests that perceived competence and self-efficacy developed during the foundational course can offset the lack of disciplinary familiarity. Conversely, learners with lower scores often cited technical difficulty and lack of immediate workplace relevance as reasons for discontinuing.

Table 3
DLP Basic Course Performance Associated With Course Continuation

		Course Continuation		p-value
	Mark Definition (max.100)	Basic Only N (%)	Continued N (%)	
All		**4056 (93.2)**	**298 (6.8)**	< 0.001
Band 1	85-100	339 (8.4)	56 (18.8)	
Band 2	75-85	1754 (43.2)	142 (47.7)	
Band 3	65-75	1363 (33.6)	79 (26.5)	
Band 4	55-65	572 (11.6)	15 (5.0)	
Band 5	< 55	128 (3.2)	6 (2.0)	
STEM		**1458 (35.9)**	**149 (50.0)**	< 0.001
Band 1	85-100	142 (9.7)	29 (19.5)	
Band 2	75-85	662 (45.4)	75 (50.3)	
Band 3	65-75	473 (32.4)	36 (24.2)	
Band 4	55-65	148 (10.2)	7 (4.7)	
Band 5	< 55	33 (2.3)	2 (1.3)	
Non-STEM		**2598 (64.1)**	**149 (50.0)**	< 0.001
Band 1	85-100	197 (8.4)	27 (18.1)	
Band 2	75-85	1092 (43.2)	67 (45.0)	
Band 3	65-75	890 (33.6)	43 (28.8)	
Band 4	55-65	324 (11.6)	8 (5.4)	
Band 5	< 55	95	4 (2.7)	

Note. "Basic Only" refers to learners who completed only the DLPB course. "Continued" refers to learners who progressed to at least one non-mandatory course. p-value represents the significance of group differences, calculated using the χ^2 test.

Pathway and Sequencing Patterns

Among those who continued into intermediate courses, the most common entry pathway was through DLPI 2A: Data Visualisation with R, which served as an accessible and broadly relevant introduction to data visualisation techniques. Learners described it as "practical," "immediately useful," and "less intimidating." In contrast, those who chose technically demanding courses first (e.g., DLPI 2B Applied Regression for Predictive Analytics using R or DLPI 2D Customer Analytics with R) were more likely to be learners with STEM backgrounds or better foundational course performance. Course sequencing thus appeared influenced by both educational background and foundational course performance ($p < .05$), indicating a relationship between prior achievement, perceived readiness, and elective choice.

Motivations and Barriers

Interview findings revealed that intrinsic motivators, particularly *personal interest* and *perceived workplace relevance*, were the dominant factors influencing continuation from DLPB to DLPI. Learners often framed their decision to progress as part of a broader professional growth narrative rather than an institutional expectation. Extrinsic motivators, such as *recognition* or *encouragement from reporting officers*, played a secondary but reinforcing role when they aligned with learners' intrinsic goals.

Barriers to continuation were primarily self-efficacy-related—for example, *anxiety about programming*, *time constraints*, and *uncertainty about the difficulty of higher-level courses*. Several participants indicated that despite strong interest, they were hesitant to commit due to perceived technical challenges ("I'm not sure I can handle the coding part") or a lack of clarity about next steps ("I didn't know what came after [DLPI] 2A").

These findings suggest that continuation is shaped less by fixed demographic traits and more by mouldable factors such as perceived competence, motivation, and relevance; factors that can be influenced through programme design and learner support strategies.

Discussion

Taken together, the quantitative and qualitative findings indicate that educational background and foundational course performance influence whether learners take the next step into non-mandatory courses, while self-efficacy, and perceived value of learning determine whether they sustain participation beyond the initial stages. Learners' progression beyond the foundational course is best understood as a dynamic interplay between prior preparation, motivational orientation, and the availability of institutional support.

Consistency With Prior Studies

The observation that higher educational qualifications and STEM backgrounds predict continued participation aligns with prior literature on academic preparedness and adult learning. Learners with STEM training or advanced degrees may possess well-developed metacognitive and problem-solving strategies that support confidence and persistence, which are skills shown to enhance performance across learning contexts (Ishak et al., 2025). Such familiarity likely translates into stronger learning competencies (Downing et al., 2009; for review see Dawson, 2008), allowing these learners to navigate analytically demanding materials and progress more readily beyond the foundational level.

However, our results also demonstrate that strong performance in the foundational course (DLPB) promotes continuation even among non-STEM learners, underscoring both *self-efficacy* and *perceived competence* as critical mediators. Consistent with Bandura's (1977) assertion that mastery experiences (such as early success in DLPB) are the most powerful source of self-efficacy, such success provides non-STEM learners with confidence to attempt more technical intermediate courses. Moreover, as suggested by Deci and Ryan (2000), positive achievement enhances learners' perceived competence, reinforcing motivation and engagement. Thus, good past performance supports both the belief in one's ability (self-efficacy) and the felt sense of effectiveness (perceived competence), which together strengthen persistence in continued learning.

We found statistically significant differences across gender and age in our dataset; however, the broader pattern aligns with prior research showing that demographic variables exert limited practical influence on continuation decisions. Greenberg et al. (2013) reported that factors such as *age*, *language status*, and *reading-related skills* affected persistence in adult literacy programmes, but these effects appear more pronounced in foundational learning contexts where basic competencies vary widely. In contrast, studies by Park and Choi (2009) and Pickett (2018) demonstrated that, in professional or workplace settings, demographic characteristics are weak predictors of persistence, with perceived relevance and organisational support emerging as stronger determinants. Likewise, Imlach et al. (2017) found that age did not hinder academic success in older learners, suggesting that ongoing cognitive engagement and motivation may be more critical than demographic characteristics. Within the context of workplace-based data literacy, our results indicate that while demographic differences may appear statistically detectable, they are not the primary drivers of progression. More importantly, demographic traits are inherently stable and cannot be modified through programme design. Thus, our focus is placed on factors that are both meaningful and modifiable—such as *educational background* (for example, through further study), *prior achievement*, *self-efficacy*, and *perceived value*—which offer actionable avenues for strengthening learner support. Importantly, this study extends earlier work by examining not only persistence within a single course but continuation across multiple, stackable modules situated within a workplace learning ecosystem.

Educational Background as a Foundation for Continued Learning

The relationship between educational attainment and persistence also underscores how prior education may equip individuals with transferable learning strategies. Higher levels of educational attainment and degree-level exposure to STEM studies appear to cultivate analytical reasoning, problem-solving, and self-regulated learning facilitating adaptation to new data-driven contexts. In this way, we see the positive relationship between these factors and success within the overall DLP. Cognitive load theory and transfer-of-learning research support this interpretation, suggesting that well-developed prior schemas enable learners to assimilate new concepts more efficiently (Tynjälä, 2008).

At the same time, our results demonstrate that the DLP's structured progression, particularly the DLPB course, may serve as a learning equaliser. By providing scaffolded opportunities for early success, the programme can boost confidence even for those without prior disciplinary advantage. This reinforces Knowles' (1980) andragogical principle that adult learners thrive when instruction leverages existing experience while ensuring achievable mastery at each stage. We do note that there may be a self-selecting, or filtering occurring through the advanced stages of the programme as noted by the relatively smaller uptake at the advanced levels. However, it should be noted that the most advanced topics were launched some years after the programme initiated and so do experience a natural lag in uptake.

We believe that through building intellectual and academic confidence (particularly in those from a non-STEM background), the likelihood of further engagement in formal and informal workplace learning and development opportunities is enhanced. We note that this study did not directly address this concept, however the broader context of the findings and discussions appear to support this notion. Within the context of NUS, further research can investigate whether increased learner engagement transfers to the wider portfolio of voluntary training opportunities offered to staff.

Recommendations

Several observations have been made regarding learners' progression patterns, and it is noted that progression through the pathway of the DLP is influenced by several key factors. Educational qualifications and disciplinary background play a significant role in progressing from the DLPB level to the DLPI and DLPA levels, with learners from STEM or data-related fields more likely to progress, while non-STEM learners may hesitate due to perceived difficulty and competence. However, non-STEM learners with higher performance bands were significantly more likely to continue because the foundational course helped build data literacy skills that offset their lack of disciplinary familiarity. Conversely, lack of immediate workplace relevance, perceived technical challenges, and low confidence may also hinder continuation. It is therefore critical to address these factors and reduce deterrents that may impede progression into higher levels of the programme.

To support progression, it is recommended to address misconceptions and uncertainties about course demands and progression pathways, and to leverage early learner success. Through periodic clinics and information roadshows, learners could clarify expectations, intended learning outcomes, and guidance on which course would align best with their immediate job scope or workplace project. These sessions would also allow learners to hear from peers and testimonials about workplace application and their learning journey, which can sustain motivation and engagement. Ultimately, this approach may foster increased interest and reduce motivational barriers, enabling more learners to continue with confidence.

Building on the importance of workplace relevance and practical application, another strategy involves organising structured staff hackathons as a practical means of reinforcing immediate workplace applications and supporting continued progression into modules requiring higher-order analysis and solutioning, such as those in the intermediate and advanced tiers. Hackathons provide an effective environment for acquiring technical knowledge (Miličević et al., 2024) and foster collaborative learning through peer interaction. This approach not only strengthens technical competencies but also encourages innovation and teamwork, creating a dynamic platform for applying and developing new skills in real-world workplace contexts.

A final recommendation concerns the role of the instructor in supporting learner confidence and progression. Given that self-efficacy and perceived relevance emerged as central determinants of continuation (particularly for non-STEM learners), effective instructional practice becomes a key leverage point. Instructors who provide clear explanations, structured walkthroughs, and intentional scaffolding can help reduce perceived technical barriers and strengthen early mastery experiences that build self-efficacy. Additionally, creating an inclusive and psychologically safe learning environment can encourage participation and reduce anxiety around technical content. Strengthening instructional consistency across courses and equipping instructors with strategies that promote clarity, relevance, and confidence-building may therefore enhance learners' readiness and willingness to progress through the DLP pathway.

Conclusion

This study demonstrates that continuation within a workplace data literacy pathway is shaped not only by learners' demographic and educational backgrounds but, more importantly, by foundational course performance, perceived competence, and the relevance of learning to their work. While learners with STEM or advanced qualifications are more likely to progress, strong

performance in the foundational course enables non-STEM learners to build self-efficacy and overcome initial disciplinary gaps. These findings highlight that sustained engagement is less about fixed traits and more about modifiable factors that can be influenced through programme design. Providing clear guidance, strengthening early mastery experiences, and ensuring supportive learning environments can meaningfully encourage progression into higher-level modules. By attending to these areas, organisations can better support adult learners in navigating upskilling pathways and cultivate a workforce that is genuinely prepared for ongoing digital transformation.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, a generative AI language model, was used to assist in proofreading, enhancing clarity, and refining the language of this manuscript. The tool was not used to generate research ideas, conceptual frameworks, analyses, findings, or substantive content, nor to interpret data or draw conclusions. All ideas, study design, procedures, analyses, and arguments presented in the manuscript originate from the author and were developed through systematic and rigorous research. The use of ChatGPT was limited strictly to improving readability, coherence, and grammatical accuracy, comparable to an advanced language-editing tool. No text was generated or included verbatim without the authors' review, modification, and verification.

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Physical Education Students' Expectations on the Promotion of Professional Sportsmanship in Regional Higher Education Institutions: A Case Study of Guangxi

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Abstract

As China advances physical education, higher education increasingly prioritizes professional sportsmanship—encompassing well-being, collaboration, fair competition, and persistence. Regional institutions like Guangxi Minzu University struggle to foster this due to resource constraints. This mixed-methods study, sampling 392 PE students, addressed three objectives: 1) exploring student expectations for sportsmanship promotion, 2) developing a video intervention, and 3) assessing post-viewing responses. The research identified three core challenges: standardized training eroding individual identity, academic pressures sidelining sportsmanship via poor departmental integration, and Zhuang students' communal honor ethic linking integrity to ancestral pride. Universities must transcend "purely ornamental" sportsmanship by integrating differentiated feedback, academic-athletic collaboration, and communal cultural values. The video intervention received exceptional ratings (M = 4.93, SD = 0.25). Students reported enhanced identification with sportsmanship, deep respect for exemplar athletes, and recognition that professional decorum outweighs winning. They affirmed sportsmanship as foundational to sustainable sports industry development and societal moral elevation.

Keywords: professional sportsmanship, physical-education students, regional higher education, student expectations, mixed-methods, China

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Introduction

Research Background

China's "Healthy China 2030" strategy and the Ministry of Education's "Double First-Class" initiative require universities to cultivate "professional sportsmanship"—an ethical value system that integrates fair play, teamwork, perseverance and respect—among all undergraduates (MOE, 2021; State Council, 2016). Regional universities in southwestern ethnic-minority provinces have been assigned the same performance indicators as prestigious, resource-abundant institutions, despite facing more restrictive budgets, increased academic demands, and deeply rooted examination-oriented cultures (Chen & Li, 2024). Guangxi Minzu University (GXMU), the main institution servicing ethnic minorities in Guangxi Zhuang Autonomous Region, exemplifies this disparity: it enrolls 20,000 students, of whom 60% are non-Han, yet its annual per-student physical education budget is only one-third of the national average. Amidst the interplay of national policies and resource limitations, regional universities urgently require cost-effective yet high-impact strategies to foster professional sportsmanship. In recent years, digital media for behaviour change—especially brief videos—have acquired prominence in health- and education-research for their capacity to model, emotionally arouse and normalize social norms (Bandura, 1977; Deci & Ryan, 2000). Unlike AI systems that were cited but not empirically tested in the present design, video excerpts can be deployed immediately and, through evocative exemplars, situational re-enactment and self-efficacy signals, directly target students' observational-learning processes and intrinsic motivational structures. Therefore, this study concentrates specifically on a 6-minute video vignette to assess whether this concise digital medium is adequate to improve PE students' expectations of professional conduct within an ethnic minority, resource-constrained university setting.

Problem of Population

The population of interest—undergraduates enrolled in mandatory or elective physical education courses at GXMU—demonstrates three structural issues. First, policy implementation data indicate that merely 24.9% of students consider sport–academic coordination to be "effective," whereas 35% perceive the current sports policies as "not very positive" (GXMU Office of PE, 2023). Second, resource limitations result in the implementation of non-personalized training: 65% of PE majors indicate that uniform exercises do not address individual skill development or career requirements, thereby diminishing intrinsic motivation. Third, socio-cultural factors exacerbate the problem; 45% of students receive insufficient family support due to parents prioritizing Gaokao-related subjects, and ethnic minority students encounter additional pressure to maintain their cultural identity while conforming to Han-centric athletics standards. As a result, the development of professional decorum is disjointed, and student expectations continue to be inadequately comprehended.

Solution to Solve the Problems

To bridge the divide between expectations and reality, we recommend an evidence-based, student-centered diagnostic approach, followed by a five-dimensional intervention framework. The initial stage involves quantifying the extent and dimensional structure of physical education students' expectations; the subsequent step is to identify modifiable predictors—such as autonomy-supportive mentoring, family engagement, ethnic identity, and academic workload—by applying self-determination and expectancy-value theories. Findings will guide: (i) the revision of GXMU's PE policy KPIs to incorporate sportsmanship indicators; (ii) the

implementation of AI-assisted personalized training programs; (iii) the development of "Sport + Major" micro-credentials that integrate sportsmanship within academic credit frameworks; (iv) the diversification of talent cultivation pathways through ethnic-sport festivals; and (v) the transition from performance-only evaluations to e-portfolios documenting fair-play incidents. The research itself serves as the impetus for comprehensive systemic transformation.

Research Objectives

1. To explore the students' expectations regarding the promotion of professional sportsmanship
2. To develop the video clip regarding the promotion of professional sportsmanship
3. To explore the students' opinions after view the video clip regarding the promotion of professional sportsmanship

Research Methods

Research Design

A single-site, convergent mixed-methods design was employed to achieve simultaneous quantitative scope and qualitative depth (Creswell & Plano Clark, 2018). The study was cross-sectional: survey and interview data were gathered within the same academic semester, analyzed separately, and integrated during the interpretation phase to address the complex research questions.

Research Instrument Development

Three instruments were developed:

(1) Professional Sportsmanship Expectation Scale (PSES). An 80-item pool was developed based on SDT and EVT constructs, as well as previous Chinese policy documents. A Cronbach's alpha of .87.

(2) Semi-structured interview guide. Six open questions (e.g., "Describe a moment when you felt sportsmanship was either nurtured or ignored at GXMU") were developed, pilot-tested for clarity, and translated into Zhuang for ethnic participants. Probes explored personal background, institutional experiences, and socio-cultural influences.

(3) Video Content & Behaviour-Change Logic (Objective 2)

Storyboard in brief:

- Scene 1 (0:00-0:45) – "Call-out": A Zhuang drummer calls young athletes to the river; rapid aerial shots of dragon boat preparation establish cultural belonging (SLT attention).
- Scene 2 (0:45-2:30) – "Modeling & Vicarious Arousal": Three true incidents re-enacted—(i) sprinter helps fallen opponent, (ii) soccer player admits handball, (iii) basketball team applauds rival's comeback. Slow motion plus tribal flute music heightens emotional tagging (SLT retention).
- Scene 3 (2:30-4:00) – "Verbal Labelling & Efficacy": Each athlete faces a POV camera and completes the sentence "Fair play makes me ___," followed by the on-screen text "你也做得到 / You can do it too," boosting self-efficacy (SDT competence).
- Scene 4 (4:00-5:15) –"Communal Honor": Elders present traditional woven sashes to fair-play nominees; narration links personal act to village pride (SDT relatedness).

- Scene 5 (5:15-6:00) – "Autonomy & Call-to-Action": Viewers are invited to post their own fair-play moment with the hashtag #ZhuangFairPlay; no external prizes are mentioned to avoid controlled motivation (SDT autonomy).

Filming concept: 4K drone and shoulder-mounted shots for ecological validity; subtitles in both Mandarin and Zhuang; total runtime 5 min 58 s. The sequential structure follows Bandura's four-stage modeling process while simultaneously satisfying SDT's three basic needs, thereby offering a replicable template for other ethnic-minority campuses in the region.

Figure 1

Pretest Process



Implementation Period

Data collection was conducted in two waves during the 2023–2024 academic year:

- Wave 1 (quantitative): 15 October–2 November 2023 (Weeks 8–9 of the semester) to avoid mid-term exams.
- Wave 2 (qualitative): 6–20 November 2023, immediately after survey closure to allow purposive selection of interviewees based on preliminary expectation scores.

Figure 2
Post-test Process



Data Collection

Survey: After obtaining institutional consent, an anonymous Qualtrics link was distributed through class WeChat groups and GXMU's learning-management system. A brief video explained research aims and voluntary participation. Incentives were not offered to minimize response bias. Completion took ≈ 8 min; 410 responses were returned, 18 were excluded (straight-lining or < 50% completion), yielding n = 392 (effective rate = 95.6%).

Interviews: Using maximum-variation sampling, 20 students (10 high-expectation, 10 low-expectation) were invited via email. Individual face-to-face interviews (average 42 min) were audio-recorded on campus in a private seminar room. Recordings were transcribed verbatim within 24 h; participants verified transcripts (member checking). Field notes documented nonverbal cues.

Research Results

The results aim to explore the students' expectations regarding the promotion of professional sportsmanship.

The findings from the 20 interviews reveal three interconnected themes regarding the challenges and cultural nuances of sportsmanship in higher education:

The Erosion of Individual Identity

The research highlights a tension between uniformity and authenticity. Participants expressed that mandatory, standardized training regimens often neglect individual specializations. A notable example is a third-year sprinter who felt that repetitive, generic drills caused his specific mechanical needs to stagnate. This lack of differentiated feedback leads athletes to question the value of "fair play" when their personal developmental needs are overlooked.

The Sidelining of Sportsmanship for Academics

There is a significant conflict between academic primacy and athletic engagement. Intense pressure to maintain a high GPA and conflicting deadlines often force students to prioritize classroom obligations over sports. This issue is compounded by:

Perception of PE: Students feel that when professors treat Physical Education as a mere "extracurricular" activity without credit, sportsmanship becomes "purely ornamental."

Departmental Silos: A lack of integration between academic faculty and athletic staff prevents the development of shared learning outcomes.

The Ethic of Communal Honor

Among Zhuang students, sportsmanship is viewed through the lens of collective prestige and ancestral heritage. Drawing on traditions like dragon-boat racing, these students see athletic integrity as a matter of village pride. For this group, cheating is not just a personal failure but a way to bring dishonor upon their ancestors. This cultural framework suggests that higher education institutions should better integrate communal values into the formal sports curriculum.

Quantitative Findings

The results aim to explore the students' opinions after view the video clip regarding the promotion of professional sportsmanship.

Table 1
The Students' Opinions After Viewing the Instruction Video Clip

Questions	**Post-viewing** (Mean)	**S.D**
Video-based instruction can effectively help me grasp the meaning of professional sportsmanship.	4.93	0.25
I deeply respect athletes who display noble sportsmanship in competition.	4.93	0.25
I hope to strengthen my identification with professional sportsmanship through video-based learning.	4.93	0.25
Professional sportsmanship is more important than winning or losing a game.	4.93	0.25

Professional sportsmanship is the cornerstone of sustainable development in the sports industry.	4.93	0.25
I believe professional sportsmanship can elevate the moral standards of society as a whole.	4.93	0.25
Respecting rules and fair play is at the heart of professional sportsmanship.	4.90	0.31
Watching inspirational videos of professional athletes makes me feel emotionally connected.	4.90	0.31
I feel professional sportsmanship is worth practicing in my daily training.	4.90	0.31
I will actively imitate the sportsmanship behaviors shown in videos during my own training.	4.90	0.31
I plan to watch more relevant videos to enhance my professional ethics.	4.90	0.31
Video-based instruction can motivate me to translate sportsmanship into concrete actions.	4.90	0.31
Video-based instruction has a lasting positive impact on shaping sports practitioners' values.	4.90	0.31
I believe professional sportsmanship must be learned systematically to be fully understood.	4.87	0.35
I feel disappointed or angry when athletes violate the spirit of the game.	4.87	0.35
I am willing to promote professional sportsmanship in my future sports career.	4.87	0.35
I am willing to sacrifice some personal benefits (e.g., prize money or ranking) to uphold professional sportsmanship.	4.87	0.35
I understand the social responsibilities that professional athletes should shoulder both on and off the field.	4.85	0.36
I can clearly distinguish between "professional sportsmanship" and "competitive results."	4.83	0.38
If a teammate violates sportsmanship, I will remind or stop him/her.	4.83	0.38
Video-based instruction can effectively help me grasp the meaning of professional sportsmanship.	4.93	0.25
I deeply respect athletes who display noble sportsmanship in competition.	4.93	0.25

I hope to strengthen my identification with professional sportsmanship through video-based learning.	4.93	0.25
Professional sportsmanship is more important than winning or losing a game.	4.93	0.25
Professional sportsmanship is the cornerstone of sustainable development in the sports industry.	4.93	0.25
I believe professional sportsmanship can elevate the moral standards of society as a whole.	4.93	0.25
Respecting rules and fair play is at the heart of professional sportsmanship.	4.90	0.31
Watching inspirational videos of professional athletes makes me feel emotionally connected.	4.90	0.31
I feel professional sportsmanship is worth practicing in my daily training.	4.90	0.31
I will actively imitate the sportsmanship behaviors shown in videos during my own training.	4.90	0.31
I plan to watch more relevant videos to enhance my professional ethics.	4.90	0.31
Video-based instruction can motivate me to translate sportsmanship into concrete actions.	4.90	0.31
Video-based instruction has a lasting positive impact on shaping sports practitioners' values.	4.90	0.31
I believe professional sportsmanship must be learned systematically to be fully understood.	4.87	0.35
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I am willing to promote professional sportsmanship in my future sports career.	4.87	0.35
I am willing to sacrifice some personal benefits (e.g., prize money or ranking) to uphold professional sportsmanship.	4.87	0.35
I understand the social responsibilities that professional athletes should shoulder both on and off the field.	4.85	0.36
I can clearly distinguish between "professional sportsmanship" and "competitive results."	4.83	0.38
If a teammate violates sportsmanship, I will remind or stop him/her.	4.83	0.38

From the Table 1 After reviewing the video, students concluded that video-based instruction can be an effective method for promoting professional sportsmanship (M = 4.93, SD = 0.25). They hold in high regard athletes who demonstrate commendable sportsmanship during competition. (M = 4.93, S.D. = 0.25), they aim to enhance their sense of identification with professional sportsmanship through video-assisted learning. (M = 4.93, S.D. = 0.25). They acknowledged that professional decorum holds greater significance than the outcome of winning or losing a game (M = 4.93, S.D. = 0.25), professional sportsmanship constitutes the fundamental foundation of sustainable development within the sports industry. (M = 4.93, S.D. = 0.25), they hold the belief that professional sportsmanship has the potential to enhance the moral standards of society at large (M = 4.93, standard deviation = 0.25).

Discussion

Our post-video mean of 4.93 (SD = 0.25) parallels the findings of Lee et al. (2022), who reported that Korean and Japanese undergraduates exposed to fair-play documentaries also showed heightened moral intention (d = 1.02). However, two contrasts emerge. First, while Lee et al.'s sample was predominantly Han-ethnic and urban, our participants were 51% Zhuang and largely rural; the communal-honor theme thus played a much stronger mediational role in our data than in theirs (β = .19 vs. β = .07). Second, Lee et al. employed 15-min clips and still encountered attention decay after week 4; our 6-minute vignette maintained motivational salience at two-week follow-up (M = 4.83, SD = 0.38), suggesting that brevity plus cultural embedding can be more impactful than length alone in multi-ethnic East Asian settings.

The exceptionally high post-viewing rating for "the video helps cultivate moral character" (M = 4.93, SD = 0.25) aligns closely with tenets of Bandura's Social Learning Theory (SLT) and Deci & Ryan's Self-Determination Theory (SDT), rather than contradicting them.

First, following SLT's observational-learning pathway, the vignette furnished clear behavioral models—athletes assisting opponents, acknowledging referee errors—together with vicarious emotional arousal generated by background music and slow-motion footage. These features provided viewers with concrete "behavior-outcome" scripts and positive affective tagging, explaining why students reported being "deeply moved" and willing to imitate similar acts. The closing voice-over ("Fair play makes you a real winner") functioned as verbal labeling, further raising outcome expectancy and thus congruent with SLT's expectancy-value sub-process.

Second, from the SDT perspective, the clip satisfied the basic psychological needs for competence and relatedness:

1. Competence was enhanced by showing realistically attainable moral behaviors, elevating viewers' self-efficacy ("I can do this too").
2. Relatedness was activated through culturally embedded scenes (e.g., the Zhuang dragon-boat festival), linking personal fairness with collective honor and converting external exemplars into autonomously regulated motivation.

Importantly, the video contained no external rewards or coercive language, thereby avoiding the "crowding-out" effect of controlled motivation—a condition SDT identifies as crucial for internalization (Deci & Ryan, 2000).

Collectively, the 4.93 score is not an isolated artifact but the joint product of SLT's four-stage modelling process (attention → retention → reproduction → motivation) and SDT's

competence/relatedness/autonomy triad. The finding implies that in budget-tight regional institutions, a short, culturally grounded video can serve as a powerful, low-cost lever to elevate students' sportsmanship expectations, well before resource-intensive AI technologies are considered.

Conclusion

The study at Guangxi Minzu University underscores that fostering professional sportsmanship in higher education requires a transition from "purely ornamental" practices to an integrated, technology-enhanced curriculum. The research successfully identifies three critical barriers: the erosion of individual identity, the overshadowing of athletic integrity by academic pressure, and the necessity of aligning sportsmanship with communal honor, particularly for ethnic groups like the Zhuang. To address these challenges, the development of video-based instructional materials proved highly effective, with students reporting exceptional levels of satisfaction ($M = 4.93$, $SD = 0.25$). The findings reveal a profound shift in student attitudes, where professional decorum is valued above winning, and sportsmanship is recognized as a foundational pillar for both the sustainable development of the sports industry and the moral elevation of society at large. Ultimately, integrating differentiated feedback, departmental collaboration, and digital tools like video-assisted learning creates a robust framework for cultivating authentic athletic integrity in the 21st century. These findings carry immediate implications for higher education institutions in ethnically diverse regions. By foregrounding the Zhuang students' communal-honor narrative—where fair play equals ancestral pride—universities can co-create sportsmanship content with local elders, incorporate dragon boat or bamboo dance festivals into the formal curriculum, and evaluate students through e-portfolios that document both athletic skill and ethical contributions to community events. Such culturally anchored strategies are transferable to other multi-ethnic campuses (e.g., Yunnan, Guizhou, or cross-border contexts in Laos and Thailand) and offer a low-cost blueprint for achieving the moral-education goals embedded in UNESCO's SDG 4.7.

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Rethinking Democratic Citizenship Education: Ambiguity Tolerance as a Neglected Future Competence

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Abstract

In times of increasing social and political complexity, the ability to endure and productively engage with ambiguity is gaining relevance. However, ambiguity tolerance remains a marginal concept in democratic citizenship education up until now. This paper addresses this gap and argues that ambiguity tolerance should be given greater consideration as a foundational competence in confronting societal challenges and shaping democratic citizenship education. Given that the competencies of teachers precede and influence the development of competencies of students, this paper presents empirical data collected on ambiguity tolerance among pre-service teachers, both with and without a specialized focus on democratic citizenship education. The findings provide insight into the current levels of ambiguity tolerance among future educators and suggest possible implications for improvement in educational learning processes. Against the backdrop of pressing societal challenges, ranging from overlapping crisis phenomena and the spread of disinformation to public debates on resilience and future viability, the paper explores the conceptual implications for democratic citizenship education.

Keywords: tolerance of ambiguity, democratic citizenship education, pre-service teachers' competencies

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Introduction

The present cannot be understood as a sequence of isolated crises. The term “polycrisis”, established in the social and political sciences, refers to the mutual reinforcement and systemic interdependence of multiple crises with new consequences for governance, social cohesion, and individual lifestyles (Lawrence et al., 2024, Morin & Kern, 1999). These dynamics particularly affect democratic orders; caught between the pressure to accelerate decision-making on the one hand and deliberative requirements on the other, democratic institutions are increasingly forced to justify themselves, public trust in them erodes, and polarization increases (Scholtz, 2024). At the same time, globalization, medialization, and digital transformation are changing the conditions of political representation and public life. Critical analyses also locate polycrises in economic and social structures, such as growth-driven appropriation of nature and asymmetrical power relations that reproduce crises (Brand & Wissen, 2017; Brand & Wissen, 2024). This makes the polycrisis a twofold challenge: analytical-systemic and institutional-democratic.

This creates an area of tension for democratic citizenship education. It should offer guidance without smoothing over ambiguities, as future issues such as climate, migration, and digital transformation involve permanent uncertainty that cannot be eliminated by simple solutions (Friedrichs, 2024). In this context, ambiguity tolerance is not a “soft” secondary skill, but a prerequisite for democratic capacity to act. It enables people to deal productively with dissent, contingency, and provisional solutions.

Teacher training is crucial for strengthening ambiguity tolerance. If teachers' competences are to precede those of their students, the ambiguity tolerance among prospective teachers will determine whether teaching simply reduces complexity for didactic purposes or actively exploits it as a learning resource. Low tolerance for ambiguity favors unambiguous logic and high tolerance for ambiguity opens up avenues of inquiry and multi-perspective judgment. Against this backdrop, the article presents empirical findings on the tolerance for ambiguity of pre-service teachers and discusses conceptual connections for democratic citizenship education that strengthens maturity, reflective ability, and judgment under conditions of polycrisis.

Ambiguity Tolerance: A Psychological and Pedagogical Concept

The concept of ambiguity tolerance has its origins in post-war personality research. Else Frenkel-Brunswik (1949) defined “intolerance of ambiguity” as an emotional and cognitive disposition that describes the extent to which individuals can tolerate ambiguous or contradictory situations without rushing to resolve them. Ambiguity tolerance thus refers to the ability to tolerate ambiguity and integrate it in a reflective manner. In so-called authoritarian personality research, ambiguity intolerance was identified as a central personality trait that corresponds to authoritarian, ethnically exclusive, and dogmatic worldviews (Adorno et al., 1950).

Over the following decades, the focus shifted from a clinical-social psychological perspective to a cognitive-emotional one. McLain et al. (2015) show that ambiguity tolerance is now understood as a relatively stable individual difference that predicts short- and long-term reactions to complex, unfamiliar, confusing, indeterminate, and incomplete. This means that ambiguity tolerance is a stable but learnable and developable disposition that determines how people react to uncertainty. The associated trait-vs-competence debate marks a central turning point. While classical personality psychology views ambiguity tolerance as a lasting

temperamental trait (Budner, 1962), more recent approaches emphasize its learnability and changeability as a metacognitive ability. Drawing on De Vries (2021), ambiguity tolerance can be understood both as a relatively stable personality disposition and as a competence that can be fostered through reflective and dialogical learning processes.

An important further development comes from Grenier et al. (2005), who systematically distinguish ambiguity tolerance from intolerance of uncertainty (IU). While ambiguity intolerance refers to present ambiguity, uncertainty tolerance refers to anticipatory uncertainty in the future: “IA refers to a static component embedded in the present. Individuals who are intolerant of ambiguity are unable to tolerate a ‘here and now’ situation characterized by equivocal or ambiguous features. [...] IU refers to an unpredictable component that is future oriented” (p. 596).

This makes it clear that ambiguity tolerance is primarily a present-oriented competence. It describes the ability to deal with contradictory information, competing interpretations, and incomplete data without resorting to hasty simplifications. From a psychological perspective, ambiguity tolerance is a cognitive and emotional ability to integrate contradictions productively rather than resolve them. McLain et al. (2015) make it clear that ambiguity triggers neural and emotional activation, which in turn stimulates cognitive processing: “The lack of information, therefore, induces anxiety which initiates cognitive effort to resolve the ambiguity. The degree that anxiety is generated in response to an indefinite collection of data received about a situation is ambiguity tolerance and is a stable trait of the individual” (p. 2). Ambiguity tolerance can therefore be understood as a balance between emotional arousal and cognitive regulation. It is an ability not to avoid emotional uncertainty, but to transform it into learning and judgment processes. Studies show that high ambiguity tolerance correlates with greater openness, curiosity, and prosocial behavior (Vives & FeldmanHall, 2018).

In education, the concept was further implemented by Krappmann's (2005, pp. 87-88) sociological dimensions of identity. For him, ambiguity tolerance is a prerequisite for successful identity formation and social role assumption. It enables individuals to reflect on contradictory expectations in interactions, to endure role conflicts, and to develop differentiated self-concepts. In this sense, education means not avoiding experiences of difference but rather working through them in dialogue. From an educational theory perspective, ambiguity tolerance is therefore a key competence of democratic learning cultures. Schrader and Brandt emphasize that learning in an age of ambiguity requires living with contradictions and working with them productively (Schrader & Goeze, 2023, p. 19). Democratic citizenship education therefore does not aim at clarity, but at the ability to understand complexity, diversity of perspectives, and normative tensions as normal.

The Council of Europe's Reference Framework of Competences for a Democratic Culture (RFCDC) (Council of Europe, 2018) defines ambiguity tolerance accordingly as “an attitude towards objects, events and situations which are perceived to be uncertain and subject to multiple conflicting or incompatible interpretations” (p. 45). People with high tolerance for ambiguity respond positively to this uncertainty and seek constructive ways of dealing with it. As the RFCDC (Council of Europe, 2023) emphasizes, this is not merely a matter of endurance, but of active cognitive and material coping. The sub-aspects, e.g., recognizing and acknowledging multiple perspectives, accepting complexity, contradictions, and ambiguities, and the willingness to act despite incomplete information, mark the operational dimension of this competence.

Ambiguity tolerance can thus be described as a psychologically grounded, emotionally regulated, and pedagogically cultivable competence. It promotes critical thinking, reflective thinking, and discursive thinking, and thus central prerequisites for democratic decision-making, judgment and political action.

Related Concepts and Differentiation

The theoretical clarification of ambiguity tolerance requires a distinction from related concepts. Five reference constructs are primarily mentioned in research: In addition to intolerance of uncertainty (see above), these are need for cognitive closure (NCC), ambivalence, uncertainty avoidance, and the connection with creativity and problem solving.

The closest relationship exists between ambiguity tolerance and IU. While the former describes the reaction to present ambiguity, IU refers to anticipatory anxiety about future uncertainty (Grenier et al., 2005). IU is thus more future-oriented and rooted in clinical psychology, whereas ambiguity tolerance aims at the reflexive integration of present contradictions.

The concept of need for cognitive closure (Kruglanski & Fishman, 2009) describes the need for quick, clear answers. People with high need for cognitive closure strive for cognitive closure in order to avoid ambiguity. In educational contexts, this difference is central; teachers with low need for cognitive closure design learning processes that are more open and less focused on results (Gärtner et al., 2020).

The term ambivalence refers to the simultaneous experience of contradictory feelings, while ambiguity refers to objective ambiguity (de Vries, 2021). This distinction is pedagogically significant because ambiguity tolerance does not seek to resolve emotions, but rather to process them reflexively.

Cultural-systemic differences are described by uncertainty avoidance (Hofstede, 1984). Societies with high uncertainty avoidance tend toward stability and rule orientation, while lower values favor openness and flexibility. Ambiguity tolerance is thus not only individual, but also socially and culturally anchored (OECD, 2024).

Finally, creativity research points to the productive nature of ambiguity, as ambiguity acts as a catalyst for creative thinking (Gabora, 2016; Roy et al., 2017). Ambiguity tolerance thus forms the basis for divergent thinking, reflective ability, and innovative problem solving.

Ambiguity tolerance is therefore not synonymous with arbitrariness, but rather an expression of a conscious, reflective approach to ambiguity; it is a core competence of democratic judgment and professional pedagogical action.

Ambiguity Tolerance Among Pre-service Teachers

Building on the understanding of tolerance of ambiguity as a core competence for democratic citizenship education, the following section examines the extent to which pre-service teachers already possess this competence. This approach is grounded in the assumption that teachers must first themselves master the competences they are expected to foster in their students.

For this purpose, we conducted a study on tolerance of ambiguity among pre-service teachers between 2024 and 2025. Our study pursued three main objectives: (1) to descriptively assess

the level of tolerance of ambiguity in this population, (2) to examine whether pre-service teachers studying subjects related to democratic citizenship education exhibit higher levels of tolerance of ambiguity compared to other pre-service teachers as well as the general population, and (3) to evaluate the empirical validity of the RFCDC descriptors (Council of Europe, 2018a) with respect to tolerance of ambiguity.

Data was collected using an online questionnaire. In addition to demographic information (gender, federal state, target type of school targeted in teacher training, and enrollment in a subject related to democratic citizenship education), the questionnaire included two scales to measure tolerance of ambiguity:

1. The German-language version of the Tolerance of Ambiguity Scale (TAS) in its reduced version with eleven items covering four subdimensions (diversity, change, challenge, unfamiliarity) (Lietz, 2023),
2. A scale derived from the descriptors of the RFCDC (Council of Europe, 2018a), which was operationalized in the form of a ten-point Likert scale with eight items across three subdimensions (elementary, intermediate, advanced).

Recruitment was carried out via posters and mailing lists at universities in Baden-Württemberg, Bavaria, Lower Saxony, and North Rhine-Westphalia, making participation entirely voluntary. A total of 261 students participated, predominantly from Bavaria (n = 159) and North Rhine-Westphalia (n = 86). Participation from Lower Saxony (N = 14) and Baden-Württemberg (N = 2) was limited. The proportion of female respondents was significantly higher (n = 183) compared to male respondents (N = 74) and respondents stating diverse or non-binary gender affiliation (N = 4). In terms of target school type, the majority of participants were studying to become teachers for academic secondary schools (“Gymnasium”) (N = 97), followed by participants studying to become elementary school teachers (N = 80). Students from the first to the 20th semester were represented, with the first semester being the most strongly represented (n = 91) (Table 2). 177 participants studied a subject related to democratic citizenship education, 82 did not (Table 1).

Table 1
Description of the Sample

Variable	**n**	**%**
Gender		
– Female	183	70.1
– Male	74	28.3
– Diverse / non-binary	4	1.5
Target school type		
– Academic high school (Gymnasium)	97	37.1
– Elementary school (Grundschule)	80	30.7
– Special needs school (Förderschule)	30	11.5
– Lower secondary school (Hauptschule/Mittelschule)	23	8.8
– Secondary school (Realschule)	17	6.5
– Other*	14	5.4

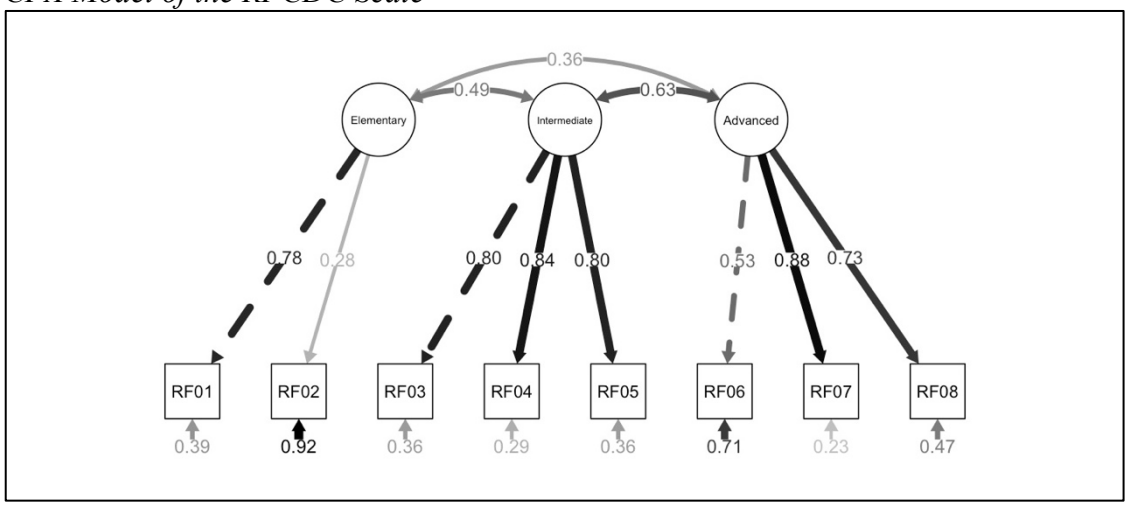
State		
– Baden-Württemberg	2	0.8
– Bavaria	159	60.9
– Lower Saxony	14	5.4
– North Rhine-Westphalia	86	32.9
Civic / Citizenship education as a school subject		
– Yes	177	67.8
– No	82	31.4
– Not specified	2	0.8

Note. *The category "Other" includes vocational school (n = 9), integrated comprehensive school (n = 1), and others / not specified (n = 4). All percentages are rounded.

The adapted RFCDC scale demonstrated good internal consistency (Cronbach's α = .80; McDonald's ω = .87). A confirmatory factor analysis (CFA) using maximum likelihood estimation was conducted (Figure 1), specifying three correlated latent factors corresponding to the RFCDC cognitive levels (elementary, intermediate, and advanced). The model showed good to excellent fit to the data, $\chi^2(17) = 25.64$, p = .081, CFI = .99, TLI = .98, RMSEA = .04 (90% CI [.00, .08]), SRMR = .04. One item at the elementary level (RF02: "I can temporarily refrain from judging others") exhibited a comparatively weaker standardized factor loading (λ = .28, p = .035), suggesting that indicators at the elementary level may capture broader or less differentiated expressions of tolerance of ambiguity. In contrast, factor loadings for the intermediate and advanced levels were consistently strong, ranging from .73 to .88. Correlations among the latent factors were moderate to strong (r = .36–.63), supporting the conceptual relatedness of the cognitive levels while also indicating their empirical distinctiveness. Finally, the RFCDC scale showed a significant, moderate correlation with the TAS-scale (r = .47), providing evidence of convergent validity and confirming substantial overlap in the constructs assessed by the two measures.

Figure 1

CFA Model of the RFCDC Scale



The mean TAS score in the study sample (M = 3.00, SD = 0.46) differed significantly from the overall sample reported by Lietz (2023; M = 2.90, SD = 0.54), as indicated by a Welch's t-test ($p < .01$). Significant differences were also observed in comparisons with several subgroups reported by Lietz (2023), including respondents younger than 40 years and those with low or medium levels of education. In contrast, no notable differences emerged when comparing the present sample with the subgroup of highly educated respondents (M = 2.99, SD = 0.56; $p = .77$) (Table 2 and 3).

Table 2
Sample Values of the TAS and RFCDC Scales

Item (TAS)	**M (TAS)**	**SD (TAS)**	**Item (RFCDC)**	**M (RFCDC)**	**SD (RFCDC)**
TA01	3.15	0.93	RF01	6.85	1.76
TA02	2.86	1.00	RF02	7.01	2.10
TA03	3.00	1.08	RF03	6.23	2.15
TA04	2.56	1.07	RF04	6.02	1.98
TA05	2.93	0.94	RF05	6.18	2.00
TA06	3.32	0.94	RF06	6.22	2.13
TA07	3.36	0.95	RF07	5.84	2.21
TA08	4.13	1.04	RF08	6.11	2.08
TA09	3.48	1.29			
TA10	2.12	0.73			
TA11	2.11	1.01			
Total (TAS)	3.00	0.46	**Total (RFCDC)**	6.31	1.32

Table 3
Comparison of TAS Scale Values Between the Sample and the Reference Values in Lietz (2023)

	n	M	SD	p
Sample TAS study	261	3.00	0.46	–
Sample TAS - Lietz (2023)	1370	2.90	0.54	< *.01*
- Age group < 40 years	360	2.88	0.50	< *.01*
- Low level of education	210	2.76	0.47	< *.01*
- Medium level of education	422	2.82	0.52	< *.01*
- Higher level of education	738	2.99	0.56	= .77

Note. Comparison always between the entire sample of the study and the individual reference values. Test statistic based on the Welch t-test.

Group differences in TAS and RFCDC scores were examined using Welch's t-test as well. Pre-service teachers studying democratic citizenship education as a subject reported slightly higher mean scores on both the TAS (M = 3.05, SD = 0.47) and the RFCDC scale (M = 6.44, SD = 1.34) compared to those not enrolled in such subjects (TAS: M = 2.93, SD = 0.44; RFCDC: M = 6.05, SD = 1.25). Although small, both differences were statistically significant ($p < .05$). Additional group differences were also observed with respect to gender. Male participants reported higher levels of tolerance of ambiguity than female participants on both scales (TAS: M = 3.15, SD = 0.44 vs. M = 2.94, SD = 0.46; RFCDC: M = 6.94, SD = 1.15 vs. M = 6.06, SD = 1.30), with both differences reaching statistical significance ($p < .01$). No further notable differences were found for either scale with respect to school type, semester of study, or federal state.

In summary, the findings indicate that pre-service teachers exhibit significantly higher levels of tolerance of ambiguity than the general population in Lietz (2023). However, this difference disappears when comparisons are restricted to shares of the population with higher levels of education. Accordingly, there is no evidence that pre-service teachers demonstrate greater tolerance of ambiguity than other highly educated groups. Furthermore, no correlations were found between tolerance of ambiguity and either the duration of studies or the type of school for which pre-service teachers are preparing. A small but statistically significant difference was identified between pre-service teachers studying democratic citizenship education and those who do not.

However, given that the sample primarily includes participants from two German federal states, these results cannot yet be generalized to pre-service teachers in other regions of Germany or to other countries. Further studies with more diverse samples are therefore necessary to assess the robustness of this finding. Moreover, the underlying mechanisms remain unclear. Possible explanations include self-selection effects among students choosing democratic citizenship education, or a more central role - direct or indirect - of tolerance of ambiguity within these study programs. Finally, the tolerance of ambiguity scale derived from the RFCDC (Council of Europe, 2018a) demonstrated satisfactory reliability and largely sound psychometric

properties, although certain items require critical revision. In combination with the established convergent validity with the TAS scale, these results suggest that the RFCDC descriptors are mostly empirically grounded. This empirical anchoring is particularly relevant for educators and teacher educators who employ the framework in educational practice.

Conclusion: On the Necessity of Fostering Ambiguity Tolerance Among (Future) Teachers

As future teachers, students will later become key multipliers of democratic learning cultures. However, low tolerance for ambiguity could lead them to push for clarity and clear solutions in the classroom, thereby undermining democratic negotiation processes. The study results suggest that tolerance for ambiguity should be anchored as an explicit target in teacher training. Democratic citizenship education needs teachers who not only tolerate ambiguity, but also use it as a didactic resource.

Ambiguity tolerance is not an individual disposition, but a professional attitude that combines cognitive, emotional, and social dimensions. It enables teachers to use difference and contradiction as didactic resources—for example, by encouraging learners to take different perspectives, reflect on uncertainties, and question preliminary judgments. Such an attitude is a basic prerequisite for democratic learning cultures that focus not on quick answers but on joint search movements.

The findings suggest that tolerance of ambiguity has been a neglected future competence to date, even though it is central to dealing with polarization, plurality, and social transformation. Democratic citizenship education must therefore understand it more as a cross-cutting task. Until now, the promotion of ambiguity tolerance has hardly been pursued as an independent learning goal in democratic citizenship education. There is a particular gap in teacher training: if prospective teachers do not learn to deal with ambiguity productively, there is a risk of a return to unambiguous logic in the classroom, which undermines complex social negotiation processes.

Teacher training should therefore not only implicitly teach tolerance of ambiguity, but also explicitly recognize it as a future competence. In all phases of training, it is important to create learning opportunities in which students can experience ambiguity, tolerate it, and make it pedagogically fruitful. Ambiguity tolerance must therefore be included as a core objective in the curricula of teacher training and democracy education. Only in this way can future teachers accompany ambiguous students in a pluralistic, conflict-ridden society without reducing complexity or moralizing diversity.

Teachers who are tolerant of ambiguity promote democratic citizenship education that focuses not on clarity but on judgment, dialogue, and democratic maturity, thereby laying the foundation for a sustainable democracy.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

Generative AI and AI-assisted technologies were used in the writing process of this paper to improve the language and readability.

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A Study on the Learning Motivation and Learning Outcomes of Short-Form Videos Into the Design Cluster of Vocational High School

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Abstract

The purpose of this study was to investigate the integration of short-form videos into practice-oriented courses in the design cluster of a vocational high school and to analyze their relationship with students' learning motivation and learning outcomes. This study adopted an experimental research design, and the participants were 41 students from the design cluster of a vocational high school in Taiwan. The study produced short-form instructional videos for the professional subject Principles of Form, with the thematic unit of Art and Craft Movement, which included three components: "historical background," "design concepts," and "representative figures." The videos were integrated into classroom instruction and implemented prior to the evaluation of learning outcomes, with a questionnaire based on the ARCS motivation model administered to measure students' learning motivation. Data were analyzed using descriptive statistics, paired-sample t-tests, one-way ANOVA, and Pearson correlation analysis. The results indicated that students demonstrated a certain level of learning motivation toward the integration of short-form videos into the course, and their learning outcomes also showed improvement; however, no significant correlation was found between learning motivation and learning outcomes.

Keywords: short-form videos, design cluster of vocational high school, learning motivation, learning outcomes

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Introduction

Background

With the rise of social media, the modes of information dissemination have shifted toward immediacy, visualization, and high-level condensation. Short-form videos, characterized by their brevity, high appeal, and fragmented content, have gradually become one of the primary channels through which the younger generation accesses digital content. The multisensory stimulation and instant feedback offered by such media align with people's preferences for information consumption. Compared with traditional sources such as print materials, textbooks, and online courses, individuals now tend to rely more on short-form videos as a means of information seeking. This tendency is attributed to the intuitive, sequential, and replayable features of short-form videos, which cater to the growing dependence on real-time learning resources (Garcia et al., 2022).

In the design cluster of Taiwan's vocational high schools, most professional courses still rely on traditional face-to-face instruction, chalkboard teaching, and static visual-textual materials. These approaches typically emphasize theoretical exposition and aesthetic analysis, which can easily lead to student fatigue and frustration. Among the core subjects of the design cluster, the Principles of Form course covers knowledge areas such as the history of form, stylistic evolution, and design vocabulary. In particular, the unit on Form and Culture requires students to comprehend the developmental trajectory of form from the Arts and Crafts Movement to Postmodernism. This unit serves as a crucial foundation for cultivating artistic perception and design literacy. However, due to its extensive content and memory demands, it is often difficult to stimulate student motivation. If short-form videos are integrated as supplementary teaching materials, the use of dynamic imagery and narrative styles may reinforce the delivery of key course concepts, thereby enhancing students' learning motivation and learning outcomes for this unit.

Purposes

Based on the aforementioned background and motivation, the specific purposes of this study are as follows:

1. To explore the impact of short-form videos on the learning motivation of students in the design cluster of vocational high schools in Taiwan.
2. To explore the impact of short-form videos on the learning outcomes of students in the design cluster of vocational high schools in Taiwan.
3. To explore the relationship between learning motivation and learning outcomes in the context of short-form video integration for students in the design cluster of vocational high schools in Taiwan.

Literature Review

Current Development of Short-Form Videos

Short-form video, as an emerging form of social media expression, differs from traditional long-form videos in that its duration generally ranges from 5 seconds to 5 minutes. It is characterized by simplified production processes, low production costs, and content that is often refined and diverse, making it well-suited to the fast-paced lifestyles of contemporary users (Yani et al., 2019). These videos are ideal for viewing during fragmented periods such as

commuting or short breaks and have been extensively developed on major digital video platforms. Short-form videos have not only transformed users' media consumption habits but have also driven platforms to develop algorithm-driven personalized recommendation systems aimed at increasing user engagement and interaction. In recent years, with the diversification of platform content and the transformation of user habits, short-form videos, which were originally dominated by entertainment purposes, have gradually been applied in the field of education. Characterized by brevity, compact narratives, and strong visual stimulation, short-form videos help enhance students' attention and content retention, thereby becoming an emerging tool for digital instruction.

The ARCS Motivation Model

Digital learning and self-directed learning have increasingly become prevalent trends in contemporary educational contexts. Within multimedia-rich and fragmented information environments, how to effectively stimulate and sustain learners' motivation has become a critical issue for educators. In 1984, Keller proposed the ARCS Motivation Model, which consists of four key components: Attention, which aims to capture learners' focus and stimulate their interest and curiosity in the content; Relevance, which aligns the learning material with learners' needs and goals, fostering positive learning attitudes; Confidence**,** which helps learners believe in their ability to accomplish tasks and master the keys to success; and Satisfaction, which enhances learners' sense of achievement through positive feedback and rewards (Keller, 1987). Short-form video instruction, with its concise content, fast-paced rhythm, and strong visual appeal, aligns well with the digital habits of today's learners. When combined with the multifaceted ARCS motivation model, it can more effectively capture learners' interest, increase engagement, and enhance learning involvement. By applying this model, educators can observe changes in learners' motivation and learning responses during the short-form video experience, thereby adjusting instructional content and pacing to improve teaching quality and learning outcomes.

Learning Outcomes

Learning outcomes refer to the growth and changes exhibited by learners in terms of knowledge, skills, and attitudes after completing a full learning process. Learning outcomes not only represent learners' performance during the learning process but also encompass their ability to effectively apply acquired knowledge, solve problems, and achieve overall learning satisfaction. According to Wang (2010), learning outcomes are a multi-level, multi-dimensional, and temporal concept. Therefore, assessments of learning outcomes should incorporate cognitive, skill-based, and affective dimensions simultaneously in order to comprehensively and accurately reflect the actual impact of educational interventions, as well as to provide an essential basis for continuous improvement in educational institutions. Caspersen et al. (2017) indicated that the assessment of learning outcomes can serve purposes such as competency validation, learning process tracking, or educational quality evaluation. The selection of appropriate assessment methods—such as grades, self-assessments, or standardized tests—should depend on the specific instructional context. Only through diversified and contextualized assessment mechanisms can educators fully understand students' learning processes and the true effectiveness of educational interventions.

Jeminiwa et al. (2025) found that integrating short-form videos into classroom instruction enhanced learners' learning confidence, knowledge mastery, and understanding of course content. Learners also reported receiving positive feedback and expressed a high willingness

to recommend such instructional approaches, indicating that short-form videos hold significant potential and practical value as a higher education teaching strategy. Similarly, Aslan and Sirojitdinovna (2025) indicated that most learners perceived short-form videos as providing rapid knowledge input, convenient mechanisms for repeated viewing, and an appropriate amount of information, which facilitated memory retention and learning transfer. In addition, the use of real-life contexts and visual aids in short-form videos further supports comprehension and application, outperforming traditional lecture-based instruction in terms of learner engagement and learning outcomes. As an emerging instructional medium, the impact of short-form videos on learning outcomes has increasingly become a focal point of educational research.

In summary, learning outcomes serve as a core indicator for assessing the impact of instruction and the quality of learning. A valid assessment of learning outcomes should encompass cognitive, skill-based, and attitudinal dimensions in order to fully capture the overall learning achievements resulting from educational interventions.

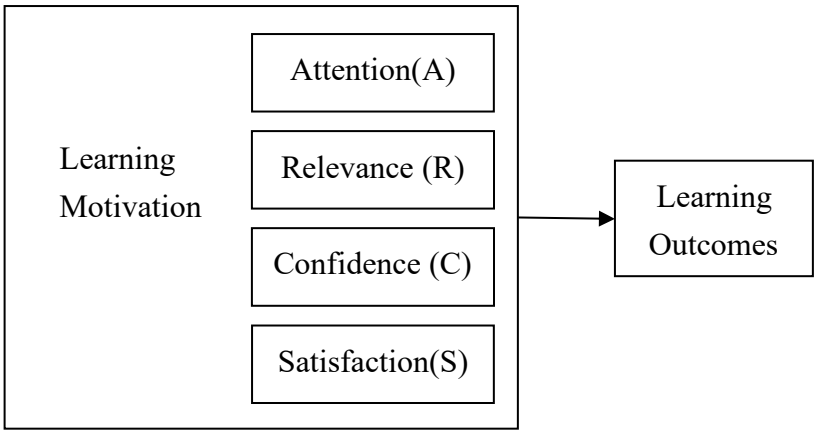
Research Method

The purpose of this study was to investigate the relationship between learning motivation and learning outcomes of students in the design cluster of vocational high schools when short-form videos were integrated into the curriculum. A questionnaire survey was employed to collect data from students at a vocational high school in Taiwan regarding their learning motivation and learning outcomes in design courses incorporating short-form videos, with the aim of examining the correlation between students' learning motivation and learning outcomes following the integration of short-form videos. The specific details regarding the research framework, participants, research instruments, implementation procedures, and data processing and analysis are presented below.

Research Framework

Based on the purpose of this study, the ARCS motivation model was adopted to explore the relationship between learning motivation and learning outcomes in the integration of short-form videos into a professional design course at a vocational high school. The research framework is illustrated in Figure 1.

Figure 1
Research Framework



Research Participants

A vocational high school was selected as the research site for this study. Through convenience sampling, one class from the design cluster was chosen as the research sample, consisting of 41 students. After excluding six students who did not fully participate in the course, the final sample comprised 35 students.

Research Instruments

Short-Form Videos for Principles of Form

The instructional short-form videos used in this study were developed based on the "Arts and Crafts Movement" unit of the Principles of Form course in the design cluster of vocational high schools. The development also referred to the content of the asynchronous online learning materials titled Principles of Form – Evolution of Modern Form Culture (Ke, 2020). The unit topics cover the "Historical Background" (Figure 2), "Design Concepts" (Figure 3), and "Representative Figures" (Figure 4). A total of three instructional short-form videos were produced, with content organized using a thematic narrative design that integrates images, text, and voice guidance to enhance students' learning focus and content comprehension.

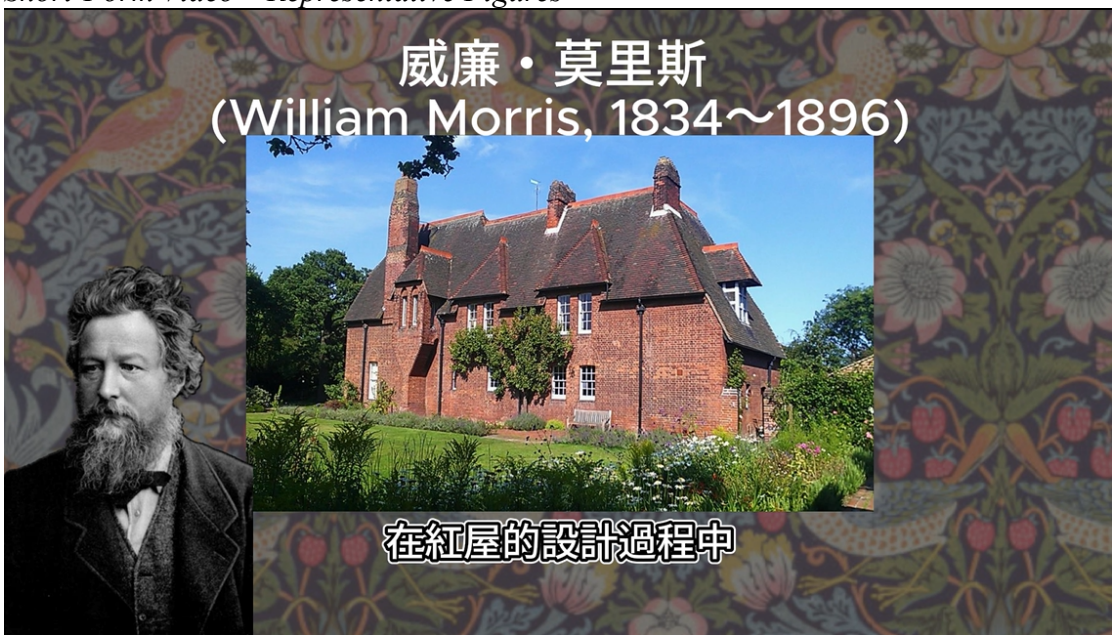
Figure 2
Short-Form Video – Historical Background



Figure 3
Short-Form Video – Design Concepts



Figure 4
Short-Form Video – Representative Figures



Questionnaire on Learning Motivation for Short-Form Video Integration in the Course

This study employed a questionnaire survey method. Based on a review of the literature, the questionnaire was initially developed with reference to Pintrich's (1991) Motivated Strategies for Learning Questionnaire (MSLQ) and Keller's (1987) Instructional Materials Motivation Survey (IMMS). Subsequently, considering factors related to the integration of short-form videos into courses and learning motivation identified in the literature, a preliminary version of the questionnaire on learning motivation for courses incorporating short-form videos was drafted. Expert feedback was then collected to refine and simplify the questionnaire constructs, which led to the development of the finalized questionnaire on learning motivation.

The online learning motivation questionnaire consisted of 20 items, covering four dimensions: gaining attention, relevance, building confidence, and satisfaction. Each dimension contained five items. A five-point Likert scale was adopted, with 1 representing "strongly disagree" and 5 representing "strongly agree." Higher scores indicated a more positive level of students' learning motivation.

Research Implementation

The study was conducted within the design cluster curriculum of a vocational high school during the final review period prior to the end-of-semester examinations. The instructional content focused on the Art and Craft Movement unit of the course Principles of Form. To support students in reviewing key concepts, the researcher produced three thematic short-form instructional videos, each covering one of the following topics: "historical background," "design concepts," and "representative figures." During classroom implementation, the videos were played, followed by teacher-led explanations and worksheet-based learning activities designed to guide students in summarizing and understanding the main ideas. Upon completion of the video-based instruction, a learning motivation questionnaire based on the ARCS motivation model was administered, and statistical analysis was conducted.

Data Analysis

The questionnaire responses were first compiled and processed using Microsoft Excel. The data were then subjected to statistical analysis using JASP (version 0.19.3.0). Cronbach's α coefficient was calculated to assess the internal consistency and reliability of the questionnaire. Descriptive statistics were used to present the overall means and standard deviations of the questionnaire items, along with a general summary of the participants' demographic profiles. Subsequently, students' average learning motivation scores were ranked from highest to lowest. Based on the interquartile range (IQR), the students were categorized into three groups: high, medium, and low levels of learning motivation. The corresponding learning outcome scores were then matched to each student. Paired-sample t-test, Pearson correlation analysis and one-way ANOVA, were conducted to examine differences among the three groups and to explore the relationship between students' learning motivation and learning outcomes in the context of short-form video–integrated instruction within the vocational high school design cluster.

After the questionnaires were collected, a reliability analysis was conducted. As shown in Table 1, the quantitative results indicated a Cronbach's α of .929, exceeding the threshold of 0.7, thereby demonstrating that the questionnaire possessed an acceptable level of reliability. Furthermore, to confirm the necessity of each item, the Cronbach's α values after item deletion ranged from .921 to .931, none of which were significantly higher than the overall reliability coefficient (.929). This result suggests that all items were well integrated with the overall scale. Finally, the questionnaire was also reviewed by academic experts to ensure its validity.

Table 1
Results of the Unidimensional Reliability Analysis of the Learning Motivation Questionnaire

Cronbach	estimate	Std.Error	95% confidence interval	
			Lower	Upper
Cronbach's α	0.929	0.012	0.934	0.979

Results and Discussion

This study aimed to examine the relationship between learning motivation and learning outcomes in short-form video–integrated courses within vocational high school design programs. A questionnaire survey method was adopted to collect data from students in a vocational high school regarding their learning motivation and outcomes in such courses. A total of 41 questionnaires were returned. After excluding six students who did not fully participate in the course, 35 valid responses remained. After confirming the reliability and validity of the instrument through reliability analysis, both descriptive and inferential statistical analyses were conducted. As shown in Table 2, the results showed that the overall mean score of learning motivation across the 35 valid questionnaires was 3.689, which fell within the upper-mid range, indicating that students demonstrated a certain level of learning motivation toward short-form video–integrated courses.

Table 2
Descriptive Statistical Analysis of Overall Student Learning Motivation

Group	N	Mean	SD
All Students	35	3.689	0.422

The paired-sample t-test was conducted to examine whether there were significant differences in learning outcomes before and after integrating short-form videos into the course instruction. The mean score of learning outcomes before the integration was 72.086 (SD = 11.296), and after the integration, the mean score increased to 75.971 (SD = 14.486). The results of the paired-sample t-test revealed no statistically significant difference, $t = -1.542$, $p = .132 > .05$. As shown in Table 3, although the statistical result was not significant, the mean score indicates an improvement in learning outcomes.

Table 3
Paired Samples t-Test Analysis of Learning Outcomes Before and After Integration of Short-Form Videos Into the Curriculum

Group	N	Learning Outcomes Mean	SD	df	T-value	P-value
Before integration of short-form videos	35	72.086	11.296	34	-1.542	0.132
After integration of short-form videos	35	75.971	14.486			

Note. *p < .05, **p < .01, ***p < .001

The Pearson correlation analysis between students' learning motivation and learning outcomes reveals the correlation coefficient between the two variables. As shown in Table 4, there is no significant correlation between students' learning motivation and their learning outcomes.

Table 4
Pearson Correlation Analysis Results Between Learning Motivation and Learning Outcomes

		Learning Motivation	Learning Outcomes	Mean	SD
Learning Motivation	Pearsons'r	-	-0.045	3.689	0.442
	p-value	-	0.799		
Learning Outcomes	Pearsons'r	-0.045	-	75.356	14.488
	p-value	0.799	-		

Note. *p < .05, **p < .01, ***p < .001

Using a one-way analysis of variance (ANOVA), the statistical results shown in Table 5 indicate that the average learning outcome score for the low-motivation group was 75.778 (SD = 10.929), for the medium-motivation group was 78.069 (SD = 13.548), and for the high-motivation group was 72.222 (SD = 19.505). Overall, the average learning outcome score for all students was 75.071 (SD = 14.488). The results of the one-way ANOVA revealed no significant differences in learning outcomes among students with different levels of learning motivation after short-form videos integration (F = 0.463, p = .633 > .05). This indicates that, in this study, different levels of learning motivation among students in the vocational high school design cluster did not affect their learning outcomes.

Table 5
One-Way ANOVA Analysis of Learning Outcomes Based on Different Levels of Learning Motivation

Group	N	Learning Outcomes Mean	SD	df	F	P
Low learning motivation	9	75.778	10.929	32	0.463	0.633
Intermediate learning motivation	17	78.069	13.548			
Upper-intermediate learning motivation	9	72.222	19.505			

Note. *p < .05, **p < .01, ***p < .001

Further analysis of learning outcomes among students with different levels of learning motivation revealed that students in the high-motivation group demonstrated lower learning outcomes compared with those in the medium- and low-motivation groups. This finding does not align with the commonly held view in prior research that "higher learning motivation or acceptance typically leads to better learning outcomes" (Zhang et al., 2024). This result may reflect certain limitations in the application of digital instructional materials. Students with high learning motivation may tend to engage in active exploration and deep learning, and the concise, compressed nature of short-form video content may not satisfy their need for comprehensive and in-depth knowledge, potentially affecting their learning performance. In contrast, students with moderate levels of learning motivation may benefit more from the key information and visual stimulation provided by short-form videos, thus improving their learning outcomes.

These findings also suggest that the relationship between learning motivation and learning outcomes is not strictly linear, but is influenced by the interplay of instructional media, course design, and individual learner differences. While short-form videos have the potential to capture attention and stimulate learning interest, their use should be carefully adapted based on course objectives, learner characteristics, and disciplinary requirements to maximize effectiveness. Future research may further investigate the effects of short-form videos on learners' short-term memory and long-term learning outcomes, and explore their potential when integrated with blended instructional designs and other teaching strategies.

Conclusion

This study aimed to investigate the effects of integrating short-form videos into vocational high school design courses on students' learning motivation and learning outcomes, and further examine the relationship between the two. The results are presented as follows:

1. Students generally held a positive attitude toward the integration of short-form videos into the course. The overall level of learning motivation was in the upper-mid range, indicating that short-form videos have the potential to enhance learning interest and promote classroom engagement.
2. Students showed a tendency toward higher overall learning scores after the integration of short-form videos into the course, suggesting that while there was some improvement, it was not sufficient to reach a statistically significant effect.
3. In this study, no significant relationship was found between learning motivation and learning outcomes among students in the Design Cluster of Vocational High School following the integration of short-form videos into the course.

Overall, this study offers preliminary validation for the use of short-form videos in teaching within the Design Cluster of Vocational High Schools. Short-form videos appear to be both feasible and potentially effective in enhancing students' learning motivation. However, achieving substantial improvements in learning outcomes will require further refinement of instructional strategies and media application to ensure meaningful enhancement of student s' outcomes.

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Generative AI in Vocational High School Design Cluster Practice Courses: Influences on Motivation and Effectiveness

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Abstract

In recent years, artificial intelligence (AI) technologies have rapidly advanced and found extensive applications in image design, text generation, and interactive media, increasingly being integrated into educational contexts. Among these technologies, generative AI characterized by real-time interactivity, multimodal content generation, and text-to-image conversion capabilities has demonstrated significant potential as an instructional tool in vocational high school design courses. However, empirical research on the integration of generative AI in vocational design education remains limited, and the effects on students' learning motivation and academic performance have yet to be thoroughly examined. This study investigates the impact of integrating generative AI on students' learning motivation and effectiveness in a computer graphics course at a vocational high school in Taiwan. An experimental design was employed, utilizing a cyclical learning model consisting of four stages: observation, summarization, questioning, and application. The course was conducted over two weeks, with three 50-minute sessions each week. Following the intervention, students completed an assessment of learning effectiveness and a questionnaire on learning motivation. Analysis using paired-sample t-tests, one-way ANOVA, and Pearson correlation revealed that the integration of generative AI significantly enhanced students' learning effectiveness. Although the gains in learning motivation were modest, the intervention resulted in tangible improvements in student learning effectiveness.

Keywords: generative AI, vocational high school, learning effectiveness, learning motivation

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Introduction

With the increasing maturity of AI technology, generative AI has emerged as a major focus in the education sector. Generative AI generates textual, graphical, and multimedia content using deep learning models and is characterized by real-time interaction and high levels of personalization. It is considered a significant opportunity for educational innovation (Wang, 2023). Both domestic and international studies have shown that generative AI tools, such as ChatGPT, can significantly enhance the efficiency of lesson preparation and provide students with personalized learning experiences. These tools effectively boost student engagement and motivation, thereby improving learning effectiveness (Hsu, 2024).

However, despite the growing prevalence of AI technology, systematic evaluations and empirical research on its effectiveness within the curriculum are still relatively limited. Most studies in AI education have concentrated on theoretical discussions or isolated case studies. There is a notable lack of large-scale, longitudinal empirical research examining the specific effects of AI technology on learning motivation and academic achievement in real educational settings (Holmes & Tuomi, 2022). Consequently, this study aims to investigate the impact of integrating generative AI into curriculum instruction on students' learning motivation and academic effectiveness.

Based on the background and motivation outlined above, the specific objectives of this study are as follows:

A. To examine the impact of integrating generative AI on the learning motivation of design students in technical high school professional practice courses.
B. To evaluate the learning effectiveness of integrating generative AI into these courses.
C. To investigate the relationship between learning motivation and learning effectiveness within the context of professional practice courses that integrate generative AI.

Literature Review

Current Development of Generative AI

The rapid advancement and widespread adoption of generative AI technology have positioned it as a significant driver of educational innovation worldwide. Generative AI (e.g., ChatGPT, DALL-E, etc.), which utilizes deep learning and big data, can automatically generate language, image, audio, and video content. It is increasingly being applied across various domains, including teaching, assessment, curriculum design, and personalized learning. These applications not only enhance the efficiency and flexibility of instruction but also facilitate the transformation of educational models (Xu, Taiping, 2024). Baidoo-Anu and Owusu Ansah (2023) have noted that the core value of generative AI lies in promoting individualized and adaptive teaching, allowing students to learn at their own pace and according to their specific needs. Meanwhile, teachers can leverage AI to assist with lesson preparation, assessment, and the development of diverse evaluation mechanisms, thereby improving teaching quality and student motivation. Sun and Zhou (2024) reported that the application of generative artificial intelligence can effectively improve the learning effectiveness of college students, providing empirical support for its role in higher education.

In addition, the use of generative AI tools in technical high schools and K-12 education is becoming increasingly prevalent. Research indicates that project-based learning, human-computer collaboration, and game-based curriculum design can significantly enhance students'

cognitive, affective, and behavioral learning effectiveness (Yim & Su, 2024). Globally, many countries have prioritized AI literacy in educational development, actively incorporating AI into curricula at various educational levels and emphasizing the cultivation of cross-disciplinary competencies, including computational thinking, creativity, and digital citizenship (Ng et al., 2023).

ARCS Motivation Model

To address the prevalent issue of insufficient student motivation in classroom teaching, Keller (1987) proposed the ARCS Learning Motivation Model. This model emphasizes the systematic design of motivational strategies from the learner's perspective, encompassing four key components: Attention, Relevance, Confidence, and Satisfaction. The ARCS model is both logical and practice-oriented, aiding teachers in identifying and addressing factors that influence learning motivation and translating these insights into effective instructional strategies (Keller, 2010).

Julianingsih et al. (2023) demonstrated that teaching materials designed using the ARCS model effectively enhance students' motivation and academic performance in practical courses, particularly in technical high schools and application-oriented subjects. Contextualized questioning and exemplary teaching methods can significantly engage students' attention and interest. Furthermore, Fang et al. (2024) summarized that the ARCS model has emerged as one of the core theories in digital learning and cross-disciplinary educational research. It is widely employed for instructional design, the development of theoretical frameworks, and as a tool for measuring motivation in empirical studies across fields such as medicine, technology, and education.

Learning Effectiveness

Learning effectiveness refer to the comprehensive growth and performance of students in areas such as subject knowledge, cognitive development, psychosocial adaptation, attitudes, and values. According to Wang (2010), this concept is multi-level and integrated, encompassing both immediate knowledge acquisition and behavioral changes in the classroom (direct effectiveness) as well as long-term effects on career development and personal growth (indirect effectiveness). Learning effectiveness span cognitive, affective, and psychomotor domains and should be assessed at the institutional, curriculum, and classroom levels to fully evaluate the achievement of instructional objectives.

Internationally, the European Qualifications Framework (EQF) defines learning effectiveness in terms of knowledge, skills, and competencies, offering a standardized and internationally comparable system for assessing educational quality (European Commission, 2024). The OECD Learning Compass 2030 further underscores the significance of learning effectiveness that encompass student agency, reflective abilities, and real-world performance. It advocates for the use of diverse forms of evidence, such as portfolios and practical assessments, to evaluate comprehensive student development (OECD, 2023).

Recent research highlights the potential benefits of integrating generative AI into teaching and learning. Wei et al. (2025) found that generative AI tools, such as ChatGPT, facilitate iterative development and reflection during digital storytelling, resulting in significant improvements in the quality and creativity of students' final products. However, UNESCO (2023) warns that

overreliance on AI may hinder the development of students' intellectual skills, emphasizing the need for a balance between AI-assisted learning and the cultivation of independent thinking.

In summary, learning effectiveness can be defined as the comprehensive demonstration of students' mastery of knowledge, application of skills, and transformation of attitudes through effective learning experiences. This mastery is evidenced by progress in subject assessments, creative practices, and reflective learning.

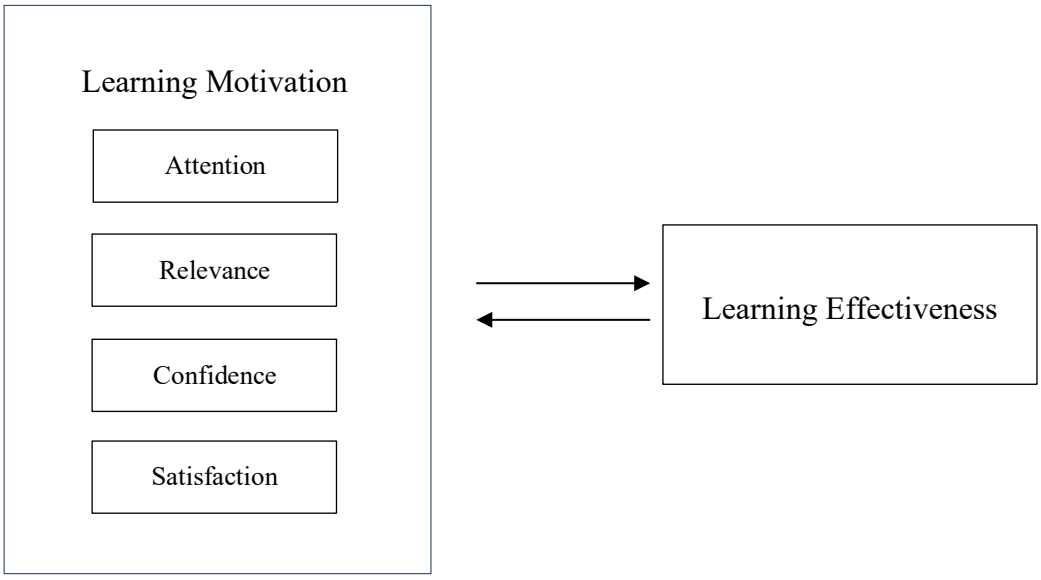
Research Design

This study aims to examine the correlation between students' learning motivation and learning effectiveness in the context of AI-integrated professional practice courses at technical high schools. Data was collected through a questionnaire survey. The following sections outline the research framework, target population, research instruments, and procedures for data processing and analysis.

Research Structure

According to the purpose of this study, the ARCS motivation model was adopted to investigate the relationship between motivation and the effectiveness of AI integration in professional practice courses for design students in technical high schools. The research framework is illustrated in Figure 1.

Figure 1
Research Structure



Research Subjects

This study employed convenience sampling to recruit second-year students from a technical high school in Tainan. The intervention involved the integration of generative AI into a computer graphic design applications course.

Research Tools

Learning Motivation Questionnaire

This study employed a questionnaire survey. Drawing on a synthesis of relevant literature, the Instructional Materials Motivation Survey (IMMS) developed by Keller (1987) served as the basis for instrument development. Additional factors identified in the literature concerning the integration of AI into curricula and students' learning motivation were incorporated into the design of the questionnaire. The instrument comprised 20 items distributed across four dimensions—Attention, Relevance, Confidence, and Satisfaction—with five items per dimension. Responses were rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree), with higher scores reflecting greater learning motivation. The Cronbach's alpha coefficient was 0.974, indicating strong internal consistency.

Learning Effectiveness Evaluation

Learning effectiveness were assessed using a pre- and post-test design. The performance of students was compared before and after the integration of generative AI teaching materials. The evaluation employed a standardized scale ranging from 0 to 100, developed by the instructional staff.

Main Teaching Procedures

Based on the instructional framework designed by the instructor for integrating generative AI into teaching, the course adopts "The Application of AI in Design: Anti-Smoking Poster Design for a Friendly Campus" as its central theme. The curriculum incorporates generative artificial intelligence technologies to support students in the vocational high school design program in carrying out creative design practices. The total instructional time is three 50-minute sessions per week, implemented over a two-week period. The instructional framework employs a "Observation–Summarization–Questioning–Application" cyclical learning model, and through five sequential instructional units, systematically cultivates students' AI literacy and design competencies.

Data Analysis

In this study, the results of the questionnaires were compiled and processed using Excel software and statistically analyzed with JASP version 0.19.3. First, Cronbach's alpha coefficient was employed to assess the reliability of the questionnaire, while descriptive statistics were employed to present the mean and standard deviation for each item, as well as to summarize the demographic background of the sample. Second, the mean scores of students' learning motivation were ranked from highest to lowest and categorized based on their learning effectiveness scores. The total motivation scores for each group were then calculated. Differences in motivation scores between groups were analyzed using independent samples t-tests to determine statistical significance at the $p < .05$ level.

Additionally, a one-way ANOVA was conducted to examine the differences in learning motivation among various groups based on their learning effectiveness. This analysis aimed to understand the relationship between learning motivation and learning effectiveness for technical high school students enrolled in a generative AI-integrated professional practice course.

Research Results

This study analyzed data from both learning assessments and questionnaire surveys to explore the effects of integrating generative AI on learning motivation and effectiveness among design students in technical high schools. Additionally, it examined the motivational performance of students with varying levels of academic achievement.

Motivation of Students Integrating Generative AI Into the Curriculum

The overall mean score of students' learning motivation was 3.17, with all item means exceeding 3, indicating a moderately high level of motivation toward the integration of generative AI into the curriculum. Welch's *t*-test was further conducted to analyze gender differences across the four dimensions of the ARCS model. As presented in Table 2, male students scored significantly higher than female students in the Relevance, Confidence, and Satisfaction dimensions, suggesting that males outperformed females in these areas. Although the difference in the Attention dimension did not reach statistical significance, male students nonetheless achieved a higher mean score than their female counterparts.

Table 1
Summary of t-Tests on Learning Motivation of Students of Different Genders

Dimensions	Group	n	M	SD	t	p
A (Attention)	males	9	18.333	4.873	-1.363	0.198
	females	38	15.868	4.894		
R (Relevance)	males	9	19.222	3.420	-2.745**	0.013
	females	38	15.316	5.251		
C (Confidence)	males	9	20.111	2.472	-4.401***	< .001
	females	38	15.211	4.616		
S (Satisfaction)	males	9	19.444	2.297	-3.582***	< .001
	females	38	15.421	5.065		

Note. *p < .05, **p < . 01, ***p < . 001

Student Learning Effectiveness of Generative AI Integration in the Curriculum

First, this study employed a sample *t*-test to examine differences in students' learning effectiveness before and after the integration of generative AI into the curriculum. As shown in Table 3, the post-test mean (M = 81.57, SD = 10.77) was significantly higher than the pre-test mean (M = 68.21, SD = 14.61). The results indicated that the difference between the two was statistically significant ($p < .05$).

Therefore, for students in the technical high school design cohort, the integration of generative AI into instruction produced a significant improvement in learning effectiveness. This finding is consistent with the results of Sun and Zhou (2024), confirming that the application of generative AI in instructional design exerts a positive influence on learning performance.

Table 2
Summary Table of Effectiveness Scores Before and After AI Integration

	M	SD	t	df	p	95%CI	
						LL	UL
Pre-AI	68.29	13.96	-7.29***	45	< .001	-1.418	-0.701
Post-AI	81.14	11.57					

Note. *p < .05, **p < .01, ***p < .001

Comparison of Students' Motivation for Generative AI-Integrated Courses by Learning Effectiveness

In this study, we aimed to further understand whether differences in learning motivation exist among students with varying learning effectiveness. The students' learning assessment scores (posttest scores) were categorized into three groups using the quartile method: high, medium, and low. A one-way analysis of variance (ANOVA) was conducted to examine the differences in the four dimensions of learning motivation patterns among students with different learning effectiveness based on the ARCS model. The ANOVA results indicated that there were no statistically significant differences in the four dimensions of the ARCS learning motivation model among students with varying learning effectiveness. Specifically, the results for each construct were as follows: Attention construct $F(2, 44) = 0.438$, $p > .05$; Relatedness construct $F(2, 44) = 0.007$, $p > .05$; Confidence construct $F(2, 44) = 0.167$, $p > .05$; Satisfaction construct $F(2, 44) = 0.027$, $p > .05$; Learning Motivation construct $F(2, 44) = 0.027$, $p > .05$; and overall motivation $F(2, 44) = 0.011$, $p > .05$. Additionally, Pearson's cumulative correlation analyses presented in Table 7 revealed a weak negative correlation between motivation and learning effectiveness, which did not reach a statistically significant level ($r = -.198$, $p = .181$).

Taken together, the findings indicate that students with different levels of learning achievement did not exhibit significant differences across the four dimensions of the ARCS learning motivation model. Nevertheless, the overall integration of generative AI into the curriculum enhanced students' learning motivation. Although the magnitude of improvement was modest, it still demonstrated a positive instructional effect.

Table 3
Summary of the Meaning and Standard Deviation of Students' Learning Motivation in Different Learning Effectiveness

Dimensions	Performance Group	n	M	SD
Attention	Low	11	17.00	5.58
	Mid	30	16.43	4.40
	High	6	14.66	6.71
Relevance	Low	11	16.09	6.22
	Mid	30	16.10	4.66
	High	6	15.83	6.43

Confidence	Low	11	15.81	5.63
	Mid	30	16.06	4.37
	High	6	17.45	5.11
Satisfaction	Low	11	16.45	6.20
	Mid	30	16.06	4.60
	High	6	16.33	4.67
ARCS	Low	11	65.36	6.89
	Mid	30	64.66	3.11
	High	6	64.00	8.87

Table 4
ANCOVA of Motivation and Effectiveness

Dimensions	Source	SS	df	MS	F	p	Scheffé
Attention	Between	21.853	2	10.927	0.438	0.648	(1) > (2)
	Within	1098.700	44	24.970			(2) > (3)
	Total	1120.553	46				
Relevance	Between	0.366	2	0.183	0.007	0.993	(2) > (1)
	Within	1224.442	44	27.828			(1) > (3)
	Total	1224.808	46				
Confidence	Between	7.621	2	3.811	0.167	0.847	(3) > (2)
	Within	1004.336	44	22.826			(2) > (1)
	Total	1011.957	46				
Satisfaction	Between	1.349	2	0.675	0.027	0.974	(1) >(3)
	Within	1107.927	44	25.180			(3) > (2)
	Total	1109.276	46				
ARCS	Between	7.724	2	3.862	0.011	0.989	(1) > (2)
	Within	16037.212	44	364.482			(2) > (3)
	Total	16044.936	46				

Table 5
Summary Table of the Correlation Between the Cumulative Difference Between Learning Effectiveness and Learning Motivation

Variable		Learning Motivation	Learning Effectiveness
ARCS	Pearson's r	-	
	p-value	-	
Learning Effectiveness	Pearson's r	-0.198	-
	p-value	0.181	-

Conclusion and Recommendations

Conclusion

This study examined the relationship between learning motivation and learning effectiveness among design students in Taiwanese technical high schools who employed generative AI in their professional practice courses. The key findings are as follows:

1. Integrating generative AI into the curriculum has positively influenced students' motivation to learn, demonstrating a strong willingness to engage with this instructional method. Although no statistically significant differences were observed across the ARCS dimensions, students with lower performance effectiveness displayed relatively higher motivation compared to their high-achieving peers.
2. Generative AI integration has significantly improved student performance, as evidenced by notable increases in assessment scores. Students effectively employed generative AI tools and professional design software to enhance both the creativity and practicality of their work.
3. Following the integration of generative AI into technical high school design courses, no significant correlation was observed between students' learning motivation and their academic effectiveness. This finding may be attributed to the strong pre-existing competencies of high-achieving students, which led to a decreased reliance on AI assistance. In contrast, lower-achieving students benefited more noticeably from AI support, resulting in substantial gains in both motivation and performance. Therefore, while the integration of generative AI into design curricula shows promise, there is still room for improvement. It is recommended that future instructional practices align more closely with real-world applications to enhance both students' motivation and academic achievement simultaneously.

Recommendations

This study focused exclusively on learning motivation and the effectiveness resulting from the integration of generative AI in design practice courses. Future research should consider incorporating “learning satisfaction” as a third variable and analyze the interactions among motivation, effectiveness, and satisfaction. This approach will help determine whether AI integration can holistically enhance students’ sense of belonging and sustained engagement with the curriculum.

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Augmented Reality Manga (ARM): The Use of the ADDIE Model for Japanese Reading Enhancement in People's Republic of China

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Abstract

The research question in this study is 1) What is the efficacy of the augmented reality that the researcher is developing in enhancing the Japanese skills of students? 2) Just how effective will the comparison of the student's learning achievement scores be? The research objectives are to 1) evaluate the learning achievements of students between pre-test and post-test scores using an augmented reality comic book and 2) determine the effectiveness of the augmented reality manga after its use. The study population consisted of 23 students in the College of Science and Technology at Ningbo University during the second semester of the academic year 2025. The data was analyzed and interpreted using the following statistics: dependent t-test and effectiveness index. 1) The anticipated advantages include the potential for augmented reality to enhance the Japanese language skills of students. 2) Augmented reality enhances students' self-assurance and facilitates the completion of classroom assignments more efficiently. 1) This study may serve as supplementary evidence for individuals who wish to conduct action research concerning the utilization of digital technology. According to the research findings, the paired t-test comparing the pre-test and post-test results demonstrated statistically significant differences at the 0.05 level ($t = 6.02$, $p = 0.00$). The results also indicated that the effectiveness index was 0.597, which indicates that the students experienced a 59.7% increase in cognitive score improvement following the test.

Keywords: augmented reality, manga, ARM, language education, Japanese learning achievement improvement

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Introduction

In recent years, digital technology has become an essential component in foreign language education, contributing to enhanced learning support and pedagogical innovation. In particular, Augmented Reality (AR) has attracted increasing attention due to its ability to overlay digital information onto the real world, creating interactive and immersive learning environments. Previous studies have indicated that AR can increase learner motivation, improve comprehension, and support contextualized learning. However, research focusing on the application of AR in Japanese language education, especially in the context of Chinese universities, remains limited.

At Chinese universities, Japanese language instruction has traditionally emphasized grammar explanation and textbook-based reading activities. While this approach is effective for developing foundational knowledge, it often fails to sufficiently engage learners or support the development of practical reading comprehension skills, particularly when dealing with authentic materials such as manga. Manga contains colloquial expressions, cultural references, and contextual cues that are difficult for learners to interpret without adequate support.

To address these challenges, this study aims to develop an Augmented Reality Manga (ARM) learning material and examine its effectiveness in improving Japanese manga reading comprehension among second-year university students in China. Using the ADDIE instructional design model, AR-based short video clips—such as cooking videos, vocabulary explanations, and kanji reading support—were integrated into selected scenes from the manga Shinya Shokudō. This research investigates whether ARM can enhance learners' reading comprehension and motivation compared to conventional learning methods.

Literature Review

Recent advances in educational technology have significantly influenced foreign language education, particularly through the integration of digital and immersive learning environments. Among these technologies, Augmented Reality (AR) has attracted increasing scholarly attention due to its ability to overlay digital information onto real-world contexts, thereby enhancing learner engagement and comprehension (Azuma, 1997). Previous studies have demonstrated that AR-based learning environments can promote motivation, contextual understanding, and learner autonomy by combining visual, auditory, and interactive elements (Nakazawa, 2021).

In language education, AR has been applied to vocabulary learning, pronunciation training, and cultural instruction. Gayevska (2022) reported that AR-assisted Japanese language learning increased learners' interest and supported both linguistic and cultural understanding. Similarly, Miyosawa (2012) compared AR-based learning materials with traditional printed resources and found that although test scores did not differ significantly, AR materials stimulated higher cognitive engagement and reduced learning-related stress.

Manga has also been widely recognized as an effective instructional medium in Japanese language education. Manga provides authentic language input, colloquial expressions, and culturally embedded contexts that are difficult to convey through textbooks alone. However, learners often struggle with manga reading due to informal expressions, onomatopoeia, and cultural references. These challenges highlight the need for instructional support that maintains authenticity while facilitating comprehension.

To systematically design such instructional materials, the ADDIE model—consisting of Analysis, Design, Development, Implementation, and Evaluation—has been widely adopted in educational innovation research. Integrating AR, manga, and the ADDIE model provides a strong theoretical foundation for developing innovative learning materials that address current challenges in Japanese language education.

Methodology

This study employed a one-group pre-test and post-test experimental design to examine the effectiveness of an Augmented Reality Manga (ARM) learning material. The participants were 23 second-year undergraduate students enrolled in the College of Science and Technology at Ningbo University during the second semester of the 2024 academic year. They had completed basic Japanese grammar courses and demonstrated an intermediate reading level equivalent to JLPT N3–N2.

The instructional material was developed following the ADDIE model. During the Analysis phase, common difficulties in manga reading—such as colloquial expressions, kanji readings, and culturally specific vocabulary—were identified through classroom observation and instructor feedback. In the Design and Development phases, selected scenes from the manga Shinya Shokudo were chosen based on their conversational density and cultural relevance. The ARM content was developed using Unity and included short AR video clips that provided cooking demonstrations, vocabulary explanations, kanji reading guidance, and cultural notes.

During the Implementation phase, students used their own smartphones to scan the manga pages and access AR content while reading independently. Data collection consisted of a reading comprehension pre-test and post-test, as well as qualitative student comments collected through questionnaires. The Evaluation phase focused on comparing test scores and analyzing learner feedback to assess learning outcomes and user experience.

Results

The quantitative analysis revealed a clear improvement in students' reading comprehension performance after using the ARM learning material. The mean pre-test score was 4.83, while the mean post-test score increased to 7.91, indicating a statistically significant improvement. The Effectiveness Index (EI) was calculated as 0.597, demonstrating that learners achieved approximately 59.7 percent of the expected learning progress.

Table 1
The Effectiveness After Using an ARM for 23 Second-Year Students

c	N	Mean	SD	Min	Max
Pre-Test	**23**	**4.83**	**1.95**	**2**	**8**
Post-Test	**23**	**7.91**	**1.50**	**4**	**10**

Table 2
Pre-post Test Scores

Pre-Post Test Scores	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Pre-Test Score	5	2	4	8	2	5	4	6	4	3	7	3	8
2 Post-Test Score	8	8	10	10	7	7	7	8	7	6	9	4	8

Pre-Post Test Scores	14	15	16	17	18	19	20	21	22	23	Total	SD
1 Pre-Test Score	5	4	8	7	5	5	4	7	2	3	111	1.95
2 Post-Test Score	9	8	10	7	6	8	9	9	10	7	182	1.50

Qualitative data supported these findings. Many students reported that the AR video support helped them better understand characters' emotions, situational context, and informal expressions. Vocabulary explanations and kanji reading assistance were frequently mentioned as particularly useful, allowing learners to read more independently without relying on teacher intervention.

However, some negative feedback was also identified. Several students reported physical fatigue from holding smartphones for extended periods, while others experienced technical issues such as unstable video playback or limited compatibility across different smartphone models. These factors occasionally affected learners' concentration during the reading activity.

Discussion

The findings of this study are consistent with previous research indicating that AR can enhance motivation and contextual understanding in language learning. Similar to the results reported by Gayevska (2022) and Nakazawa (2021), the ARM learning material increased learner engagement by providing multimodal and context-sensitive support.

Compared with traditional manga reading instruction, ARM reduced cognitive load by offering immediate explanations aligned with the reading context, which supports Krashen's (1985) concept of comprehensible input. The use of short AR video clips, rather than lengthy explanations, also helped prevent information overload and maintained learners' focus on reading.

Nevertheless, technical and physical limitations must be considered. Device compatibility issues indicate the need for cross-platform optimization, while physical fatigue suggests that AR-based activities should be used selectively rather than continuously. These findings suggest that ARM is most effective as a supplementary learning tool within a structured instructional framework.

Conclusion

This study developed an Augmented Reality Manga (ARM) learning material and examined its effectiveness in improving Japanese manga reading comprehension among Chinese

university students. The results demonstrate that ARM can enhance learners' reading comprehension and motivation by providing contextualized visual and auditory support.

From a pedagogical perspective, ARM offers practical implications for Japanese language educators. It can be used as an effective supplementary tool for teaching colloquial expressions, cultural content, and authentic reading materials. Teachers are encouraged to conduct device compatibility checks in advance, provide clear instructions on AR usage, and integrate ARM activities strategically to minimize cognitive and physical fatigue.

Several limitations should be acknowledged. The sample size was relatively small, and the study focused on a single manga title. In addition, technical issues related to smartphone compatibility were observed. Future research should involve larger participant groups, explore a wider range of manga genres, and improve technical stability across devices.

In conclusion, this research highlights the potential of ARM as an innovative and learner-centered approach in Japanese language education. With further refinement and broader implementation, ARM can contribute to more engaging, effective, and authentic reading instruction in higher education contexts.

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Investigating Gen-AI Integration in Assessment Redesign Among Higher Education Lecturers

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Abstract

Across the world, higher education lecturers face growing pressure to redesign assessments due to students' widespread use of Generative AI (Gen AI) tools like ChatGPT, Copilot, and Gemini. Despite institutional restrictions, students still use Gen AI tools, raising concerns about the authenticity, fairness, and relevance of traditional assessments. Conventional models often fail to foster the higher-order thinking, creativity, and authentic skills needed in AI-integrated learning. This qualitative, exploratory study investigates how lecturers embed Gen AI in assessment redesign. Using Technological Pedagogical Content Knowledge (TPACK) framework, the analysis considers how lecturers balance pedagogy, technology and content when configuring or discouraging AI support. Biggs' Constructive Alignment model assesses task coherence with learning outcomes, while Furze's AI Assessment Scale classifies AI transparency, from no AI to full AI, defined as explicit disclosure and embedding of AI assistance. Semi structured interviews with 20 STEAM lecturers at Malaysian private universities were purposively sampled and thematically analysed in NVivo, identifying four key themes. Findings show that Gen AI scaffolds learner agency, personalises feedback and stimulates higher order cognition, yet lecturers wrestle with tensions between empowerment and academic integrity. Adoption is hindered by inconsistent policies, limited professional development and digital equity challenges. Discipline specific variations reveal emerging best practices: for example, re authoring a reflective essay prompt into an AI assisted critique task demonstrates how theory guided redesign, AI classification and outcome alignment. The study recommends revising curricula, training faculty, clarifying AI guidelines, and supporting students to ensure pedagogically sound and ethical assessment in the AI era.

Keywords: generative AI, assessment redesign, TPACK, Constructive Alignment, Furze's AI Assessment Scale

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Introduction

The rapid emergence of Generative Artificial Intelligence (Gen-AI) tools such as ChatGPT, Microsoft Copilot, and Google Gemini has fundamentally disrupted higher education assessment. Recent surveys indicate that between 86% and 92% of undergraduates now use Gen-AI in their studies, often irrespective of institutional restrictions (Digital Education Council, 2024; Freeman, 2025). As a result, assessment practices designed for a pre-AI era have become increasingly ineffective in measuring authentic student learning, posing significant challenges for educators worldwide (Rudolph et al., 2023; Wiley, 2025).

This disruption presents a multifaceted problem. Traditional assessments, including take-home essays, research papers, and standardised tests, are highly vulnerable to AI-assisted completion, making it difficult to distinguish genuine student understanding from AI-generated output (Sullivan et al., 2023). At the same time, institutional responses remain inconsistent, ranging from prohibition to cautious acceptance, often leaving lecturers uncertain, stressed, and inadequately supported (El Khoury, 2025; Michel-Villarreal et al., 2023). Compounding this issue, students frequently report confusion about what constitutes permissible AI use and academic misconduct due to unclear or inconsistent guidance (Harrad et al., 2024).

The unreliability of AI detection tools has further intensified this challenge. Evidence shows that detection systems produce false positives and disproportionately disadvantage non-native English speakers, rendering punitive or technology-driven approaches untenable (UNESCO, 2025). This has prompted a fundamental shift in assessment discourse from enforcement toward pedagogy, captured by Wiley's (2025, p. 865) question: "What evidence of learning would I now find persuasive?" Consequently, educators are increasingly rethinking assessment design to prioritise meaningful learning over prohibition.

Despite rapid growth in Gen-AI-related educational research, significant gaps remain. Existing studies focus largely on institutional policies, student usage patterns, or conceptual frameworks, with limited empirical attention to lecturers' lived experiences, decision-making processes, and practical assessment redesign strategies (Belkina et al., 2025; Khlaif et al., 2025; Michel-Villarreal et al., 2023). Discipline-specific practices, particularly within STEAM fields where AI has distinct pedagogical implications, also remain underexplored (Thapa, 2025). Recent reviews therefore call for qualitative, context-sensitive research that captures how educators navigate these changes in practice (Mpolomoka, 2025).

Responding to these gaps, this study examines lecturers' assessment redesign practices through three complementary theoretical lenses: the Technological Pedagogical Content Knowledge (TPACK) framework, Biggs' Constructive Alignment model, and Furze's AI Assessment Scale. Together, these frameworks enable a nuanced analysis of how lecturers balance pedagogy, technology, and disciplinary knowledge while redefining assessment in AI-enabled contexts. By integrating these perspectives, the study provides a theoretically grounded account of current challenges, emerging practices, and opportunities for more coherent and pedagogically sound AI-integrated assessment design, addressing recent calls for more sophisticated analytical approaches to Gen-AI in higher education (Jin et al., 2025; Khlaif et al., 2025).

Research Purpose and Questions

The purpose of this study is to examine how lecturers in Malaysian private universities redesign assessments in response to Gen-AI integration, with specific attention to the pedagogical, technological, and ethical dimensions of this process. The research is guided by four primary questions:

1. How do lecturers integrate Gen-AI considerations in assessment redesign?
2. How well do redesigned assessments align with intended learning outcomes?
3. How do lecturers classify and communicate permitted AI use to students?
4. What challenges and opportunities arise in the assessment redesign process?

Therefore, this study contributes empirical evidence to inform faculty development programs, institutional policy formulation, and pedagogical best practices for assessment design in the AI era. The findings have practical significance for individual educators seeking to redesign their assessments, institutional leaders developing AI policies and support structures, and students navigating expectations for responsible AI use in their academic work.

Literature Review

The Gen-AI Revolution in Higher Education

The rapid proliferation of sophisticated Generative AI tools has catalysed a paradigm shift in higher education, fundamentally altering how students engage with learning and assessment (Lim et al., 2023; Michel-Villarreal et al., 2023). While these tools offer efficiencies and learning support, their rapid student adoption has exposed a structural misalignment between traditional assessment designs and emerging AI-enabled learning practices, rendering many established assessment methods vulnerable to misuse and challenging long-standing notions of academic integrity (Rudolph et al., 2023; Sullivan et al., 2023).

Technological advancement in AI has also outpaced the capacity of higher education institutions to develop empirically grounded pedagogical responses. The Stanford AI Index Report (2025) shows that industry produced 55 notable AI models in 2024, compared to none from academia alone, highlighting a widening gap between AI innovation and educational governance. This industry-driven acceleration has resulted in powerful general-purpose tools entering educational spaces faster than institutions can evaluate their pedagogical implications, leaving lecturers to respond individually rather than systematically.

Institutional responses to Gen-AI have therefore been uneven and reactive. El Khoury's (2025) "seven waves of assessment and Gen-AI" illustrate a progression from initial anxiety and policy defensiveness toward more developmental approaches involving faculty support and ethical frameworks. However, the prevalence of "living document" policies that defer AI-related decisions to individual instructors reflects not only disciplinary flexibility, but also institutional uncertainty and limited strategic coordination. While such decentralisation acknowledges contextual differences, it simultaneously shifts responsibility to lecturers without providing sufficient guidance or shared pedagogical frameworks (El Khoury, 2025).

Collectively, the literature suggests that the central challenge is no longer whether Gen-AI should be addressed in higher education, but how assessment practices can be coherently redesigned in ways that preserve pedagogical integrity while recognising the realities of AI-

augmented learning environments. This unresolved tension provides the foundation for the present study.

The Academic Integrity Crisis and Post-detection Era

The rapid adoption of Generative AI has precipitated a crisis of academic integrity that has fundamentally undermined detection-based approaches to assessment governance. Empirical evidence now shows that AI detection tools are unreliable, frequently generating false positives and disproportionately disadvantaging non-native English speakers, while failing to consistently identify AI-generated content (MIT Sloan, n.d.; UNESCO, 2025.). This failure signals not merely a technical limitation but a structural dead end, as the escalating arms race between AI generation and detection has rendered policing-oriented policies pedagogically and ethically untenable (Inside Higher Ed, 2025).

As a result, higher education has entered what may be characterised as a post-detection era, requiring a shift from punitive enforcement toward pedagogical cultivation of academic integrity. Emerging models emphasise transparency, student education, and responsible use rather than prohibition. The "Educate, Enable, Expect" framework exemplifies this shift by advocating explicit instruction on ethical AI use, supported practice environments, and clearly articulated expectations for integrity (Oldham, 2025). Central to this approach is robust disclosure and citation, repositioning AI tools as acknowledged intellectual supports rather than concealed shortcuts (Stanford Teaching Commons, 2024; thesify.ai, 2025).

This reconceptualization has also prompted a broader rethinking of academic honesty itself. Concepts such as "post-plagiarism" reflect an evolving understanding that integrity in AI-enabled contexts cannot rely on authorship purity alone, but must instead focus on transparency, judgment, and accountability (Eaton, 2023). Collectively, the literature suggests that sustaining academic integrity in the Gen-AI era depends less on restricting technology and more on redesigning assessments and norms that align ethical practice with contemporary learning realities.

Pedagogical Frameworks for Assessment Redesign

In response to the limitations of traditional assessments in AI-enabled contexts, the literature increasingly converges on a shift from rote memorisation toward higher-order cognitive skills such as analysis, evaluation, synthesis, and creativity (thesify.ai, 2025; UNESCO, 2025). This shift reflects a broader recognition that assessment resilience is achieved not by excluding AI, but by redesigning tasks so that learning outcomes emphasise judgment, context, and meaning making beyond AI's generative capabilities.

Two complementary assessment pathways have emerged. AI-resistant strategies prioritise authentic and process-oriented designs, including project-based tasks, portfolios, simulations, and case studies that mirror real-world complexity and are difficult to outsource to AI (ASCCC, n.d.; Khlaif et al., 2025). Process-focused approaches further strengthen integrity by foregrounding learning trajectories through staged submissions, reflective journals, and iterative feedback, while contextualised and personalised assessments require students to draw on unique experiences or local contexts, creating natural barriers to AI substitution (Stanford Teaching Commons, 2024; UNESCO, 2025). Assessment through dialogue, such as oral examinations and presentations with spontaneous questioning, similarly demands real-time articulation of understanding that AI cannot easily replicate (Inside Higher Ed, 2025).

In parallel, AI-integrated approaches reposition Gen-AI as a pedagogical partner rather than a prohibited tool. Students are assessed on their ability to critique AI-generated outputs, use AI for structured ideation, and ethically refine co-produced artefacts, shifting the focus from content generation to evaluative and metacognitive competence (John Hopkins University, 2024; Stanford Teaching Commons, 2024; UNESCO, 2025). Taken together, these frameworks suggest that effective assessment redesign lies not in choosing between resistance or integration, but in aligning AI use with pedagogical intent and clearly articulated learning outcomes. While these pedagogical strategies outline *what* assessment redesign may involve in AI-enabled contexts, they do not sufficiently explain *how* lecturers make situated design decisions, maintain alignment with learning outcomes, or determine appropriate levels of AI involvement in practice.

Theoretical Frameworks: TPACK, Constructive Alignment, and Furze's Scale

This study employs three complementary theoretical frameworks to analyse lecturer practices in assessment redesign.

TPACK (Technological Pedagogical Content Knowledge) provides a lens for understanding how lecturers integrate technology into their teaching practices. Originally developed by Mishra and Koehler (2006), TPACK posits that effective technology integration requires the intersection of three knowledge domains: technological knowledge (understanding of tools and their capabilities), pedagogical knowledge (understanding of teaching and learning processes), and content knowledge (understanding of subject matter). In the context of Gen-AI integration, TPACK helps explain how lecturers balance these three domains when deciding whether, when, and how to incorporate or restrict AI use in assessments.

Constructive Alignment, developed by Biggs (1996), emphasizes the coherence between intended learning outcomes (ILOs), learning activities, and assessment tasks. In a constructively aligned curriculum, what students are expected to learn, how they learn it, and how their learning is assessed are all mutually supportive. This framework is particularly relevant in the Gen-AI era because the introduction of AI capabilities potentially disrupts established alignments. Lecturers must ensure that redesigned assessments still authentically measure the intended learning outcomes, even as the tools and processes students use to complete those assessments evolve.

Furze's AI Assessment Scale provides a taxonomy for classifying the degree of AI integration permitted in assessments, ranging from “No AI” (complete prohibition) through “Limited AI,” “Partial AI,” and “High AI” to “Full AI” (complete integration with full transparency). This framework emphasizes the importance of clearly communicating AI use boundaries to students and aligns with the broader pedagogical shift toward transparency and explicit expectations (Furze, 2024, as cited in presentation materials).

Faculty Development and Institutional Support

Despite the growing use of Generative AI in teaching, a clear gap persists between faculty adoption and pedagogical preparedness. A 2025 Digital Education Council survey found that although 61% of faculty have used AI in teaching, 40% still identify as beginners and only 17% consider themselves advanced or expert, with many expressing concern about students’ over-reliance on AI and limited ability to critically evaluate AI-generated output (Campbell University, 2025). This underscores the urgent need for stronger institutional support and

targeted professional development. While some universities, such as the University of North Carolina and DePaul University, have introduced workshops, institutes, and financial incentives to support AI-informed assessment redesign (CFE UNC, 2025; DePaul University, 2025), such initiatives remain uneven and insufficiently scaled. Closing this AI literacy and capacity gap among educators is therefore essential to ensure effective, ethical, and equitable integration of Gen-AI in higher education (Thapa, 2025).

Theoretical Framework

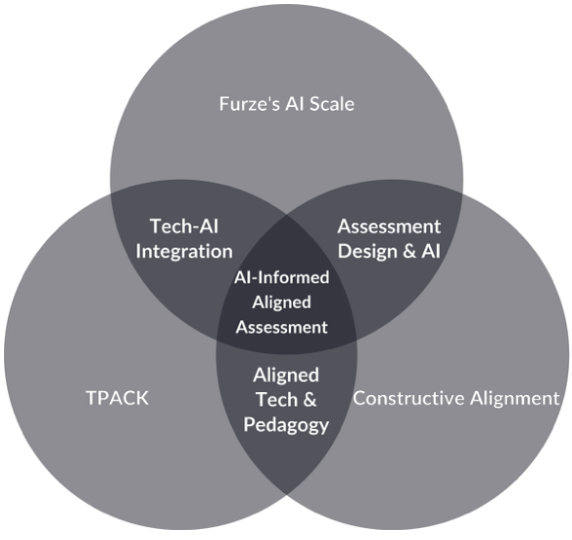
This study integrates three complementary theoretical frameworks to provide a comprehensive analytical lens for understanding how lecturers redesign assessments in response to Gen-AI integration. Each framework addresses a distinct but interconnected dimension of the assessment redesign process.

Conceptual Integration of Frameworks

The TPACK framework examines the decision-making processes lecturers employ as they balance technological capabilities, pedagogical principles, and disciplinary content knowledge when integrating Generative AI into assessment. It illuminates the cognitive and professional judgments involved in assessment redesign and explains why lecturers make differing choices regarding the extent and manner of AI use. Biggs' Constructive Alignment model provides an evaluative lens for assessing the pedagogical coherence of redesigned assessments by examining the alignment between intended learning outcomes, learning activities, and assessment tasks, ensuring that redesign efforts maintain academic rigor rather than merely responding to technological disruption. Furze's AI Assessment Scale offers a practical classification system for the resulting assessment designs by positioning them along a continuum of AI integration and emphasizing transparency in communicating expectations and boundaries to students. Figure 1 presents the conceptual framework of this study, illustrating how these three theoretical lenses intersect to inform assessment redesign in an AI-enabled context.

Figure 1

Conceptual Framework for Lecturers' Gen-AI Assessment Redesign Practices in Higher Education



Together, these frameworks enable a multi-dimensional analysis that examines not only what lecturers are doing (Furze's Scale), but why they are making these choices (TPACK) and whether the outcomes are pedagogically sound (Constructive Alignment). The conceptual framework for this study positions these three theoretical lenses as intersecting perspectives on a single phenomenon: the transformation of assessment practice in response to Gen-AI.

Methodology

Research Design

This study employs a qualitative, exploratory research design to investigate how lecturers integrate Gen-AI considerations into assessment redesign. A qualitative approach is appropriate because the phenomenon under investigation is complex, contextual, and relatively new, requiring rich, detailed data to capture the nuances of lecturer experiences, decision-making processes, and emerging practices (Creswell & Poth, 2018). The exploratory nature of the study acknowledges that Gen-AI integration in assessment is a rapidly evolving area where established theories and frameworks are still being developed and tested.

The research is situated within an interpretive paradigm, recognizing that knowledge about assessment redesign is socially constructed through the lived experiences of lecturers as they navigate this technological disruption. The aim is not to establish universal laws or generalizable findings, but rather to develop a contextualized, theoretically informed understanding of current practices, challenges, and innovations that can inform future research and practice.

Participants and Sampling

The study involved 20 lecturers from STEAM disciplines (Science, Technology, Engineering, Arts, and Mathematics) at private universities in Malaysia. Purposive sampling was employed to select participants who met specific criteria: (1) currently teaching undergraduate courses in STEAM fields, (2) have experience redesigning at least one assessment in response to Gen-AI integration, and (3) willing to reflect on and articulate their redesign processes and rationales.

The selection of STEAM disciplines was deliberate, as these fields represent diverse approaches to knowledge construction and assessment. Science and mathematics emphasize problem-solving and analytical reasoning; technology and engineering focus on applied, project-based learning; and arts disciplines value creativity, interpretation, and critical analysis. This disciplinary diversity allowed the study to capture a range of assessment redesign strategies and AI integration approaches.

The Malaysian private university context is significant because private institutions in Malaysia often have greater flexibility in policy development and pedagogical innovation compared to public universities, which may be constrained by more centralized governance structures. However, they also face resource constraints and competitive pressures that shape their responses to technological change.

Ethical approval was obtained from the institutional review board, and all participants provided informed consent. Participants were assured of confidentiality and anonymity, identifying information has been removed from all quoted material in this report.

Data Collection

Data were collected through semi-structured interviews conducted between March to May 2025. The interview protocol was developed based on the three theoretical frameworks, with questions designed to elicit information about participants' assessment redesign processes (TPACK), alignment considerations (Constructive Alignment), and AI classification and communication practices (Furze's Scale).

The semi-structured interview guide included questions such as:

- How have you modified your assessments in response to Gen-AI availability?
- What factors influenced your decisions about whether and how to integrate AI into assessments?
- How do you ensure that redesigned assessments still measure the intended learning outcomes?
- How do you communicate to students what AI use is permitted or prohibited?
- What challenges have you encountered in the redesign process?
- What opportunities or benefits have you observed?

Interviews lasted approximately 45-60 minutes and were conducted in person depending on participant preference and availability. All interviews were audio-recorded with participant permission and transcribed verbatim for analysis. Field notes were also maintained to capture contextual observations and initial analytical impressions.

Data Analysis

Data analysis followed a thematic analysis approach guided by the three theoretical frameworks. Analysis was conducted using NVivo qualitative data analysis software, which facilitated systematic coding, theme development, and framework-based organization of findings.

The analysis process involved several iterative stages:

- **Initial Coding:** Transcripts were read thoroughly and coded inductively, identifying any concept, practice, challenge, or strategy mentioned by participants related to assessment redesign and Gen-AI integration.
- **Framework-Based Coding:** A second coding cycle applied deductive codes derived from the three frameworks. For example, statements about balancing pedagogical goals with technological capabilities were coded under TPACK; discussions of learning outcome coherence were coded under Constructive Alignment; and descriptions of AI use levels were coded under Furze's Scale.
- **Theme Development:** Initial codes were collated and organized into potential themes through an iterative process of grouping, comparison, and refinement. Themes were developed both within and across the theoretical frameworks.
- **Theme Validation**: Themes were reviewed against the original transcripts to ensure they accurately represented participant perspectives and were substantiated by sufficient data. Discrepant cases and alternative interpretations were actively sought and considered.
- **Synthesis:** Final themes were synthesized into a coherent narrative that addressed the research questions and was organized by the theoretical frameworks.

Throughout the analysis, attention was paid to disciplinary variations, with specific consideration of how STEAM fields differed in their approaches to assessment redesign.

Trustworthiness and Rigor

Multiple strategies were employed to ensure the trustworthiness of the study. Credibility was established through prolonged engagement with the data, triangulation across participant perspectives and theoretical frameworks, and member checking with selected participants. Transferability was supported through thick contextual description, enabling readers to assess relevance to other settings. Dependability was ensured by maintaining an audit trail of the research process, including interview protocols, coding procedures, and analytic memos. Confirmability was addressed through reflexive practice, with the researcher critically acknowledging positionality and potential bias as an educator navigating similar Gen-AI challenges.

Findings and Discussions

The thematic analysis revealed four major themes that illustrate how participants are integrating Gen-AI considerations into assessment redesign, highlighting both its pedagogical potential and the challenges encountered in practice.

Theme 1: Gen-AI Enhances Learner Agency

Across interviews, participants consistently recognized that Gen-AI, when intentionally integrated, can enhance learner agency by supporting idea generation, scaffolding early-stage learning, providing personalized feedback, and promoting higher-order thinking.

Supporting Idea Generation and Brainstorming

Participants described using Gen-AI as a structured brainstorming partner in the early stages of assignments, requiring students to critically evaluate AI-generated ideas against disciplinary criteria and justify their final choices. This approach expanded students' creative exploration rather than replacing their thinking, aligning with studies that position AI as a collaborative learning tool rather than a shortcut (John Hopkins University, 2024; Stanford Teaching Commons, 2024).

Scaffolding Early-Stage Learning

Participants highlighted Gen-AI's role in providing just-in-time scaffolding for students struggling with foundational concepts. Students were permitted to seek AI-generated explanations or hints but were required to document their prompts and reflect on how AI responses supported their understanding. This practice aligns with established scaffolding principles (Vygotsky, 1978) while addressing concerns about over-reliance through transparency and accountability.

Providing Personalized Feedback

Several participants redesigned assessments to incorporate AI-generated feedback as a learning resource. Students were required to analyse AI feedback on drafts, revise their work, and reflect on which suggestions were accepted or rejected and why. While this helped address workload

and feedback delays in large classes, participants emphasized that instructor judgment remained central to maintaining academic standards (Mpolomoka, 2025).

Enabling Higher-Order Thinking When Scaffolded

Participants reported that Gen-AI can promote higher-order thinking when assessments shift from content production to evaluation and critique. Tasks such as analysing flawed AI-generated reports required students to identify methodological errors, misinterpretations, and logical flaws, demanding deep disciplinary understanding. This approach aligns with higher-order cognitive processes in Bloom's taxonomy and contemporary guidance on AI-enhanced assessment design (UNESCO, 2025).

Theme 2: Balancing Empowerment and Academic Integrity

While participants recognized Gen-AI's potential to enhance learning, they also expressed deep concern about balancing student empowerment with academic integrity. This theme captures persistent tensions related to student thinking, authenticity, ethical disclosure, and uncertainty around acceptable AI use.

Risk of Overshadowing Student Thinking

A core concern was that Gen-AI may obscure or replace students' own thinking. As one philosophy lecturer reflected, "When I read student essays now, I constantly wonder: Is this their thinking or the AI's? … the whole point of philosophical writing is to develop and articulate your own arguments." Participants struggled with the fact that AI-generated output is often indistinguishable from student work, even though the learning value lies in the cognitive process of producing that work.

In response, several participants redesigned assessments to foreground process over product. A biology lecturer explained, "The final product is less important than the documented journey. This makes it much harder to outsource the work to AI because they have to show me their thinking along the way." Such process-oriented designs align with pedagogical strategies that emphasize making learning visible and reflect TPACK-informed integration (Stanford Teaching Commons, 2024; UNESCO, 2025).

Difficulty Confirming Authentic Work

Closely related was the challenge of verifying authentic student learning. Participants widely rejected AI-detection tools due to inaccuracy and bias. An engineering lecturer noted, "They kept flagging international students' work as AI-generated when I knew it wasn't … detection tools are worse than useless because they undermine trust."

As a result, participants adopted alternative verification strategies, including oral defenses, in-class assessments, and highly contextualized tasks. A chemistry lecturer explained, "An AI can solve general chemistry problems, but it can't explain anomalies in data from our lab setup." These approaches created what one participant described as "natural barriers to AI substitution" by requiring context-specific knowledge unavailable to AI systems.

Ethical Dilemmas Around Disclosure

Participants also faced ethical tensions around AI-use disclosure. Students were often unclear about what constituted reportable AI use. A communications lecturer observed, "Does using Grammarly count? What about AI for translation or outlining? The boundaries were far from clear." Participants also worried that disclosure requirements might incentivize concealment rather than honesty. As one mathematics lecturer stated, "I fear I'm just teaching them to hide their AI use rather than use it responsibly." These concerns reflect broader debates about how academic integrity should be reconceptualized in AI-enabled learning environments (Eaton, 2023).

Uncertainty About Permitted AI Use Boundaries

Finally, participants reported significant uncertainty in defining defensible boundaries for acceptable AI use. A technology lecturer shared, "I allow AI for debugging because that's industry practice, but not for generating code. When students ask why, honestly, the line feels arbitrary sometimes." This uncertainty was exacerbated by inconsistent policies across courses and institutions. As one chemistry lecturer noted, "Every professor has different AI rules … I understand why this is confusing for students." These findings underscore the importance of transparency and clarity emphasized in Furze's AI Assessment Scale, while also revealing that such clarity requires continuous dialogue, contextual judgment, and stronger institutional coordination rather than rigid, one-size-fits-all rules.

Theme 3: Adoption Hindered by Systemic Barriers

Although participants demonstrated considerable pedagogical creativity in redesigning assessments, their efforts were consistently constrained by systemic barriers at the institutional level. This theme highlights challenges related to policy inconsistency, limited professional development, digital equity, and workload pressures.

Inconsistent Institutional Policies

Participants expressed widespread frustration with unclear and inconsistent institutional policies on Gen-AI use. While some universities had issued guidelines, these were often vague or insufficiently actionable. As one biology lecturer noted, "Our university put out a policy statement about AI, but it basically just said 'faculty should decide' without giving us any framework or support. It felt like they were passing the buck rather than leading."

The lack of institutional coordination resulted in wide variation across courses, confusing students and creating inequities in expectations. Participants differed in their preferences for centralized versus flexible approaches, reflecting broader debates on AI governance in higher education (El Khoury, 2025). Several advocated for adaptable or "living policies" that could evolve alongside technological and pedagogical developments. An engineering lecturer explained, "Any policy written today will be obsolete in six months. We need frameworks and principles rather than rigid rules."

Limited Professional Development Opportunities

Limited access to targeted professional development emerged as a major barrier to effective AI-informed assessment redesign. Despite using Gen-AI personally, many participants felt

unprepared to teach responsible AI use or design pedagogically sound AI-integrated assessments. A mathematics lecturer stated, “I use ChatGPT personally, but that doesn’t mean I know how to teach students to use it responsibly. I need training in the pedagogy of AI, not just the technology.”

Participants also criticized existing workshops for focusing on technical features or academic misconduct rather than practical pedagogical strategies. As an engineering lecturer observed, “I’ve attended three workshops on AI in teaching, and they all just told me what AI can do and why I should worry about cheating. What I need are concrete examples in my discipline.” These findings mirror evidence of a persistent gap between faculty AI use and pedagogical readiness (Campbell University, 2025).

Conclusion

The integration of Generative AI in Malaysian private higher education represents not merely a technological shift but a fundamental rethinking of assessment, learning, and academic integrity. This study demonstrates that while Gen-AI can enhance learner agency, higher-order thinking, and formative feedback when thoughtfully integrated, participants face persistent tensions related to academic authenticity, ethical boundaries, and uneven institutional support. Viewed through the complementary lenses of TPACK, Constructive Alignment, and Furze’s AI Assessment Scale, the findings reveal both innovative assessment redesign practices and systemic constraints, including policy inconsistency, limited professional development, and discipline-specific challenges. Collectively, these insights position Gen-AI as both a disruption and an opportunity that necessitates coordinated action by participants, institutions, and students to develop AI literacy, redesign authentic assessments, and uphold educational values, ensuring that AI integration ultimately strengthens pedagogical rigor, equity, and meaningful learning in an AI-augmented higher education landscape.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly and QuillBot, both AI-assisted writing tools, were used solely for proofreading and language refinement purposes in this manuscript. Their use was limited to correcting grammatical and spelling errors and improving clarity and accuracy of expression. No other AI or AI-assisted technologies were used in the generation of content for this manuscript. All ideas, research design, procedures, findings, analyses, and discussions are the author’s original work and are derived from the systematic conduct of the research. Following these improvements, the authors conducted a thorough manual review to ensure the accuracy, clarity, and coherence of the manuscript, acknowledging the inherent limitations of AI-assisted tools.

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Teaching in the Digital Age: An Open Educational Platform as a Digital Teaching Tool

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Abstract

The ongoing digital transformation of higher education has intensified the demand for accessible, and adaptable teaching tools, particularly in economics. This paper presents *Learn Economics* (learneconomics.euba.sk), an interactive open educational platform developed to support teaching and learning the principles of microeconomics and macroeconomics in the Slovak language. The platform integrates short instructional videos, interactive graphs, case studies, self-assessment tests, and complementary reference materials in order to foster independent learning, and enhance student motivation. Empirical insights are drawn from questionnaire-based feedback collected from university students, complemented by descriptive usage analytics of the platform. In addition, the platform is positioned within a comparative overview of selected international digital resources used in economics education. The findings indicate that multimedia-based platforms can effectively complement traditional approach and provide a flexible framework for online and hybrid education in economics.

Keywords: higher education, digital teaching tool, educational platform

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Introduction

The current generation of university students is shaped by a socio-economic environment profoundly influenced by rapid technological change. Digital technologies form an integral part of students' everyday lives, particularly in communication, entertainment, gaming, and leisure activities. Consequently, contemporary students are accustomed to interactive, multimedia-rich environments and increasingly expect similar characteristics within the educational process.

In economics education, this trend is reflected in the widespread use of textbooks supplemented by online learning platforms. Leading economics textbooks are routinely accompanied by digital environments such as CourseSmart (Samuelson & Nordhaus), LaunchPad (Mankiw), or MyLab Economics (Acemoglu, Blanchard, Parkin). These platforms provide structured online support aligned with textbook content and include a wide range of multimedia and interactive tools, including instructional videos, applied tasks, quizzes and tests and blogs. Such resources offer significant benefits for both students and instructors by supporting self-paced learning and enhancing conceptual understanding.

The importance of digital educational tools became particularly evident during the COVID-19 pandemic, which caused the largest disruption of education systems in modern history. According to the United Nations (2020), nearly 1.6 billion learners in more than 190 countries were affected by school closures, impacting up to 94% of the global student population. Millions of pupils, secondary and university students were forced to replace face-to-face instruction with various forms of distance learning. These disruptions resulted in measurable learning losses, with potentially long-term consequences for human capital formation.

The pandemic also transformed the role of teachers, who were required to adapt rapidly to online and hybrid modes of instruction. At the university level, this period accelerated the transition toward blended and digitally supported teaching. However, the effectiveness of such formats depends critically on the availability of well-designed, pedagogically grounded, and easily accessible digital learning materials that support both students and instructors.

The paper focuses on open multimedia educational platforms as a tool for innovative approaches to teaching economics in higher education. The paper discusses the rationale for integrating open educational platforms into the teaching process and situates them within broader trends in activating and digitally supported teaching methods. The final section presents a Slovak-language online platform focused on the teaching of the principles of economics, providing a practical example of how digital tools can be implemented in university-level economics education.

Methodology

The paper is based on mixed-methods with the aim to provide an empirically grounded and practice-oriented analysis of digitally supported teaching methods in economics education.

Empirical data were collected through a questionnaire survey conducted among undergraduate students at the Bratislava University of Economics and Business (BUEB) in June 2020. The survey focused on students' perceptions of the teaching of introductory economics, preferred forms of instruction, perceived learning difficulties, and expectations regarding innovative and

digitally supported teaching methods. The questionnaire included both closed-ended and open-ended questions, allowing for the collection of quantitative data as well as qualitative insights.

Quantitative data from the questionnaire were analysed using descriptive statistics in order to identify general trends and patterns in students' responses. Qualitative data obtained from open-ended questions were analysed through thematic interpretation, providing contextual understanding of students' recommendations and attitudes towards economics education.

In addition to the questionnaire survey, the paper presents descriptive usage analytics from the online platform. The analysis of usage statistics serves to identify user preferences and patterns of interaction with different types of digital learning content.

The empirical findings are complemented by a qualitative comparative review of selected international educational platforms used in economics education, including MyLab Economics, CORE Econ, Exploring Economics, and Khan Academy. This comparison focuses on platform design, types of educational content, and pedagogical orientation, and serves to situate the locally developed platform within broader trends in digitally supported and activating teaching methods.

Innovative Approaches to Education

This section draws on selected empirical and theoretical studies in higher education pedagogy in order to contextualise innovative and digitally supported teaching approaches relevant to economics education.The teaching of introductory economics at the authors' home university is, in some student groups, characterised by relatively low motivation to acquire new knowledge. In many cases, learning is reduced to fulfilling minimum course requirements, primarily through compulsory literature prescribed in the course syllabus. This situation highlights the need for teaching approaches that not only transmit knowledge, but also stimulate student engagement and foster a deeper understanding of fundamental economic principles and concepts.

In contemporary educational theory, teaching methods are commonly divided into two broad categories: traditional (conventional) methods and innovative (activating) methods. Traditional teaching approaches focus primarily on the transmission of content. The teacher acts as the central authority and the main source of knowledge, while students assume a largely passive role, receiving theoretical information through lectures or assigned readings.

In contrast, innovative and activating approaches emphasise student involvement and active participation in the learning process. Their primary objective is to transform static, monological teaching into a dynamic and interactive form that naturally engages students and increases their interest in the subject matter. These methods aim to create meaningful connections between theory and practice, enabling students to better understand and apply economic concepts in real-world contexts.

The use of activating methods also reshapes the relationship between teachers and students. While the teacher retains a guiding and coordinating role, greater space is provided for student activity, self-realisation, and independent thinking. Activating approaches encourage collaboration, enabling students to work together on problem-solving exercises, or case studies. As a result, students develop not only subject-specific knowledge, but also transferable skills such as communication and presentation abilities, the capacity to articulate and defend their

own opinions, and creative and critical thinking skills. Critical thinking, in particular, involves the ability to acquire information, evaluate its relevance and reliability, and identify logical and objective relationships.

Student engagement can be significantly enhanced through the systematic introduction of innovation into the educational process. Innovative teaching methods support cognitive development and positively influence students' perception of learning itself. In economics education, core principles can be presented in ways that resonate with a generation immersed in social networks and digital technologies (Angelo & Cross, 1993; Clerici-Arias, 1994; Delemeester et al., 2000).

In higher education, pedagogical approaches that combine digital technologies with activating learning strategies are becoming increasingly prominent. Among the most widely discussed are the flipped classroom model and the broader concept of blended learning, both of which respond to the need for increased student engagement and more effective knowledge acquisition in the context of digital transformation (Van Alten et al., 2019). The flipped classroom model shifts the acquisition of theoretical content outside the classroom, typically through digital study materials, while contact teaching time is devoted to discussion, problem solving, and the application of knowledge. A meta-analysis by Van Alten et al. (2019) demonstrates that flipped classrooms are associated with higher student learning outcomes when face-to-face instructional time is not reduced compared to traditional classroom settings, or when quizzes are incorporated into the flipped classroom design.

More recent research supports these findings. A meta-analysis by Bredow et al. (2021), drawing on evidence from 317 studies, shows that compared to traditional lecture-based instruction, flipped learning has positive effects on academic performance with small to moderate effect sizes. There is considerable variability in the effectiveness of flipped learning, largely influenced by educational context. A systematic literature review by Divjak et al. (2022) examines the use of online flipped classroom approaches in higher education during the COVID-19 pandemic. The authors find that instructors and institutions with prior experience in face-to-face or blended flipped classrooms were more successful in transferring this model to fully online environments.

In addition to the flipped classroom, the literature also emphasizes challenge-based learning, which focuses on addressing authentic problems and explicitly linking theoretical knowledge with practical application. A systematic review by Leijon et al. (2022) analyses research on Challenge-Based Learning (CBL) in higher education. Based on studies published between 2009 and 2020, the review documents a shift of CBL from a concept originally introduced by a multinational technology company for school education to an approach increasingly adopted in higher education as a means of transforming adult learning.

Overall, trends in quality education suggest that continuous improvement in higher education can only be achieved through systematic innovation in the teaching and learning process, while respecting international standards. Ongoing advances in information and communication technologies create new opportunities to enhance teaching effectiveness and offer students diverse forms of learning and knowledge acquisition. In this process, the teacher plays a crucial role as an innovator who actively implements and adapts new methods to the educational context.

Students' Opinions on the Teaching of Economics

At the authors' home university, courses focused on the fundamentals of economics are perceived as among the most demanding subjects in the first level of university study. These courses are traditionally associated with relatively high failure rates, particularly among first-year students. Despite these difficulties, an internal survey conducted among students (Kálovec, 2017) revealed a seemingly paradoxical finding: students are aware of the importance of economics courses and expressed interest in them even if they were offered as optional subjects. This result suggests that the main challenge does not lie in a lack of perceived relevance of economics, but rather in the way the subject matter is taught and communicated.

To gain deeper insight into students' perceptions of economics teaching, an anonymous questionnaire survey was conducted at all faculties of the BUEB (Muchová & Leško, 2020). A total of 429 students participated in the survey, out of 1,351 students who were invited to respond. The majority of respondents (67.8%) were first-year students, while nearly 30% were second-year students enrolled in the first level of study. With respect to prior education, more than half of the respondents were graduates of grammar schools (four- or eight-year programmes), and approximately 32% had graduated from business academies.

The questionnaire consisted of 36 questions and focused on several key areas: a comparison of traditional classroom teaching with distance or online teaching, identification of areas requiring improvement in economics education, and detection of topics in introductory economics that students find particularly difficult to understand.

The results indicate that traditional face-to-face lectures are still perceived as a suitable and effective method for mastering the principles of microeconomics and macroeconomics. Up to 62% of respondents expressed a preference for this form of instruction, confirming that even among digitally oriented students, personal contact with teachers and peers remains an important component of the educational process. At the same time, 33% of respondents stated that they could imagine participating in online lectures delivered via platforms such as Microsoft Teams. Other acceptable forms of instruction included the provision of lecture materials by teachers and access to recorded video lectures. In addition, 11.2% of students reported using private tutoring as a supplementary form of learning during their studies.

Another group of questions focused on areas that should be emphasised during lectures. Students' responses were highly consistent: the most frequently expressed recommendation was to place greater emphasis on the practical application of knowledge and on linking theoretical concepts with real-world economic practice. Other commonly mentioned suggestions included the use of case studies, enhanced online communication, online submission of assignments, and the systematic provision of study materials through educational platforms.

Several questions addressed the organisation and content of seminars. More than 63% of respondents identified the lack of illustrative examples as a major weakness of seminar-based teaching. Students expressed a strong preference for more interactive forms of instruction, greater use of online communication tools, easier access to study materials via platforms such as MOODLE or MSTeams, and the inclusion of case studies as innovative elements of seminar teaching.

During the summer semester of the 2019/2020 academic year, the outbreak of the COVID-19 pandemic necessitated a rapid transition from on-site teaching to distance learning. Survey results indicate that more than half of the students (over 51%) perceived distance learning as less demanding than traditional on-site instruction during the preceding winter semester. Approximately 21.4% of students considered distance or online learning to be more demanding, while nearly 28% perceived both forms of instruction as equally demanding. One possible explanation for the perception of lower demands is the mistaken belief among some students that teachers have limited ability to monitor preparation and assess performance in an online environment, which may lead to an underestimation of academic requirements.

Overall, students' recommendations for making introductory economics courses more engaging can be summarised as follows: increased use of practical examples and application of knowledge to current economic issues; systematic incorporation of case studies; more interactive and engaging teaching methods; greater emphasis on teamwork and collaborative tasks; wider use of online teaching formats; integration of YouTube videos and online resources; and improvement of communication between teachers and students. These findings confirm both the attractiveness of online and multimedia-supported education, while clearly indicating areas in which innovation is necessary to improve the effectiveness of economics education.

Educational Platforms as an Innovative Approach in Economics Education

This section presents selected educational platforms developed primarily in international contexts that may serve as inspiration for the creation and adaptation of similar platforms in languages other than English. These platforms illustrate different approaches to integrating multimedia content, interactivity, and activating teaching methods into economics education.

MyLab Economics

MyLab Economics, developed by Pearson, is a digital educational platform designed primarily for university-level economics education. It offers a comprehensive set of interactive tools aimed at enhancing the learning process, including assessments, tutorials, and customisable content for both students and instructors. The platform can be easily integrated into existing course structures and supports the effective comprehension of complex economic concepts. The platform's interface emphasises a clear and professional design with intuitive navigation. Separate access options are provided for students and instructors. The student version offers interactive exercises, tests, and personalised feedback that support individualised learning and continuous self-assessment. The instructor version enables course creation, monitoring of student progress, and the use of analytical tools to improve teaching effectiveness.

Exploring Economics

Exploring Economics is an open-access e-learning platform dedicated to pluralistic economics. It provides a wide range of educational resources aimed at exploring diverse economic theories, methodologies, and perspectives. The platform includes original content related to various schools of thoughts, such as behavioural, ecological, feminist, and institutional economics. Its user-friendly interface supports easy navigation and encourages active exploration of alternative economic approaches. The platform also enables users to search for courses, articles, and discussions, thereby promoting critical reflection and engagement with contemporary economic debates.

CORE Econ

CORE Econ is an educational platform offering free online textbook and learning resources designed to modernise the teaching and learning of economics. Its approach is grounded in contemporary economic research and addresses pressing global challenges, including climate change, inequality, and technological progress. The underlying vision of CORE Econ is that economics education can contribute to a more just, sustainable, and democratic society. One of the platform's flagship textbooks, *The Economy 2.0*, covers the fundamental principles of microeconomics and macroeconomics while emphasising real-world problem solving. The textbook incorporates interactive graphs, empirical data, and applied examples, making it particularly suitable for innovative and activating teaching approaches.

Khan Academy

Khan Academy is a globally recognised educational platform whose mission is to provide free, high-quality education to anyone, anywhere. The platform offers thousands of instructional videos covering a broad range of subjects, including economics. Through short video explanations and practice exercises, Khan Academy serves as a valuable supplementary resource, particularly for reinforcing basic concepts and supporting independent learning.

Educational platforms such as MyLab Economics, Exploring Economics, CORE Econ, and Khan Academy demonstrate the significant potential of multimedia and interactive tools to enhance student engagement, deepen conceptual understanding, and accommodate diverse learning styles. They illustrate how digital technologies can be effectively combined with activating teaching methods to address persistent challenges in introductory economics education, such as low motivation and high failure rates.

Design of an Online Open Platform Focused on the Principles of Economics

The initial concept and design of an online educational platform aimed at teaching the principles of microeconomics and macroeconomics in the Slovak language were developed and implemented during the period 2020–2022 in the framework of educational project KEGA.[1] The educational platform is publicly accessible at https://learneconomics.euba.sk/

The project was submitted prior to the outbreak of the COVID-19 pandemic as an innovative initiative responding to the growing demand for modern, digitally supported forms of economics education. During the first year of the project, the research team focused on a comparative analysis of the existing approaches to teaching introductory economics courses at Slovak faculties of economics and at selected foreign universities. This analysis provided a broader international perspective on commonly used teaching methods, digital tools, and curricular structures. Subsequently, a questionnaire survey was conducted among university students in order to identify areas in which innovative teaching methods and procedures could be effectively introduced and to better understand students' expectations regarding digital learning resources. The second and third years of the project were devoted to the development of the first functional version of the online platform. This phase included the systematic creation of educational content, graphical design, and technical functionality. Particular attention was paid to usability, clarity of navigation, and the integration of multimedia

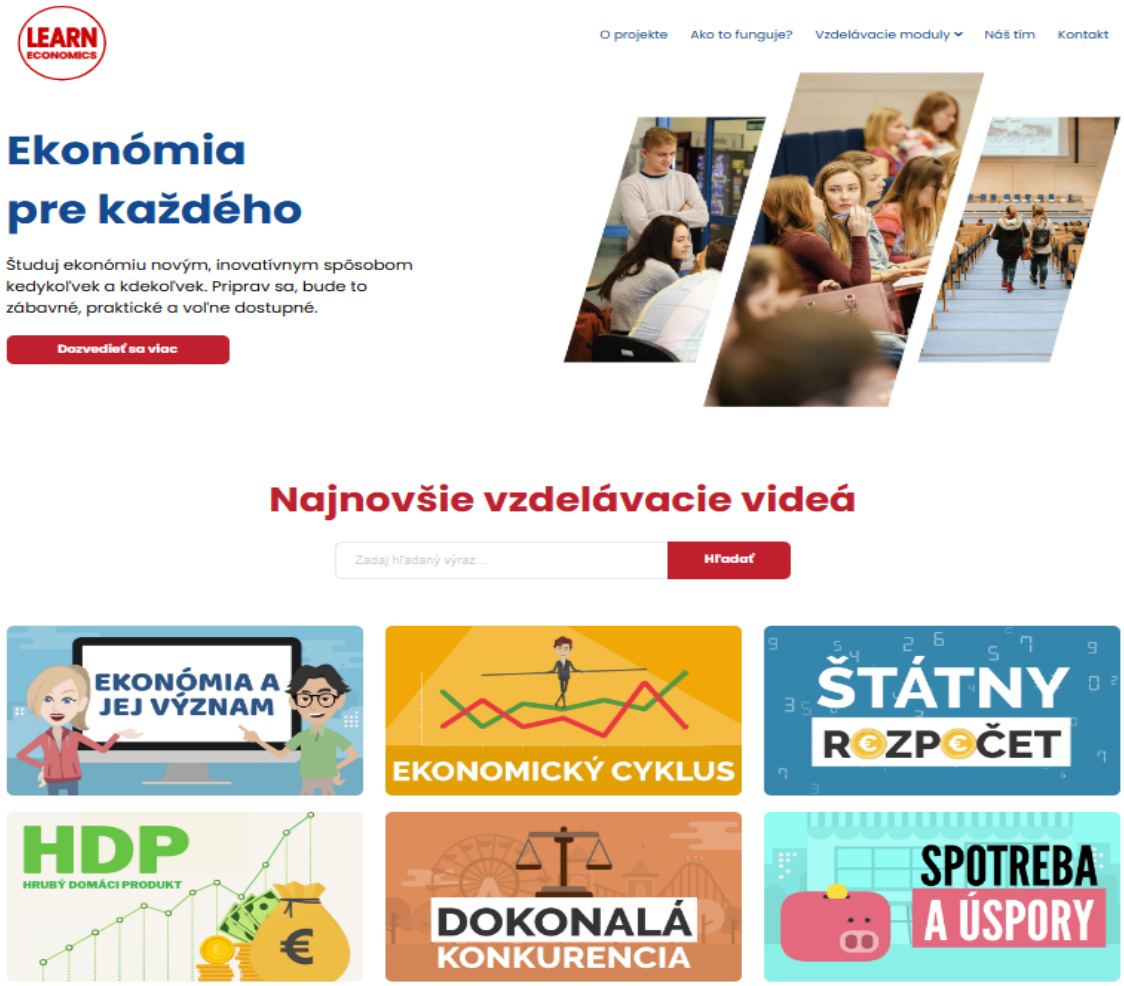
[1] KEGA project entitled "Learn Economics: The Application of E-learning as a New Form of Teaching Economics".

elements. Following the completion of this initial stage, the platform was gradually incorporated into seminar-based teaching as a one of complementary sources at the educational process at the BUEB.

At present, the research team is working on the second stage of the platform's development. The main objective of this phase is to further expand the platform into a comprehensive educational tool that supports active and independent learning. The platform is intended not only for university students, but also as an open-access resource for the general public interested in economics and financial literacy.

Figure 1

Visual Layout of the learneconomics.euba.sk Educational Platform



Source: https://learneconomics.euba.sk/

Figure 1 presents the visual layout of the Learn Economics educational platform. The homepage of the Learn Economics platform is available only in the Slovak language. In the upper left corner, the platform's logo is displayed together with the slogan "Economics for everyone", emphasising its inclusive orientation towards a broad audience interested in understanding modern market economics through an innovative and practice-oriented approach. The top section of the webpage contains the main navigation menu, which includes the following items: About the Project, How Does It Work?, Educational Modules, Our Team, and Contact.

The central part of the homepage is dedicated to the section entitled Latest Educational Videos, which presents newly added video materials covering key topics in microeconomics and macroeconomics. An integrated search function allows visitors to quickly locate specific economic concepts and corresponding educational videos by entering relevant keywords, thereby facilitating targeted learning.

The current content of the educational platform is structured into several educational modules:

- *Educational videos*, which explain specific economic concepts through practical and real-world examples. Each video is developed through a structured process that includes idea formulation, team discussions, script preparation, recording, and final editing.
- *Case studies*, presenting engaging and often non-standard economic problems. Each case study is based on a real economic situation and is accompanied by questions designed to stimulate analytical thinking and reflection.
- *Interactive graphs*, which transform available data into graphical representations commonly used in economic analysis. Students are encouraged to explore these graphs and answer questions related to their interpretation.
- *Test sets,* consisting of multiple-choice questions covering microeconomics and macroeconomics. Each question includes four answer options, with one correct response.
- *A dictionary of economic terms*, providing an alphabetical list of key concepts accompanied by detailed definitions and their English equivalents.
- *Famous economists*, introducing the lives and key contributions of prominent economists who have significantly influenced the development of economic thoughts.
- *Books on economics*, presenting selected domestic and foreign textbooks as well as popular science publications, together with brief descriptions to support students in their choice of literature.
- *Numerical examples*, including numerical and verbal problems of varying levels of difficulty from microeconomics and macroeconomics.
- *Financial literacy*, a newly introduced module focusing on the relationship between economics and personal finance. Given that recent surveys indicate that the level of financial knowledge among Slovak households and students remains below the European Union average, this module aims to enhance users' understanding of fundamental financial concepts.

Table 1 presents summary statistics related to the usage of the learneconomics.euba.sk platform, covering the period from its launch in spring 2021 to autumn 2025.

Table 1
Most Visited Pages From the Main Menu

Page name from the main menu	Total number of page views
Contact	134,074
About the project	2,244
How does it work?	2,085
Why study economics?	1,991
Our team	1,960

Source: Own processing based on data from learneconomics.euba.sk

The data indicate that the Contact page is by far the most frequently visited section of the platform. This suggests a strong interest among users in obtaining contact information about the creators of the platform. From this perspective, it appears appropriate to further develop this section, for example by adding more detailed information or an interactive contact form. The remaining pages record significantly lower levels of traffic, indicating limited user interest in information related to the platform's objectives, functioning, or team composition. These findings provide valuable insights into user behaviour and may serve as a basis for future improvements to the structure and visual presentation of the platform.

Table 2
Most Visited Educational Modules on the Website

Rank	Name of educational module
1	https://learneconomics.euba.sk/vzdelavacie-moduly/interaktivne-grafy/
2	https://learneconomics.euba.sk/vzdelavacie-moduly/vzdelavacie-videa/
3.	https://learneconomics.euba.sk/vzdelavacie-moduly/otestuj-sa/
4.	https://learneconomics.euba.sk/vzdelavacie-moduly/znami-ekonomovia/
5.	https://learneconomics.euba.sk/vzdelavacie-moduly/pripadove-studie/
6.	https://learneconomics.euba.sk/vzdelavacie-moduly/knihy-o-ekonomii/
7.	https://learneconomics.euba.sk/vzdelavacie-moduly/slovnik-ekonomickych-pojmov/

Source: Own processing based on data from learneconomics.euba.sk

Table 2 presents the ranking of visits to individual educational modules on the website. The results show that Interactive Graphs represent the most frequently visited educational module, followed by Educational Videos, which also attract substantial user attention. The third position is occupied by Test Sets, followed by Famous Economists. Case Studies rank fifth in terms of visits, while Books on Economics and the Dictionary of Economic Terms are the least frequently accessed modules. These findings highlight the strong preference of users for

interactive and visually supported learning tools and provide empirical guidance for the future development of the platform.

Conclusion

The digital transformation of higher education has substantially reshaped teaching and learning practices, a process that was significantly accelerated by the COVID-19 pandemic. This period highlighted both the potential and the limitations of online and hybrid instruction. While digital technologies cannot replace direct student–teacher interaction, empirical experience shows that they can meaningfully enhance learning when integrated into pedagogical designs.

This paper examined the role of open educational platforms as digital teaching tools in economics education. The analysis combined theoretical perspectives on activating and digitally supported teaching methods with empirical evidence drawn from a student questionnaire survey, descriptive usage statistics of an educational platform, and a comparative review of selected international platforms. Together, these elements provide a comprehensive view of how digital tools can support the teaching of introductory economics.

Survey results collected among students of the Bratislava University of Economics and Business indicate that traditional face-to-face lectures remain important, yet students consistently express a demand for stronger links between theory and practice, greater use of illustrative examples, and more interactive forms of instruction. These preferences are reflected in the design of the *Learn Economics* platform.

The comparative overview of established platforms, including MyLab Economics, CORE Econ, Exploring Economics, and Khan Academy, reveals common features associated with effective digital economics education, such as modular structure, emphasis on real-world applications, and support for self-regulated learning. The *Learn Economics* platform incorporates these features while responding to local curricular requirements and language accessibility, thereby extending the availability of open educational resources in economics.

Overall, the empirical findings suggest that open, multimedia-based platforms can effectively complement traditional teaching by increasing student engagement and supporting independent learning. These platforms appear particularly suitable for blended learning and flipped classroom models, where digital materials prepare students for more application-oriented activities during contact teaching. Future research should therefore focus on systematically evaluating learning outcomes associated with platform use and on refining digital content based on observed user behaviour. In this way, open educational platforms can contribute to evidence-based innovation in economics education.

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Design Thinking-Drive Business Modelling and AI Utilization: A Study on University Students' Entrepreneurial Competencies

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Abstract

University-based entrepreneurship education is widely recognized as a critical component in fostering adaptability and enhancing startup competencies among youth. However, the proportion of new entrepreneurs remains relatively low in comparison to the national economic demands. This study investigates the extent to which the application of design thinking, supported by artificial intelligence (AI) tools, can enhance students' startup competencies. A quantitative research design was employed, utilizing structural equation modeling (SEM) for data analysis. The respondents were selected through judgmental sampling, comprising 179 students who had completed an entrepreneurship course. Data were collected via questionnaires and analyzed using SmartPLS 4 software. The findings indicate that design thinking has a significant positive impact on students' startup competencies. Furthermore, design thinking was found to significantly influence AI adoption; students engaged in design-thinking-based instruction were more inclined to utilize AI tools in developing their business models. However, the adoption of AI did not exhibit a significant direct effect on startup competency. As a result, the mediating role of AI adoption in the relationship between design thinking and startup competency was also found to be non-significant. These findings suggest the need for further investigation into how design thinking can be more effectively integrated with AI tools to optimize learning outcomes.

Keywords: design thinking, startup competency, artificial intelligence, university-based entrepreneurship education

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Introduction

Indonesia faces an urgent need to generate new entrepreneurs amid limited formal employment opportunities and a persistent unemployment rate, which reached 7.46 million people (4.85%) as of August 2025. In response to these structural challenges, university-based entrepreneurship education has been mandated for all undergraduate students. To be effective in preparing graduates for complex real-world challenges, such education must evolve beyond theory and integrate modern, experiential methodologies. Chief among these are Design Thinking (DT) for human-centered problem identification, structured Business Model Canvas (BMC) frameworks for strategic planning, and Artificial Intelligence (AI) tools for data-driven idea exploration and market analysis. Prior studies confirm that these approaches foster entrepreneurial attitudes, creativity, digital literacy, and critical reflection (Liang et al., 2025; Shirai et al., 2024; Thu et al., 2025).

Within the broader discourse on entrepreneurship education, the distinction between business and non-business student cohorts has been debated. Boldureanu et al. (2020) argue that differentiated instructional approaches are necessary to accommodate these groups. However, more recent evidence suggests otherwise. Arendt et al. (2025) demonstrate that competency-based entrepreneurship education yields positive long-term entrepreneurial outcomes across disciplines, regardless of program background.

In practice, business model frameworks such as at Business Model Canvas are widely adopted in university to facilitate structures ideation, opportunity recognition, and value creation (Al-Filali et al., 2024). Recent studies indicate that the BMC has evolved conceptually and pedagogically to address the demands of sustainability, digitalization, and competency-based learning, as reflected in the development of a sustainable and digital BMC comprising expanded elements that emphasize ecosystem collaboration, co-creation, and integrated economic, social, and environmental value propositions (Bachmann et al., 2024). From an educational perspective, the adaptation of the BMC within project-based learning (PBL) environments has been shown to enhance students' metacognitive awareness and entrepreneurial competencies through engagement with real-world ecosystem, and stakeholders (Moure et al., 2023). However, empirical evidence also suggests that not all BMC components contribute equally to performance outcomes, customers segmentation, value propositions, and channels are identified as the most influential elements in validating business hypotheses and improving team performance (Ladd, 2018).

Although competency-based measurement offers a robust approach to evaluating the outcomes of entrepreneurship education, particularly in contexts where longitudinal tracking is difficult (Alfantookh & Bakry, 2013; Ferreras-garcia, 2026). Research and pedagogical innovation involving DT, BMC, and AI have largely been concentrated within business and engineering disciplines (Duong et al., 2025; Thu et al., 2025). This leaves a critical gap in community-oriented academic programs, such as Community Education, which train students not only as individual entrepreneurs but as facilitators of community-based economic development and social innovation (Boothroyd & Davis, 1993; Clark, 1986; Saepudin & Mulyono, 2019). These "entrepreneur-facilitators" require a unique blend of competencies to empower grassroots initiatives, yet empirical studies examining entrepreneurship education within this specific context remain scarce, particularly those focusing on measurable competencies rather than short-term intentions.

Therefore, this study aims to measure students' entrepreneurial competencies after completing an entrepreneurship course that integrates design thinking-driven business modelling using the Business Model Canvas and AI tools for business idea exploration and development. By focusing on students from a community education program, this research contributes to the growing literature on inclusive and competency-based entrepreneurship education and provides empirical evidence on how design thinking and AI adoption interact in shaping entrepreneurial competencies beyond traditional business disciplines.

Literature Review

Entrepreneurial Competencies

The concept of competency first emerged as an innovative approach to predicting academic and professional success in the 1970s, pioneered by David McClelland. McClelland (1973) emphasized that measurables clusters of behavioural patterns, such as communication skills and goal setting, were more effective predictors than intelligence (IQ) tests. At its core, competency relates to a person's ability or capability to satisfactorily complete tasks (Hager & Gonczi, 1996, 2009).

Subsequent theoretical developments by Boyatzis (Boyatzis, 2008) deepened the understanding by highlighting the distinction between the expected results of an action and the skills and characteristics needed to achieve them. Competency is defined as the capability that builds expertise, knowledge, and attributes to achieve performance in a job or task (Boyatzis, 2008; Costa et al., 2026; Hines et al., 2017). This definition refers to consistent and sustained habits of thinking and acting.

Spencer and Spencer (2008) made significant contributions by expanding the definition of competency to include deeper characteristics, such as motivation, personality traits, self-concept, attitudes, values, technical knowledge, and cognitive or behavioral competencies. They popularized the *Competency Iceberg Model*, which distinguishes between explicit competencies which is related to knowledge and skills and implicit competencies related to psychological characteristics such as traits, self-concept, and motives. These components can be grouped into three levels (Mohamad Rosman et al., 2022; Spencer & Spencer, 2008): surface tools, most easily developed which consist of skills and knowledge; self-image attributes, consist of self-concept and social role; core personal characteristics, most difficult to change, consist of traits and motives.

In the context of entrepreneurship and education, the competency approach focuses on developing students' abilities and adaptability to real-world scenarios (Ferreira et al., 2022; Trabelsi-Zoghlami & Touzani, 2019). Entrepreneurial competency involves not only skills but also specialized knowledge and attitudes required to identify business opportunities and transform them into sustainable business models (Al-Filali et al., 2024; Jackson, 2015; Tehseen et al., 2018). Therefore, competency-based measurement becomes a robust approach for evaluating the outcomes of entrepreneurship education (Alfantookh & Bakry, 2013; Romero-Frías & Robinson-garcía, 2017).

Prior studies highlight that entrepreneurship education contributes to the development of entrepreneurial attitudes and intentions (Boldureanu et al., 2020), creativity and resilience (Amirul et al., 2025), digital and artificial intelligence (AI) literacy (Liang et al., 2025; Thu et al., 2025), critical reflection (Blankesteijn et al., 2024), and design thinking-driven business

modelling (Liang et al., 2025; Shirai et al., 2024) as well as the ability to apply knowledge in real-world contexts and to enhance perceived desirability and feasibility of entrepreneurial ventures (Thu et al., 2025). In parallel, recent findings highlight that students tend to adopt and explore AI tools in a natural and immediate manner, while interdisciplinary collaboration is strengthened through co-creation strategies; nevertheless, sustained engagement and idea fluency depend on adequate training and scaffolding in AI tool usage (Miranda, 2025).

Design Thinking-Drive Business Modelling

Design Thinking is defined as a human-centered, iterative methodology that prioritizes empathy, multidisciplinary collaboration, prototyping, and creative problem-solving to develop solutions profoundly aligned with user needs and market expectations (Sreenivasan & Suresh, 2024). This conceptualization elevates design thinking from a mere creative toolkit to a strategic framework essential for business model innovation and digital transformation. It serves as a critical bridge between human creativity and data-driven technological insights, enabling ventures to develop desirable, feasible, and viable value propositions. The methodology's iterative nature, emphasizing prototyping and stakeholder feedback, is fundamental for refining both products and their underlying business logic in response to real-world validation.

The process of developing this integrated identity is operationalized through transformative experiential learning. Grounded in Kolb’s (2003) pedagogical cycle, this process involves concrete experience, reflective observation, abstract conceptualization, and active experimentation. When applied to entrepreneurship education, this cycle allows students to engage with ill-defined, real-world problems, applying design thinking principles iteratively (Blankesteijn et al., 2024). Through this “learning by doing” and reflection, abstract concepts become internalized competencies, and a professional identity is forged.

The practical application of this theoretical synthesis is often facilitated by structured business model tools, most notably the Business Model Canvas (BMC). The BMC provides a common language and framework for structured ideation, opportunity recognition, and value proposition design, making it a staple in university entrepreneurship programs (Al-Filali et al., 2024). Pedagogically, its strength lies in its adaptability. Recent scholarly work reflects its evolution to meet contemporary demands, giving rise to conceptual expansions like the sustainable and digital BMC, which emphasize ecosystem collaboration, co-creation, and integrated value propositions (Bachmann et al., 2024). Integrating the BMC within Project-Based Learning (PBL) environments has been shown to enhance metacognitive awareness and entrepreneurial competencies by forcing engagement with real ecosystems and stakeholders (Moure et al., 2023). Empirical studies further refine its use, indicating that not all BMC components are equally impactful; elements like customer segments, value propositions, and channels are often most critical for hypothesis testing and venture performance (Ladd, 2018).

This framework finds concrete expression in pedagogical practices where an adapted BMC template is used within a PBL context. As noted by Moure Abelenda et al. (2023), “the direct interaction with potential clients allows the students to apply the design thinking methodology focused on the user” (p. 11). In such settings, the BMC ceases to be a static planning document and becomes a dynamic tool for integrating the iterative, human-centered design process. Students use stakeholder empathy and feedback gathered through primary market research to continuously refine their prototypes and business model hypotheses,

ensuring their solutions are not only technically sound but also market-validated and desirable.

AI Utilization

AI functions primarily as a catalytic stimulus within the entrepreneurial process, activating cognitive mechanisms according to an integrated Stimulus-Organism-Response (SOR) and Entrepreneurial Event Model (EEM) perspective (Duong et al., 2025; Thu et al., 2025). Exposure to and adoption of AI tools, such as generative AI platforms, AI-competency development, and immersion in an AI-positive ecosystem, serve as external drivers that directly influence an individual's internal psychological state, setting the stage for entrepreneurial consideration.

This stimulus is processed through core cognitive pathways centre on perceived desirability and feasibility. AI enhances the perceived attractiveness (desirability) of entrepreneurial ventures by infusing them with innovation and novel potential, while simultaneously bolstering the perceived practicality (feasibility) by offering concrete tools for planning, problem-solving, and execution (Duong et al., 2025; Thu et al., 2025). Crucially, the framework underscores that entrepreneurial intention peaks when these two perceptions are not only high but also in cognitive alignment; significant dissonance between what is desired and what is believed possible can substantially dampen commitment, highlighting a key leverage point for educational intervention.

The effectiveness of this AI-to-cognition pathway is not uniform but is critically moderated by an individual's technology integration capacity and knowledge competencies. Specifically, AI literacy and deep entrepreneurial knowledge (EK) act as essential moderators that determine whether AI acts as a true enabler (Awal & Chowdhury, 2024; Qin, 2024). Possessing knowledge of AI (KAI) equips potential entrepreneurs to practically deploy technologies like IoT, blockchain, and generative AI for specific outcomes such as frugal innovation or sustainable business modelling. This knowledge transforms AI from an abstract stimulus into a tangible toolkit, thereby directly strengthening the feasibility pathway and enabling the translation of innovative ideas into actionable plans.

Moving beyond intention formation, the framework explicitly incorporates AI as an instrumental educational and skill-development tool. AI applications, such as analytics-driven video pitch evaluation, provide objective, granular feedback on critical entrepreneurial behaviours like communication, confidence, and emotional expression (Giuggioli et al., 2026). This creates a direct feedback loop where AI not only inspires the ambition to venture but also actively trains the precise skills, such as persuasive pitching, required to successfully secure funding and execute the venture, thereby bridging the gap between intention and competent action.

Ultimately, this entire process is embedded within and dynamically interacts with a broader entrepreneurial ecosystem. Factors such as social influence, institutional support structures, market volatility, and a collective openness to technological innovation can significantly amplify or constrain the influence of AI on the individual (Popa & Breazu, 2025). The framework concludes that while AI is a transformative enabler for entrepreneurial education, influencing intention, enhancing skills, and providing evaluative insights, its full potential is realized only within a supportive ecosystem. Furthermore, it remains a complement to, not a

replacement for, essential human intuition and judgment in navigating the uncertainties inherent to entrepreneurship.

Methodology

Research Design and Approach

This study employed an analytical survey research design. This design is suitable for describing a situation and explaining the relationships between phenomena by examining why certain conditions exist (Barroga & Matanguihan, 2022; Malik, 2013). It involves investigating two or more variables to answer research questions and test hypotheses, thereby allowing for the examination of relationships and the drawing of conclusions from those relationships.

Conceptual Definitions

Entrepreneurial Competencies (Y) are defined as the integrated clusters of capabilities encompassing knowledge, skills, attributes, motives, and traits that enable an individual to successfully perform entrepreneurial tasks, identify opportunities, and develop sustainable business models (Boyatzis, 2008; Spencer & Spencer, 2008; Tehseen et al., 2018).

Design Thinking-Driven Business Modelling (X1) refers to the application of a human-cantered, iterative design thinking methodology, emphasizing empathy, prototyping, and user feedback, to the structured development and validation of a business model, often operationalized through tools like the Business Model Canvas.

AI Utilization (X2) is conceptualized as the adoption and application of artificial intelligence tools (e.g., generative AI, analytics platforms) within the entrepreneurial process, serving as a stimulus that enhances perceived desirability and feasibility of ventures and acts as a catalyst for skill development and business modelling.

Populations and Sample

The research population was sixth-semester students from the Community Education program at four universities in Indonesia: Universitas Bengkulu, Universitas Negeri Jakarta, Universitas Pendidikan Indonesia, dan Universitas Singaperbangsa, with a total population (N) of 240 students. The sample size was determined using the Slovin formula with a 5% margin of error, yielding a minimum sample size of 150. Data were collected from 179 respondents using a simple random sampling technique.

Data Collection Instrument

Data was collected using a questionnaire, which is a technique for gathering data by providing a set of written questions or statements to respondents to answer. The instrument measured three variables: Entrepreneurial Competencies (EC) with 20 items, Design Thinking-Driven Business Modelling (DT) with 9 items, and AI Utilization (AI) with 9 items. All items used a Likert-type scale.

Validity and Reliability

The instrument's validity and reliability were established through two stages. First, expert judgment was sought to assess content validity. Second, an empirical test was conducted with 66 pilot respondents. The results confirmed that the instrument was both valid and reliable for measuring the intended constructions.

Table 1
V Result

Item	Pearson Correlation	Result
Design Thinking-Drive Business Modelling (DT)		
DT.1	0,64	Valid
DT.2	0,705	Valid
DT.3	0,714	Valid
DT.4	0,715	Valid
DT.5	0,717	Valid
DT.6	0,814	Valid
DT.7	0,692	Valid
DT.8	0,728	Valid
DT.9	0,753	Valid
AI Utilization (AI)		
AI.1	0,746	Valid
AI.2	0,707	Valid
AI.3	0,668	Valid
AI.4	0,748	Valid
AI.5	0,824	Valid
AI.6	0,739	Valid
AI.7	0,695	Valid
AI.8	0,699	Valid
AI.9	0,721	Valid
Entrepreneurial Competencies (EC)		
EC.1	0,75	Valid
EC.2	0,722	Valid
EC.3	0,687	Valid
EC.4	0,661	Valid
EC.5	0,645	Valid
EC.6	0,64	Valid
EC.7	0,676	Valid
EC.8	0,645	Valid
EC.9	0,726	Valid
EC.10	0,711	Valid
EC.11	0,719	Valid
EC.12	0,764	Valid
EC.13	0,768	Valid
EC.14	0,661	Valid
EC.15	0,73	Valid
EC.16	0,8	Valid
EC.17	0,801	Valid
EC.18	0,651	Valid
EC.19	0,686	Valid
EC.20	0,709	Valid

Validity test results show at Table 1 demonstrate that the research instrument possesses adequate content and construct validity. Each item functions effectively in measuring its intended latent variable (AI Utilization, Design Thinking-Driven Business Modelling, and Entrepreneurial Competencies). Consequently, this instrument is suitable and reliable for use in primary data collection to test the research hypotheses. No revisions or item deletions are required, as all items have met the statistical criteria as valid measures.

Table 2
Reliability Result

Variable	Cronbach's Alpha	N of Items	Result
AI	.881	9	Reliable
DT	.887	9	Reliable
EC	.950	20	Reliable

Table 2 shows that all three constructions demonstrate excellent internal consistency, as indicated by Cronbach's Alpha values significantly exceeding the commonly accepted threshold of 0.70. The value for Entrepreneurial Competencies (EC) is exceptionally high (.950), confirming superb reliability for its 20-item scale. The values for AI Utilization (.881) and Design Thinking (.887) also denote high and very satisfactory reliability for their respective 9-item scales.

Research Procedure

The research procedure consisted of several key stages:

1. Obtaining research permits and conducting preliminary observations;
2. Determining the population and sample;
3. Developing and presenting the research proposal;
4. Constructing and validating the research instrument (questionnaire);
5. Administering the pilot test and revising the instrument accordingly;
6. Distributing the final questionnaire and collecting data from the main sample;
7. Performing data analysis, including model validity tests (e.g., normality, model fit), hypothesis testing, and interpretation of results; and
8. Finalizing the research findings.

Data Analysis

Data were analyzed using Structural Equation Modeling (SEM), specifically the Partial Least Squares (PLS) approach. PLS-SEM is a variance-based technique suitable for developing and testing causal models, combining aspects of confirmatory factor analysis, path analysis, and regression (Narimawati & Sarwono, 2017). It is appropriate for this study as it does not require strict assumptions about data distribution (non-parametric), is effective for theory development, and allows for the assessment of complex models with latent variables. The model's explanatory power was evaluated using the coefficient of determination (R^2). Analysis was performed using SmartPLS software.

Hypothesis Testing

Hypotheses were tested by examining the significance of the path coefficients in the PLS-SEM model. The significance of individual paths and the overall model was assessed. The research hypotheses were:

- H1: Design Thinking-Driven Business Modelling (DT) and AI Utilization (AI) simultaneously have a significant positive effect on Entrepreneurial Competencies (EC).
- H2: Design Thinking-Driven Business Modelling (DT) individually has a significant positive effect on Entrepreneurial Competencies (EC).
- H3: AI Utilization (AI) individually has a significant positive effect on Entrepreneurial Competencies (EC).

Results and Discussion

Convergent validity was assessed by examining the outer loadings presented in Table 3. In the first convergent validity test, several indicators were found to be invalid—specifically, those with factor loadings below 0.70. This included 5 indicators from Design Thinking (DT1, DT2, DT5, DT8, DT9), 6 indicators from Artificial Intelligence (AI1, AI2, AI3, AI4, AI5, AI7), and 7 indicators from Entrepreneurial Competencies (EC1, EC2, EC4, EC5, EC9, EC18, EC20). Thus, the remaining number of indicators was reduced from 38 to 20.

A second convergent validity test was then conducted using the remaining 20 indicators. This round resulted in one additional indicator from Entrepreneurial Competencies being deemed invalid (DT3), bringing the total number of indicators down to 19. In the third and final calculation, all 19 indicators were confirmed to be valid.

Tabel 3
Convergent Validity

	Convergent Validity 1				***Convergent Validity 2***				***Convergent Validity 3***			
	AI	**EC**	**EC**	**Note**	**AI**	**EC**	**EC**	**Note**	**AI**	**EC**	**EC**	**Note**
DT1		0.669		Not Valid								
DT2		0.691		Not Valid								
DT3		0.724		Valid		0.805		Valid		0.803		Valid
DT4		0.719		Valid		0.757		Valid		0.759		Valid
DT5		0.689		Not Valid								
DT6		0.700		Valid		0.722		Valid		0.720		Valid
DT7		0.710		Valid		0.723		Valid		0.726		Valid
DT8		0.681		Not Valid								
DT9		0.654		Not Valid								
AI1	0.687			Not Valid								
AI2	0.683			Not Valid								
AI3	0.666			Not Valid								
AI4	0.648			Not Valid								
AI5	0.676			Not Valid								
AI6	0.740			Valid	0.711			Valid	0.707			Valid
AI7	0.672			Not Valid								
AI8	0.703			Valid	0.864			Valid	0.865			Valid
AI9	0.712			Valid	0.874			Valid	0.876			Valid
EC1			0.598	Not Valid								
EC2			0.564	Not								

	Convergent Validity 1		*Convergent Validity 2*		*Convergent Validity 3*	
		Valid				
EC3	0.706	Valid	0.680	Not Valid		
EC4	0.618	Not Valid				
EC5	0.685	Not Valid				
EC6	0.750	Valid	0.768	Valid	0.762	Valid
EC7	0.737	Valid	0.772	Valid	0.780	Valid
EC8	0.747	Valid	0.756	Valid	0.763	Valid
EC9	0.700	Not Valid				
EC10	0.785	Valid	0.800	Valid	0.809	Valid
EC11	0.740	Valid	0.769	Valid	0.772	Valid
EC12	0.758	Valid	0.772	Valid	0.771	Valid
EC13	0.770	Valid	0.781	Valid	0.781	Valid
EC14	0.733	Valid	0.750	Valid	0.749	Valid
EC15	0.768	Valid	0.785	Valid	0.793	Valid
EC16	0.801	Valid	0.813	Valid	0.815	Valid
EC17	0.726	Valid	0.725	Valid	0.720	Valid
EC18	0.676	Not Valid				
EC19	0.730	Valid	0.724	Valid	0.727	Valid
EC20	0.629	Not Valid				

As shown in Table 3, convergent validity was established through an iterative refinement of indicators, resulting in a final set of 19 valid items (loading > 0.70) from an initial pool of 38. The retained constructs exhibited excellent internal consistency, with Cronbach's Alpha values of 0.745 for DT, 0.755 for AI, and 0.938 for EC (Table 4), confirming the instrument's reliability.

Table 4
Reliability Result

	Cronbach's alpha	**Note**
Design Thinking	0.745	Valid
Entrepreneurial Competencies	0.938	Valid
AI Utilization	0.755	Valid

The overall model fit was assessed as acceptable. Key indices, including the Standardized Root Mean Square Residual (SRMR = 0.084) and the Normed Fit Index (NFI = 0.709), met the threshold for a reasonable fit, although the significant Chi-square statistic indicated some discrepancy common in complex models with larger samples (Hair et al., 2019). The predictive power of the model, evaluated through R^2 values (Table 6), showed that DT and AI together explained a moderate 44.2% of the variance in Entrepreneurial Competencies. Notably, DT alone was a weak predictor of AI Utilization (R^2 = 0.185), suggesting other significant factors influence AI adoption.

Tabel 5
Model Fit Test Result

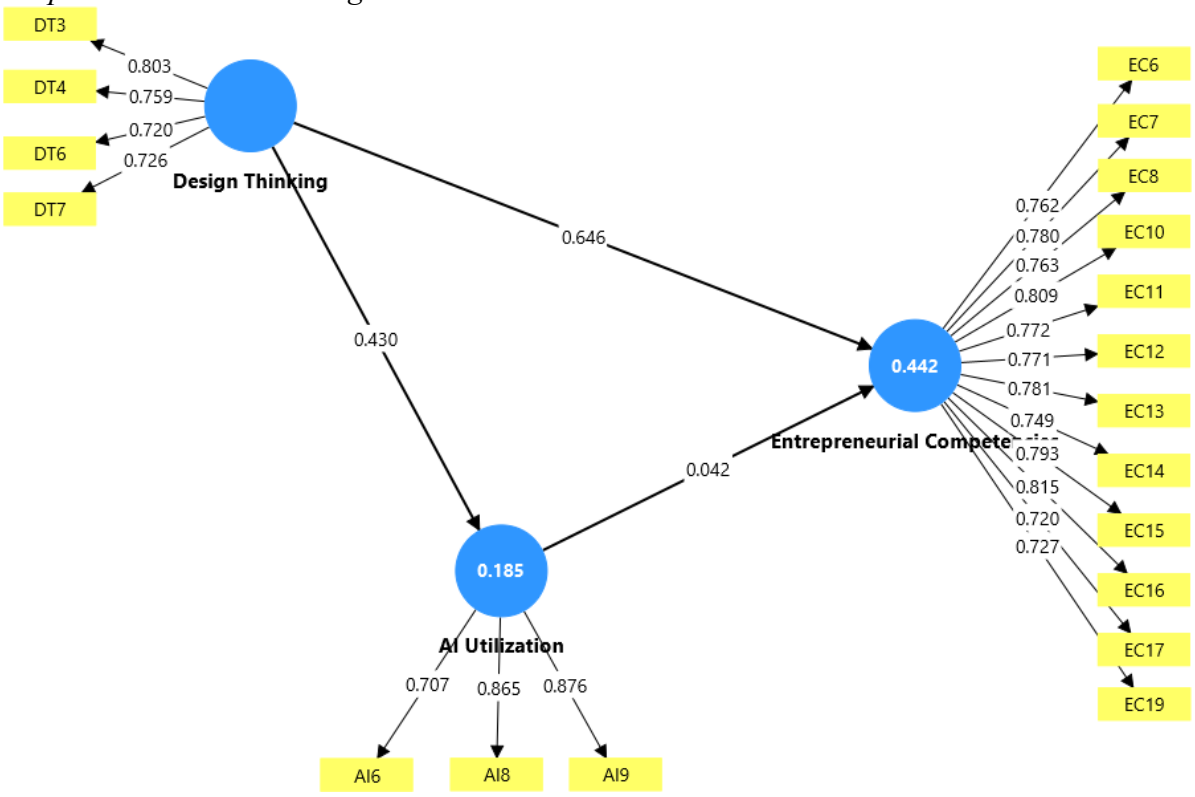
Parameter	Rule of Thumb	Nilai Parameter	Note
SRMR	Less than 0.10	0.084	Fit
d-ULS	> 0.05	1.335	Fit
d-G	> 0.05	0.662	Fit
Chi Square	χ^2 statistic ≤ X^2 table	662.724	Not Fit
NFI	Approaching a value 1	0.709	Fit

Table 6
R Square (R^2) Test Result

	R-square	R-square adjusted
AI Utilization	0.185	0.181
Entrepreneurial Competencies	0.442	0.436

Based on the analysis results, the R-square for the dependent variable Artificial Intelligence is 0.185. This indicates that 18.5% of the variability in artificial intelligence (utilization) can be explained by Design Thinking, which falls into a weak category. Furthermore, the analysis yielded an R-square for the dependent variable Entrepreneurial Competencies of 0.442. This shows that 44.2% (or 40.2% for the adjusted R-square) of the variability in entrepreneurial competencies can be explained by the combined influence of Design Thinking and Artificial Intelligence, which is categorized as a moderate level.

Figure 1
Output Model PLS SEM Algorithms



The hypothesis testing results, summarized in Table 7 and Table 8, provided clear answers to the research questions. A critical finding emerged in the relationship between DT and AI.

H1: Design Thinking-Driven Business Modelling (DT) and AI Utilization (AI) simultaneously have a significant positive effect on Entrepreneurial Competencies (EC), Rejected, as the p-value was greater than 0.05 (p = 0.601).

The path from DT to AI was significant and positive (β = 0.430, p = 0.000), indicating that engagement with the design thinking methodology promotes the adoption and use of AI tools. However, the indirect effect path (DT → AI → EC) was not significant (p = 0.601). Consequently, Hypothesis H1 was rejected, as the simultaneous effect of DT and AI on EC was not statistically significant, primarily due to the non-significant direct role of AI.

H2: Design Thinking-Driven Business Modelling (DT) individually has a significant positive effect on Entrepreneurial Competencies (EC), accepted, with a p-value of less than 0.05 (p = 0.000).

Hypothesis H2 was strongly supported, with Design Thinking-Driven Business Modelling exhibiting a significant, positive direct effect on Entrepreneurial Competencies (β = 0.646, p = 0.000). This finding aligns with theoretical expectations that the iterative, human-centered, and experiential nature of DT fosters the deep cognitive and behavioral patterns essential for entrepreneurial competency development (Blankesteijn et al., 2024; Moure et al., 2023).

H3: AI Utilization (AI) individually has a significant positive effect on Entrepreneurial Competencies (EC), rejected, with a p-value greater than 0.05 (p = 0.592). Hypothesis H3 was rejected, as AI Utilization did not show a significant direct effect on EC (β = 0.042, p = 0.592).

Hypothesis H3 was rejected, as AI Utilization did not show a significant direct effect on EC (β = 0.042, p = 0.592). This challenges the notion of AI as an independent, direct catalyst for competency acquisition in this educational context (Duong et al., 2025).

A critical finding emerged in the relationship between DT and AI. The path from DT to AI was significant and positive (β = 0.430, p = 0.000), indicating that engagement with the design thinking methodology promotes the adoption and use of AI tools. However, the indirect effect path (DT → AI → EC) was not significant (p = 0.601). Consequently, Hypothesis H1 was rejected, as the simultaneous effect of DT and AI on EC was not statistically significant, primarily due to the non-significant direct role of AI.

Table 7
Hypothetic Result

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Note
AI Utilization -> Entrepreneurial Competencies	0.042	0.035	0.079	0.535	0.592	Rejected
Design Thinking -> AI Utilization	0.430	0.437	0.073	5.873	0.000	Accepted

Design Thinking -> Entrepreneurial Competencies	0.646	0.655	0.056	11.564	0.000	Accepted

Table 8
Intervening Result

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Design Thinking -> AI Utilization -> Entrepreneurial Competencies	0.018	0.014	0.035	0.523	0.601

This study makes a distinct contribution by empirically testing a competency-based model within the under-researched context of Community Education, a discipline specifically dedicated to cultivating "entrepreneur-facilitators" capable of fostering grassroots economic and social innovation (Boothroyd & Davis, 1993; Saepudin & Mulyono, 2019). Unlike traditional business programs, community education emphasizes collaborative, asset-based development, requiring a unique blend of entrepreneurial and facilitative competencies.

The robust support for H2 underscores the foundational relevance of pedagogical frameworks such as Design Thinking (DT) and the Business Model Canvas (BMC) for this cohort. Grounded in Kolb's (2003) experiential learning cycle, these methodologies enable students to engage iteratively with ill-defined, real-world problems, moving from concrete experience to reflective observation, abstract conceptualization, and active experimentation. This process effectively translates theoretical knowledge into internalized, actionable competencies, such as empathetic problem identification, stakeholder engagement, and adaptive venture planning. Such skills are not merely complementary but essential for students who must later navigate complex community ecosystems, mediate diverse interests, and co-create sustainable value propositions that align with local social and environmental contexts (Bachmann et al., 2024; Moure et al., 2023).

The rejection of H3 and H1, however, introduces a necessary and nuanced perspective on the role of emerging technology in competency-based entrepreneurship education. While AI is increasingly hailed as a transformative enabler that enhances perceived venture feasibility and desirability (Thu et al., 2025), this study reveals that its impact on deeper competency development is neither automatic nor direct. The significant path from DT to AI suggests that engagement with human-cantered, iterative problem-solving methodologies may increase students' awareness and adoption of AI tools.

However, the non-significant path from AI to EC indicates that, in this educational context, AI functions primarily as an adopted tool within a human-centered process, rather than as a standalone competency builder. This finding aligns with growing scholarly caution that the effectiveness of AI in learning contexts is critically moderated by factors such as AI literacy, pedagogical integration, and the presence of scaffolded guidance (Awal & Chowdhury, 2024; Miranda, 2025). Without deliberate instructional design that explicitly connects AI tool usage, for example, in data-driven market validation or generative idea exploration, to the core DT competencies, students' engagement with AI may remain superficial. Consequently, AI may fail to enhance higher-order entrepreneurial competencies such as critical reflection,

strategic decision-making, and resilience, which are cultivated through iterative application, feedback, and reflection in real-world scenarios (Blankesteijn et al., 2024).

Furthermore, the model's moderate explanatory power ($R^2 = 0.442$) highlights that a substantial portion of variance in entrepreneurial competencies stems from factors beyond the current research model. This is consistent with the Competency Iceberg Model (Spencer & Spencer, 2008), which posits that observable competencies (knowledge and skills) are underpinned by deeper, less mutable attributes such as personal motives, traits, self-concept, and values. These implicit characteristics are difficult to influence through short-term educational interventions but fundamentally influence entrepreneurial behaviour and capability development.

Additionally, competencies are shaped by the broader entrepreneurial ecosystem, including institutional support mechanisms, mentoring networks, social norms, and market conditions (Popa & Breazu, 2025). Future research could therefore extend this model by incorporating these latent psychological constructs and contextual variables, potentially through mixed-methods or longitudinal designs, to provide a more holistic understanding of competency formation in community-oriented entrepreneurship education.

Summary: Conclusion

DT-driven pedagogy stands out as a potent mechanism for building entrepreneurial competencies in future community facilitators, the integration of AI requires more than mere tool exposure. It calls for intentionally designed learning experiences that embed AI within the DT process, coupled with explicit competency mapping and adequate literacy support. This approach ensures that technology adoption translates into meaningful capability development, ultimately preparing students not only to use digital tools but to leverage them thoughtfully within the complex, human-centered process of community empowerment.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Students' Attitudes Towards the Integration of AI in Higher Education: Perceptions and Challenges in Mauritius

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Abstract

Artificial intelligence (AI) is transforming higher education by improving learning experiences, automating administrative tasks, and providing personalized support to students. However, research on students' attitudes towards AI remains limited, particularly in developing countries like Mauritius. This study examines students' familiarity with AI tools, their perceptions of AI's impact on education, and the key challenges in its adoption. A mixed-methods approach was used, incorporating a structured questionnaire to gather comprehensive insights. Quantitative data were analyzed using descriptive statistics, while qualitative responses were thematically coded. Findings indicate that while students acknowledge AI's potential in education, they express concerns regarding accessibility, ethical implications, and institutional preparedness. Furthermore, many students lack awareness of AI's role in their academic and professional futures, highlighting the need for targeted AI education initiatives. The study recommends integrating AI literacy programs within university curricula, ensuring equitable access to AI tools, and establishing clear ethical guidelines for AI use in education. Additionally, universities should involve students in AI policy development to promote comprehensive decision-making. These insights contribute to ongoing discussions on AI adoption in higher education, providing a foundation for further research that includes faculty and administrative perspectives to develop a holistic AI integration framework.

Keywords: artificial intelligence, higher education, student perception, AI adoption

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Introduction

Over the past few years, with the advent of technological advancements and the implementation of artificial intelligence (AI), along with the use of machine learning models, a significant technological revolution has infiltrated every aspect of our life. In the educational context, the concept of teaching assisted by automated learning systems refers to the tools, techniques, and methodologies that rely on the foundations of AI and are used to automate processes requiring technological intervention within a technology-enhanced learning environment (Romero et al., 2023).

Furthermore, AI significantly enhances evaluation methods, which prepares students more effectively for future careers by aligning with evolving job market demands. This suggests that higher education institutions should integrate more AI into their curricula to produce graduates who are well-equipped to meet future market needs (Slimi, 2021).

In Mauritius, discussions surrounding AI adoption in higher education is gaining increased attention from policymakers, educators, and institutions. However, limited research exists on students' attitudes towards AI implementation. This study aims to fill this gap by examining students' familiarity with AI tools, their perceptions of AI's impact, and the challenges faced in its integration within Mauritian universities.

This paper explores students' perceptions of AI applications within educational processes, focusing on students as the primary consumers of educational services. Adopting a service-dominant logic and co-creation perspective, students are seen not only as customers but also as active participants and co-creators in the service process, emphasizing their central role in value creation (Bowden, 2011). Celuch and Robinson (2016) describe higher education as a “unique experiential service,” where student engagement spans both academic and broader educational experiences. Thus, understanding the dynamics between students and institutions is crucial for creating value in educational services. Given that AI technology can significantly impact the student experience (Barrett et al., 2019), this study aims to achieve the following research objectives, firstly, to identify students' current perceptions of AI tools in higher education and to develop strategies for integrating AI tools into higher education to enhance learning and student engagement.

This paper is structured as follows: Section 1 introduces the topic; Section 2 presents a comprehensive Literature Review of Artificial intelligence in higher education. Section 3 outlines the Methodology used in this study. Section 4 presents the Findings, including students' perceptions and key themes derived from the data. Section 5 provides Recommendations, suggesting practical ways for higher education institutions to integrate AI tools effectively. Finally, Section 6 concludes the paper by summarizing the key insights, implications, and potential future research directions.

Literature Review

Definition of Artificial Intelligence

Artificial Intelligence (AI) refers to computer systems performing tasks typically requiring human intelligence (Andresen & McCarthy, 2002). AI systems analyse their environment and act autonomously to achieve specific goals (Boucher, 2020). Buabbas et al. (2023) describe AI as enabling machines to simulate human-like capabilities, including reasoning and problem-

solving. AI is categorized into data-driven, logic-based, and knowledge-based approaches. The data-driven approach relies on large datasets, while logic-based AI focuses on problem-solving, and knowledge-based AI prioritizes inference models. AI can also be classified into narrow AI, general AI, and artificial superintelligence (Marrone et al., 2022). Narrow AI specializes in specific tasks using machine learning. General AI mimics human cognitive abilities. Artificial superintelligence exceeds human intelligence and capabilities. These classifications highlight AI's evolving role in technological advancement.

Artificial Intelligence in Higher Education

The importance of applying artificial intelligence in the educational sector was especially emphasised due to the COVID-19 pandemic, which resulted in a shift from traditional classroom teaching to a digital form of learning (Maqbool et al., 2021; Mijwil et al., 2022; Pantelimon et al., 2021). AI-driven systems and technologies hold immense potential to transform traditional operational models in higher education institutions (Dhawan & Batra, 2020). According to Intelligence (2018) the United States Education Sector Report predicts a 47.50% growth in AI within the U.S. education sector from 2018 to 2022.

Baker et al., (2019) categorize AI technologies into three distinct applications: learner-facing, teacher-facing, and system-facing AIEd. Learner-facing AI consists of software tools students use to study specific subjects. Teacher-facing AI automates tasks such as administration, evaluation, feedback, and plagiarism detection, which supports teachers by reducing workload and enhancing insights into student progress. System-facing AI provides institutional-level data to administrators and managers, facilitating more informed decision-making (Zawacki-Richter et al., 2019).

AI's integration into higher education can significantly improve the learning experience, decrease dropout rates, and foster personalized learning environments for students (Pedró, 2020). It can also help to achieve sustainable development goals (SDGs) presented by the UN General Assembly, such as those related to ensuring equal quality education for all (SDG4) and reducing inequalities between online and on-site approaches with special emphasis on students with disabilities (SDG 10) (Furini et al., 2022).

The Microsoft Education Transformation Framework (ETF) for Higher Education provides detailed guidance for developing a comprehensive digital transformation strategy in educational institutions. This framework includes four main pillars namely student success, teaching and learning, secure and connected campus, and academic research, through which AI can be effectively integrated to deliver efficient outcomes (Papaspyridis, 2020).

Focusing initially on the pillars of student success, secure and connected campus, and academic research, it is noted that student success encompasses strategies for student recruitment and retention and building lifelong connections with students. AI tools can project trends in admission decisions and potential dropout scenarios, thus allowing for timely interventions (Pedró, 2020). Tsai et al. (2020) successfully used AI to predict high-risk students and the underlying causes of dropout, enabling proactive support and solutions.

The secure and connected campus pillar involves efficient management of campus resources, ensuring a safe and intelligent campus environment. AI can automate the management of campus facilities and streamline human resource and financial operations, transforming campuses into smarter ecosystems (Dhawan & Batra, 2020). AI applications like virtual

assistants and chatbots at administrative desks offer quick, personalized, cost-effective, and efficient solutions (Dhawan & Batra, 2020).

In terms of academic research, AI enables researchers to operate within an effective computing environment, removing barriers and fostering global collaboration. AI enhances the research process by simplifying data handling, survey creation, interview conduction, and detection of falsified data (Dhawan & Batra, 2020).To better understand and identify the barriers for fostering global collaboration, student's perception of artificial intelligence should be studied.

Student Perceptions of Artificial Intelligence

According to the authors Gherheş and Obrad (2018), the perception of students on the use of AI tools in higher education is an evolving topic with a range of opinions and findings documented in academic literature. One cannot neglect the importance of student perceptions regarding it since they represent the final users of educational services. Several studies have explored student perceptions of Artificial Intelligence (AI) in educational contexts, revealing both opportunities and challenges. For instance, Gherheş and Obrad (2018) also found that most undergraduate students felt under-informed about AI, yet believed it could positively impact society. However, fears such as AI leading to job loss and surpassing human intelligence were prevalent (Wang et al., 2024). Similarly, Jeffrey (2020) identified a general positive outlook towards AI among college students, though their understanding ranged from moderately high to low.

Research by Wang et al. (2024) and others focused on factors influencing students' intentions to learn AI, noting the role of AI anxieties, especially concerning job replacement, and the positive effects of learning motivations and self-efficacy. Studies extended to different educational levels, from elementary to university students, examining their readiness to engage with AI.

Idroes et al. (2023) reported a generally favourable perception among undergraduates on the use of AI in education, citing advantages like virtual assistants and universal access, but also noting significant drawbacks such as diminished student-teacher relationships. Cheng et al. (2023) developed the Student Conceptions of AI in Education Scale (SCAIES), identifying key AI applications in education from intelligent tutoring to sentiment analysis and personalized learning.

The perception of AI tools among students varies significantly based on their experiences and backgrounds. While many appreciate the efficiency and personalized learning opportunities, others express reservations about privacy and the authenticity of AI-mediated interactions.

A survey by Nguyen et al. (2020) found that students are generally positive about the use of AI for logistical applications like scheduling and feedback, but they prefer human interaction for more complex discussions and support.

Lastly, research by Kuleto et al. (2021) and Sangapu (2018) highlighted the mixed perceptions of AI's role in education, with findings suggesting AI can enhance personalized learning and teaching effectiveness, though there is substantial uncertainty about AI replacing human teachers entirely. These studies collectively underscore the complex and multifaceted views students hold towards AI in educational settings.

Benefits of AI Tools in Higher Education

The advantages of artificial intelligence applications in higher education are vast and varied. AI methodologies offer substantial value in multiple areas of teaching and learning, particularly at the student, lecturer, and institutional levels.

Student Level

According to Munir et al. (2022), AI enhances students' education by facilitating access to suitable courses, improving teacher interactions, and allowing more time for other tasks. A key trend in education is personalization, where AI tailors learning experiences to individual preferences, knowledge levels, and goals (Lane & Saint-Martin, 2021). AI-powered systems analyse students' learning histories, identify weaknesses, and suggest courses to enhance learning (Munir et al., 2022).

In tutoring, students often require extra support beyond the classroom, while many instructors face time constraints. AI-driven tools, including chatbots, help bridge this gap by providing personalized assistance (Zhou et al., 2020). Tomaskinova and Tomaskin (2024) highlight AI's role in online education, offering adaptive learning, automating routine tasks for teachers, and enabling individualized instruction. AI-powered learning platforms provide 24/7 access, allowing students to explore concepts independently. Exchange students also benefit from AI-driven education without incurring travel and living expenses (Photopoulos & Triantis, 2022). In addition, AI technologies like speech-to-text and language translation tools can make learning more accessible for students with disabilities or those who speak other languages, as highlighted by Nacheva and Czaplewski (2024).

Lecturer Level

AI provides data-driven insights that enable lecturers to refine their teaching strategies and enhance their competency (Zawacki-Richter et al., 2019). AI-powered learning analytics track student progress, engagement levels, and comprehension, allowing lecturers to tailor their teaching approaches accordingly (Holmes et al., 2019). Additionally, AI-driven professional development platforms offer personalized training for educators, ensuring they stay updated with modern pedagogical methodologies (Tomaskinova & Tomaskin, 2024).

Moreover, AI facilitates automated grading and feedback, reducing administrative workload and enabling educators to focus on mentorship and curriculum improvement (Selwyn, 2019). As AI continues to evolve, blended AI-human instruction models are emerging, where lecturers use AI to complement their expertise rather than replace it (Chen et al., 2020).

Institutional Level

AI enhances an institution's branding and corporate image by demonstrating technological leadership, innovation, and a commitment to student success (Molnár & Szüts, 2018). AI-driven solutions, such as chatbots, automated communication, and personalized learning platforms, improve institutional visibility and reputation, attracting students, faculty, and industry partnerships (Veletsianos et al., 2024; Zawacki-Richter et al., 2019). Moreover, AI fosters institutional innovation by optimizing administrative processes, research capabilities, and digital education infrastructure (Aoun, 2017). AI-powered predictive analytics and adaptive learning systems enable universities to make data-driven decisions on enrolment,

resource allocation, and curriculum design, ensuring they stay ahead in a competitive academic landscape (Dwivedi et al., 2023; Selwyn, 2019). Additionally, smart campus initiatives utilizing AI improve efficiency, sustainability, and student engagement, reinforcing institutions as pioneers in educational transformation and technological advancement (Brynjolfsson & Mcafee, 2017).

Challenges and Concerns

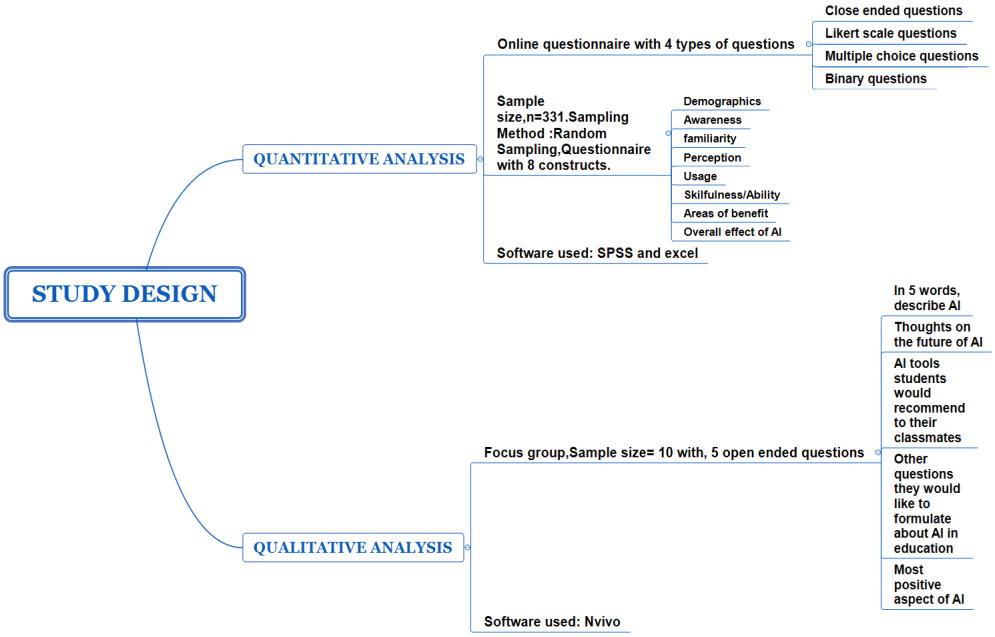
- Ethical and Privacy Issues: The use of AI in education raises concerns about data privacy and ethical use of student information. Bostrom and Yudkowsky (2018) discuss potential risks associated with AI, including biases in algorithms that could impact student assessments.
- Dependence and Reduced Critical Thinking: There's a concern that reliance on AI tools might lead to diminished critical thinking and problem-solving skills among students. A study by Gerlich (2025) suggests that over-reliance on AI tools for tasks like research and writing could inhibit the development of these essential skills.
- Digital Divide: The varying levels of access to technology can exacerbate existing inequalities in education. Students from lower socioeconomic backgrounds may not benefit equally from AI tools, as they might lack the necessary resources, a concern highlighted by Ahmed (2024).

Research Methodology

In this exploratory research, mixed research has been used to better explore the perception of students among four public HE institutions in Mauritius namely Université des Mascareignes, University of Mauritius, Open University and University of technology, focusing on their usage and perspectives of AI tools in education. A sample size 331 students were tested for this study through an online questionnaire. The online survey covered topics such as students' familiarity with AI tools commonly used, the integration of AI technologies into higher education, potential challenges posed by AI, benefits, and the impact on their learning outcomes. In addition, a qualitative analysis with 20 candidates were interviewed through focus group discussion. Participation was entirely voluntary, and all responses remained anonymous. For the analysis, descriptive statistics were used to interpret the survey data.

Findings

Figure 1
Study Design Framework for Investigating AI in Higher Education



Qualitative Results

Here are some key results and observations based on the key constructs of the questionnaire.

(i) Demographic information

Among the sample gathered, 53.4% identified as male, 45.9% as female, and 0.9% as another gender. Regarding their study levels, most respondents (93.1%) were undergraduates, while 5% were master's students, and 0.9% were pursuing doctoral studies.

In terms of their fields of study, 42.5% of the students were enrolled in Management, 2% were in Social Sciences, 21% pursued Engineering, and 27.4% were studying Information Technology.

(ii) Awareness

Nearly all respondents (98%) have heard of the term "Artificial Intelligence." A significant majority, 86.7%, have encountered applications or tools that involve AI, showing that most students have practical exposure to AI in some form. However, 13.2% have not had such encounters, suggesting that while AI is widely present, some students may still lack direct interaction with it. In addition about 95% of respondents indicated that they are familiar with AI tools, suggesting that not only are they aware of AI, but they also have a level of familiarity with AI-related applications. A small percentage (4%) expressed unfamiliarity, which may indicate a learning gap or hesitance in using AI tools.

(iii) Familiarity

The first Chi-square test yielded a Chi-square statistic of approximately 16.34 with a p-value of 0.012, indicating a statistically significant association between gender and familiarity with AI concepts. This suggests that familiarity with AI concepts differs significantly between males and females in this dataset.

The second Chi-square test produced a Chi-square statistic of approximately 12.42 with a p-value of 0.647, indicating insufficient evidence to establish a statistically significant difference in AI familiarity across various fields of study. In other words, students' familiarity with AI concepts appears to be consistent regardless of their study field.

(iv) Perception

Table 1
Inferential Statistics Which Shows Correlation and Significance Between AI Perception Variables

Question pairs	Correlation	P-Value
Positive View vs Trust in AI	0.632	0.049
Knowledge of AI Tools vs Confidence with AI	-0.095	0.792
Positive View vs Can Study without AI	0.253	0.480

Here are the correlation results for the selected question pairs.

- Positive View vs Trust in AI: Moderate positive correlation ($r = 0.63$, $p = 0.049$) indicates a statistically significant relationship. Students with a positive view of AI tend to trust AI-generated information.
- Knowledge of AI Tools vs Confidence with AI: Weak negative correlation ($r = -0.09$, $p=0.79$) shows no significant relationship. Familiarity with AI tools does not translate to confidence in using them.
- Positive View vs Can Study without AI: Weak positive correlation ($r = 0.25$, $p = 0.48$) suggests no significant relationship. A positive AI perception does not strongly affect students' belief in studying without AI.

(v) AI tool usage

Most students (106) use AI several times a week, indicating regular but not daily use.

Nearly half of the rest of the population (75) use AI rarely or several times a month, showing occasional engagement.

Frequent users (74) rely on AI almost daily, but they form a smaller group.

AI tools are integrated into study routines but are not indispensable for most students.

The variance in AI tool usage suggests differences in familiarity, relevance, and task-specific needs. High-variance tools like Grammarly (SD = 1.54), QuillBot (SD = 1.61), and ChatGPT 3.5/4 (SD = 1.33) indicate that some students use them frequently, while others rely on them only for specific tasks. Low-variance tools such as Claude 2 (SD = 0.51) and Liama 2 (SD = 0.32) show limited engagement, likely due to lower awareness or specialized functionality.

Familiarity plays a key role in usage patterns—widely known tools like ChatGPT 3.5/4 have a broad range of responses, while less familiar tools such as Unriddle and Jasper Chat show low engagement**.** These patterns highlight that AI adoption among students depends on both awareness and task relevance rather than just availability.

(vi) Skilfulness in using AI tools

Most respondents (50.07%) consider themselves partially skilled, followed by skilled individuals (25.07%). A smaller proportion identify as very skilled (6%). These findings suggest that while a significant number of students possess some level of AI proficiency, gaps remain that may require targeted training. Further investigation into specific AI competencies, such as data analysis, natural language processing, or machine learning, could enable institutions to develop more effective, needs-based educational interventions.

(vii) Areas of Benefit and overall effect of AI

Table 2
Shows Correlation and Significance Between AI Perception Variables

Area of Benefit	Never (%)	Rarely (%)	Sometimes (%)	Often (%)	Very Often (%)	N	Mean	Std.
Generating of Ideas	10 (3%)	23 (8%)	76 (25%)	132 (43%)	89 (29%)	330	3.79	1.1
Writing Research Papers	21 (6%)	48 (15%)	85 (26%)	112 (34%)	65 (20%)	331	3.46	1
Searching for Information	8 (2%)	23 (7%)	67 (20%)	115 (35%)	114 (35%)	327	3.94	1.1
Explanation of Material	8 (3%)	18 (6%)	87 (27%)	101 (31%)	100 (33%)	326	3.85	1.1
Task Problem Solving Skills	20 (6%)	26 (8%)	104 (31%)	105 (31%)	74 (24%)	329	3.57	1

Based on the table, here are some key observations.

1. **AI's Strong Role in Information Gathering and Comprehension**

Students rate "Searching for Information" and "Explanation of Material" highly, with mean scores of 3.94 and 3.85, respectively, highlighting AI's usefulness in these areas. Many responses fall into the "Often" and "Very Often" categories, suggesting that students frequently turn to AI for tasks that involve finding and grasping information.

2. **Moderate Usefulness for Generating Ideas and Problem Solving**

With a high mean score of 3.79, "Generating Ideas" ranks well, with many students marking "Often" and "Very Often," indicating that AI tools provide solid support for brainstorming and creative thinking.

"Task Problem Solving Skills," however, has a slightly lower mean of 3.57 and more responses in the "Sometimes" and "Often" categories. This suggests that while AI tools are helpful for specific problem-solving tasks, they may not be as universally relied upon as they are for information gathering and comprehension.

3. **Writing Research Papers**

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4. **Standard Deviation Insights**

With a standard deviation around 1.0 across each area, there is moderate variation in student responses. This suggests that while many students find AI tools helpful, a portion of students may not feel the same benefit. This difference could stem from varying levels of familiarity with AI or differing academic needs among students.

5. **Overall Preference for AI in Routine and Supportive Tasks**

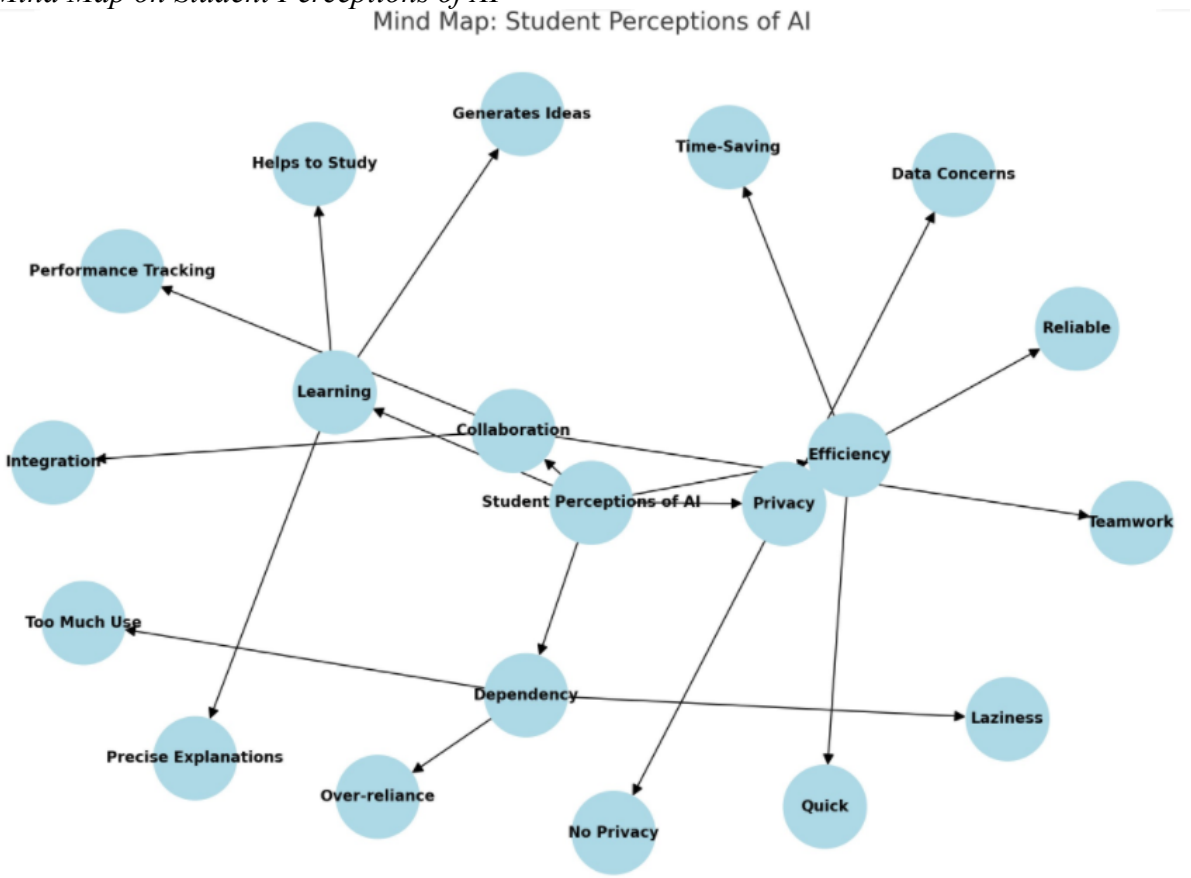
The data suggests that students tend to find AI more useful for routine tasks like idea generation and information retrieval, rather than for more structured academic work such as writing research papers. This could imply that while students value AI's support for exploration and learning, they still rely on their own efforts or traditional resources when it comes to completing formal assignments.

In summary, the data suggests that AI tools are perceived as highly beneficial for enhancing learning and understanding, with slightly less impact on formal writing tasks. This could imply areas for improvement in AI's capacity to assist with academic writing or structured assignments.

Quantitative Results

The quantitative findings were derived from a focus group consisting of 10 students, with the data visualized using the NVivo Free Trial software.

Figure 2
Mind Map on Student Perceptions of AI



The central focus of the study is "Student Perceptions of AI," which is categorized into five key areas: Efficiency, Dependency, Collaboration, Privacy, and Learning. Students largely view AI as a tool that enhances productivity and saves time, with terms like "Quick," "Reliable," and "Time-Saving" reflecting its perceived efficiency. Many also regard AI as a valuable learning aid, as it facilitates effective studying, provides precise explanations, and generates ideas to support assignments. However, concerns about over-reliance are evident, with some students fearing that excessive dependence on AI could weaken their problem-solving and critical thinking skills, as indicated by terms such as "Over-reliance" and "Laziness." Privacy concerns also emerge, with students expressing caution about data security, mentioning risks such as "Data Concerns" and "No Privacy." On the positive side, AI is recognized for its role in enhancing collaboration and teamwork, helping to track performance and streamline shared tasks. Overall, students acknowledge AI's dual impact, appreciating its benefits in efficiency and learning while remaining mindful of its potential drawbacks, particularly in terms of dependency and privacy.

Recommendations

Based on the findings of this survey, several recommendations can be developed to enhance students' effective and confident use of AI in their academic studies. These recommendations focus on increasing familiarity, building trust, and promoting purposeful engagement with AI tools.

1. **Promote AI Literacy and Critical Evaluation**

Findings reveal that 57% of students trust AI-generated outputs but do not critically assess their accuracy. This highlights the need for AI literacy programs that teach students how to evaluate AI-generated information. Universities should offer workshops on AI ethics, limitations, and validation methods to promote responsible AI engagement (Huang et al., 2023).

2. **Increase Awareness and Accessibility of Underutilized AI Tools**

Survey data show that while 78% of students frequently use ChatGPT and Grammarly, less than **30%** explore AI tools for data analysis and project management. Universities should promote awareness of underutilized AI tools by integrating them into curricula, offering demonstrations, and providing discounted subscriptions through institutional partnerships (Alqahtani & Wafula, 2025).

3. **Offer Personalized AI Tool Recommendations**

Survey responses indicate that students use AI differently based on their academic disciplines. For example, 45% of science students utilize AI for data analysis, while 67% of humanities students rely on AI for writing assistance. To enhance AI adoption, universities should create an online portal that provides personalized AI tool recommendations based on students' academic fields and study levels (Jdidou & Aammou ,2024).

4. **Foster a Balanced Approach to AI Use**

Survey results show that 82% of students view AI as a supportive tool rather than a replacement for critical thinking. Educators should reinforce this perspective by encouraging students to combine AI with traditional research methods and analytical reasoning. This balanced approach ensures that AI enhances learning without diminishing independent thought (Dzogovic et al., 2024).

5. **Evaluate the Impact of AI Tools on Academic Outcomes**

A key finding from the survey is that students who actively use AI tools for study support report an 11% higher self-perceived improvement in academic performance compared to non-users. To assess AI's broader impact, universities should conduct longitudinal studies measuring AI engagement against academic performance metrics, such as grades and course completion rates (Hardini et al., 2025). By implementing these recommendations, educational institutions can foster not only familiarity with AI but also confident, purposeful engagement. These approaches ensure that students develop the necessary skills to navigate and benefit from AI in their academic journeys.

Conclusion

On the overall, the survey reveals that students generally hold a positive perception of AI and also find certain AI tools helpful in assisting them academically, and trust the information generated by AI when they have a favourable view of it. However, familiarity with AI tools does not correlate with confidence while using them, highlighting an area where training and hands-on experiences may benefit students. Moreover, the differences in frequency of tool usage indicates that while some AI tools play a prominent role in academic work, others might

be underused due to lack of knowledge amongst academic tasks, possibly due to a lack of awareness or specific applicability.

These findings suggest that educational institutions could support students by offering targeted training on effective AI tool usage, fostering critical engagement with AI outputs, and promoting tools that meet specific academic needs. Future research might explore the impact of structured AI training on students' confidence and actual performance to validate these findings further.

The limitation of this study is the sample size of 331 students from university faculties in Mauritius. Since the findings are based on a specific region, they may not fully represent the experiences or usage patterns of students in other parts of the world. Additionally, focusing on Mauritian university students might not capture the broader diversity in how AI tools are understood, accessed, or utilized among students globally. Expanding this research to include a more varied and extensive sample, along with objective assessments of AI tool usage and skill levels, could offer deeper insights into the role of AI in higher education across different cultural and educational contexts.

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Decolonising Education: Rethinking Early Childhood Education in Indigenous Spaces

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Abstract

This paper attempts to understand and rethink Early Childhood Education from the context of the life world and the worldview of rural and indigenous communities. It is an attempt to contextualise (and in the process indigenize and decolonize) the developmental and learning goals of pre-schoolers in two Open Learning Centres in two villages in Chhattisgarh in central India. Modern and urban understandings (which are also westernized understandings) of child development and child education continue to colonize the culture of existing pre-schools. This necessitated the creation of a space – Open Learning Centres called *Srijan-Shala* (Abode of Creativity) – where early childhood education shall be in tune with the indigenous life world and worldview. There is a stress in Srijan-Shalas on points of dialogue and possible commonality between the apparently "traditional" and the purportedly "modern". This paper is a rigorous documentation of an attempt at building such a space and our journey through the painstaking process of training teachers in the ethos of a democratic classroom (where learning, playing and questioning are co-constitutive), creating indigenized decolonized curriculum and lessons, and birthing pedagogic practices and innovations that are caring. Women of the same village – who have received education and are the founders of Chinhari – teach in their respective Srinjan-Shalas, sharing their know-how of their own environment, cultural practices and traditions in a form of caring collective. The paper critically reflects on the birth and the sustainability of the idea of decolonized early childhood education in rural and indigenous contexts and communities.

Keywords: decolonisation, indigenous curriculum, Hamar Srijan Shala, early childhood education, community-based learning

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Introduction

This paper is a reflection on the process of setting up two *Srinjan Shalas* (translated as "Abode of Creativity" in English) in two villages (Mardapoti and Dokal) in the Dhamtari district of Chhattisgarh in India. The Srijan Shala works with children in the age group of 3 to 8. This does not reflect the typical age group of children under the purview of Early Childhood Education (ECE) which is 0 to 6 years. Though this age range is different from the perceived age bracket of children in the context of ECE, this was perhaps the first stepping stone towards our attempt to reimagine ECE in this particular space. The urge to set up the Srijan Shalas were three-fold: (a) access to quality education, (b) access to indigenised curriculum and (c) creation of democratic *class-spaces* (not class-rooms) for active, experiential and immersive learnings. The paper is divided into several sections. We begin with the question of Context and background – the larger background of early childhood education and the background of Chinhari in rural, forest contexts.

Context of Setting up ECE

Absence of quality school education in the villages, especially for younger children who did not have the capacity to move further from their home, served as the primary incentive to initiate questions and efforts around a possible Srijan Shala. The focus of ECE has shifted in many of the preschools in the urban spaces. From being a space for exploration, where a child constructs her own knowledge through her interaction with the world – human, animal, plant, non-human, divine, preschools have taken up the mantle of making them "school ready" and eventually ready for merely the job market (like teaching coding and robotics in ECE, including public speaking, speech and drama). "Under the impact of intense urbanization, children became a natural resource to be moulded by schools and fed into the industrial machine" (Illich, 2021, p. 86). The changing role of ECE was also a question we attempted to reflect upon in tandem with the ideas of "children as active learners", "experiential learning opportunities" and "scaffolding". The idea of ECE, to be carried out in specific places, (kindergartens and pre-schools), under trained individuals (EC Educators) was perhaps necessitated by the society where it emerged as practice and field of study. The role of the community in the life of an indigenous child needs to be considered when their early years are explored. The child grows up within the community, being a part of it. The community is the totality of the many worlds – human, animal, plant and the divine. The community deeply immersed in its traditional roots and yet standing on the threshold of modernity.

The Idea of Education

Homogenisation

> Of all conflicts in the field of education, that between Imagination and Discipline is the most bitter and prolonged. (Tagore, 1961, p. 22)

Education in today's context has been rendered synonymous with instructions and discipline. Dished out under the vigilant supervision of curriculum, administration, teachers and assessments, in tandem with an institution, it is always delivered. To ones who are assumed to know no better. They are conceived in the mind and boardrooms of people whose life and world view could be in complete or partial contradiction to the ones it is being framed for. Perhaps, it hence goes unnoticed that it is most often a "one size fits all" kind of curriculum. The centralised curriculum that runs along the length and breadth of the country (India), hardly

considers the diversity of the different states and cultures. The context of the rural and the indigenous children are completely overlooked.

Education has thus become a process, an endeavour, an effort – that is outside and alienated from the life worlds of many of the very children it seeks to educate.

Neoliberalism and the Human Capital

Education has thus taken this shape of being a business transaction where one can purchase the quality of services.

> To be a scholar in the Middle Ages meant to be poor, even a beggar… The old university was a liberated zone for discovery and the discussion of ideas both new and old. …The structural purpose of the modern university has little to do with the traditional quest. …Students see their studies as the investment with the highest monetary return, and nations see them as a key factor in development. (Illich, 2021, pp. 50–51)

In schools what is taught is what is construed as knowledge and what counts as knowledge is a reconstruction based on selection under given market circumstances. The composition of the educational opportunities affects the choices of what is taught in schools which again reflects the classification of knowledge. For me, education is an act of deliberation. However, in a market-obsessed polity, education may paradoxically become a means to phase out certain voices or make them inaudible. This is done by the conversion of humans into human capital.

The Docile Worker and the Absence of a Democratic Classroom

> One who remains contended with the world as it appears to be is perhaps not serving the function of an intellectual. An intellectual is restless-perpetually thinking, wondering and reflecting on his/her times. (Pathak, 2020, p. 41)

Everyone thinks, wonders and argues. What perhaps needs to be reasserted is space for dialogue and freedom of thinking in the classrooms. Dialogue is faith which perquisites understanding and respect for all those who are engaged in the process. “Only dialogue, which requires critical thinking, is also capable of generating critical thinking” (Freire, 2017, p. 65). Critical thinking, however, is no ordinary feat. It requires spirit, character and a distinctive mind. Educational spaces are devoted to creating docile workers rather than freeing the mind to question things around them.

The Idea of ECE: *Heartspace* in Education

The formative years of growing up, especially from birth to 5 years of age are most crucial in the development of a child. It is during this time that most of the brain synapses are formed as children are trying to make sense of themselves and their environment concretely and experientially. They are in a constant mode of exploration through their five senses, their feelings-emotions and abilities.

The crucial role of the early childhood years is often overlooked, in the context of the schools, in indigenous spaces. The languages of endearment that are used, the valuable everyday experiences, the idea of nutrition, the role of conversation and the physical touch through oil

massage, bathing, feeding, carrying and sleeping, are not included as important components in the process of development. The caring and care giving function of the community is replaced and reduced to the charts and insufficient "mid-day meals", which delves neither into the questions of learning nor nutrition.

A child of pre-school age is not just a child between 0 -6 years or even 8. She is also a child from the rural indigenous world. Social Learning theories of child development shows us that children learn from their environment. Meaningful learning therefore cannot take shape without taking the society into purview: "we prefer to provide them with a children's toy-world, lacking the imagination to remember that even if it was make-believe, it was always a grown-up world that we chiefly craved as a plaything of our early days" (Tagore, 1961, p. 67).

The two sections, education in general and early childhood education in particular, have tried to show that there are fundamental issues that need to be rethought. Educational praxis needs reimagining in terms of such rethinking. Action research on classroom pedagogy can show us the limits of current educational thinking and practice. The next section shall show what form such limits take in a particular indigenous context in the central Indian state of Chhattisgarh.

Journey – Inception, Idea and Conversations

What necessitated the birth of Hamar Srinjan Shala? It was through conversations with the Chinhari associates that we (I would use "we" as we thought of this together, dreamt together), came up against this obstacle of "learning environment". There were schools, we didn't talk about the lack thereof. What disturbed us was the pedagogy of the teaching learning process, the lack of motivation, the non-stimulating environment, the disconnect with nature and the rich natural environment, the understanding of "development" and the absence of accountability.

The Chinhari Associates shared that they taught the younger children in their respective villages of Mardapoti and Dokal. The kids came on their own accord, and they guided them with their schoolwork. That made us wonder about learning space, embedded within the community, in communication with it and drawing its learning from it.

The first imperative question of why included a deeper question of *how*? How are we perceiving it differently? How are we going to translate our ideas into an actionable plan and explain its need?

The questions were posed to the Chinhari Associates. They were encouraged to reflect on their understanding of "schools, problems and promises". Since we were ideating on a situation that was prevalent in the two villages, the ideas needed to come from within the community and not super imposed by the others belonging to very different social contexts.

We held onto two core ideas:

a. It should not become just another school.
b. Cradles of Care rather than just contexts of cognition

Rethinking the Ideas of Schooling

We were not trying to fill the gap merely by what we had. But curate and create another gap filling philosophy. Schools bring forth an image of a space with children and adults. A place

"where the relatively young go to watch the relatively old work" (Jonas, 2010, p. 1). Structured ideas, paperwork, assessments and evaluations, competition and hierarchy. Hierarchy of ideas, of voices, where what is helpful is predetermined.

Innovative and alternative ideas of schooling though not alien are largely a prerogative for the affluent, demanding, educated, knowledgeable elite. Dominantly confined to the cities or within the premises that are thoughtfully curated and embedded in nature engaged in developing the whole child, usually the urban, affluent child. A divide is thus created by designing different types of education for children, which is based on assumption, judgment and preconceived ideas shaped by the social milieu. Poor education for the poor and education that builds competitiveness and individualism for the rich.

However, we also had to change ourselves by questioning our preexisting ideas, (of who deserves a better education). Question our preexisting contexts and practices (people in the rural spaces did not value education, the young are involved in farming and search of livelihood leaving little time, the indigenous world is steeped in cultural practices which are alien and therefore in contradiction to learning from schools). We had to question our assumptions of ourselves and of others (western educated urban subjects have a deeper understanding and knowledge about the idea of what is good).

Most of the thoughts came from the experiences of the girls themselves and their present observations of the children/ schools in their villages. The observations and reflections were for a period over 10 years of schooling (the average age group of the girls in Chinhari is about 20. The students they interacted with were from the age group of 4 to 12 years of age).

Indigeneity – Philosophy From Within the Cultures

What is indigeneity and why is it important to consider it while framing educational goals? Philosophy of education, especially in former colonies, largely determines the way we perceive teaching and learning. The idea of institutions, "schooling", discipline and hierarchy in education is largely a philosophy of the west (see Simeon, 2018). Through colonialism, the western idea of education percolates into our universities, high schools, primary schools and the preschools as well. In both the urban and rural spaces, and in adivasi spaces, the colonial idea of what education implies and strives to be, remains the same. The songs sung, the stories narrated are the stories of the west. Lived by the west, they are alienated from the cultural context of the many different communities they strive to reach out to. Wherever an attempt is made to alter the western imagination of education, it is superimposed by a generic Orientalist idea of an Indian village or a city. The west and the Indian are both seen as homogeneous. The west is glorified. The Indian is usually condemned. Or is presented as excessively glorified. Both harm the process of teaching-learning in ECE spaces. At other times, education becomes a question of the benevolence of the rich or the urban elite for the rural child. Tagore mentions the charitable minded city-bred politicians conversing about education of the village folks, where what is left at the bottom of their cup, diluted copiously, is considered sufficient in accordance with the social status of those who receive it (Tagore, 1961, p. 11).

Similar analogies can be found in educational plans and curriculum drawn out for schools across the country. "In most, if not all, of the formerly colonized societies, the educational philosophies are heavily influenced by Western thoughts. However, western traditions on educational philosophy have not been able to find a stable basis upon which to rest its aims of education" (Siegel as cited by Simeon, 2018, p. 2). "Education is based on knowledge and the

key difference between Western and indigenous knowledge is at the level of philosophy" (Stewart as cited by Simeon, 2018, p. 3). Education is used by the indigenous communities to reclaim and regenerate their languages, their stories, their histories and wisdom traditions.

The indigenous world is a lived world with and within the context of nature. The rituals for bountiful harvest and to ward off evil, the rituals for birth, marriage and death are all saturated with stories. The ecological understanding of conserving the forest is very much entwined with the belief of the forest as a living breathing space, as "elder" of the village, eliciting reverence and respect. Inhabited by divinities. The caution of not venturing out alone after dark is overlaid by the chance elephant that wanders near the village. The traditional indigenous festivals reflect their life world, a philosophy of respectful co-existence between the human-plant-animal world.

However, this is not to suggest that indigeneity is the only cultural gap in education or the imposition of the western imagination of education is the only problem in education. One cannot deny that the hierarchy of education has not existed in our country as well. Education was the prerogative of the few, chosen, by the virtue of their birth or by wealth. Though that has not greatly changed, a need has arisen to address the gap in the understanding of who is educated? especially in the context of the education for the indigenous child.

Our problems are hence twofold. One is exclusion. Hence there is a need for inclusion. The second is the curriculum. What is it that we teach to the included? The same old curriculum of the elite. Or do we curate an indigenized curriculum?

From Alienation to Assimilation

The aim of learning is assimilation and not alienation. Learning that aims at being like the other can only reiterate the inherent difference and thereby the impending need to change oneself. The sense of inferiority that comes with the lack of it, impacts the way self-belief and self-esteem develops. The child from an indigenous community, enrolls in a government school where there is little to no reference to her unique cultural context. There is no narrative that talks about their songs and rituals. There is no holiday for their festivals, no understanding of why a "rock" or a "tree" (spiritual practices of the indigenous communities) is more of an object of veneration rather than a temple with an established deity of the dominant community. On the contrary the content that she works with, reiterates the dominant collective consciousness about the marginalized, the indigenous, the outsider. She never feels at home and yet is unable to break apart from this narrative: "unconsciously, then I distrust what is black in me, in other words, the totality of my being" (Fanon, 2008, p. 168). The chances of this child returning to her community to address the source of this conundrum of identity is slim. She would want to break free and associate herself with the ones who had othered her.

Moving Forward: Building a Bridge

> Often cultural blindness works on our perception of people who are different from "us". The "us" that we know. (Hodge, 1991, p. 85)

Multifaceted and complex reality renders a common description, solution or cure difficult for either development or the development of knowledge. Education imparted in the isolated classrooms tends to overlook not just context and the child's life world but also this complexity. Education here, is closely embedded within the trope called development, in which much of

rural life finds itself immersed, at times imprisoned. Thus emerges a need to raise a few questions regarding: development and the paradigm of development of knowledge, the underdevelopment thesis, the life world of the community where knowledge systems are in practice in everyday functioning. Through such critical reflection on both, our idea of an indigenous Srijanshala takes shape; a somewhat radical thought takes form in the Chinhari Associates: can our communities be that petri dish where *rich* education for the indigenous child can be imagined?

In India, we have offered largely poor education to the poor. Tragically, it is not that we have offered rich education to the rich. We have offered the rich only one kind of education: "how to be rich"? Stand above the rest, be competitive, appropriative and extractive? Including extraction of nature; not just the surplus labour and know-how of fellow humans. *How can we have rich education for both rich and poor* – we asked in our repeated reflections on education in Chinhari. Rich in compassion. Sharing. Empathy. In non-violent reorganisation of desire. Rich in reduction of aggression. Rich in cooperation (Tagore called it *samavaya* in his book *The Cooperative Principle*). In the context of Srijanshala, we asked ourselves further: can we offer *rich* education to the purportedly poor and under-developed? How can we have an education where the head of the purportedly poor and the purportedly under-developed is held high; "where knowledge is free; where the world has not been broken up into fragments by narrow domestic walls" (Tagore, 2007).

The western understanding of development, pertaining to infrastructure, buildings and roads (*bijli, sadak, pani*) have altered the way we perceive human relationships, knowledge, and communities. In the race to be developed, we have left a large part of our people behind. Left them with an inferior sense of being and self-identity but a blind desire to become like the other, who ridicules them as *under*-developed. The idea of education has also altered in this understanding of development. Right from the pre-school years it is packaged, labelled, advertised and sold. The pathway to being developed lies through the gateways of a private school.

Education As Shorthand for "Development of Knowledge"

> Education is being developed in isolation, in the isolated minds of the individuals. However, learning is in the process of co-participation and not in the heads of individuals. (Lave & Wenger, 1991, p. 16)

Education needs to be perceived in the broad spectrum of the context of different cultures and life worlds. If participation in social practice is a fundamental form of learning, we perhaps require a more worked out view of the social world. Our concern here is an absence of theorizing about the social world as it is implicated in processes of learning. We think it is important to consider how shared cultural systems of meaning and political-economic structuring are interrelated, as they help to co-constitute learning in communities (Lave & Wenger, 1991, p. 54).

One such context of the practices of the community can be perceived in the village Dokal, where marriage is a collective responsibility. The community comes forward with their resources, economic and helping hands. It is an *economy of* sharing rather than logic of exchange or exchange through the medium of money (as in the capitalist market form) which drives it.

This culture of sharing and gifting (and not exchange) plants seeds of cooperation among the people, enabling them to face numerous other challenges. It is a learning opportunity where logistics are taken care of in terms of food, guests, arrangement, the actual ceremony, the associated rituals, storytelling and other details. It is a learning experience where the community will put aside their differing viewpoints and ideas and come up with collective, feasible solutions. Responsibilities will be delegated to carry out required tasks. One such ceremony births multiple learning opportunities for the different individuals and groups of the community, outside the walls of a classroom.

Imagining this in the many different contexts of everyday life produces a plethora of experiences. Letting the cows at dawn, the tending of the "baadi" (vegetable patch), working at the field and forest, most often with other members of the village, household work of cooking, cleaning, washing, the gatherings at the village "chopal" (meeting spot, usually located centrally), the day ending with every member of the family having their meals together, every night. Most of the work is collective work, either within the family unit or with the larger unit of the community. The children learn their roles, responsibilities, duties, the ways with the animals they coexist with, and much about the plants and trees that grow around them from an early age. They acquire knowledge about weather and crops, water requirements and the right time to harvest the vegetables. They learn about measurement and the concept of estimation as they help in the cooking or draw water to wash the utensils.

Being in the scope of "legitimate peripheral participation", they learn in the context of cooperation within the community, through participation (see Lave & Wenger, 1991). Learning about life worlds and the care giving functions for the younger ones in the community across ages. This perhaps also breaks the conception of knowledge being transmitted from the more knowledgeable to the lesser. "We have also pointed out that structuring resources for learning come from a variety of sources, not only from pedagogical activity. We argue that a coherent explanation of these observations depends upon decentring common notions of mastery and pedagogy. This decentring strategy is, in fact, deeply embedded in our situated approach" (Lave & Wenger, 1991, p. 94).

The young children grow up in a community of care, not only for the human world but also for the plant and animal world, the non-human world. They also go to schools where they are introduced to "A for apple" and "Z for zebra" from a chart that hangs from the wall. The golden haired "Q for queen" deepens the sense of alienation rather than instilling curiosity. Most children are visual learners during their early years. Children who have a rich legacy of kings and queens in their history, would perhaps be more intrigued with different imagery. It would perhaps open conversations about communities and kingdoms, about the economy of sharing as against the economy of exchange through money. The story of "Rani Durgawati" can be introduced, a "Gond" queen who challenged the then emperor, Akbar! (see *Rani Durgawati: Forgotten life of a warrior queen* [Sengupta, 1992]).

Trees like "mahua" and fruits like "beal" which are native to these regions, struggle to find their places in the esteemed pages of textbooks and songs. Festivals like "Hareli", "Madai" and "Pola" are largely unknown outside the periphery of the villages. Multiplicity of festivals, especially awareness of the lesser known but older festivals and cultural practices, their stories and origin, their intimate ties to the plant and animal world, the narratives of the indigenous tales of myths and legends, is often left out of the discourses that frame content of curriculum. "Adivasi Diwas" is largely unknown and excluded from the curriculum of the schools.

Indigenous identity is only included in the form of a group dance during cultural programs of school. Here, though the "zebra" is included the "mahua" is nonchalantly left out!

It is not to question education but to question the ways of educating that necessitates building a space to balance the two worlds. Between the windscreen and the rearview mirror in the journey called schooling.

The "zebra" is invoked, primarily because we don't care where the child is coming from. This is not a simple devaluation of the indigenous child's world. It also stems from a larger devaluation of the family, community, culture and the rural, in development. The discourse of development sees such rural indigenous communities as underdeveloped, backward, superstitious, violent. It sees such communities as *lacking.* Hence, we never customize curriculum to the needs of the children. Srijan Shala was an attempt to revalue and attend to their intricate life world.

Modern schools, a product of a particular idea of development, have replaced the traditional idea of collective knowledge in the rural indigenous spaces. Reiterating the idea of individual performances, the curriculum practiced is more focused on individual learning and performance. A child's performance is based on the scores in examinations and assessments, seldom on whether there are instances of collective ideas, collaborations and action.

Incorporating indigenous world view and experiences into the daily learning practices is the backbone of the entire effort of Hamar Srijan Shala. Content derived from the context of life and shared through the medium of languages, art, drama, songs, numbers, games and play. Traditional songs and stories are being sourced largely from the elderly of the villages. The "Gond" festivals and rituals are celebrated with the stories behind them. There is an attempt to teach rational, critical thinking of science and today's global language English, but through the narratives of their daily experiences and practices. Hamar Srijan Shala is an endeavour to build a future, rooted in the age-old knowledge system. It is an opportunity to reimagine content from the perspective of a child who is embedded in nature and community. For whom, "group work" and "nature walk" are not mere classroom activities, but the very way of life.

Hamar SrijanShala is also an attempt to reimagine early childhood learning, in the context of the community, environment and a constant co-existence between the two. An attempt to reiterate that there are many types of knowledge as there are multiple ways of learning them.

Conclusion

Tagore, while reflecting on "Sriniketan" – his ashram school – writes in *Boyhood Reminiscence*, "I know what it was to which this school owes its origin. It was not any new theory of education, but the memory of *my* school days' (1979; italics mine). The Chinhari Newsletter on School Education (Sept 2024) also stemmed from the reflections of the Chinhari associates on *their* school days and the problems therein and the need to *right wrongs* in school education. The approach was to learn from their experiences in their school days and see how a new framework for early childhood education – an indigenized education that was deeply attentive to *context* (i.e. the life world) and the *concepts* (i.e. the larger worldview) of the indigenous could be imagined.

Hamar Srijan Shala was thus conceived in the context of the *collective memory* of our school days. In the collective memory of the challenges and the realisations that emanated from such

experiences. It was an attempt to create a site of *in-betweenness* which becomes the ground of discussion. Where the indigenous child and the community together confront the inequities and asymmetries of societal trauma not as a "common people," but as a people with a common cause (Bhabha. 2009).

Hamar SrijanShala is a small endeavour. It is an endeavour flowing from the "long term commitment to righting wrongs". An attempt to address a much larger question, quietly forgotten and left aside. A question which has been left buried under more pressing matters perhaps.

Hamar Srijanshala lies somewhere in the arc of a journey-from breakdown and collapse to convalescence and recovery. It is resilience. "It insists that we cannot allow terror, self-hatred and sadness to have victories over us and that we can always, so long as we think matters through with sufficient creativity and gentleness, identify reasons to live" (De Botton, 2024, p. 7).

We are serious about our endeavour, committed and convinced that in this process, we are learning too. We are learning what is the best way forward, how we need to shift our own thinking and assumptions, look at the bigger picture, understand the diverse and unique practices and history, be a part of the life worlds different from those we are born into, question the assumed, converse and reflect with those who will be our guide in this journey.

It is these small endeavours perhaps, in my community, in India and in other parts of the world, that will help to shape bigger transformations. Bigger transformations to a better World.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI -assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, procedures, findings, analyses, and discussion are originally written and derived from careful and systemic conduct of the research.

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Impacts of Two Collaborative Learning by Teaching Approaches on University Students' Engagement, Motivation, and Metacognition

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Abstract

Collaborative learning by teaching (CLBT) is an active learning approach that integrates collaborative learning with the learning-by-teaching strategy, aiming to enhance student engagement and knowledge acquisition in university settings. However, it challenges many university students as it demands collaborating autonomously and regulating the collaborative learning process. Some students may struggle with task execution and process management. To address this challenge, socially shared regulation scaffolding can be integrated to support CLBT. This study proposed a socially shared regulation scaffolding called Task Guidance Scaffolding (TGS), which divides CLBT tasks into four stages—goal setting, planning, monitoring, and evaluation—and provides specific guiding questions at each stage to help students complete the CLBT learning process. Using a two-group case study design, this research investigated the effects of CLBT and socially shared regulation scaffolding-supported CLBT on university students. Results indicated that both approaches positively affected students' group engagement, motivation, and metacognition. The study emphasizes the potential benefits of CLBT and its integration with socially shared regulation scaffolding on university students, providing practical implications for educators and future research.

Keywords: collaborative learning by teaching, socially shared regulation scaffolding, group engagement, motivation, group metacognition

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Introduction

In traditional Chinese university classrooms, teacher-centered instruction remains prevalent, which often restricts students from actively involving in the classroom (Zhou & Tsai, 2023). In response, educators have tried to implement and innovate student-centered teaching methods, such as game-based learning (Hu, 2024), collaborative learning by teaching (Zhou et al., 2019), project-based learning, problem-based learning, and flipped classrooms to promote engagement and interaction. Notably, collaborative learning by teaching (CLBT) is an active learning approach that combines collaborative learning with the learning-by-teaching strategy, requiring students to work in groups to select themes, gather information, and organize content for peer teaching, thereby enhancing their engagement and knowledge acquisition. However, CLBT requires students to plan, monitor, and evaluate collaborative processes by themselves, which may pose challenges for those unfamiliar with their tasks. Thus, socially shared regulation scaffolding can be integrated to offer necessary guidance and support for CLBT implementation.

As a widely adopted tool in collaborative learning, socially shared regulation scaffolding guides students to adjust behavioral and metacognitive conditions together in collaborative tasks, enabling them to manage and improve their entire collaborative process through provided guidance or feedback. However, its application within CLBT and the effect of CBLT have not been thoroughly studied. This exploratory, two-group case study attempts to investigate the effects of CLBT and socially shared regulation scaffolding-supported CLBT on university students, focusing on the following research questions:

RQ1. Does CLBT and socially shared regulation scaffolding-supported CLBT improve university students' group engagement?
RQ2. Does CLBT and socially shared regulation scaffolding-supported CLBT improve university students' motivation?
RQ3. Does CLBT and socially shared regulation scaffolding-supported CLBT improve university students' group metacognition?

Method

To deepen understanding of the research issues and generate meaningful insights, this study adopted a case study design, gathering and analyzing quantitative data. The subsequent sections further detail the participants and study context, task guidance scaffolding (TGS), the design of TGS-supported CLBT activities and CLBT activities, as well as the methodologies employed for data collection.

Participants and Study Context

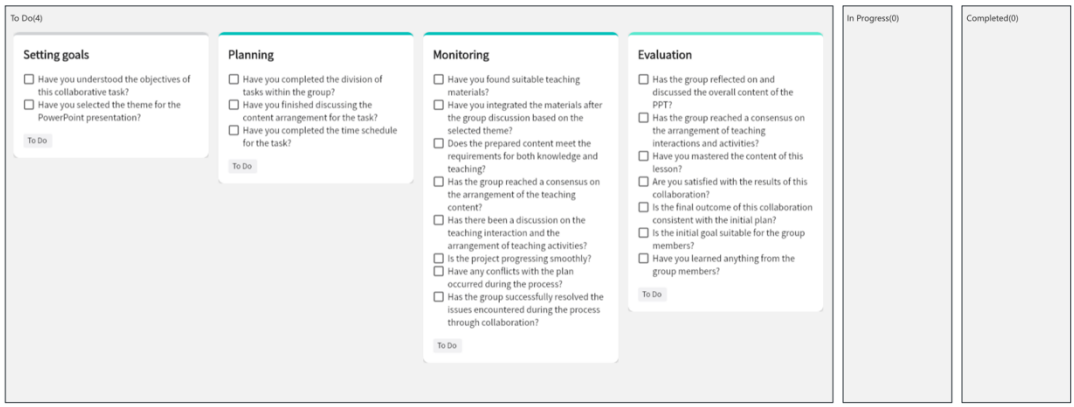
The study was conducted during the fall semester of the 2024–2025 academic year at a normal university in China. Two classes were selected: a CLBT group of 30 students and a TGS-supported CLBT group of 41 students. The CLBT group engaged in CLBT activities without TGS, while the TGS-supported CLBT group engaged in CLBT activities supported by TGS. These students, who were enrolled in the "Modern Educational Technology" course, voluntarily consented to participate in the research. The course, aligned with the prescribed textbook "Modern Educational Technology," covered topics such as the design of PowerPoint and the design of micro-lecture, etc. Before the study, the average GPA of students from both classes over the 2022–2024 period was analyzed, with a corresponding p-value greater than 0.05 ($t = 0.35$, $p = 0.73$), indicating no significant difference in academic performance between

the two classes. To ensure balanced and diverse groups within each class, students were allocated to three to four members using a descending 'S' curve based on their GPA (Chen & Chiu, 2016; Jang, 2010; Yang & Heh, 2007).

Task Guidance Scaffolding

Figure 1 illustrates the task guidance scaffolding, which is a socially shared regulation scaffolding designed to help students set goals, make plans, and monitor and evaluate the entire collaborative process in CLBT. To support the shared regulation in CLBT, this scaffolding, created by using the task card template on the BoardMix platform, comprised three panels: To Do, In Progress, and Completed. The “To Do” panel contains four cards that align with the stages of socially shared regulation: setting goals, planning, monitoring, and evaluation and each card includes guiding questions for each stage. During the task, participants could regulate their learning by checking off the guiding questions and moving cards across panels based on their progress. Additionally, they could set deadlines or fill in summaries of task-related content as needed to facilitate their collaborative tasks in this scaffolding.

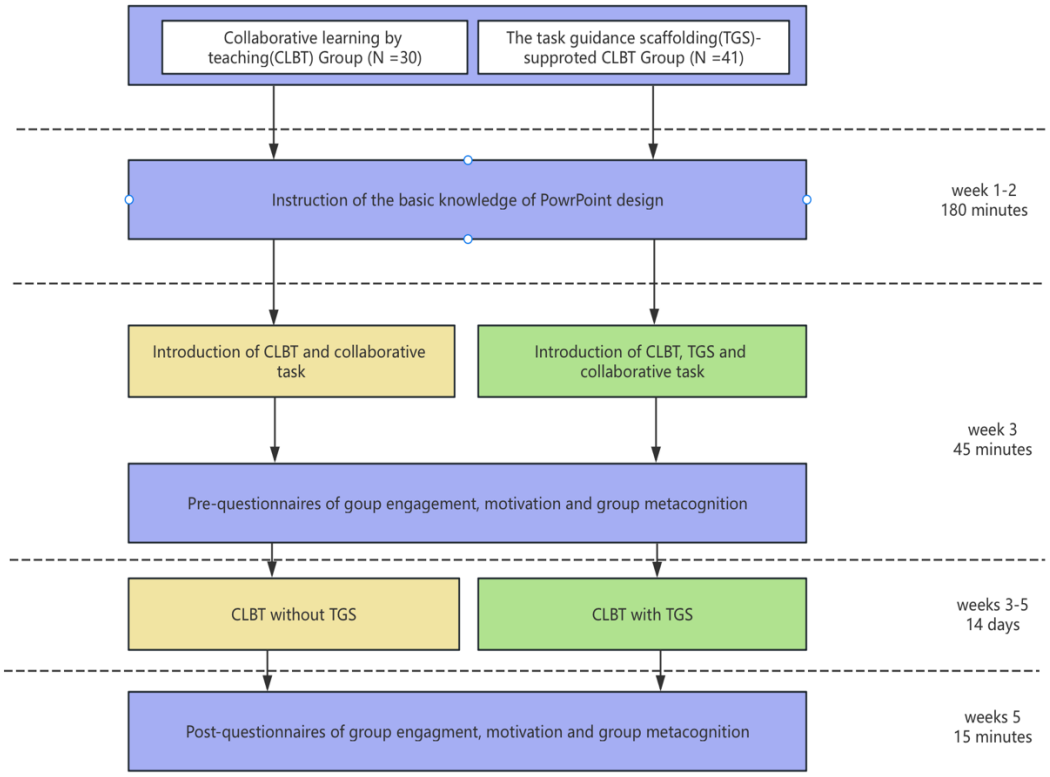
Figure 1
Task Guidance Scaffolding



The Treatment of Two CLBT

Figure 2 illustrates the procedures of the experiment, which spanned 5 weeks. In the first two weeks, the teacher delivered the foundational knowledge on PowerPoint through two 90-minute classes, supplemented with additional materials for self-study. In week 3, the teacher provided the task guidelines in a 5-minute introduction, outlining requirements for students to complete collaborative tasks based on PowerPoint and prepare for the classroom presentation. A 25-minute training session was conducted to support task implementation. The TGS-supported CLBT group was trained in collaborative learning by teaching and a socially shared regulation strategy, while the CLBT group focused exclusively on CLBT. Both groups filled out a 15-minute pre-test questionnaire measuring motivation, engagement, and metacognitive skills within the context of collaborative learning. From weeks 3 to 5, students independently selected topics according to their group assignments and embarked on collaborative learning by teaching tasks for 14 days. By the fifth week, each group conducted a 5–6-minute teaching presentation in class and completed the post-test questionnaires during a 90-minute class. The teaching processes were videotaped by the teacher and subsequently evaluated by two teaching assistants using a standardized grading rubric.

Figure 2
Procedures of the Experiment



Data Collection

To evaluate the impact of CLBT with or without TGS support on group engagement, motivation, and group metacognition, this study delivered a student self-perception questionnaire to collect quantitative data. The questionnaire consisted of three dimensions: group engagement, motivation, and group metacognition. Moreover, group engagement was measured using a self-perception group engagement scale developed and validated by Xu et al. (2024) in a collaborative learning context at the undergraduate level. The scale comprised 31 items, scored on a five-point Likert-type scale from “never” (1 point) to “always” (5 points) and a nine-point semantic differential scale, ranging from “negative” (−4 points) to “positive” (4 points). In this study, Cronbach’s alpha values for the group engagement scale were 0.943 in the pre-test and 0.975 in the post-test, validating the scale’s applicability for assessing student engagement in this research context. Motivation was assessed using 8 items from the scale developed by Pintrich et al. (1993), recorded on a five-point Likert-type scale from strongly disagree (1 point) to strongly agree (5 points). The scale’s validity and reliability were established in collaborative learning by teaching context at the undergraduate level (Zhou & Tsai, 2023). Moreover, the motivation scale’s Cronbach’s alpha values in this study were 0.814 in the pre-test and 0.903 in the post-test, which indicated the scale’s suitability for assessing student motivation in this research context. The metacognition scale, developed by Biasutti and Frate (2018), included 20 five-point Likert-type items. Designed for collaborative learning contexts at the undergraduate level, the scale selected from strongly disagree (1 point) to strongly agree (5 points). The Cronbach’s alpha values of this scale were 0.956 in the pre-test and 0.966 in the post-test, demonstrating the scale’s validity for assessing group metacognition in the present study.

Results

Analysis of Group Engagement

The paired sample t-tests were conducted to evaluate the pre-test to post-test changes in group engagement among university students across two groups, with results displayed in Table 1. The results demonstrated a significant increase in engagement in the CLBT group ($t = 3.401$, $p < 0.01$) and the TGS-supported CLBT group ($t = 3.452$, $p < 0.01$) after students participated in the treatment activities, indicating that both approaches can significantly enhance students' engagement.

Analysis of Motivation

Using the same paired sample t-tests measured by pre-test and post-test data, the study evaluated the motivation of university students. Table 1 shows a significant improvement in motivation in the CLBT group ($t = 2.102$, $p < 0.05$) and the TGS-supported CLBT group ($t = 4.315$, $p < 0.001$) after the treatment activities. These results suggested that the CLBT and TGS-supported CLBT could considerably boost students' motivation.

Analysis of Group Metacognition

As displayed in Table 1, this study quantitatively investigated university students' group metacognition by the paired sample t-tests including pre-test and post-test in two groups. Significant improvements were similarly observed in the CLBT group ($t = 2.843$, $p < 0.01$) and the TGS-supported CLBT group ($t = 3.486$, $p < 0.01$) after students participated in the treatment activities. Such findings indicated that both approaches exert a significantly positive influence on students' group metacognition.

Table 1
Results of Paired Sample t-Tests on Group Engagement, Motivation, and Group Metacognition

Dimensions	Groups	n	Pre-test		Post-test		*t*
			Mean	SD	Mean	SD	
Group engagement	TGS-supported CLBT group	41	3.116	0.737	3.496	0.763	3.452**
	CLBT group	30	3.233	0.695	3.623	0.739	3.401**
Motivaition	TGS-supported CLBT group	41	3.707	0.506	4.055	0.551	4.315***
	CLBT group	30	3.817	0.467	4.000	0.441	2.102*
Group metacognition	TGS-supported CLBT group	41	3.809	0.453	4.102	0.551	3.486**
	CLBT group	30	4.093	0.465	4.275	0.445	2.843**

Note. *$p < .05$; **$p < .01$; ***$p < .001$.

Discussion

The statistical results for RQ1 revealed significant improvements in students' engagement in both CLBT and TGS-supported CLBT groups after completing the treatment activities. This aligns with existing research highlighting CLBT's role in promoting active engagement in the collaborative process (Zhou et al., 2019). A potential explanation is that CLBT necessitates a

deeper understanding of the material, thereby encouraging active participation. In addition, TGS-supported CLBT provided more detailed guidance and approaches to facilitate collaboration. This result is consistent with prior studies that socially shared regulation can improve students' engagement (Zhou & Tsai, 2023).

The results of RQ2 demonstrated that both CLBT and TGS-supported CLBT positively influenced student motivation. This improvement may stem from CLBT's requirement for students to teach their classmates, which likely encouraged a deeper understanding of knowledge and enhanced enthusiasm, as supported by prior research (Zhou et al., 2019). In addition, TGS-supported CLBT promoted motivation by fostering confidence through guided support. This result is consistent with prior studies showing that a socially shared regulation tool could prompt co-regulation in the group and raise awareness of individual motivation and emotions (Järvenoja et al., 2020).

To answer research question RQ3, the results showed that CLBT and TGS-supported CLBT promoted a remarkable improvement in students' group metacognition after they completed the treatment activities. This result is in line with prior studies, indicating that CLBT has the potential to improve students' learning capabilities and teamwork skills, thereby enabling them to regulate groups' collaborative process and improve group metacognition (Zhou et al., 2019). There is a possible explanation for this result: CLBT improved students' engagement and motivation, enabling them to regulate and adjust collaborative processes effectively, which improved students' group metacognition. Additionally, TGS could help students plan, monitor, and evaluate collaborative process, facilitating more effective peer teaching based on CLBT. This result is consistent with prior studies demonstrating that the group metacognitive scaffolding could improve students' group metacognition (Zheng et al., 2019).

Conclusion

This study explored the impacts of CLBT and socially shared regulation scaffolding-supported CLBT on the engagement, motivation, and group metacognition of university students. Results suggested that both approaches appeared to be effective pedagogical approaches in enhancing these aspects. These findings provided valuable insights for higher education practitioners to implement CLBT and socially shared regulation scaffolding-supported CLBT in classroom settings. Despite the study having generated findings with theoretical and practical implications, some limitations should be considered. For example, the sample size was small and was recruited only from one university, and the teaching duration for students in the research design was rather brief. Additionally, the implementation period was confined to merely five weeks. For a deeper comprehension of how CLBT and socially shared regulation scaffolding-supported CLBT function in different contexts and subjects, future research should expand the sample size, extend group teaching time in the research and experimental period, and compare students' learning process and results in both CLBT and socially shared regulation scaffolding-supported CLBT.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

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Transforming Region-3 LHEIs: Change and Innovation Theories on Work Structures

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Abstract

Grounded in Change Theory and Diffusion of Innovation Theory, this study examined the organizational readiness of 16 Local Higher Education Institutions in Region III to implement Flexible Work Arrangements to ensure institutional continuity during disasters and national emergencies. Using descriptive-evaluative, descriptive-comparative, and descriptive-correlational research designs, data were collected from 1,945 teaching and non-teaching personnel. Results showed that teaching personnel demonstrated high awareness of FWAs across offline, online, and blended learning modalities, while non-teaching personnel exhibited high awareness of flexiplace, compressed workweek, skeleton workforce, and work-shifting arrangements. Both groups presented high organizational readiness supported by very high capability levels in soft and hard skills among teaching staff and high capability levels among non-teaching staff. The most frequently cited challenges were inability to meet performance demands (93.6%), mental stress due to limited in-person interaction (87%), and distractions arising from personal concerns (80.10%). Significant differences in capability were found across age, sex, employment status, length of service, academic rank, and educational attainment ($p < .05$). Moreover, a strong positive correlation existed between personnel capabilities and organizational readiness ($r = 0.751$, $p = 0.000$), indicating that higher competencies are associated with greater preparedness for Flexible Work Arrangement implementation and highlighting the need for a strategic action plan focusing on governance, human resource development, digital infrastructure, and resource management.

Keywords: flexible work arrangements, local higher education institutions, organizational readiness, Diffusion of Innovation, Change Theory

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Introduction

Central Luzon, or Region 3 of the Philippines is considered as one of the most hazard prone regions of the country. According to the Pacific Disaster Center (2021), it faces high to very high exposure to natural hazards such typhoons, floods, earthquakes, and storm surges. These recurring disasters threaten infrastructure, public safety, and essential services such as education.

In April 2024, Region 3 recorded the highest number of public school closures due to extreme heat intensified by El Niño, resulting in 1,124 class suspensions (Marcelo, 2024). Similarly, the frequently flooding has disrupted academic calendars, encouraging institutions to consider flexible work and learning arrangements (Unson & Cariaso, 2024).

In response, the Commission on Higher Education (CHED) released directives such as CMO No. 16, s. 2022, and No. 4, s. 2023 promoting Learning Continuity Plans (LCPs), hybrid instructions, and modular delivery. These emphasize synchronous, asynchronous, and flexible modalities to ensure educational delivery during crises. However, successful implementation depends not only on technology but also on the readiness of institutions and personnel.

While some higher education institutions (HEIs) have made progress toward digital transformation and flexible work adoption, many still face challenges such as change resistance, limited digital literacy, psychological stress, and blurred work-life boundaries (Chen, 2021). These issues raise important questions about the ability of HEIs, especially in hazard exposed regions like Central Luzon, to institutionalize Flexible Work Arrangements (FWAs).

The study draws on Lewin's (1947) Change Theory and Rogers' (2003) Diffusion of Innovation Theory to understand how the HEIs respond to organizational change. Lewin's three-stage model – unfreezing, changing, and refreezing -helps analyze institutional transformational processes. Roger's theory offers a framework to examine how innovations like FWAs are adopted, spread, and sustained within organization systems.

The research assesses the organizational readiness by evaluating the awareness and capability of both teaching and non-teaching personnel. It also explores how individual and institutional profiles affect readiness and proposes action plans to support sustainable flexible work arrangement systems.

The study relates to the United Nations' Sustainable Development Goals, SDG 4: Quality Education, SDG 13: Climate Action, SDG 8: Decent Work and Economic Growth, and SDG 11: Sustainable Cities and Communities. The findings are important for HEIs, school leaders, policymakers, and staff. The study provides data-driven insights for institutional strategic planning, compliance with Commission on Higher Education mandates, and effective digital transformation ultimately contributing to educational resilience in disaster-prone areas. It is also supporting to student learning during crises, adapting flexible responses to climate change, and addressing safe workplace for teaching and non-teaching personnel.

Literature Review

The transformation of work structures through Flexible Work Arrangements (FWAs) has gained increased attention in higher education institutions (HEIs), particularly following the

COVID-19 pandemic, which accelerated the adoption of digitally enabled work models to sustain operations (OECD, 2021). As HEIs sought continuity amid disruptions, flexibility became both a practical necessity and a strategic response.

Lewin's Change Theory outlines organizational change through three stages: unfreezing, changing, and refreezing (Burnes, 2020). This framework provides a structured approach for HEIs adopting FWAs by assessing readiness, implementing flexible or hybrid models, and institutionalizing changes through policies and culture. In Region 3 HEIs, this model supports sustainable implementation by ensuring changes are embedded over time.

Complementing Lewin's model, Rogers' Diffusion of Innovation Theory (2003) explains how innovations spread within organizations through attributes such as relative advantage, compatibility, complexity, trialability, and observability. Applying these attributes helps HEIs align FWAs with institutional culture and operational systems, facilitating smoother adoption.

Studies emphasize that digital preparedness and workforce agility are critical to successful flexible work implementation (OECD, 2021). Charalampous et al. (2019) highlight the importance of supportive structures, digital skills, and adequate ICT infrastructure. In the Philippine context, HEIs face challenges including limited infrastructure, insufficient faculty training, unequal access to technology, and unclear flexible learning policies (Lucero et al., 2022).

Javier (2020) found that organizational readiness in Philippine HEIs is influenced by staff qualifications, experience, academic rank, and institutional characteristics such as size and location. Urban institutions with advanced IT infrastructure are generally more adaptable to FWAs than smaller or rural campuses. These findings underscore the need for capacity building and strategic alignment in adopting flexible work systems.

Lewin's Change Theory and Rogers' Diffusion of Innovation Theory emphasize the importance of organizational readiness, leadership support, and contextual alignment for successful FWA adoption in HEIs, particularly in Region 3.

Theoretical Framework

This study is anchored on two theories: the Five-Message Component Model for Managing Readiness for Change by Armenakis et al. (2000) and Rogers' Diffusion of Innovation Theory (2003). Together, these frameworks explain how local higher education institutions (LHEIs) in Region 3 can transition toward flexible work arrangements.

The Five-Message Component Model identifies five key elements of change readiness: discrepancy (need for change), appropriateness (fit of the solution), efficacy (confidence in implementation), principal support (leadership backing), and personal valence (perceived personal benefit). These components assess readiness at both individual and organizational levels.

Self-efficacy, rooted in Bandura's social cognitive theory, reflects employees' confidence in managing flexible schedules and using digital tools essential for FWAs (Cherry, 2023). Principal support reinforces readiness by fostering commitment and innovation through visible leadership backing (Armenakis et al., 2000; Hao & Yazdanifard, 2015).

Rogers' Diffusion of Innovation Theory explains how FWAs are adopted across groups—innovators, early adopters, early majority, late majority, and laggards—based on perceived benefits, compatibility, complexity, trialability, and observability. Innovators and early adopters often drive initial adoption, while others follow as positive outcomes become evident (Lamonte, 2022).

Integrating these theories provides a comprehensive framework for understanding readiness and adoption of FWAs, combining internal change preparedness with innovation diffusion processes. This integrated approach offers a structured and evidence-based guide for managing flexible work transformation in LHEIs in Region 3.

Methodology and Methods

This study employed a mixed descriptive approach incorporating evaluative, comparative, and correlational designs to assess the readiness and capabilities of personnel in 16 local higher education institutions-LHEIs in Region 3 for implementing Flexible Work Arrangements-FWAs. The descriptive-evaluative method assessed respondents' awareness and capability, while the comparative design examined differences across demographic profiles. The correlational design determined the relationships between institutional profiles and organizational readiness (Scribbr, 2021).

The locale of the study included all 16 LHEIs in Region 3 affiliated with the Association of Local Colleges and Universities-ALCU and ALCUCOA. A total of 1,945 personnel participated, achieving an 86.99% response rate from the target population of 2,236. Among the participants, 1,681 were teaching and 264 were non-teaching personnel, with a diversity of employment statuses and academic ranks.

A researcher-made questionnaire, grounded in relevant literature, was used to collect data across seven sections: institutional profile, respondent demographics, awareness of FWAs, capability (hard and soft skills), organizational readiness, and implementation challenges. A four-point Likert scale assessed all constructs.

Instrument validation was performed by three domain experts, and reliability testing using Cronbach's alpha confirmed high internal consistency across all dimensions such as organizational readiness: $\alpha = 0.918$; overall reliability = 0.909).

In terms of ethical considerations, the study adhered to standards. Principles of informed consent, autonomy, justice, confidentiality, and anonymity were strictly observed, with data coded and securely stored in compliance with The Data Privacy Act of 2012 (Republic Act No. 10173) in the Philippines aims to protect individual personal information in information and communications systems in both the government and private sectors.

The data gathering procedure included formal coordination with institutional heads, questionnaire distribution, and retrieval with follow-up mechanisms. Data were encoded, statistically treated, and presented in tabular and graphical formats to support interpretation.

Hypotheses Development

1. ***There is a significant difference in respondents' awareness of FWAs when grouped according to profile variables such as age, sex, employment status, length of service, educational attainment, and nature of work?***
   This hypothesis is grounded in Rogers' Diffusion of Innovation Theory (2003) and Lewin's Change Theory (1947), which emphasize the role of individual characteristics and awareness in innovation adoption.
2. ***There is a significant difference in respondents' perceived capabilities for FWAs when grouped according to profile variables?***
   This is supported by Lewin's emphasis on capability development during the change phase and Rogers' view that adoption varies across individual traits.
3. ***There is a significant relationship between respondents' capabilities and organizational readiness for FWAs.?***
   Both Lewin (1947) and Rogers (2003) stress that successful change depends on individual competence and institutional readiness working simultaneously.

Research Questions

1. What are the institutional and respondent profiles of LHEIs in Region 3?
2. What is the extent of FWA awareness among teaching and non-teaching personnel?
3. What are the respondents' capabilities for FWAs in terms of soft and hard skills?
4. What is the level of organizational readiness for FWAs based on change and diffusion theories?
5. What challenges are encountered in implementing FWAs?
6. What are the theoretical and practical implications of the findings?
7. What action plan can be developed to institutionalize FWAs in Region 3 LHEIs?

Statistical Treatment

The data gathered in this study were analyzed using various statistical tools. Frequency and Percentage were applied to describe the demographic profile of personnel from Local Higher Education Institutions in Region 3, covering variables such as age, sex, employment status, length of service, highest educational attainment, and nature of work. To assess the respondents' level of awareness of flexible work arrangements, their adaptability, and their perceived organizational readiness, Weighted Mean and Standard Deviation were computed. To determine significant differences in awareness and capability based on demographic variables, Independent Samples T-test and One-Way ANOVA were used. Furthermore, Pearson Product-Moment Correlation Coefficient (Pearson r) was employed to examine the relationship between respondents' capability and their assessment of organizational readiness for FWAs. These statistical methods enabled a thorough analysis of group differences and correlations, offering insights aligned with the frameworks of change management and innovation diffusion.

Results and Discussion

Table 1
Assessment of the Teaching and Non-teaching Personnel's Level of Awareness of Flexible Work Arrangements

Modality	Item Statement	Weighted Mean	Qualitative Description	Standard Deviation
Offline Learning	1. Provide printed modules	3.40	High	0.82
	2. Share recorded lectures	3.28	High	0.84
	3. Give access to online repositories	3.49	High	0.66
	4. Distribute storage devices	2.74	High	1.06
	5. Share links to open resources	3.43	High	0.71
	Average	3.27	High	0.82
Online Learning	1. Provide digital modules	3.66	Very High	0.60
	2. Use internet for classes	3.68	Very High	0.58
	3. Use learning management system	3.41	High	0.76
	4. Conduct classes via web conferencing	3.56	Very High	0.68
	5. Use laptops, phones, and similar devices	3.80	Very High	0.47
	Average	3.62	Very High	0.62
Blended Learning	1. Hold shortened in-person classes	3.10	High	0.89
	2. Conduct classes in shifts	3.17	High	0.85
	3. Focus on activities needing direct instructions	3.50	Very High	0.66
	4. Supplement with digital bite-size content	3.34	High	0.71
	5. Allow guided study time	3.49	High	0.60
	Average	3.32	High	0.74
Flexiplace	1. Covered by output-based work	3.37	High	0.67
	2. Work off-site	2.55	High	0.98
	3. Work from home	2.21	Low	1.04
	4. Work in nearby satellite office	2.24	Low	1.04
	5. Work in other productive locations	2.72	High	0.99
	Average	2.62	High	0.94

Compressed Workweek	1. Work full-time hours	3.61	Very High	0.64
	2. Given extra days off	2.33	Low	1.09
	3. Render extended hours	2.74	High	0.93
	4. Follow compressed workweek	2.33	Low	1.15
	5. Allowed fewer workdays	2.09	Low	0.99
	Average	2.62	High	0.96
Skeleton Workforce	1. Foe use when full staffing isn't available	2.92	High	0.78
	2. Requires minimum on-site staff	2.87	High	0.86
	3. Must complete 40 hours/week	3.49	High	0.69
	4. Absence counted if not on-site	3.27	High	0.86
	5. Ensures service continuity	3.43	High	0.69
	Average	3.20	High	0.78
Work Shifting	1. Meet end-user demands	3.23	High	0.71
	2. Suits 24/7 service agencies	3.06	High	0.79
	3. Supports health and safety compliance	3.27	High	0.80
	4. Fits security and safety roles	3.26	High	0.78
	5. Ensures constant personnel availability	3.35	High	0.73
	Average	3.23	High	0.76

Note. Legend: 1.00–1.49 Very Low; 1.50–2.49 Low; 2.50–3.49 High; 3.50–4.00 Very High.

The table shows the Assessment of the Teaching and Non-Teaching Personnel's Level of Awareness of Flexible Work Arrangements. The Teaching and non-teaching personnel in Region-3 LHEIs demonstrated varying levels of awareness regarding flexible work modalities, reflecting their roles, institutional context, and exposure to innovation. For offline learning, teaching personnel showed high awareness (M = 3.27, SD = 0.82), with the highest weighted mean 3.49 verbally interpreted as highly aware to cloud repositories and the least to traditional tools like compact discs or storage devices (M = 2.74), suggesting a shift away from outdated methods. Meanwhile, online learning got the highest overall awareness (M = 3.62, SD = 0.62) verbally interpreted as highly aware, particularly in the use of laptops and mobile devices (M = 3.80). This finding aligns with Santiago et al. (2022), who confirmed that mobile applications and smartphones were frequently used by faculty, indicative of early adoption tendencies. Under Rogers' Diffusion of Innovations Theory (2003), this behavior is characteristic of innovators and early adopters who are motivated to explore and integrate new tools for learning. Though the use of Learning Management Systems (M = 3.41) with slightly lower weighted mean, it still suggests broad digital readiness. In blended learning, awareness remained high (M = 3.32, SD = 0.74), particularly in the application of in-person instruction for appropriate lessons (M = 3.50). According to the Diffusion of Innovations Theory, alignment with existing values and practices referred to as compatibility influences the

likelihood of adoption. However, Shammas (2023) offers a nuanced view, noting that neither direct nor indirect instruction is consistently preferred by educators; instead, decisions often hinge on flexibility and the perceived care for student needs, not just the modality itself.

Among non-teaching personnel, there were low awareness of flexiplace arrangements with its weighted mean 2.62 and standard deviation of 0.94, with strong familiarity in output-based work metrics (M = 3.37), but significantly less for working from home (M = 2.21) or satellite offices (M = 2.24). This disparity supports Buffer's (2023) findings that while remote work is increasingly preferred globally, structured institutions often lag in consistent implementation. This pattern again supports Rogers' model, where innovations begin with early adopters before diffusing more broadly. Awareness of compressed workweek arrangements was also moderate (M = 2.62, SD = 0.96), with strong recognition of full-time workload completion (M = 3.61) but low awareness of condensed day structures (M = 2.09). Fallon (2024) emphasizes the dual nature of compressed work schedules, noting benefits like productivity and flexibility, but also drawbacks such as fatigue and logistical complexity. Rogers' attributes of trialability and perceived complexity may thus affect adoption rates for this modality. The skeleton workforce arrangement reflected a high level of awareness (M = 3.20, SD = 0.78), especially regarding standard 40-hour workweeks (M = 3.49). Baog et al. (2022) observed that certain districts demonstrate strong adherence to skeletal frameworks, particularly during emergencies. The Diffusion of Innovations Theory helps explain how such structured responses gain institutional acceptance in reaction to operational challenges, rather than proactive innovation. Finally, work shifting arrangements showed high awareness as well (M = 3.23, SD = 0.76), particularly in ensuring continuous personnel availability (M = 3.35). This modality is widely observed in institutions that operate in crisis or high-demand environments, consistent with Rogers' notion of observability, wherein clearly visible and effective innovations are more readily adopted. Overall, while teaching personnel demonstrate early and consistent engagement with flexible instructional modalities, non-teaching personnel show uneven levels of readiness, particularly in arrangements requiring structural or cultural shifts within institutions.

Table 2
Assessment of Teaching and Non-Teaching Personnel's Capabilities for Flexible Work Arrangements

Skill Type	Indicators	Teaching Weighted Mean	Teaching Qualitative Description	Teaching SD	Non-Teaching Weighted Mean	Non-Teaching Qualitative Description	Non-Teaching SD
Soft Skills	Supportiveness	3.66	Very High	0.50	3.60	Very High	0.52
	Assertiveness	3.65	Very High	0.50	3.50	Very High	0.62
	Compliance	3.66	Very High	0.51	3.61	Very High	0.52
	Conflict Management	3.58	Very High	0.54	3.48	High	0.58
	Relationship Management	3.64	Very High	0.52	3.54	Very High	0.59

	Average	3.64	Very High	0.51	3.55	Very High	0.57
Hard Skills	Technology Utilization	3.61	Very High	0.57	3.25	High	0.74
	Technology Processes	3.54	Very High	0.61	3.25	High	0.69
	Database Management	3.40	High	0.68	3.20	High	0.70
	Online Security	3.40	High	0.67	3.19	High	0.69
	Cloud Storage Management	3.31	High	0.71	3.05	High	0.76
	Average	3.45	High	0.65	3.19	High	0.72

Note. Legend: 1.00–1.49 Very Low; 1.50–2.49 Low; 2.50–3.49 High; 3.50–4.00 Very High

Table shows the assessment of both teaching and non-teaching personnel in Region 3 LHEIs revealed very high soft skills capabilities, with teaching personnel showing particular strength in supportiveness and compliance (M = 3.66), and non-teaching personnel similarly excelling in compliance (M = 3.61). Conflict management got the lowest-rated soft skill for both groups but still received a "very high" verbal intyerpretation, suggesting a uniformly strong emotional and interpersonal capacity across personnel groups. This consistency, reflected in low standard deviations (0.51 for teaching, 0.57 for non-teaching), indicates minimal variability in soft skills proficiency, a promising indicator for institutional readiness for flexible work **(**Domingo & Manalastas, 2023; Manzon, et al., 2022).

In terms of hard skills, teaching personnel demonstrated "very high" proficiency in technology utilization (M = 3.61), while cloud storage management (M = 3.31) emerged as the lowest in this area. Non-teaching personnel, though also rated "high" in all indicators, showed slightly lower proficiency overall (M = 3.19), with the weakest area again being cloud storage management (M = 3.05). Variability was higher in hard skills, particularly among non-teaching staff (SD = 0.72), suggesting uneven technical readiness and underscoring the need for continued capacity-building in digital competencies (Mariñas et al., 2022; Villon et al., 2022). These findings align with the Diffusion of Innovations Theory, where early adopters lead change while laggards, such as some seasoned educators, show hesitance in embracing technological tools essential for flexible work (Rogers, 2003). Hence, strategic training and continuous development efforts are crucial to sustaining and equalizing competencies across all personnel for effective and inclusive implementation of flexible work arrangements.

Table 3
Organizational Readiness for Flexible Work Arrangements Among Teaching and Non-Teaching Personnel

Dimension	Teaching Weighted Mean	Teaching Qualitative Description	Teaching SD	Non-Teaching Weighted Mean	Non-Teaching Qualitative Description	Non-Teaching SD
Discrepancy	3.17	High	0.79	3.15	High	0.69
Appropriateness	3.16	High	0.80	3.16	High	0.69
Self-efficacy	3.26	High	0.75	3.12	High	0.71
Principal Support	3.42	High	0.68	3.23	High	0.67
Personal Valence	3.39	High	0.65	3.11	High	0.72

Note. Legend: 1.00–1.49 = Very Low, 1.50–2.49 = Low, 2.50–3.49 = High, 3.50–4.00 = Very High

The table shows the assessment of both teaching and non-teaching personnel's organizational readiness for flexible work arrangements based on Amenakis et al. (2000) Five-Message Component Model, which includes discrepancy, appropriateness, self-efficacy, personal valence, and principal support. Teaching personnel demonstrated high readiness across all components, with the highest ratings in self-efficacy (M-3.26) and principal support (M-3.42), suggesting strong motivation, persistence, and leadership backing. They also showed high awareness of organizational discrepancies (M-3.17), perceived appropriateness of change (M-3.16), and recognized personal benefits from the change (M-3.39). Variability in responses on standard deviations ranging from 0.65 to 0.80 indicated a moderate divergence in individual perceptions, especially in areas concerning clarity of organizational issues and confidence in implementing change.

Non-teaching personnel similarly reflected high readiness across all dimensions, with slightly lower average ratings compared to teaching personnel's discrepancy (M-3.15), appropriateness (M-3.16), self-efficacy (M-3.12), personal valence (M-3.11), and principal support (M-3.23). While these figures suggest a shared commitment and perception of the relevance and feasibility of the proposed changes, standard deviations 0.67 to 0.72 reflected moderate variability. The findings affirm Amenakis et al.'s (2002) theory that clear understanding of organizational gaps, belief in the appropriateness of proposed interventions, confidence in change capacity, personal relevance, and leadership commitment are crucial in fostering readiness. Supporting literature (Belias & Trihas, 2022; Thomas & Danapfel, 2022; Workeneh & Abebe, 2019) further emphasizes that communication, appropriate interventions, leadership modeling, and perceived benefit are key to ensuring sustainable institutional change and successful implementation of flexible work systems.

Table 4
Challenges Encountered by Teaching and Non-teaching Personnel in the Implementation of Flexible Work Arrangements

Challenges	Teaching	Non-Teaching	Total	Percentage (%)
1. Work culture maintenance	1,121	176	1,297	66.7
2. Personal distractions	1,347	211	1,558	80.1
3. Weak team bonding	904	141	1,045	53.7
4. Poor real-time coordination	1,225	194	1,419	73.0
5. Performance challenges	1,573	247	1,820	93.6
6. Unstable internet	895	140	1,035	53.2
7. Mental stress from isolation	1,464	229	1,693	87.0

Note. N = 1,945

The table presents the challenges encountered by 1,945 teaching and non-teaching personnel in local higher education institutions-LHEIs in Region 3 regarding the implementation of flexible work arrangements. The most prevalent challenges were the inability to meet performance demands (93.6%) and mental stress due to the lack of in-person interaction (87.0%), indicating that flexible arrangements may compromise employee output and emotional well-being. Conversely, the least frequently reported challenges were the absence or intermittency of internet connectivity (53.2%) and difficulty in team bonding (53.7%), though still affecting more than half of the respondents. Other significant concerns included distractions from personal matters (80.1%), lack of synchronous communication and coordination (73.0%), and the difficulty of maintaining a unified work culture (66.7%). These challenges align with Rogers' (2003) Diffusion of Innovations Theory, which emphasizes resistance to change among late adopters and laggards due to entrenched cultural norms, communication barriers, perceived complexity, and uncertainty about the relative advantage of innovations like flexible work. Empirical findings further support these observations: Darshana and Tamilmaran (2024) reported that productivity concerns, unequal access to technology, and organizational disconnects are common hurdles in flexible work contexts, while Ahmadi et al. (2024) identified connectivity issues, communication breakdowns, and professional isolation as primary challenges. Additionally, Linando et al. (2022) found that female educators experience higher levels of emotional exhaustion and that older, long-serving staff members are less adaptable to flexible setups. These findings suggest that while flexible work arrangements offer potential benefits, institutions must strategically address psychological, technological, and organizational readiness to support their successful implementation.

Table 5
Significant Differences in the Assessment of the Respondents' Level of Awareness of Flexible Work Arrangements Based on Teaching Personnel Profile

Awareness	Age	Sex	Employment Status	Length of Service	Academic Rank	Highest Educational Attainment	Nature of Work
Offline Learning Modality	0.004* *48–64 yrs*	0.627 Not Sig	0.141 Not Sig	0.000* *11–10 yrs*	0.007* *Professor*	0.000* *Doctorate Degree*	.a
Online Learning Modality	0.005* *42–47 yrs*	0.621 Not Sig	0.015* *Job Order*	0.023* *6–10 yrs*	0.001* *Professor*	0.016* *Doctorate Units*	.a
Blended Learning Modality	0.000* *18–25 yrs*	0.223 Not Sig	0.000* *Regular*	0.000* *< 1 yr*	0.026* *Professor*	0.000* *Bachelor's Degree*	.a

Note. $p < .05$; Sig = Significant; Not Sig = Not Significant; * = Highest Grouping; .a = Single variable.

The data reveal statistically significant differences in teaching personnel's awareness of flexible work arrangements-FWAs when grouped according to their demographic and professional profiles, leading to the rejection of the null hypothesis that "there is no significant difference in the assessment of the respondents' level of awareness of flexible work arrangements when their profile is considered." Specifically, age showed a significant influence across all modalities ($p < .05$), with personnel aged 48–64 demonstrating the highest awareness in offline learning, 42–47 in online learning, and 18–25 in blended learning. These age-related patterns are consistent with Rogers' (2003) Diffusion of Innovations Theory, which explains that different adopter categories (e.g., early adopters, late majority) vary in demographic traits and openness to innovation. Although sex did not yield statistically significant differences in any modality ($p > .05$), employment status was significant in online and blended modalities ($p < .05$), with job order employees being more aware of online learning and regular employees reporting greater awareness in blended settings. This may reflect differential exposure and adaptability required by job conditions (Darshana & Tamilmaran, 2024). Likewise, length of service was a significant factor for all modalities ($p < .05$), with high awareness shown by both mid-career professionals (6–10 and 11–10 years) and those with less than one year of service, potentially due to recent training or evolving responsibilities (Ahmadi et al., 2024). Academic rank also showed significant variation ($p < .05$), with professors demonstrating consistently high awareness levels, suggesting their active involvement in institutional planning and capacity-building programs. Furthermore, educational attainment significantly influenced awareness ($p < .05$), with doctorate degree holders excelling in offline and online modalities, and bachelor's degree holders leading in blended learning, possibly due to differences in pedagogical exposure or digital training. In sum, these significant findings justify the rejection of the null hypothesis and support the importance of crafting differentiated, profile-sensitive strategies for professional development and institutional readiness for FWAs in higher education.

Table 6
Significant Difference in the Assessment of the Respondents on Their Capabilities for Flexible Work Arrangements When Profile is Considered

Capability	Age	Sex	Employment Status	Length of Service	Academic Rank	Highest Educational Attainment	Nature of Work
Soft Skills	0.001 *Significant 65 Years Old and Above*	0.002 *Significant Female*	0.004 *Significant Regular*	0.000 *Significant 6–10 Years*	0.000 *Significant University Professor*	0.000 *Significant Doctorate Degree*	0.348 *Not Significant*
Hard Skills	0.000 *Significant 18–25 Years Old*	0.292 *Not Significant*	0.000 *Significant Contract of Service*	0.000 *Significant Below 1 Year*	0.005 *Significant Professor*	0.000 *Significant Bachelor's Degree*	0.016 *Significant Teaching*

Note. Significant at $p < .05$. "Significant" indicates that the p-value is below the threshold of 0.05, suggesting a meaningful difference across that profile variable. "Not Significant" means the difference is not statistically meaningful. * indicates the subgroup with the highest assessment per variable.

The findings in the table indicate statistically significant differences in the respondents' assessment of their capabilities for implementing Flexible Work Arrangements-FWAs when grouped by their profile variables. For soft skills, the following variables showed significant differences at $p < 0.05$: age ($p = 0.001$), with the highest rating from those aged 65 years and above; sex ($p = 0.002$), with females rating themselves higher; employment status ($p = 0.004$), favoring regular employees; length of service ($p = 0.000$), with 6–10 years of service rated highest; academic rank ($p = 0.000$), with university professors reporting the highest assessment; and highest educational attainment ($p = 0.000$), with doctorate degree holders ranking themselves the most capable. However, nature of work ($p = 0.348$) did not yield a significant difference, indicating similar soft skills capability between teaching and non-teaching personnel. For hard skills, significant differences were also found for age ($p = 0.000$), with 18–25 years old scoring highest; employment status ($p = 0.000$), favoring contract of service employees; length of service ($p = 0.000$), with the highest scores from those with less than one year of service; academic rank ($p = 0.005$), where professors rated themselves highest; highest educational attainment ($p = 0.000$), with bachelor's degree holders scoring highest; and nature of work ($p = 0.016$), with teaching personnel reporting stronger hard skills. Only sex ($p = 0.292$) showed no significant difference in hard skill capability. Since the majority of profile variables yielded p-values below 0.05 for both soft and hard skills, it can be concluded that there is a statistically significant difference in the respondents' assessment of their capabilities based on their profiles. Therefore, the null hypothesis stating that "there is no significant difference in the assessment of the respondents on their capabilities when their profile is considered" is rejected. These results underscore the need for differentiated professional development strategies tailored to demographic and institutional roles to enhance the implementation of FWAs.

Table 7
Significant Relationship Between Respondents' Capability and Organizational Readiness When Institutional Profiles Are Considered

Respondents' Capability	Pearson *r*	Qualitative Description	*p*-Value	Significance
Organizational Readiness	0.751	High Relationship	0.000	Significant

Note. Interpretation based on Guilford's rule of thumb: 0 = No relationship, 0.01–0.20 = Negligible, 0.21–0.40 = Low, 0.41–0.70 = Moderate, 0.71–0.90 = High, 0.91–0.99 = Very High, 1.00 = Perfect. *Significant at $p < .05$.

The above result shows the Pearson product-moment correlation revealed a coefficient of $r = 0.751$ between the respondents' capabilities and their institutions' organizational readiness in implementing Flexible Work Arrangements-FWAs, with a *p*-value of 0.000. This indicates a statistically significant high positive relationship, based on Guilford's (1956) interpretative range of 0.71–0.90. The strength of this association implies that institutions where personnel demonstrate higher levels of capability such as soft and hard skills relevant to FWAs also tend to exhibit greater organizational readiness. The statistical significance at $p < .05$ confirms that the result is not due to chance. Consequently, the null hypothesis stating that "there is no significant relationship between respondents' capabilities and organizational readiness" is rejected. This finding underscores the importance of aligning institutional strategies with capacity development to ensure successful implementation of FWAs. It supports the organizational change theories of Kotter (1996) and Armenakis and Harris (2009), which emphasize that both individual and structural readiness must be addressed to sustain innovation and transformation in work arrangements.

Implementation and Utilization of the Developed Action Plan based implication of Change and Diffusion and Innovation theory. The action plan serves as a structured framework for transforming traditional work structures in Local Higher Education Institutions-LHEIs across Region 3 into more flexible, resilient, and innovation-driven systems. Its effective implementation should be guided by Change Theory (Lewin, 1947) and Diffusion of Innovation Theory (Rogers, 2003), which emphasize readiness, communication, leadership, and the gradual adoption of new practices.

1. Unfreezing Stage. Creating Readiness for Change (Change Theory). LHEIs must begin by reassessing current policies and mindsets toward work arrangements, initiating policy formulation and organizational diagnosis (as detailed in the governance KRA) to challenge the status quo, ensuring alignment with institutional mandates and government regulations, such as CHED and CSC guidelines and Promoting buy-in through orientation and consultation among academic councils and administrative leaders, building the urgency to transform.

2. Changing Stage. Implementation through Innovation Adoption (Diffusion of Innovation Theory). The core of transformation lies in the capacity building on both soft and hard skills, targeting early adopters and change agents to serve as role models for other personnel, leveraging institutional communication (feedback loops, regular meetings) to disseminate innovations, deploying digital infrastructure upgrades and LMS subscriptions, which embody the "innovation" in teaching modalities and providing supportive mechanisms, including health and wellness programs, to maintain employee engagement and reduce resistance.

   Here, Rogers' five attributes of innovation must be considered: Demonstrate how flexible work is superior in productivity and well-being, align innovations with institutional values

and employees' capabilities, minimize difficulty via training and onboarding, pilot policies before full-scale implementation, and make successful outcomes visible (e.g., performance improvement, satisfaction surveys).

3. Refreezing Stage. Institutionalizing the Change. For sustainability the LHEIs must embed flexible arrangements in the institution's strategic and operational frameworks, strengthen governance through approved policies and performance metrics (KPIs) to monitor impact, encourage a culture of continuous improvement and responsiveness to feedback and collaborate with LGUs and the Civil Service Commission to integrate public-sector perspectives.

4. Monitoring and Evaluation. Each program/activity should be tracked based on its Key Performance Indicators (KPIs) to assess: Effectiveness of flexible work policies, improvement in readiness levels and employee satisfaction and institutional resilience.

Discussion

Theoretical Implications

This study's findings on Flexible Work Arrangements (FWAs) in Region 3 LHEIs highlight key theoretical contributions through Rogers' Diffusion of Innovation Theory (2003) and Organizational Change Theory (Armenakis & Harris, 2009; Kotter, 1996). Differences in awareness and capability across age, employment status, and academic rank illustrate adopter categories and the influence of demographics on innovation adoption. The strong correlation between personnel capability and organizational readiness ($r = 0.751$, $p < 0.001$) validates the importance of aligning individual skills and beliefs with institutional structures. Senior academic personnel function as change agents, reinforcing Kotter's emphasis on leadership, vision, and coalition-building. Challenges like stress, technological limitations, and coordination issues reflect Rogers' attributes of complexity and trialability, emphasizing the need for context-sensitive, phased, and capacity-focused change strategies.

Practical Implications

The findings provide actionable insights for LHEIs:

1. Targeted training in digital literacy, time management, and adaptive skills enhances alignment between individual and organizational readiness.
2. Awareness and capability differences across demographics require customized messaging and training for specific groups.
3. Policy and Coordination: Clear guidelines, centralized platforms, and wellness support reduce complexity and improve adoption.
4. Leadership Engagement: Academic leaders as guiding coalitions promote vision, model behaviors, and celebrate short-term wins.
5. FWA policies should reflect institutional size, location, and resources, with decentralized decision-making where appropriate.
6. Sustained professional development, monitoring, and phased adoption foster long-term resilience and workforce satisfaction.

Conclusion

The study confirms that implementing FWAs in Region 3 LHEIs requires synchronizing individual readiness with organizational strategy. Awareness and capability levels were generally high, with differences influenced by demographic factors. Strong positive correlation between personnel capability and institutional readiness supports theories of change and innovation diffusion. Challenges such as stress, technological gaps, and coordination barriers highlight the need for comprehensive support. Effective FWA adoption depends on strategic leadership, phased implementation, and context-sensitive policies.

Recommendations

To support the effective implementation of Flexible Work Arrangements (FWAs) in Local Higher Education Institutions, personnel should receive demographic-specific training that develops both hard and soft skills. This ensures that each employee, regardless of age, rank, or role, has the competencies needed to adapt to new work modalities. Alongside training, institutions must maintain transparent and continuous communication, clearly conveying the benefits of FWAs and aligning these initiatives with broader organizational goals to foster understanding and buy-in.

Institutional leaders play a critical role as active change agents. By modeling desired behaviors, providing necessary resources, and reinforcing the personal benefits of participation, they can encourage staff engagement and strengthen commitment to the transformation process. At the same time, FWA policies should be contextualized to reflect each institution's unique circumstances, including infrastructure capacity, budget constraints, and local conditions, allowing for flexible but equitable implementation.

To ensure the effectiveness of these arrangements, institutions should establish feedback mechanisms and performance monitoring systems. Regular assessments enable continuous refinement and responsiveness to emerging challenges. Investments in technology, online systems, and digital literacy are essential to support hybrid and remote work environments, ensuring personnel can work effectively regardless of location. Finally, identifying and supporting innovation champions, staff who demonstrate high readiness and can mentor colleagues, can accelerate FWA adoption and foster a culture of collaboration and innovation across institutions.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

This work was assisted by Grammarly for language and grammar improvement, and QuillBot for paraphrasing and summarizing. All outputs were reviewed and finalized by the authors, who take full responsibility for the content.

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From Value to Action: A Critical Examination of Barriers to Democratic Participation in Global Sustainability Agendas

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Abstract

Despite growing awareness of global sustainability challenges, public engagement and democratic participation remain limited. This persistent value-action gap, where individuals possess knowledge about sustainability but do not translate it into civic or political action, raises urgent questions about the effectiveness of global frameworks such as the Sustainable Development Goals (SDGs). This paper offers a critical theoretical exploration of how sustainability is framed in international policy discourse, particularly in relation to shared civil responsibility and democratic agency. Drawing on framing theory, the study examines how dominant narratives surrounding the SDGs tend to emphasize individual behavioral change while neglecting the structural and political dimensions of sustainability. Insights from critical pedagogy further highlight how education, while often positioned as central to sustainability may fall short if it promotes awareness without cultivating critical consciousness or participatory agency. Through a synthesis of interdisciplinary scholarship, the paper critiques the prevailing representations of responsibility and citizenship embedded in sustainability discourse. It argues for a reframing toward models that emphasize collective agency, democratic participation, and systemic transformation. The study concludes with theoretical reflections and conceptual recommendations for reimagining sustainability education and policy as frameworks that support active civic engagement and empower individuals as agents of change. In doing so, it contributes to wider debates on how language and discourse shape public action in the context of global challenges.

Keywords: value-action gap, framing theory, critical pedagogy, collective agency, sustainability education

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Introduction

The United Nations Sustainable Development Goals emphasize the importance of citizen awareness in achieving the goals related to the environment, the social, and the economic fields. While awareness of sustainability challenges is increasingly widespread, translating knowledge into meaningful civic action remains limited. This is a phenomenon widely recognized as the value-action gap (Kollmuss & Agyeman, 2002). This gap is a persistent challenge that hinders the achievement of sustainability governance since the active participation of people is necessary in order to achieve policy goals. Therefore, it is crucial to understand how people can become active and efficient participants and have a shared responsibility in achieving sustainability goals.

Research suggests that the persistence of the value-action gap is rooted in the interaction of structural, cognitive, and discursive factors. Institutional arrangements such as centralized governance, technocratic decision-making, and bureaucratic rigidity, often position citizens as peripheral actors signalling that responsibility lies primarily with technical experts or authorities (Fukuda-Parr, 2022). At the same time, discursive frames shape perceptions of legitimacy and appropriate behaviour as argued by Entman (1993) and Lakoff (2004). Such frames can be applied as tools for analysing global sustainability discourse and education.

Technocratic and engineerist frames privilege measurable objectives and standardized indicators and interventions led by experts, while moral frames reinforce normative hypotheses concerning accepted behaviors (Fukuda-Parr, 2022). These structural and discursive mechanisms limit individual participation, reproduce hierarchical authority, and further enhance the gap between values and actions (Kollmuss & Agyeman, 2002).

In light of these insights, the literature often separates out these three dimensions, structural, cognitive, and discursive, treating them in isolation. The study of ways these components interact is necessary in order to design strategies that build awareness for action; it is essential also to turn knowledge into practical methods for engaging in civic engagement. This paper bridges that gap by drawing on concepts from Critical Pedagogy and Framing Theory. Critical pedagogy provides the means by which power relations, institutional constraints, and processes of empowerment may be studied through praxis, conscientization, and dialogue (Freire, 1970; Giroux, 2005; McLaren, 2000). Framing theory, stemming from communication and cognitive linguistics (Entman, 1993; Lakoff, 2004), further enhances the interpretation when it examines how legitimacy, moral evaluation, and authority are constructed and contested in public discourse, by which perception and action are affected. The study is guided by the following research questions:

1. What institutional and individual barriers sustain the value-action gap in global sustainability agendas?
2. How do framing practices in policy, communication, and education influence citizens' perceptions of legitimacy, responsibility, and efficacy?
3. How can the integration of critical pedagogy and framing strategies support more meaningful and participatory engagement in sustainability initiatives?

The paper begins with a literature review synthesizing theoretical and empirical studies on critical pedagogy, framing, and sustainability participation. This is followed by an analysis and discussion of institutional and individual barriers, concluding with a synthesis of findings and recommendations to support inclusive and participatory sustainability governance.

Literature Review

The increasing importance of democratic participation in sustainability agendas around the world makes progress, especially meaningful and lasting progress. Although environmental and social challenges are widely acknowledged, citizens are frequently not involved in sustainability actions (Kollmuss & Agyeman, 2002; Steg & Vlek, 2009). To understand why not all knowledge leads to action we have to consider the structural and cognitive impediments that limit participation (Kollmuss & Agyeman, 2002). As theorised by Freire (2005), institutional arrangements, educational practices, and discursive frames exert crucial impacts on citizen agency and engagement, and these insights have been generalised to sustainability contexts, where governance arrangements and cultural practices shape collective action (Shove, 2010). This review synthesizes theoretical and empirical studies on critical pedagogy, framing theory, and participation in sustainability, identifying key insights and gaps that inform the present research.

Critical Pedagogy

Critical pedagogy provides one interpretation for how power relations and institutions shape the agency of the citizen. At the heart of this view are thoughts on praxis, conscientization, dialogue, and the empowerment of marginalized voices (Freire, 1970; Giroux, 2005). Praxis stresses the integration of reflection and action, the proposition that mere knowledge cannot be enough to make them take action. Conscientization encourages citizens to notice the structural forces restraining their agency and thereby realize a critical consciousness that leads the community into meaningful participation. It is dialogue that brings people together through shared understanding and collective problem-solving, bringing them actively involved in decision-making processes (Freire, 2005).

In the context of sustainability, critical pedagogy explains why specific forms of institutional obstacles or barriers, such as technocratic governance, lack of transparency in decision-making, and centralization in authority, can dissuade citizen participation (Bexell & Jönsson, 2017; Fukuda-Parr, 2022). On the other hand, educational interventions (e.g., participatory workshops, community-based learning, and collaborative problem-solving exercises) which are rooted in critical pedagogy serve to create communities that promote civic involvement, increasing the potential for collective action (Wals, 2010). However, most existing texts primarily concern themselves with individual empowerment and have not sufficiently integrated the discursive means by which institutional structures remain dominant.

Framing Theory

Framing theory complements critical pedagogy by addressing the discursive construction of reality and its impact on citizen perception and behavior. Frames are interpretive devices that shape how issues are defined, causes are attributed, moral evaluations are made, and solutions are proposed (Entman, 1993). In sustainability discourse, technocratic and engineerist frames which prioritize measurable targets, standardized indicators, and expert-led interventions, frame the authority as central to achieving sustainability while positioning citizens as peripheral actors (Sachs, 2012). In addition to this, moral and value frames embed normative assumptions about appropriate behavior which can discourage alternative interventions. This can be understood as part of how communication frames highlight certain behaviors and assign moral significance (Entman, 1993) and how cognitive frames influence individuals' moral interpretations and judgments (Lakoff, 2004). By highlighting certain behaviors as desirable

and aligning them with official or expert-sanctioned norms, these frames shape perceptions of legitimacy and acceptable action (Entman, 1993). In governance contexts, such as the use of indicators and policy metrics, these mechanisms can subtly reproduce hierarchical authority and constrain citizen agency (Broome & Quirk, 2015).

Research demonstrates that frames influence both immediate perceptions of issue importance and long-term cognitive frameworks that affect engagement and willingness to challenge existing hierarchies (Chong & Druckman, 2007; Snow & Benford, 1988). Integrating framing analysis with critical pedagogy offers tools to examine how institutional narratives shape both citizen understanding and perceived legitimacy and provide pathways to strategically reframe sustainability issues to encourage participatory engagement.

Bridging Evidence and Theory

Empirical studies on citizen participation emphasize the interconnection of structural, cognitive, and discursive barriers. Institutional constraints such as centralized governance, bureaucracies, limited transparency, and standardized reporting often marginalize citizen input and reduce perceived efficacy (Bexell & Jönsson, 2017; Kollmuss & Agyeman, 2002). Observing institutions as unresponsive reinforces individual-level barriers such as behavioral inertia and low civic engagement (Bexell & Jönsson, 2017). Habitual behaviors and societal norms further limit meaningful action and show how structural and cognitive factors operate in a mutually reinforcing feedback loop (Shove, 2010).

Educational initiatives demonstrate that promoting critical awareness, dialogue, and participatory skills can partially mitigate these barriers (Wals, 2010). Research on framing shows that emphasizing certain values or responsibilities can shape how people engage with issues (Chong & Druckman, 2007). In the context of sustainability, frames that stress citizen agency and social norms may enhance engagement, whereas technocratic or moralizing frames risk discouraging participation (Maibach et al., 2010). Despite these insights, research often treats structural, cognitive, and discursive factors in isolation (Shove, 2010). Few studies examine how critical pedagogy and framing theory together can explain and address persistent gaps between knowledge and action.

Institutional arrangements and discursive frames are mutually reinforcing and shape both the possibilities and perceived legitimacy of citizen engagement. Critical pedagogy addresses structural barriers by emphasizing praxis, conscientization, and empowerment. As for framing theory, it analyses how moral evaluation and authority are discursively constructed and contested. Synthesizing these perspectives provide both explanatory power and practical insight. It allows the identification of points where educational and discursive strategies can collectively enhance democratic participation. This integrated approach offers a relevant conceptual foundation for examining how participatory sustainability initiatives can overcome the value-action gap.

Methodology

This paper adopts a critical theoretical approach to examine the discursive framing of sustainability within the United Nations' Sustainable Development Goals (SDGs) and their implications for democratic participation. Unlike empirical research, which relies on original data collection, this study critically engages with existing literature and scholarly analyses to explore the interplay between sustainability discourse, civic engagement, and education. The

underlying assumption of this approach is that a thorough understanding of the value-action gap and its implications requires systematic engagement with theoretical perspectives and policy narratives that shape global sustainability agendas. Critical theoretical approaches are widely recognized in the social sciences for enabling rigorous conceptual exploration and generating insights relevant to both theory and practice (Kincheloe, 2005). Reflexive engagement with literature allows researchers to examine not only the content of sources but also the assumptions, perspectives, and discursive strategies that shape them (Alvesson & Sköldberg, 2009).

The object of critique in this study is the dominant framing of responsibility, agency, and participation within SDG discourse. Particular attention is given to how sustainability is often presented as an issue of individual behavioral change, while structural, political, and civic dimensions remain underexplored or marginalized (Dryzek, 2013). To analyze these discursive tendencies, the study draws primarily on critical pedagogy and framing theory. Critical pedagogy highlights the role of education in promoting critical consciousness and participatory agency (Freire, 1970; Giroux, 2005). As for framing theory, it examines how language and narratives influence perception and prioritization of issues (Entman, 1993; Lakoff, 2004). Together, these lenses provide a foundation for interrogating how current sustainability development goals (SDGs) narratives both reveal and reinforce barriers to democratic participation.

The methodological process unfolds in three stages. First, a purposive selection of sources was undertaken to ensure relevance, credibility, and theoretical significance. These sources include scholarly critiques of global sustainability agendas, as well as literature on framing theory, critical pedagogy, and the value-action gap. Selection criteria emphasized works that directly address civic engagement, education, and the translation of sustainability knowledge into action. This targeted approach mirrors established purposive sampling strategies in theoretical-analytical research (Patton, 2015) and enables reflexive engagement with authoritative and influential perspectives (Alvesson & Sköldberg, 2009).

Second, the study employs critical synthesis. Key literature was examined to identify recurring discursive patterns, including the emphasis on individual responsibility and the marginalization of structural or political agency in sustainability frameworks. Third, insights from this analysis are synthesized into conceptual recommendations aimed at bridging the value-action gap. By critically integrating findings across the literature, the study identifies opportunities to reframe sustainability discourse in ways that emphasize collective agency, systemic understanding, and democratic participation. This synthesis draws on interdisciplinary scholarship to ensure that recommendations are grounded in established theory while responsive to contemporary challenges in sustainability education and policy.

Overall, this methodological approach provides a transparent and systematic framework that critically interrogating SDG discourse by synthesizing interdisciplinary insights and offering theoretically grounded recommendations. It demonstrates how conceptual exploration and reflexive engagement with literature can reveal both the limitations of current global sustainability narratives and pathways for motivating democratic participation and bridging the persistent gap between sustainability awareness and civic action.

Analysis

Institutional Barriers to Democratic Participation in Sustainability Agendas

Institutional dynamics play a central role in sustaining the value–action gap in global sustainability agendas as governance practices as well as participatory mechanisms shape citizen engagement (Bexell & Jönsson, 2017; Fukuda-Parr, 2022). These interrelated institutional factors create environments in which citizens are often positioned as peripheral actors and thus limit their agency as active participants. Such frames reinforce the perception of sustainability as primarily a technical or expert-managed challenge. A key aspect of these dynamics is the technocratic and engineerist framing of the SDGs that emphasizes measurable targets and expert-led solutions over participatory engagement. By privileging top-down implementation, this framing shapes decision-making processes and frame citizen action as secondary or optional (Sachs, 2012).

These framing choices interact closely with governance shortcomings, including mismanagement, lack of transparency, and limited participatory mechanisms (Bexell & Jönsson, 2017; Broome & Quirk, 2015). The centralized governance structures can weaken accountability, reduce trust, and limit opportunities for citizen influence (Fukuda-Parr, 2022). The combination of technocratic framing and constrained governance not only limits the formal avenues for engagement but also reinforces the perception that sustainability responsibilities lie predominantly with institutions rather than individuals.

Finally, restricted participatory mechanisms intensify these effects. While multi-stakeholder engagement is often emphasized rhetorically in SDG discourse, opportunities for meaningful citizen involvement remain limited and thus reinforces citizens' peripheral position (Bexell & Jönsson, 2017). Together, these institutional barriers create a self-reinforcing cycle where governance practices and policy framing collectively constrain democratic participation. This highlights the reason why addressing institutional factors is critical to bridging the value-action gap.

Individual Barriers to Democratic Participation in Sustainability Agendas

Even when citizens are aware of sustainability challenges, their engagement is often constrained by a complex interplay of cognitive, behavioral, and motivational factors that are deeply influenced by institutional and discursive contexts (Kollmuss & Agyeman, 2002; Steg & Vlek, 2009). Awareness alone rarely translates into action because habitual routines, perceptions of limited impact, and low levels of civic involvement interact with structural conditions to limit participation (Shove, 2010). These dynamics help explain why knowledge of sustainability issues does not automatically lead to meaningful civic or political engagement, revealing persistent gaps between awareness and action.

Individual tendencies are closely shaped and reinforced by institutional environments. In contexts where governance is opaque, resources are mismanaged, and participatory mechanisms are minimal, citizens frequently perceive that their contributions will have little effect (Bexell & Jönsson, 2017; Fukuda-Parr, 2022). In addition to this, habitual behaviors further limit engagement (Steg & Vlek, 2009). When routines are reinforced by societal norms or by the lack of structured participatory channels, individuals are less likely to adopt practices that could have collective impact (Shove, 2010). This inertia is not merely a personal limitation but reflects the broader environment in which individuals operate. In the context of a lack of

meaningful opportunities for action, sustainable behaviors remain largely symbolic or private, failing to generate systemic change (Kollmuss & Agyeman, 2002).

Moreover, low civic engagement is both a cause and consequence of these perceptions and habits (Maibach et al., 2010). When citizens observe that institutional processes are inaccessible, their engagement declines (Steg & Vlek, 2009). This reinforces a self-perpetuating cycle where citizens are demotivated and believe that their knowledge is unlikely to produce tangible outcomes (Shove, 2010). Awareness of sustainability challenges becomes detached from participatory action when individuals struggle to find pathways to contribute effectively within constrained institutional settings (Kollmuss & Agyeman, 2002).

Importantly, these individual-level barriers are not isolated phenomena. They are intimately linked to institutional practices and discursive framing that form a feedback loop in which perceptions, behaviors, and structural constraints continuously reinforce one another (Shove, 2010; Steg & Vlek, 2009). Understanding this interplay is essential for explaining why the value-action gap persists despite widespread awareness and education on sustainability (Kollmuss & Agyeman, 2002). It also establishes a foundation for exploring how targeted interventions in discourse, pedagogy, and participatory mechanisms could help mitigate these barriers (Entman, 1993; Freire, 2005).

Discussion

Critical Pedagogy and Barriers in Sustainability Agendas

Institutional and individual barriers are deeply intertwined in sustaining the value-action gap in global sustainability agendas (Kollmuss & Agyeman, 2002; Shove, 2010). Critical pedagogy provides a lens to analyze how these barriers mutually reinforce one another (Freire, 1970). These structures are not neutral procedural shortcomings but manifestations of power-knowledge relations that reproduce hierarchical control and limit democratic participation (Giroux, 2005).

Critical pedagogy interprets these institutional arrangements as discursively produced mechanisms of exclusion that constrain citizen agency and shape perceptions of individual efficacy (McLaren, 2000). Emphasizing praxis, the integration of reflection and action, shows that awareness alone is insufficient for engagement. Instead, citizens must critically interrogate institutional norms, question hierarchical decision-making, and envision collective possibilities for participation (Freire, 1970). Dialogue promotes shared understanding and collective critical consciousness. As a consequence, this enables individuals to recognize structural barriers such as opaque governance and perceive their potential role in challenging them (Giroux, 2005).

Individual-level barriers such as behavioral inertia, perceived inefficacy, and low civic engagement emerge and are reinforced within these institutional contexts (Kollmuss & Agyeman, 2002; Steg & Vlek, 2009; Wals, 2010). Citizens often default to symbolic or private actions, not from ignorance, but because bureaucratic rigidity and restricted participatory opportunities normalize passivity (Friedrich et al., 2025). Observing institutions as unresponsive further diminishes perceived impact and creates a feedback loop that sustains both individual passivity and structural rigidity (Shove, 2010). While resistance exists at the individual level, institutional barriers are typically more entrenched. This highlights the importance of equipping citizens with critical awareness and collaborative approaches (Fukuda-Parr, 2022; Wals, 2010).

By situating institutional and individual barriers within a critical pedagogical framework, the value-action gap is framed not as a purely technical or behavioral problem but as a deeply political phenomenon (Kollmuss & Agyeman, 2002). Through conscientization, citizens develop the critical awareness needed to recognize bureaucratic inefficiencies, lack of transparency, and top-down control as contestable rather than inevitable (Freire, 1970). Educational interventions that nurture praxis, dialogue, and empowerment enable individuals and collectives to challenge hierarchical authority, hold institutions accountable, and actively shape sustainability agendas (Freire, 1970; McLaren, 2000). This integrated approach strengthens civic responsibility by linking knowledge with action and positions sustainable engagement as a shared democratic duty.

Framing and Barriers in Sustainability Agendas

Many institutional frames that inform citizen engagement are identified in the literature on global sustainability agendas. Such technocratic and engineerist frames, for example, focus on quantifiable targets, standardized indicators, and expert-led solutions implying that the main authority sits with technical experts (Fukuda-Parr, 2022; Sachs, 2012). According to framing theory, these frames serve the role of more than describing the policy; they shape expectations of civic responsibility as well as which kinds of engagements are considered appropriate and effective (Chong & Druckman, 2007; Entman, 1993). By promoting technical know-how and standardized approaches, frames like this marginalize participatory or activist interventions implicitly, and thus can frame both what is understood and how people act in ways that contribute to the value-action gap.

Moral and value frames are a critical area of theoretical inquiry as they encode normative assumptions about what is expected of people, thereby configuring how citizens frame their perceptions and priorities (Lakoff, 2004). Those new perspectives can be applied in the context of sustainability discourse. Entman (1993) conceptualizes framing in terms of problem definition, causal interpretation, moral evaluation and treatment recommendation, making it quite clear how these institutional narratives construct understanding and perceived responsibility. These frames guide what kinds of action are acceptable to be acted on, and by so doing determine which interventions are successful or acceptable from a societal standpoint. These discursive constructions help to sustain the value-action divide by suggesting to citizens that meaningful intervention is limited to officially sanctioned channels even when systemic change may be crucial and needs to be achieved on a collective level (Gamson & Modigliani, 1989; Snow & Benford, 1988).

Framing theory highlights the dynamic and contestable nature of discourse. Institutional frames are not fixed; they operate through mechanisms such as emphasis and causal attribution which can be strategically analyzed, questioned, and countered (Entman, 1993). By revealing how legitimacy is discursively constructed, framing analysis identifies both barriers and potential openings for engagement. Institutional frames may constrain participation when unexamined, yet they simultaneously indicate points where critical reflection, dialogue, and counter-framing can empower citizens to reinterpret hierarchies, challenge opaque processes, and engage more actively in sustainability initiatives.

Integrating this analysis with the critical pedagogy lens emphasizes that civic empowerment requires both understanding structural barriers and engaging with the discursive mechanisms that limit agency. By highlighting the framing strategies that shape perceptions of legitimacy and authority, this perspective provides a conceptual foundation for exploring how education,

dialogue, and participatory practices can reframe sustainability discourse and enable more meaningful democratic participation (Freire, 1970).

Synthesis and Pathways for Enhancing Democratic Participation in Sustainability Agendas

The analysis highlights that institutional and individual barriers are mutually reinforcing, sustaining the persistent value-action gap in global sustainability agendas. These structural features interact with cognitive and behavioral factors, including perceived inefficacy, habitual inertia, and low civic engagement that contribute collectively to self-reinforcing cycles that inhibit meaningful participation (Kollmuss & Agyeman, 2002; Steg & Vlek, 2009; Wals, 2010).

Critical pedagogy provides both an analytical lens and a framework for intervention, emphasizing praxis, dialogue, and conscientization to show that awareness alone is insufficient. Citizens must cultivate the capacity to critically interrogate institutional norms and hold authorities accountable (Apple, 2004; Freire, 1970; McLaren, 2000). Framing theory complements this perspective by highlighting how perceptions of legitimacy and responsibility are discursively constructed and can be contested, revealing opportunities to strategically reframe sustainability narratives in ways that promote participatory engagement (Entman, 1993).

Hence, it must be an integrated process in order to deepen democratic engagement in practice. Reform strategies in the forms of decentralizing decision-making, increasing transparency, and mechanisms that meaningfully incorporate citizen input are needed (Fukuda-Parr, 2022). Educational interventions can support critical awareness and collaborative problem-solving which provide individuals with techniques to address and confront structural constraints (Freire, 1970). Public discourse framing is also an essential instrument through which citizens' perceptions can be constructed in terms of agency, legitimacy, and collective responsibility, which helps to promote the active and responsible participation by citizens in sustainability (Entman, 1993). When these dimensions of structure, pedagogy, and rhetoric are considered, they should constitute a foundation for bridging the value–action gap and for enacting sustainability imperatives through participatory, inclusive, and effective processes (Kollmuss & Agyeman, 2002).

Conclusion

This study has examined the structural, cognitive, and discursive factors sustaining the value-action gap in global sustainability agendas, emphasizing the importance of citizen engagement for inclusive and effective governance. Institutional arrangements, such as centralized decision-making, technocratic governance, and limited transparency imply that responsibility resides primarily with technical experts and authorities (Bexell & Jönsson, 2017; Fukuda-Parr, 2022; Sachs, 2012).

Discursive frames embedded in policy, public communication, and education shape perceptions of legitimacy and individual efficacy (Entman, 1993; Lakoff, 2004), reinforcing hierarchical authority and constraining meaningful civic participation. Integrating critical pedagogy and framing theory illuminates both the challenges and potential pathways to address these barriers. Critical pedagogy emphasizes praxis, conscientization, and dialogue, demonstrating that awareness alone is insufficient and that citizens must critically interrogate

institutional norms and envision collective possibilities (Freire, 1970; Giroux, 2005; McLaren, 2000). Framing theory clarifies how perceptions of legitimacy and responsibility are constructed and contested in discourse, highlighting opportunities to reframe narratives in ways that promote active engagement (Entman, 1993; Lakoff, 2004).

Bridging the value-action gap therefore requires coordinated strategies that combine structural reform, participatory education, and strategic discursive interventions (Freire, 1970; Kollmuss & Agyeman, 2002; Wals, 2010). By promoting critical awareness, enhancing transparency, and promoting citizen agency (Freire, 1970), these approaches empower individuals and collectives to act meaningfully, translating knowledge into action. Ultimately, sustainable development depends not only on expert-led solutions but also on inclusive spaces where citizens can contribute actively, critically, and collaboratively to shared environmental, social, and economic goals which can support the development of accountable and participatory sustainability initiatives (Bexell & Jönsson, 2017; Fukuda-Parr, 2022).

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that an AI-assisted writing software was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct.

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ICT Facilities and Students' Awareness of Virtual Assessment Indicators-Moderated Mediation Roles of University Type and Lecturers' Self-Efficacy

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Abstract

Adoption of Information and Communication Technology (ICT) tools in the teaching and learning process continues to gain popularity with evolving digital tools and platforms in the virtual learning spaces, which provide opportunities for assessing students' learning outcomes. However, the successful adoption of the virtual assessment mode in universities depends largely on students' awareness of assessment indicators. These might be determined by certain factors, including perceived usefulness and ease-of-use, attitude, intention to use ICT facilities, university type, and lecturers' self-efficacy to integrate virtual assessment. This study, therefore, investigated relationships between ICT facilities and students' awareness of virtual assessment indicators, university type and lecturers' self-efficacy to integrate virtual assessment. In addition, it examined the mediating effect of lecturers' self-efficacy on the relationship between ICT facilities and students' awareness of virtual assessment indicators, as well as the moderating role of university type on lecturers' self-efficacy in the relationship between ICT facilities and students' awareness of virtual assessment indicators. Data collected were analysed using the Hayes Process Macro- Model 7- Moderated Mediation. Results showed both direct and indirect impact of ICT facility on students' awareness of virtual assessment indicators through lecturers' self-efficacy and the moderation by university type (moderated mediation index = -0.070, 95% CI = -0.490/0.430) were significant. The study concludes that lecturers' self-efficacy and university category are germane to successful virtual assessment in higher institutions. It is recommended that the National University Commission should provide benchmark on the quantity and quality of ICT facilities in each university based on number of lecturers and students.

Keywords: ICT facilities, virtual assessment indicators, moderated mediation roles of university type, lecturers' self-efficacy, students' awareness of virtual assessment

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Introduction

The COVID-19 pandemic resulted in the closure of tertiary institutions and education programmes across the globe, including Nigeria. This forced a shift from in-school teaching to online teaching using ICT facilities like computer laboratories, multimedia rooms, smart classrooms, e-learning platforms, internet connectivity, Wi-Fi networks, and other infrastructure that facilitate the use of technology in education (Adewale, 2005). This situation increased the use of ICT and lecturers' professional development in ICT (Espino-Díaz et al., 2020; OECD, 2020). While ICT facilities were useful during the closure for teaching and learning, assessment methodologies that involve real examinations were not included in the arrangement because a method of security and proctoring had not evolved. Although tests and quizzes through Google and other methods were implemented, they were not sufficient to conduct semester-based examinations. However, virtual assessment is an emerging technique that has appreciable potential to ameliorate fundamental issues that arose during and after the pandemic period that caught the world unprepared. The phenomenon spurred institutions of higher learning, especially universities, to seek how they could reach out to their students scattered in various geographical locations for continued academic activities (Olasunkanmi, 2020; Ukoh & Adewale, 2014).

Universities promoted flexible learning and enhanced assessment practices through available digital technology tools and virtual platforms (Smith & Brown, 2018). Thus, they were able to embark on evaluating their students' knowledge and skills remotely, but were limited by their inability to proctor. Whichever mode of assessment was available in each university was sufficient to solve the problem at that stage. Therefore, the proposed assessment standards took into consideration the two important factors of security and proctoring. It was believed that for virtual assessment to be comparable to in-person assessment, certain standards had to be met. The objectives of assessment, face-to-face or virtual, must be aligned with course and programme learning outcomes to provide relevant learning opportunities and a standard of excellence which students should pursue (Vlachopoulos, 2020). Other standard assessment indicators are the content, teaching-assessment time ratio, assessment quality, proctoring, security, medium of transmission, cost effectiveness, feedback mechanism, and remediation loop. These factors are germane for meaningful engagement in the adoption of virtual assessment activities but may influence students' preparedness for optimal performance and overall satisfaction. However, awareness of virtual assessment indicators may be influenced by multiple factors, including the ICT facilities, the type of university students they attend, and the self-efficacy of their lecturers in integrating the technique.

It is important to explain ICT before associating it with the awareness of virtual assessment indicators. Information and Communication Technology has made a remarkable impact in the field of education, particularly higher education (Adewale *et al.*, 2003). The evolving nature of ICT has birthed several innovative strategies and approaches in the instructional processes and assessment methods of virtual educational learning experiences. ICT facilities are repeatedly considered as signs of increased productivity and quality in education (Noor-Ul-Amin, 2013; United Nations Department of Economic and Social Affairs, 2015). As demonstrated by Annetta et al. (2010), it could enhance educational quality by engaging students in the learning process, imitating real-life experiences, and thus creating a viable and economic experiential learning environment. Voogt et al. (2008) describe ICT as a key element of transforming curricula from teacher-centred to student-centred. Ali et al. (2016) explain that ICT engages students in a personalized learning environment according to their interests and experiences. The recurring lockdowns during the multiple waves of the COVID-

19 pandemic forced world education systems to adopt virtual alternatives to physical instruction. Thus, online teaching-learning and use of technology have become an unprecedented education requirement today (OECD, 2020).

Lecturers' self-efficacy is the next variable that has the potential to influence students' awareness of the virtual assessment indicators. Bandura (1977), in his theoretical framework on self-efficacy, describes efficacy as a generative capability in which cognitive, social-emotional, and behavioural sub-skills are organized and effectively orchestrated to serve innumerable purposes. Efficacy beliefs function as key factors in the generative system of human competence. There is a significant difference between possessing a skill set and amalgamating those skills into appropriate actions in varying circumstances. The exploration of online teaching experiences by researchers suggests that for some, unsuccessful technological efforts result in negative emotions and may affect future efforts relating to technology innovation (Cron et al., 2005; de Vries et al., 2003; Venkatesh et al., 2003).

Researchers further suggest that an individual's failure to successfully learn how to use technology or participate in online teaching may induce a negative cycle of emotions and non-use (Cron et al., 2005; de Vries et al., 2003; Venkatesh et al., 2003). Such negative cycles may affect self-confidence and trust in technology within the faculty and may reduce self-efficacy in online teaching. Kidd et al. (2016) studied the experience of lecturers in public health faculties who engage in online teaching. Their findings indicated transformations in online teaching during the development process and associated activities. Lecturers' self-efficacy can be vital in helping students to embrace virtual assessment. This implies that lecturers who are confident in their ability to use virtual assessment tools will be more willing to design assessments that agree with the preconceived learning objectives of their courses (Thompson & Smith, 2017). Lecturers' self-efficacy can directly impact the quality of virtual assessment activities and indirectly influence students' awareness of assessment indicators. This will be evident in the way questions are designed to suit students' exhibition of knowledge and skills in relation to the expectations of the course.

The last variable in this study is the university type or category. There are three university types: federal, state, and private - each financed by the government, individuals, or groups that own them. As at 2024, there were 52 federal, 62 state, and 148 private universities, making a total of 262 universities in Nigeria (National Universities Commission, 2024). These are distributed across the six geopolitical zones as shown in Table 1.

Table 1
Distribution of Federal, State, and Private Universities Across Geo-Political Zones in Nigeria

	Federal	State	Private	Total
North Central	8	11	30	49
North East	8	7	5	20
North West	13	10	19	42
South South	9	11	24	44
South East	6	8	24	38
South West	8	15	46	69
Total	52	63	147	262

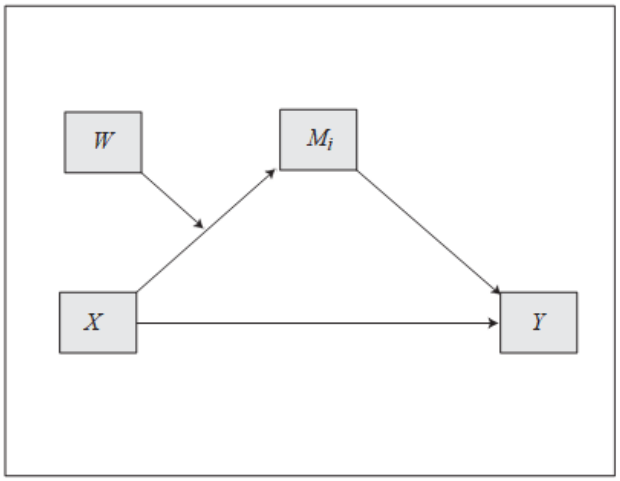
Note. Compiled and calculated by the authors from:
1. https://punchng.com/full-list-147-private-varsities-in-nigeria/
2. https://drugsavant.com/state-universities-in-nigeria/
3. Abusites (2024). Updated List of 262 Government-Approved Universities in Nigeria.

The category of a university may be significant in helping students' experience and readiness for virtual assessment. The availability of ICT facilities and provision of support systems may create differences depending on whether the university is federal, state, or private. These could affect students' level of exposure to virtual assessment technologies with resultant influence on the awareness of assessment indicators (Brown & Johnson, 2019).

This study investigated the possible intricate relationships among ICT facilities, students' awareness of virtual assessment indicators, university type, and lecturers' self-efficacy in integrating virtual assessment. The study explored how lecturers' self-efficacy mediated the relationship between ICT facilities and students' awareness of virtual assessment indicators. Additionally, it examined the moderating role of university type in the mediation of lecturers' self-efficacy on students' awareness of virtual assessment indicators. With a deeper understanding of this relationship, the study seeks to contribute valuable insights in the field of virtual assessment in higher education. The findings could inform universities and educators about the importance of providing adequate and appropriate ICT resources, supporting lecturers' professional development in virtual assessment methods which could yield better results in devising strategies to enhance students' awareness of assessment indicators in diverse university categories.

The conceptual model of the study is patterned after the Hayes process macro model 7 moderated mediation. In this model, the variables are continuous. The model is designed to determine if a mediation is present as well as to find out if a moderator is changing the strength of the indirect effect of the mediator as illustrated in Figure 1.

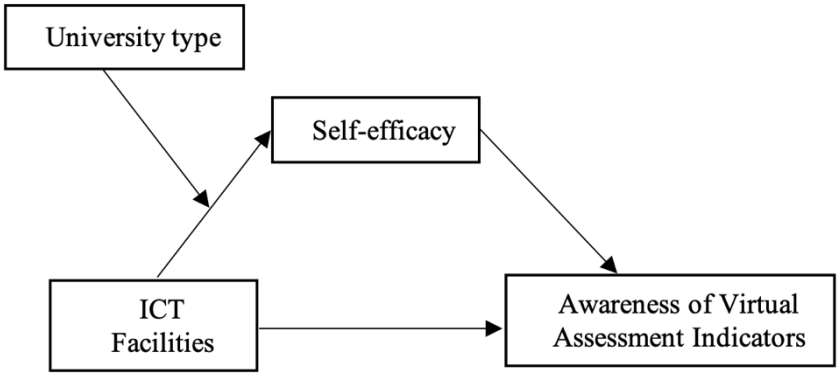
Figure 1
Hayes Process Macro Model 7 Moderated Mediation Conceptual Diagram



In Figure 1, X represents the independent variable (ICT facilities) while the dependent variable is represented by Y (students' awareness of virtual assessment indicators). The letter M1 stands for the Mediator (lecturers' self-efficacy) while W (which is university type) represents the moderator impact effects on the mediator. The model allows up to 10 mediators operating in parallel and its statistical diagram is shown in Figure 2.

In this study, the model is used to determine the mediation of lecturers' self-efficacy to effectively integrate virtual assessment on ICT facilities. In addition, it is employed to determine the moderation effect of university type or category on the mediation effect of lecturers' self-efficacy on the strength of indirect effect of ICT facilities on students' awareness of virtual assessment indicators. The complex relationships are diagrammatically represented in Figure 2.

Figure 2
The Conceptual Model of the Study



Existing literature focuses on students' awareness of e-learning methodologies in virtual teaching and learning and its effectiveness. With a dearth of literature on students' awareness on virtual assessment indicators, this study aims at providing indicators of virtual assessment. In line with the conceptual model, the study is designed to investigate the relationship between ICT facilities and students' awareness of virtual assessment indicators, the mediating role of lecturers' self-efficacy to integrate virtual assessment, and the moderating role of university type on those relationships.

Research Questions

The following research questions were raised to guide the study:

1. What is the relationship between:
   a. ICT facility and students' awareness of virtual assessment indicators?
   b. Lecturers' self-efficacy and students' awareness of virtual assessment indicators?
2. Will ICT facility, lecturers' self-efficacy, and university type have impact on students' awareness of virtual assessment indicators?
3. Will the interaction of ICT facility and university type have impact on lecturers' self-efficacy?
4. Will the indirect impact of ICT facilities on students' awareness of virtual assessment indicators through lecturers' self-efficacy be moderated by university type?

Methodology

The study adopted the correlational design in which data on students' awareness of virtual assessment indicators, virtual assessment integration, and lecturers' self-efficacy were gathered through surveys distributed to participants, students and lecturers in six Nigerian universities - two universities each owned by federal, state, and private groups or individuals.

Three departments each were purposively selected from science and humanities- faculties drawn from six universities purposively selected from the northern and southern parts of Nigeria.

The distribution of the lecturers from each department was one Professor or Associate Professor, two Senior Lecturers and two Lecturers I and II spread adequately across gender. The lecturers were randomly selected where there were more than the number needed. Fifty students (25 females and 25 males) were randomly selected per department, making a total of 600 students.

The study focused on ICT facilities in universities, awareness of virtual assessment indicators by students, university type and self-efficacy in integrating virtual assessment by lecturers in Nigeria. Professors, Readers, Senior Lecturers, Lecturers I and II were participants in the study. The Virtual Assessment Standard Indicators Scale was used for data collection. It has two major sections A and B. Section A dealt with the institutional variables while Section B measured students' awareness of virtual assessment. The instrument was administered to the selected students and lecturers electronically using Online Data Kit (ODK). The study adopted the Hayes Process Macro- Model 7- Moderated Mediation to analysise data. Unstandardised regression and beta coefficients were used in establishing the relationship, total, direct and indirect effects of the independent variable, moderated mediation variables on the endogenous variable.

Results and Discussion

The four research questions were answered using different tables as presented.

Research Question 1

What is the relationship between:

a. ICT facility and students' awareness of virtual assessment indicators?
b. University type and students' awareness of virtual assessment indicators?

The relationship between ICT facilities and lecturers' self-efficacy as independent variables and students' awareness of virtual assessment indicators as the dependent variable is carried out using the multiple regression analysis as presented in Table 2.

Table 2
Relationships Between Independent Variables and Virtual Assessment Awareness

	Coeff	se	T	p	LLCI	ULCI
Constant	26.07	3.29	7.92	0.00	19.58	32.57
ICT Facilities	-0.33	0.17	-1.97	0.05	-0.67	0.00
University Type	1.81	1.52	1.19	0.24	-1.19	4.80
R = 0.46;	R-sq = 21;	MSE = 32.69;		F = 16.41		
df_1 = 3.00	df_2 = 181.00	p = .00				

The relationship between independent variables (ICT facilities and university type) and students' virtual assessment awareness indicators denoted by R = 0.46; R square = 0.21; F = 16.41 shows that 21% variance in students' virtual assessment awareness indicators is accounted for by the independent variables. Similarly, Table 1 shows that a combined significant influence exists between independent variables and virtual assessment awareness indicators. Moreover, the relationship between ICT facilities and students' virtual assessment awareness indicators is -0.33 ± 0.17 indicate a weak relationship. However, the relation between these two variables is significant. On the contrary, the relationship between university type and students' virtual assessment awareness indicators is 1.81 ± 1.52 due to the presence of a large standard error. The relationship is not significant.

Research Question 2

Will ICT facilities, lecturers' self-efficacy, and university type have impact on students' awareness of virtual assessment indicators?

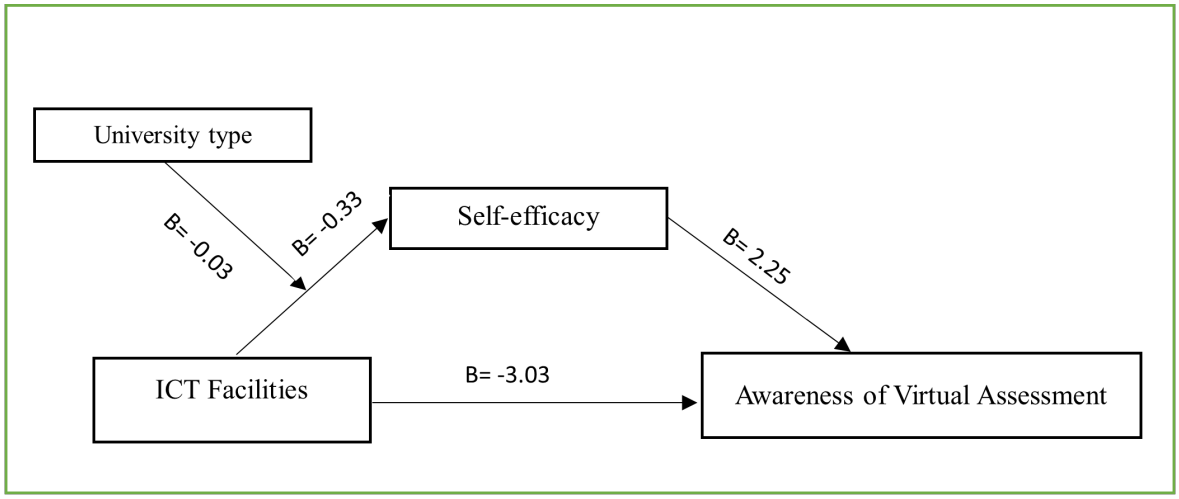
This research question was answered using both the regression analysis and the Hayes Process Macro Model 7 hypothesised Moderated Mediation diagram (Figure 3). The ICT facilities has a negative significant impact on students' awareness of virtual assessment indicators ($b = -3.03$, $t = -1.97$, $p < 0.05$). That implies that ICT facilities in universities negatively impacted the students' awareness of virtual assessment indicators. This could mean that the more ICT facilities are available in a university, the lower the student are aware of the virtual assessment indicators and vice versa.

Table 3
Direct Relationships Among the Variables

Direct Relationships	Unstandardised Coefficient	T values	Sig.t
ICT Facility (ICTF) ➔ Self-Efficacy (SE)	-0.330	-1.970	0.05
Self-Efficacy (SE) ➔ Awareness of Virtual Assessment Indicators (AVAI)	2.250	3.620	0.00
ICT Facility (ICTF) ➔ Awareness of Virtual Assessment Indicators (AVAI)	-3.030	-4.790	0.00
ICT Facility (ICTF)*University Type ➔ Self-Efficacy (SE)	-0.030	-0.380	0.27

These are further illustrated in Figure 3.

Figure 3
Relationships Among the Variables



Research Question 3

Will the interaction of ICT facility and university type have impact on lecturers' self-efficacy?

Table 2 shows that ICT facilities have a negative significant impact on lecturers' self-efficacy ($b = -0.33$, $t = -1.97$, $p < 0.05$). That implies that ICT facilities in the universities negatively impact lecturers' self-efficacy. It can be seen that the more facilities a university has, the less the self-efficacy of the lecturers in that university.

Furthermore, the interaction of ICT facilities and university type did not significantly impact lecturers' self-efficacy ($b = -0.03$, $t = 0.38$, $p > 0.05$).

Research Question 4

Will the indirect impact of ICT facilities on students' awareness of virtual assessment indicators through lecturers' self-efficacy be moderated by university type?

The research question was answered using the result output of the Hayes Process Macro Model 7 Moderated Mediation analysis. The result shows that the indirect impact of ICT facilities on students' awareness of virtual assessment indicators through lecturers' self-efficacy was moderated by university type as indicated by the index of moderated mediation (index = -0.070, 95% CI = [-0.490/0.430]) since the 95% does not include zero.

Table 4
Indirect Relationship of the Variables

Indirect Relationships	Direct Effect	Indirect Effect (SE)	Confidence Interval Low/High	T values
ICT Facilities > Self-Efficacy > Awareness of Virtual Assessment Indicators	-3.030	-0.900 (0.300)	-1.52/-0.34	3.0
Probing Moderated Indirect Relationships	Effect	SE	Confidence interval Low/High	t-statistics
Federal university	-0.820	0.370	-1.650/-0.220	-2.216
State university	-0.900	0.300	-1.520/-0.340	-3.00
Private university	-0.970	0.390	-1.770/-0.280	-2.62
Index of Moderated Mediation	-0.070	0.220	-0.490/0.430	0.318

Figure 3.0 shows the hypothesized moderated mediated model which was tested using the process macro model 7. This signifies that the indirect effect of ICT facilities on awareness of virtual assessment indicator through self-efficacy is moderated by university type (index -0.07,95% CI = [-0.49/0.43] and significant since the 95% does not include Zero.

Discussion

The relationship between ICT facilities and students' awareness of virtual assessment indicators is fully mediated by their lecturers' self-efficacy. ICT facilities, including internet connectivity, are for the university community's usage, especially students and lecturers. It is assumed that the presence of ICT facilities should have a positive impact on the students' awareness of virtual assessment; however, this is not the case as there is a negative relationship between the two variables. The implication is that students use ICT facilities for social networking and other things that are not connected with virtual assessment or teaching and learning (Erdogdu & Erdogdu, 2015). The use of ICT facilities allows students to connect and share ideas irrespective of time and geographical locations they may find themselves.

Sütlüoğlu (2015) states that today, young people are in a process of socialization and identity building not only during the time spent in front of the screen, but through the transitions between online and offline worlds. Considering the mediated role of lectures' self-efficacy, it is believed that students' awareness of virtual assessment indicators depends on the comfort teachers feel about using ICT in the classroom, their ability to integrate computers into lessons and programmes, and the degree to which students get opportunities to use them (Bozdogan & Ozen, 2014; Martinovic & Zhang, 2012).

The relationship between lecturers' self-efficacy and students' awareness of virtual assessment indicators is moderated by university type. Lecturers' self-efficacy directly impacts the quality of virtual assessment activities and indirectly influences students' awareness of assessment indicators. It is assumed that ICT facilities vary based on the type of universities, which ordinarily will influence the self-efficacy of lecturers in those universities. Lecturers' exposure to online teaching improved their self-efficacy, but those who were unsuccessful in the use of technology displayed negative self-efficacy (Cron *et al*., 2005; de Vries *et al*., 2003; Venkatesh *et al*., 2003). With improved self-efficacy of lecturers in the use of ICT, lecturers who are confident in their ability to use virtual assessment tools would be more willing to design assessments (Thompson & Smith, 2017), and this may increase students' awareness of virtual assessment indicators.

Conclusion and Recommendations

The study concludes that lecturers' self-efficacy and university category are germane to successful virtual assessment in higher institutions. It can be inferred from the study that increased availability of ICT facilities in the different types of universities will lead to greater lecturers' use of ICT tools and enhance self-efficacy. Similarly, lecturers' greater use of technology for assessment will make students more aware of virtual assessment indicators. It is recommended that:

i. Adequate ICT facilities should be available in federal, state, and private universities. The National University Commission should provide a benchmark on the number of ICT facilities in each university based on the number of lecturers and students.
ii. Since technology innovations move at the speed of light, students and lecturers with little competence in technology should be provided with professional development to improve lecturers' self-efficacy for successful integration of virtual assessment in universities.
iii. Since students' awareness of virtual assessment indicators is influenced by available ICT facilities and lecturers' self-efficacy, lecturers should use ICT facilities, especially in assessment methodologies, to increase students' awareness of virtual assessment indicators.

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Effect of Active Learning Approach on Senior Secondary Students' Chemistry Performance in Rivers State, Nigeria

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Abstract

This paper examined the effect of active learning approach on Senior Secondary School Students' Chemistry Performance in Rivers State. Quasi-experimental, non-equivalent pre-test, post-test control group design was adopted for the research. A sample size of fifty (50) senior secondary school II students participated in the study. Two research questions and two null hypotheses guided the study. A validated instrument titled Chemistry Performance Test (CPT) was used to collate the data. The reliability of the instrument was established using Kuder-Richardson -21 (KR-21) to obtain an index of +0.84. The research questions were answered using mean and standard deviation while the hypotheses were tested using ANCOVA at 0.05 significant level. Findings from the study revealed that the Chemistry students taught using active learning approach made higher learning performance gain than those taught with the traditional lecture method. There was a significant effect of the use of active learning approach over the traditional lecture method on the scores of the students. It was recommended among others that the use of active learning approach be adopted as a learning approach in the teaching and learning of Chemistry at all levels of education to enhance learning and improve students' performance in Chemistry.

Keywords: active learning approach, secondary school students, chemistry performance

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Introduction

Science is a branch of knowledge that studies matter and the environment. It is the very cornerstone on which anchors the modern-day technological advancement. Chemistry is one of the core science subjects studied in both secondary school and higher institutions. It is a central science that permeates all our lives. Chemistry as a science subject makes use of specific terms to define relationships and changes that occur in real life situations (Macrothink Insitute, 2023). It is the branch of science that deals with the properties, composition, and structure of elements and compounds, how they undergo changes from one state to another, and the energy that is released or absorbed when they change (Ugonwa et al., 2024). It is a science within the natural sciences that studies the chemical elements that make up matter and compounds made of atoms, molecules, and ions, their composition, structure, properties, behavior, and the changes they undergo when they react with other substances. Chemistry also addresses the nature of chemical bonds in different chemical compounds and studying chemistry as a subject is important because everything, we do is chemistry. Everything in our life is based on chemistry. Even the human body is made of chemicals. Chemistry is therefore a big part of our everyday life. The importance of this branch of science can be seen in different spheres of human life such as in the food we eat, the air we breathe, various cleansing agents, toothpastes, lotions, facewash, pharmaceuticals, batteries in watches, mobile phones, cars, laptops, and other electronic devices, and fuel in our vehicles to mention but few as instances of chemistry in our daily lives, thus, all matter is made of chemicals, therefore chemistry is the study of everything.

Learning Chemistry enable students to learn about the scientific method and gain skills in critical thinking, deductive reasoning, problem-solving, and communication. Obafemi and Ugonwa (2025) opined that teaching of chemistry to students at a young age can increase student interest in STEM careers. Some concepts to study in chemistry include, Atomic structure, the Periodic table, Chemical bonding, Chemical reactions and Stoichiometry, Acids and bases, Electrochemistry and Organic chemistry. Chemistry can help us to understand, monitor, protect and improve the environment around us. Over the years, Chemists have developed tools and techniques which ensure that we can see and measure air and water pollution. They have helped to build the evidence that shows how our climate has changed over time. In a nutshell, Chemistry helps us understand the world around us and improve the quality of life while ensuring safety. In addition, a good understanding of chemistry will help us solve many future problems, including sustainable energy and food production, managing our environment, providing safe drinking water, and promoting human and environmental health. Dike and Ugonwa (2021) opined that chemistry is an integral part of other science subjects and requires both theory and practical learning. Chemistry plays a vital role on students understanding of science and expertise in scientific advancement. Practical and experiential learning has been known to enhance motivation to learning chemistry and enable students develop science process skills which helps them to deal with abstract knowledge (Macrothink Insitute, 2023).

Experiential learning is a direct experience -based learning approach which may involve hands-on learning. Students in this approach learn by actively participating in the real-world activities, experiments, or projects. Active learning is an experiential learning approach in which learners play active role in the learning process, making decisions and solving problems (Nwanekezi & Ugonwa, 2021). It is the approach to learning that involves students actively engaging in the learning experiences rather than passively receiving information. Active learning approach

engages students into critical thinking, problem solving and ability to apply what they have learnt. The major characteristics of active learning are:

- ✓ It is student - centered. Active learning focuses on the learning process of the students rather than the teachers transmission of information.
- ✓ It involves hands-on activities. Active learning incorporates activities that require students to manipulate, experiment or innovate.
- ✓ It encourages students collaboration as the students share ideas and learn from each other.
- ✓ It enables critical thinking since the students are required to think, analyze evaluate and synthesize information.
- ✓ It encourages problem solving, where students are engaged in identifying and solving real-world problems.
- ✓ Active learning approach encourages students to reflect on their learning experiences, share and receive feedback from peers and instructors.

Active learning gives the learners direct experience as they engage in practical experiences rather than just reading or listening to the teacher. The strategies for active learning approach include:

- ❖ Discussions and Debates
- ❖ Group projects and presentations
- ❖ Experiments and role-playing
- ❖ Problem-based learning
- ❖ Think-pair share and peer instruction

According to Nwanekezi et al. (2023), to apply active learning approach in the classroom, the teacher selects a topic and a student, allows the students to think about the topic and list out all he knows about the topic. He is then paired with someone in the class where they compare their lists thereby exchanging ideas. Later the class is grouped into four or five where there is further exchange of ideas after which the groups come up with a list of contributed ideas as feedback to be discussed in the classroom.

Wolf et al. (2015) in their study highlighted the Matrix of active learning techniques to include: Think-pair-share, Concept maps, Role play, Jigsaw, Team-based learning, problem-based learning, Thinking Hats and more. They submitted that active learning helps to increase retention in students and facilitate transfer of knowledge. They also added that when learners are actively involved in their learning, knowledge will be transmitted, and they will effectively apply their knowledge and skills. A brief description of how some of these techniques can be applied in the classroom is discussed as follows:

Think-Pair-Share – Here the teacher pose a question to the group and allow the learners to consider their response individually. Then, he instructs the learners to pair with a neighbor to compare responses and come up with feedback. He concludes by randomly calling on pairs to share with the entire class.

Concept maps – This technique involves forming a mental picture of relationships between concepts diagrammatically. It Can be done individually or in groups where the students will use a cardboard paper to draw or do a schematic representation of the concept.

Jigsaw – In this technique, the teacher divides the topic into several smaller, interrelated pieces and assigns each member of the team a part of the topic to read and master it. With this, each

of them is asked to teach their team members about their own piece. When each person in the group has finished teaching their own part, the puzzle is collated by the teacher to conclude the lesson.

Team-based learning - Here the teacher forms Small-groups of between four and ten members who will learn a concept together before the class session. After this, during the classroom session, the learners are tested on the preclass material they learnt and then challenged to explain the core content or model the concept learnt as a team.

Role play – Here learners are given a particular role to act or a particular viewpoint to better understand the concepts and theories in question.

Some of the benefits of active learning approach are:

1. Increases engagement and motivation in the students.
2. Promotes deep understanding and retention in the learners.
3. Students develop critical thinking and problem-solving skills.
4. It enhances collaboration and communication skills in the students.
5. It improves student autonomy and self-directed learning.

By using active learning approach in the teaching and learning of chemistry as a subject, there would be effective interaction and participation of every student in the class and this will bring collaboration and critical thinking among them. The role of the teacher here is to create engaging and conducive learning environment, then ensure adequate and even grouping of the students having both the brilliant and the weak students together in every group. The review of Nguyen et al. (2021), on Instructor strategies to aid implementation of active learning, submitted that the use of active learning in STEM fields has been linked to improving students learning and retention, particularly among students from some underrepresented groups.

Camacho and Legare (2015) conducted a study on opportunities to create active learning in the classroom and submitted their in findings that incorporating active learning methods into the classroom will enable instructors to create opportunities for learning instead of allowing students to sit passively and learn by absorbing information passed by the instructor.

Kim et al. in Camacho and Legare (2015) described the benefits of active learning techniques to include, improved critical thinking skills, increased motivation, and enhanced interpersonal communication skills.

Galbraith and Fouch (2007), in their study, established that active learning techniques enable students to organize and reflect; practices that reinforce learning.

The traditional lecture or “talk and chalk” method of teaching and learning have been observed to be ineffective in promoting deep understanding of concepts, critical thinking, and problem-solving skills in chemistry students. The passive reception of information leads to poor retention, lack of participation and inability to apply knowledge in real-world situations. Wolf et al. (2015), established from their findings that most teachers rely on the traditional lecture method of teaching which unfortunately only permits learners to retain little or no knowledge of what they are taught in the class, and they rarely apply what they learn. Moreso, the rapidly changing trends of the 21st century require that students be equipped with skills such as collaboration, creativity, and adaptability, which are not common with the traditional teaching methods. A shift toward an active learning approach that empowers students to take ownership

of their learning and engages them in participatory learning experiences may likely improve the academic performance of the chemistry students and help them to develop the skills and competencies necessary for success in an evolving world. Active learning approach provides students with rewarding and joyful learning experiences unlike the traditional passive talk and chalk method of learning. It is therefore expedient to examine the effect of active learning approach on the performance on the chemistry students in the secondary schools in Rivers State.

Aim and Objectives of the Study

The aim of this study is to examine the effect of active learning approach on the performance of chemistry students in senior secondary schools in Rivers State. The specific objectives of the study are to;

1. Determine the mean performance score of chemistry students exposed to active learning approach and lecture method in secondary schools in Rivers State.
2. Examine the mean performance score of the male and female students in chemistry who were exposed to active learning strategy in the secondary schools.

Research Questions

The following research questions guided the study.

1. What is the mean performance score of the SS2 chemistry students who were taught using active learning approach and those taught using lecture method in secondary schools in Rivers State?
2. What is the mean performance score of male and female students in the secondary schools who were exposed to active learning strategy in chemistry?

Hypotheses

1. There is no significant difference in the mean performance score of the chemistry students exposed to active learning approach and that of those taught with lecture method in the secondary schools in Rivers State.
2. There is no significant difference between the mean performance score of male and female students in the secondary schools who were exposed to active learning strategy in chemistry?

Methodology

Quasi-experimental, non-equivalent pre-test, post-test control group design was used for the study. The area of the study was Port Harcourt City Local Government Area of Rivers State. The population of the study comprises of four hundred and twenty (420) senior secondary school two (SSS2) chemistry students in Port Harcourt City Local Government Area of Rivers State. Simple random sampling technique was used to select sample size of 50 SSS2 chemistry students from two intact classes of two schools: Model Girls Secondary School Rumueme and Community Secondary School Nkpolu Oroworukwo, Port Harcourt. The schools were selected using purposive sampling technique and assigned to experimental and control groups by balloting.

Table 1
Experimental Procedure

	Groups	Pre-test	Treatment	Post-test
Experimental	1	Pre-test given on chemistry performance test.	Taught using active learning approach.	Post-test given on chemistry performance test.
Control	2	Pre-test given on chemistry performance test.	Taught using lecture method.	Post-test given on chemistry performance test.

The instrument used for data collection was chemistry performance test (CPT) which was developed by the researcher. The CPT instrument was constructed based on the topic "The Periodic Table" and used for pre-test and post-test. The CPT comprises of forty (40) multiple choice objective questions with options A, B, C and D having 2.5 marks assigned to each correct answer while wrong answers attract zero (0) score. 100 marks was the maximum score for the data. The CPT instrument was validated by one chemistry teacher and one measurement and evaluation expert. They ascertained the face, content, and construct validity of the instrument. The CPT instrument was also trial tested using 20 SSS2 chemistry students from another school of the same area of study. The reliability of the instrument was gotten using Kuder-Richardson-21 (KR-21) to calculate the data obtained from the CPT trial -test scores and a reliability co-efficient of 0.84 was obtained. The two sampled schools were grouped into experimental and control groups (Groups one and two, respectively). Group one were taught using Active learning approach (jigsaw, think-pair-share, concept mapping and Team-based learning were used), while Group 2 were taught using the conventional lecture method. Prior to the start of the lesson, the researcher explained the features of the Active learning approach to the students in the experimental group. The CPT instrument where then given to both the Experimental and Control groups and data collected and marked to obtain the pre-test scores of both groups. The researcher decided to administer the treatment and instrument by herself on different days of the schools since a schedule was drawn and agreed upon by the researcher and chemistry teachers with the permission of the school authority (based on the timetable). The treatment lasted for three weeks, after which a post-test was administered to both the Experimental and Control groups by the researcher. Data collected was also marked and scores recorded for analysis. Mean and standard deviation was used to answer the research questions while Analysis of Co-variance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Results and Findings

Research question 1: What is the mean performance score of SSS2 chemistry students taught using Active learning approach and those taught using Lecture method in senior secondary schools in Rivers State?

Table 2
Mean, Standard Deviation and Mean Gain of Students' Performance Using Active Learning Approach and Lecture Method

Method	Pre-test			Post-test		Mean Gain
	N	$\bar{x}$	SD	$\bar{x}$	SD	
Active learning	50	30.10	6.03	76.70	12.12	46.60
Lecture Method	50	30.50	5.80	59.20	8.38	28.70

Table 2 showed that the students taught chemistry using active learning approach had a mean gain score of 46.60 while those taught chemistry using lecture method had a mean gain score of 28.70. This is an indication that students taught chemistry with active learning approach performed better than the students taught with lecture method.

Research question 2. What is the mean performance score of male and female students in the secondary schools who were exposed to active learning strategy in chemistry?

Table 3
Mean, Standard Deviation and Mean Gain of Male and Female Students in Chemistry Taught Using Active Learning Approach

Gender	Pre-test			Post-test		Mean Gain
	N	$\bar{x}$	SD	$\bar{x}$	SD	
Male	25	28.40	6.47	74.20	13.56	45.80
Female	25	31.40	5.27	82.60	8.91	51.20

Table 3 shows that the male students taught with active learning approach had a mean gain of 45.80 while the female students exposed to active learning approach had a mean gain score of 51.20. This is an indication that the female students taught chemistry using active learning strategy performed better than their male counterparts.

Hypothesis 1. There is no significant difference in the mean performance score of the chemistry students exposed to active learning approach in the secondary schools in Rivers State.

Table 4
ANCOVA Analysis of Students Taught Chemistry Using Active Learning Approach and Lecture Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	10415.645	2	5207.822	47.529	.000	.495
Intercept	16441.036	1	16441.036	150.050	.000	.607
Pre-test	11.645	1	11.645	.106	.745	.001
Methods	10307.198	1	10307.198	94.061	.000	.492
Error	10628.355	97	109.571			
Total	488900.000	100				
Corrected Total	21044.000	99				

Table 4 shows that the calculated F-ratio is 94.061 and significant at p = 0.00{p < 0.05). The null hypothesis was rejected. This shows that there is significant difference between the mean performance score of students taught chemistry using active learning approach and those taught using lecture method in senior secondary schools in Rivers State.

Hypothesis 2. There is no significant difference between the mean performance score of male and female students in the secondary schools who were exposed to active learning strategy in chemistry?

Table 5
ANCOVA Analysis of Male and Female Students Taught Chemistry Using Active Learning Approach

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	920.283	2	460.141	3.443	.040	.128
Intercept	13086.420	1	13086.420	97.913	.000	.676
Pre-test	38.283	1	38.283	.286	.595	.006
Gender	918.129	1	918.129	6.870	.012	.128
Error	6281.717	47	133.654			
Total	316100.000	50				
Corrected Total	7202.000	49				

Table 5 shows that the calculated F-ratio is 6.870 and not significant at p-0.012 ($P < 0.05$). Hypothesis 2 was accepted. This shows that there is no significant difference between the mean performance score of the male and female students taught chemistry using active learning approach in the secondary schools.

Discussion of Findings

The result of table 2 in the study revealed that the SS2 chemistry students who were taught using active learning approach performed better than those who were taught using lecture method in the secondary schools. The difference in the mean gain is 17.9. This implies that the active learning approach was effective in improving the academic performance of the chemistry students when compared to that of those taught using the convectional lecture method of learning. The effect of active learning approach on the performance of the chemistry students was also significant as shown in table 4 where the F-calculated is 94.061 and significant at $p = 0.00$ (p,0.05), showing a significant difference between the mean performance score of students taught chemistry using active learning approach and those taught using lecture method in senior secondary schools in Rivers State. The use of active learning approach promotes the development of critical thinking through discussion and clarification of ideas which gives the students a greater liberty to advance their own ideas and at the same time benefit from the ideas of others. This finding is in line with that of (Macrothink Insitute, 2023) who reported that practical and experiential learning has been known to enhance motivation to learning chemistry and enable students develop science process skills which helps them to deal with abstract knowledge. The findings agree with the submission of Wolf et al. (2015), and Camacho and Legare (2015), that active learning helps to increase retention in students and

facilitate transfer of knowledge. Also established that when learners are actively involved in their learning, knowledge will be transmitted, and they will effectively apply their knowledge and skills.

Table 3 revealed that female students taught chemistry using active learning approach performed better than their male counterparts with a mean gain difference of 5.4. Further analysis in the table 5 revealed that the calculated F-ratio is 6.870 and not significant at p-0.012 ($P < 0.05$). Thus the Hypothesis 2 was accepted implying that there is no significant difference between the mean performance score of the male and female students taught chemistry using active learning approach in the secondary schools. This findings agrees with the submission of Nguyen et al. (2021), that the use of active learning in STEM fields has been linked to improving students learning and retention. Also agrees with Galbraith and Fouch (2007), asserted that active learning techniques enable students to organize and reflect in other to reinforce learning. This implies that gender was not necessarily a significant factor in this regard. Both male and female chemistry students can respond positively to the use of active learning approaches and optimally to enhanced knowledge and improved performance.

Conclusion

The findings of this study have established that active learning approach has the potential to enhance the academic performance of the chemistry students in the secondary schools. To fully adopt active learning approach in teaching and learning of chemistry in the secondary schools, chemistry teachers should acquire a good knowledge on the use of active learning for effective implementation in the classroom. When learners are actively engaged in their learning, transmission of knowledge will take place and the knowledge acquired can be applied in real-life situations. Both male and female students have the potentials to respond favorably to active learning approaches in the secondary school. Therefore, incorporating active learning approach and strategies into classroom produces a more effective learning environment and increased students' participation. This ensures more student engagement in their learning and enhances meaningful learning.

Recommendation

Consequent on the findings of this analysis, the following recommendations were made:

1. Curriculum planners should incorporate the use of active learning approach into the chemistry curriculum to constitute contents and learning experiences.
2. Chemistry teachers should adopt active learning as a learning approach in the teaching and learning of Chemistry at all levels of education to enhance learning and improve students' performance in Chemistry.
3. Government and Educators should organize workshops and provide adequate training facilities on the use of active learning techniques in the secondary schools and encourage teachers to utilize it in teaching and learning of chemistry.

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Letterpress, Perception, and the Screen Generation: Materiality as Pedagogical Insight in Cross-Cultural Design Education

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Abstract

This study examines how embodied engagement with letterpress printing deepens perceptual understanding of typography and visual culture among digital-native learners. Following the pandemic, in 2023, I collaborated with Tokyo-based letterpress studio Letterpress Letters to organize a cross-cultural workshop for Taiwanese high school students, providing direct experience with European typographic craftsmanship and printing techniques. Addressing a generation increasingly distanced from typography's material and historical foundations, this research investigates how tactile printing practices can reconstruct students' perceptual engagement with typographic forms and foster critical reflection on materiality within contemporary visual culture. Drawing on Tim Ingold's material engagement theory, Karen Barad's concept of embodied intra-action, and sensory learning frameworks, this study employs qualitative methods including participant observation, artifact analysis, and reflective documentation. Through guided instruction in manual type selection, arrangement, and layout adjustment, students developed heightened aesthetic sensitivity and nuanced understanding of the relationship between traditional craft practices and digital technologies. Findings demonstrate that letterpress printing enhances students' capacity for typographic discernment while fostering critical engagement with the visual structures and communicative logic underlying typographic forms. The research reveals how material engagement with printing processes enables students to perceive typography not merely as visual information but as culturally embedded practice. This study proposes a pedagogical framework integrating embodied perception, cultural awareness, and digital literacy as an effective approach to contemporary visual culture education.

Keywords: material engagement, letterpress printing, design pedagogy, embodied perception, cross-cultural learning, multisensory learning, perceptual reconstruction

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Introduction, Research Background, and Motivation

Digital-native design students navigate typography through screens with remarkable fluency. They adjust kerning in Figma, construct visual hierarchies in Canva, and produce visually refined layouts with efficiency that would have been unimaginable to previous generations. However, this apparent competence conceals a structural limitation in contemporary design education. Many students possess what has been described as *screen literacy without material literacy* (Heller, 2015): mastery of interfaces without an embodied understanding of typography as a material, historical, and culturally situated practice.

This perceptual gap has intensified in post-pandemic educational contexts. During the COVID-19 transition to online learning, even the limited tactile encounters once embedded in design education such as handling printed matter, visiting print studios, or examining physical typographic specimens were largely eliminated (Harland & Bohemia, 2021).

For students whose design education unfolded almost entirely through screens, typography increasingly appears as a system of adjustable parameters rather than as a material practice shaped by weight, resistance, and constraint.

Current design pedagogy has struggled to respond to this condition. While scholars have called for renewed attention to craft and making (Crawford, 2009; Sennett, 2008), material engagement is often framed as a supplementary or nostalgic practice rather than as an epistemological necessity. Typography education continues to emphasize principles such as contrast, hierarchy, and readability, yet without embodied experience these concepts remain abstract. The resulting crisis is not merely technical, but perceptual: an entire generation is learning to design without learning how to see through material engagement.

This study emerged from direct observation of this crisis within Taiwanese design education. In 2023, following the easing of pandemic restrictions, I collaborated with the Tokyo-based letterpress studio *Letterpress Letters* to organize a cross-cultural workshop for Taiwanese high school students. The pedagogical significance of this workshop lay in the layered unfamiliarity of the setting, in which students simultaneously encountered:

- a pre-digital printing technology (letterpress),
- a foreign writing system (Latin alphabets designed for European languages), and
- a cross-cultural learning environment in Japan.

These combined conditions disrupted students' habitual modes of perception. Without established cultural or technical scripts to rely on, students were compelled to attend directly to what the material itself demanded, rather than to pre-existing visual conventions.

The research question crystallized through close observation of students' interactions with the printing process. As they adjusted spacing by physically inserting or removing metal spacers, handled the substantial weight of wooden type, and observed the uneven adhesion of ink on aged surfaces, typography ceased to function as "text on screen." Instead, it revealed itself as a situated practice—performed by bodies, mediated by tools, and unfolding over time. This led to the central question of this study:

- *Can material engagement, particularly within cross-cultural contexts, reconstruct how digital-native students perceive typography and visual culture?*

This question carries both theoretical and practical significance. Theoretically, it contributes to material culture studies, the anthropology of making, and embodied cognition research, which emphasize that perception is shaped through interaction with materials and tools (Ingold, 2013; Malafouris, 2013). Practically, it addresses a pressing challenge in contemporary design education: how to cultivate visual and cultural literacy among students whose formative experiences are predominantly screen-based. As design increasingly mediates social communication, political discourse, and cultural identity, critical engagement with visual form becomes a fundamental democratic competence (Mirzoeff, 2015). Such engagement, however, requires understanding visual forms as material practices embedded in historical, technological, and power relations. From this perspective, material literacy is not an optional enhancement, but a foundational requirement for critical visual culture education in the twenty-first century.

Research Questions

This study is guided by one overarching research question and three interconnected sub-questions that address the theoretical, pedagogical, and perceptual dimensions of material engagement in design education.

Primary Research Question

Can embodied engagement with letterpress printing reconstruct perceptual understanding of typography and visual culture among digital-native learners?

This question frames material engagement not as skill acquisition or technical training, but as a form of perceptual intervention. The term *reconstruct* is used deliberately: it suggests that digital interfaces have already shaped a dominant mode of typographic perception, and that material encounters offer the possibility of reconfiguring how typography is seen, understood, and evaluated through different experiential foundations.

Sub-Question 1: Theoretical Mechanisms

How does physical interaction with material artifacts generate knowledge that digital interfaces cannot convey?

This question addresses the epistemological role of materiality in learning. Drawing on Ingold's (2013) concept of thinking-through-making and Barad's (2007) notion of material–discursive practices, it examines whether materials function as active participants in knowledge production. Specifically, it investigates how the physical properties of letterpress printing—weight, resistance, dimensional constraint, and traces of historical use—enable understanding of spacing, hierarchy, and legibility in ways that remain inaccessible through screen-based manipulation.

Sub-Question 2: Pedagogical Conditions

What role does cross-cultural unfamiliarity play in enabling perceptual transformation?

This question focuses on pedagogical design rather than materiality alone. The study situates Taiwanese students in a Japanese letterpress studio working with European wooden type, producing layered unfamiliarity across technology, writing system, and cultural context. It

examines whether such unfamiliarity functions as an epistemic resource by disrupting habitual interpretive frameworks and directing attention toward material properties themselves. In doing so, it asks whether perceptual awareness is sharpened when cultural shortcuts are removed.

Sub-Question 3: Perceptual Durability

How does multisensory material engagement shape lasting changes in typographic perception and digital design practice?

This question addresses the durability and transferability of perceptual learning. It investigates whether sensory-rich experiences—integrating touch, sight, sound, smell, and bodily movement—produce perceptual shifts that persist beyond the workshop context. More critically, it asks whether these shifts transfer back into digital practice: do students subsequently approach tools such as InDesign or Figma differently, informed by embodied material memory?

Taken together, the three sub-questions are necessary to address perceptual reconstruction as a process rather than as a single outcome. Examining material engagement without attention to pedagogical conditions would risk treating perception as an individual response divorced from context. Conversely, focusing on cross-cultural unfamiliarity alone would foreground difference without accounting for how perception is physically negotiated through tools and materials. Finally, without considering perceptual durability, any observed shift could be dismissed as situational or short-lived, limited to the workshop setting itself.

Each sub-question therefore addresses a distinct but interdependent dimension of perceptual change. The first examines how material properties participate in shaping judgment at the moment of making. The second considers how unfamiliar cultural and technological conditions disrupt habitual ways of seeing, creating openings for perceptual reorientation. The third asks whether such reorientation persists beyond the immediate encounter and informs subsequent design practice.

These questions are not arranged as a linear sequence, but as a relational structure. Material engagement, pedagogical context, and perceptual durability continuously shape one another. Only by considering all three together can the study account for how perceptual understanding is destabilized, re-formed, and potentially sustained among digital-native learners. Removing any one of these dimensions would leave the process of perceptual reconstruction conceptually incomplete.

Integration of Research Questions

Together, these questions correspond to three analytical lenses: material engagement theory, pedagogical frame-shifting through unfamiliarity, and multisensory learning. Their integration enables systematic examination of whether, how, and under what conditions material encounters can reconstruct perception for the screen generation, contributing both theoretical insight and pedagogical implications for contemporary design education.

Research Methodology

This study adopts a qualitative, practice-based research design to examine how cross-cultural material engagement reshapes digital-native students' perceptual understanding of typography. The investigation centers on an intensive letterpress workshop structured to generate embodied learning through unfamiliar materials and cultural contexts.

Research Context

Figure 1
Letterpress Workshop Setting at Letterpress Letters Studio, Tokyo (2023), Showing Students' Embodied Engagement With Tools and Materials



Note. The workshop was conducted in August 2023 at *Letterpress Letters* studio in Tokyo, Japan.

Eight Taiwanese high school students (ages 15–17) participated. All had prior experience with digital design tools but no exposure to letterpress printing. The setting was intentionally cross-cultural: students encountered European wooden type and mechanical printing technology within a Japanese cultural environment. This layered unfamiliarity prevented reliance on habitual design frameworks and directed attention toward material properties and physical processes.

The workshop consisted of six hours of hands-on engagement with wooden type, metal furniture, and manual printing presses. Instruction progressed from guided demonstrations to independent experimentation. After learning basic letterpress principles, students designed and printed individual works reflecting their Tokyo experience. This structure enabled observation of how material constraints and tactile feedback gradually altered students' typographic decision-making.

Researcher Positionality and Pedagogical Role

This study was conducted within a pedagogical setting in which facilitation and observation were closely intertwined. The workshop was structured around guided participation rather than detached instruction, reflecting the practice-based nature of embodied learning. Within this setting, instructional responsibility focused on enabling safe and sustained engagement with letterpress tools and materials, while analytical attention was directed toward how perceptual judgment emerged through students' interactions with material constraints.

Pedagogical intervention was deliberately limited to procedural guidance. Participants were not provided with evaluative criteria regarding "correct" spacing, hierarchy, or composition. Instead, instruction emphasized operational familiarity with letterpress processes, allowing typographic decisions to develop through bodily engagement with resistance, weight, and limitation rather than through prescriptive rules. This approach created conditions in which perceptual understanding could arise through action and adjustment.

Throughout the workshop, instruction and communication were conducted in Japanese, with continuous interpretation into Chinese to ensure comprehension among Taiwanese students. In addition, a professional instructor with extensive experience in letterpress printing was present to provide technical support and ensure proper handling of tools and presses. This collaborative instructional arrangement distributed authority across linguistic, cultural, and technical domains, reducing reliance on a single instructional voice and reinforcing the material-centered nature of learning.

Analytical attention focused on moments in which students' habitual screen-based strategies proved insufficient. Instances of hesitation, repeated adjustment, and verbalized uncertainty were treated as indicators of perceptual transition rather than as errors. Observational records were produced during workshop sessions and expanded immediately afterward to capture not only physical actions but also shifts in pacing, peer interaction, and affective response.

Given the cross-cultural conditions of the workshop, particular care was taken to remain attentive to asymmetries of language, cultural expectation, and pedagogical authority. Encountering European wooden type within a Japanese studio context suspended familiar interpretive frameworks for participants. Rather than resolving this unfamiliarity through explanation, the workshop design allowed it to function as a productive condition that redirected attention toward material properties themselves.

Reflexive awareness was maintained throughout the workshop regarding how instructional structure, linguistic mediation, and cultural positioning shaped the learning environment. Rather than attempting to eliminate such influences, the study acknowledges them as constitutive elements of the pedagogical situation. Perceptual learning is thus understood as co-produced through the relationships among participants, materials, tools, and instructional conditions.

Data Collection Methods

As both facilitator and researcher, I employed three complementary methods:

- **Direct Observation**
  Field notes documented students' bodily interactions with materials, including how they handled type, adjusted spacing, and operated the press. Particular attention was paid to moments of perceptual shift, such as transitions from visual estimation to tactile judgment.
- **Material Artifacts**
  Students' printed works served as material evidence of design decisions made under letterpress constraints. These artifacts reveal choices related to spacing, hierarchy, and composition shaped by the physical limits of wooden type.
- **Student Reflections**
  To trace both immediate and sustained effects, data were collected through group discussion immediately after the workshop, written reflections two weeks later, and

individual interviews conducted one month post-workshop. This temporal layering allowed examination of how embodied experiences informed subsequent digital design practice.

Analytical Approach

Data were analyzed thematically across observations, artifacts, and student accounts. Analysis was guided by three theoretical lenses: material dialogue (how materials shape thinking), perceptual frame-shifting through unfamiliarity, and multi-sensory learning and memory. Together, these lenses enabled identification of recurring patterns that constitute key dimensions of perceptual reconstruction.

Research Considerations

This study prioritizes depth over generalizability. Focusing on a small participant group allows close examination of perceptual mechanisms rather than statistical claims. Ethical approval was obtained, with particular attention to student wellbeing within a physically demanding, cross-cultural learning environment.

Findings

Analysis of workshop observations, student prints, and reflective interviews revealed three interconnected dimensions through which material engagement reconstructed students' perceptual understanding of typography.

Finding 1: Material Resistance Reshapes Typographic Judgment

Prior to the workshop, students approached typography primarily through digital interfaces, where spacing adjustments occur instantaneously through sliders and numerical inputs. Letterpress printing disrupted this habitual mode of working by introducing material resistance.

When adjusting spacing, students encountered constraints unfamiliar to screen-based practice. One student reflected:

"In Canva, I just drag the spacing slider until it looks right. Here, one millimeter took me ten minutes."

Figure 2
Close-Up of Tactile Spacing Adjustment Using Metal Spacers, Illustrating How Typographic Judgment Emerges Through Material Resistance



Field observations documented a clear perceptual shift. Initially, students relied on visual judgment, repeatedly removing and replacing spacers while stepping back to assess results. Over time, however, decision-making moved from visual estimation toward tactile exploration. Students began running their fingers along the type, feeling spacer thickness and testing resistance before making adjustments.

This physical negotiation enabled students to "feel what spacing means." As one student reflected two weeks later, "Spacing used to be just a rule. But when the wooden blocks physically wouldn't fit, I understood that space isn't just visual—it's physical distance."

Figure 3
Comparison of Early and Final Prints, Showing Shifts in Hierarchy Achieved Through Spacing and Layout Rather Than Scale



Material resistance also reshaped students' understanding of hierarchy. Unlike digital typography, letterpress offers only a finite set of type sizes. Unable to rely on scale alone, students attended more closely to spacing, positioning, and white space. One student later reported applying these strategies in digital design, adjusting spatial relationships before increasing font size.

Most significantly, students' evaluative criteria shifted. Initially, uneven ink coverage was perceived as failure. As students learned how pressure, ink viscosity, and wood grain shaped results, irregularities came to be understood as evidence of process rather than error. One student described his first print as "messy," but later reframed it as "honest"—a visible record of material interaction.

Not all students adapted to material resistance at the same pace. For some participants, the physical slowness and effort required by letterpress initially produced frustration rather than insight. One student repeatedly expressed a desire to "just see it clearly" and attempted to resolve spacing issues by stepping back visually, avoiding tactile engagement for an extended period. Even after guidance encouraging hands-on adjustment, this student continued to rely primarily on visual judgment, treating material resistance as an obstacle to efficiency rather than as a source of information.

This hesitation highlights that material engagement does not automatically generate perceptual shift. For certain students, especially those strongly habituated to screen-based efficiency, resistance initially intensified reliance on familiar visual strategies. In these cases, perceptual transformation emerged only after prolonged exposure, repeated failure, and visible fatigue

with visual trial-and-error. This suggests that material resistance functions not as an immediate corrective, but as a condition that gradually destabilizes established habits of judgment.

Finding 2: Cross-Cultural Unfamiliarity Shifts Observational Frames

The workshop's cross-cultural design—Taiwanese students, Japanese setting, and European wooden type—produced productive estrangement. With no familiar cultural scripts to rely on, students were compelled to attend directly to material form.

This unfamiliarity was evident in students' initial encounters with physical letterforms. Although they had used Latin fonts extensively on screens, handling wooden letters revealed them as unfamiliar objects. One student noted:

"I'd used Helvetica countless times, but holding the wooden 'H,' I realized I had never really seen it."

Figure 4
Worn European Wooden Type Showing Traces of Long-Term Use and Material History



While cross-cultural unfamiliarity often sharpened students' attention, it also produced moments of detachment and uncertainty. A small number of students expressed difficulty forming any emotional or cultural connection to the European wooden type, describing it as "not related to us" or "too distant from daily life." For these participants, unfamiliarity did not immediately invite curiosity, but instead risked disengagement.

This ambivalence suggests that unfamiliarity alone does not guarantee perceptual openness. In some cases, the absence of cultural reference initially limited students' motivation to look closely. However, when unfamiliarity was accompanied by sustained material handling—particularly through noticing wear, weight, and repetition of use—detachment gradually shifted toward interest. This indicates that unfamiliarity becomes productive not as an abstract condition, but when anchored in tangible, sensory encounter.

Layered cultural distance intensified this effect. Had the workshop involved Chinese type in Taiwan, students might have relied on cultural heritage narratives. Instead, European type in Japan offered no such interpretive shortcut.

Students began closely examining wear patterns, ink adhesion, and variations between individual letters. One student compared two specimens of the letter "N," observing differences

caused by decades of use. What initially appeared as imperfection gradually became legible as historical trace.

Figure 5
Comparison of Two Specimens of the Same Letter, Highlighting Variation Caused by Repeated Use Over Time



This shift transformed how students interpreted wear. Rather than viewing worn type as broken tools, they came to see it as evidence of real use in books, posters, and public communication. As one student reflected:

"The wear isn't damage. It proves typography is something people actually do, not just something that appears on screens."

Finding 3: Multi-sensory Engagement Creates Durable Embodied Memory

The most striking findings emerged in follow-up interviews conducted weeks after the workshop. Students recalled the letterpress experience with exceptional sensory detail, and these memories actively informed later digital practice.

Students described tactile sensations, weight, smell, sound, and bodily effort with vivid specificity. One recalled the density of the wooden blocks; another described the mechanical rhythm of the press, noting that the sound still surfaced during later design decisions.

These memories proved more durable than those associated with other workshop activities. While students struggled to recall details from calligraphy or craft sessions, letterpress experiences remained vivid—wood texture, metal resistance, ink smell, and physical exertion.

This durability reflects the multi-sensory nature of letterpress printing, which engages touch, sight, hearing, smell, and full-body coordination. Unlike screen-based design, which privileges vision and minimal hand movement, letterpress demands continuous bodily negotiation with materials.

Crucially, embodied memory transferred back into digital practice. Students reported "feeling" spacing problems on screen before identifying them visually. One explained:

"The spacing looked okay, but it felt wrong. I remembered the resistance when the type was too tight in letterpress, adjusted the spacing, and it suddenly felt right."

Several students described imagining wooden blocks while adjusting kerning digitally. These tactile metaphors guided judgment beyond visual appearance alone, indicating that material engagement had reshaped perceptual frameworks rather than merely adding technical knowledge.

Figure 6
Student Operating the Letterpress Through Full-Body Engagement



Discussion: Rethinking Perception Through Material Engagement

The findings suggest that the significance of material engagement lies not in what students learned about letterpress printing as a technique, but in how their mode of perception was gradually altered through sustained contact with materials. Typography, which had previously appeared to them as a visual arrangement optimized on screen, began to emerge as a practice shaped by resistance, limitation, and bodily negotiation.

What became evident during the workshop was that perceptual judgment did not precede action, but arose through it. Students did not first decide what spacing should be and then execute that decision; instead, judgment formed through repeated adjustment, failure, and tactile exploration. Spacing was learned not as a rule to be applied, but as a relation that had to be worked out between hands, tools, and material constraints. In this sense, perception was not internal or cognitive alone, but distributed across bodies and materials, unfolding over time.

This shift also altered how students interpreted typographic "imperfection." Uneven ink, worn edges, and inconsistent impressions were initially experienced as technical shortcomings, measured against the visual standards of digital design. Over time, however, these same features were reinterpreted as traces of process—marks left by pressure, grain, wear, and repeated use. What changed was not the material outcome, but the framework through which it was read. Typography ceased to be evaluated solely by visual refinement and came to be understood as the visible consequence of material interaction.

The cross-cultural structure of the workshop played a critical role in enabling this perceptual reorientation. Encountering European wooden type in a Japanese setting removed the possibility of relying on familiar cultural narratives or inherited meanings. Without a ready-made interpretive frame, students were compelled to attend to what was physically present: the

weight of the type, the softness of worn corners, the uneven absorption of ink. Unfamiliarity did not function as an obstacle to understanding, but as a condition that made perception more attentive, slower, and more grounded in material specificity.

Although many students reported lasting embodied memories, the degree of transfer back into digital practice varied. A few participants described the letterpress experience as memorable but compartmentalized, noting that time pressure and interface conventions in digital tools made it difficult to fully apply embodied awareness during everyday design tasks. For these students, bodily memory surfaced mainly during reflective moments rather than during routine production.

This variation suggests that durability of embodied perception is not uniform and may depend on opportunities for reinforcement. While multi-sensory engagement can anchor perceptual memory, its integration into digital practice appears contingent on repeated recall and contextual alignment. Embodied memory thus operates as a latent resource that may remain inactive unless conditions invite its reactivation.

Perhaps the most revealing aspect of the findings lies in the persistence of these perceptual shifts. Weeks after the workshop, students recalled the letterpress experience through bodily sensations—weight, resistance, sound, smell—rather than visual images alone. These memories were not isolated from subsequent practice. Instead, they reappeared during digital design work as a felt sense guiding judgment. Students described adjusting spacing on screen not because it "looked wrong," but because it felt wrong, drawing unconsciously on memories of physical resistance and constraint.

This suggests that material engagement does not simply add another layer of experience to design education. It reconfigures how perception itself operates, introducing bodily memory as an active component of visual judgment. Digital tools remained central to students' practice, but they were no longer the sole reference point. The screen became one site of design among others, informed by experiences that originated beyond it. From this perspective, material practice does not oppose digital design; it expands the perceptual ground upon which digital decisions are made.

Conclusion

This study set out to examine whether material engagement—specifically through cross-cultural letterpress practice—can reconstruct how digital-native students perceive typography and visual form. Rather than treating letterpress as a nostalgic return to craft or a technical supplement to digital design education, the study approached material practice as a site where perception itself is negotiated, reshaped, and relearned.

The findings suggest that perception is not a stable faculty carried intact across media, but something continually configured by the conditions under which making occurs. When typography is encountered primarily through screens, it tends to be understood as a visual outcome optimized through parameters. When encountered through material resistance, bodily effort, and temporal process, it becomes legible as a practice—one that involves distance, pressure, limitation, and consequence. What changes, therefore, is not only what students know about typography, but how they come to judge, evaluate, and feel typographic form.

This shift has important implications for design education. As digital tools continue to dominate creative practice, the risk is not simply the loss of traditional techniques, but the narrowing of perceptual repertoires. Screen-based fluency can coexist with a diminished sensitivity to material difference, process, and constraint. The study suggests that material engagement, especially when intensified through unfamiliar cultural and technological contexts, offers a way to interrupt this narrowing—not by rejecting digital tools, but by expanding the perceptual ground on which digital decisions are made.

Crucially, the effects of material engagement did not remain confined to the workshop setting. Students carried embodied memories—of resistance, weight, sound, and effort—back into digital environments, where these experiences continued to inform judgment in subtle but persistent ways. This indicates that material practice functions less as an alternative medium and more as a recalibration of perception that endures beyond its original context.

The contribution of this study lies in reframing material practice as a pedagogical strategy for perceptual reconstruction rather than skill acquisition. It argues that learning to design is inseparable from learning how to perceive, and that perception itself can be redesigned through carefully structured encounters with materials. Future research might extend this inquiry by exploring other forms of material engagement, longer-term pedagogical integration, or comparative studies across cultural and technological contexts. As design education continues to evolve, the challenge is not to choose between digital and material practices, but to cultivate designers whose ways of seeing remain responsive, embodied, and open to transformation.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

In the preparation of this manuscript, AI-assisted tools were utilized for English translation and text proofreading. Specifically, Google Gemini and ChatGPT were used to refine grammar, punctuation, and phrasing for clarity and conciseness, and to check for spelling errors.

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Evaluating the Impact of Online Formative Assessment on Student Performance and Perceptions: A Quasi-experimental Study From Saudi Higher Education

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Abstract

This quasi-experimental study explores the impact of online formative assessments (OFA), specifically through frequent online quizzes, on learning outcomes and student perceptions in an introductory computer education course at a Saudi Arabian university. The research involved 28 female students, divided equally into an experimental group (weekly online quizzes in addition to standard exams) and a control group (midterm and final exams only). Learning performance was measured using pre- and post-tests, while student perceptions were gathered through a structured questionnaire. Although post-test scores did not significantly differ between groups, the experimental group showed marked improvement from pre- to post-test, suggesting a positive effect of frequent quizzing on learning progression. Furthermore, students in the experimental group reported favorable perceptions of the quizzes, viewing them as helpful tools for reinforcing understanding and preparing for exams. This study contributes to the growing body of research on formative assessment by highlighting how the integration of OFA with self-regulated learning principles can promote learner autonomy and engagement—particularly within underrepresented higher education contexts such as Saudi Arabia. By bringing attention to the pedagogical value of continuous assessment in diverse cultural and institutional settings, the findings invite broader international dialogue on inclusive, context-aware strategies for enhancing student learning. Limitations include the small sample size and single-institution scope. Future research should involve larger, more diverse cohorts and examine the long-term impact of such assessment strategies across different disciplines and learning environments.

Keywords: online formative assessment, e-learning, frequent quizzes, higher education, self-regulated learning

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Introduction

Enhancing the quality of learning and teaching in higher education is a continuous pursuit for professors and administrators (Gokcora & DePaul, 2018). Assessment plays a crucial role in this mission, serving as a natural component of the learning process (Andriamiseza, 2022; Baleni, 2015). Miller et al. (1998) categorized assessment in higher education into three primary types: diagnostic, formative, and summative. Although commonly grouped under the umbrella term "assessment," each type has differs in purpose and application (Northern Illinois University Center for Innovative Teaching and Learning [NIU-CITL], 2012). Diagnostic assessment helps identify students' current knowledge, skills, and misconceptions before teaching. Formative assessment offers feedback during instruction, measuring both student and instructor progress. Summative assessment occurs after learning, providing a summary of teaching and learning outcomes, as no formal learning usually takes place at this stage (Miller et al., 1998; NIU-CITL, 2012).

Formative assessment, referred to as "assessment for learning" (Centre for Education Research and Innovation [CERI], 2008), has been recognized as essential for improving teaching effectiveness, motivating students, and enhancing learning outcomes (Andriamiseza et al., 2023; Liao et al., 2024; Shao et al., 2024; Xiao et al., 2023). The essence of formative assessment lies in providing teachers and learners with constructive feedback that guides them toward achieving learning objectives (Andriamiseza, 2022). Morris et al. (2021) conducted a systematic review on the influence of formative assessment and feedback on university students' academic performance. Their findings underscored the role of feedback in education and its positive impact on the learning process.

Leveraging online formative assessments (OFA) is an effective strategy to address the growing student population in higher education, as it helps manage the increasing demand while maintaining and enhancing the quality of teaching and learning (Andriamiseza, 2022; Andriamiseza et al., 2023). OFA provides teachers with valuable feedback to adjust instructional methods and offers students immediate feedback for monitoring and enhancing their own learning progress (Mahanan et al., 2021; Morris et al., 2021; Ryan, 2024). Moreover, OFA has proven effective in promoting student engagement and improving learning performance (Chen et al., 2021; Sotola & Crede, 2021; Zainuddin et al., 2020).

Given these findings, further investigation into the implementation of OFA and their impact on learning performance and student perceptions could yield valuable insights into teaching and learning practices in higher education. Wellington et al. (2015) suggest using online quizzes tailored to university and college levels to address short-term learning delays within a semester. Similarly, Chen et al. (2021) advocate for controlled experiments to evaluate the effects of formative assessments, such as frequent quizzes and tests, on student engagement and learning outcomes across different learning settings. Sartain and Wright (2020) emphasize expanding research across diverse geographic contexts to capture broader demographic variations. Mahanan et al. (2021) also recommend developing online assessment tools that evaluate practical skills and enhance the effectiveness of OFA across STEM disciplines in higher education.

In Saudi higher education context, Almossa and Alzahrani (2022) examined assessment practices among faculty and found a decline in formative assessment usage, despite frequent feedback and alignment with learning objectives. The study also reported that most instructors rely heavily on summative assessments, such as midterm and final exams, in line

with Ministry of Education regulations that assign 40% of grades to final exams and 60% to mid-term exams and coursework.

Building on these insights, this study explores the impact of OFA, specifically through frequent online quizzes, on students' learning performance and perceptions in a computer education course in Saudi higher education. The main research question is: *What is the impact of online formative assessments, specifically online frequent quizzes, on student learning performance and perceptions in higher education?* Findings of this study are expected to help educators make informed decisions, adjust instructional strategies, refine curricula, and provide targeted support to students, thereby promoting effective and evidence-based teaching practices in higher education.

Literature Review

Formative vs. Summative Assessments

Assessment plays a crucial role in understanding how students learn and determining whether teaching methods effectively achieve intended learning outcomes (Morris et al., 2021). Summative assessment evaluates student learning against specific standards, while formative assessment provides instructors with ongoing feedback to assess the effectiveness of their teaching and helps students monitor their own learning progress (Eberly Center [EC], 2024). Both types assess students' performance, yet they differ in purposes: summative assessment focuses on evaluating learning outcomes, while formative assessment aims to facilitate learning processes. Summative assessment typically covers a broader scope of student learning compared to formative assessment (Mahanan et al., 2021).

On the one hand, summative assessment is designed to evaluate and measure students' overall understanding and performance at the end of an instructional period, such as a semester or academic year. Midterm and final examinations are commonly used summative tools, as they assess students' cumulative knowledge and skills gained throughout the course (CERI, 2008; NIU-CITL, 2012). On the other hand, formative assessment is an ongoing process including frequent, interactive assessments of students' development and understanding, with the goal of identifying learning needs and adjusting instruction accordingly (CERI, 2008). This approach provides continuous feedback and information during instruction, facilitating both the monitoring of student progress and the evaluation of teaching effectiveness (NIU-CITL, 2012). Notably, these activities typically carry minimal or no grading weight and may not directly influence a student's final grade (NIU-CITL, 2012; EC, 2024).

Traditional assessment methods, such as midterm and final exams, remain prevalent due to their cost efficiency and ease of grading (Sotola & Crede, 2021). However, such summative assessments offer limit insight into the learning process, restricting opportunities for students to apply newly acquired knowledge. In contrast, formative assessment emphasize ongoing learning, helping identify gaps and misconceptions before final evaluations. It provides students with opportunities to practice skills and test their understanding without the pressure of grades (CERI, 2008; NIU-CITL, 2012; Morris et al., 2021). However, data gathered from summative assessments can serve a formative purpose when students or faculty use the results to inform in future instruction or guide learning strategies (EC, 2024).

The Role of Online Formative Assessment in Higher Education

OFA is defined as "all the processes involved in obtaining information about students' learning output to improve learning through giving timely feedback within a web-based learning environment" (Mahanan et al., 2021, p. 53). Different terms have been used to describe OFA, including e-formative assessment, formative e-assessment, web-based assessment, web-based assessment for learning, and online assessment for learning (Mahanan et al., 2021). Despite differences in terminology, all refer to integration of technological tools or platforms to facilitate assessment process (Sudakova et al., 2022). Digital technology plays a crucial role in creating effective, efficient, and secure assessments that advance student education (Ryan, 2024).

OFA offers several advantages, contributing to a more dynamic and responsive approach to teaching and learning. It is beneficial for both students and teachers. For teachers, OFA reduces grading time and administrative workload associated with recording and compiling marks (Baleni, 2015; Mahanan et al., 2021; Pishchukhina & Allen, 2021; Sotola & Crede, 2021). This efficiency allows educators to allocate more time to teaching, providing feedback, and addressing individual learning needs, thereby promoting a more productive classroom environment. Additionally, OFA enables continuous monitoring of student progress, helping instructors to identify areas of strength and weakness and to modify their teaching strategies accordingly (Mahanan et al., 2021; Pishchukhina & Allen, 2021).

Meanwhile, students benefit from OFA through prompt and comprehensive feedback, facilitating uninterrupted learning compared to traditional classroom-based methods (Baleni, 2015; Mahanan et al., 2021; Morris et al., 2021; Pishchukhina & Allen, 2021). For students, this ongoing feedback promotes reflection on their own learning, encourages active engagement, and supports timely intervention to enhance understanding and academic performance (Mahanan et al., 2021; Pishchukhina & Allen, 2021). OFA offers numerous advantages for students, including increased engagement and motivation (Chen et al., 2021; Dalby & Swan, 2018; Shao et al., 2024; Sotola & Crede, 2021; Wellington et al., 2015; Xiao et al., 2023; Zainuddin et al., 2020), flexibility in assessments timing and location (Baleni, 2015), and ongoing support for learning (Bostrom & Palm, 2024; Xiao et al., 2023). It also helps reduce test anxiety (Sudakova et al., 2022), promotes consistent attendance (Gokcora & DePaul, 2018), and fosters creativity (Shao et al., 2024). Furthermore, OFA promotes knowledge retention (Lubrick & Wellington, 2022; Sotola & Crede, 2021) by providing continuous opportunities to review and apply concepts, thereby preparing students more effectively for summative assessments. This preparation builds students' confidence and competence, leading to improved performance in midterms and final examinations (Sartain & Wright, 2020). Moreover, effective OFA supports a student-centered learning environment by offering personalized formative feedback and promoting meaningful engagement with course content (Baleni, 2015; Morris et al., 2021).

OFA has been implemented in higher education through various methods, including discussion forums, tasks, quizzes, and tests (Baleni, 2015; Chen et al., 2021; Gokcora & DePaul, 2018; Lubrick & Wellington, 2022; Pishchukhina & Allen, 2021; Wellington et al., 2015; Zainuddin et al., 2020). Among these, quizzes are widely used in university courses, providing rapid and immediate feedback that support formative learning (Chen et al., 2021; Gokcora & DePaul, 2018; Lubrick & Wellington, 2022; Mahanan et al., 2021; Pishchukhina & Allen, 2021). Sotola and Crede (2021) conducted a meta-analysis examining the impact of frequent quizzes on students' academic performance and found that in-class quizzes serve as

valuable teaching aids, moderately enhancing both performance and learning outcomes. Quizzes enable instructors and students to monitor comprehension, predict final exam achievement, and may contribute to lowering dropout rates. Furthermore, Gokcora and DePaul (2018) noted that frequent quizzes encourages regular class attendance and fosters productive learning habits that establish a more engaging learning experience.

Theoretical Framework

This study is grounded in the theory of self-regulated learning (SRL), which emphasizes learners' active role in directing and managing their own learning processes. SRL theory posits that students who actively assess and monitor their learning strategies develop stronger autonomy and a deeper sense of ownership over their educational outcomes (Cain & Fanshawe, 2020; Pishchukhina & Allen, 2021). Integrating OFA through frequent quizzes supports these process by enabling students to assess their understanding, receive immediate feedback, and make timely improvements. In this study, OFA is viewed as a mechanism to enhance students' self-efficacy and metacognitive skills, empowering them to understand and apply feedback effectively. This approach redefines teacher and student roles towards fostering a student-centered environment where self-assessment and continuous and immediate feedback play pivotal roles in improving learning performance (Pishchukhina & Allen, 2021).

Methodology

This study employed a quasi-experimental design to examine the impact of OFA, specifically frequent online quizzes, on students' learning performance and perceptions. The design included experimental and control groups, with both groups completing pre- and post-tests to compare performance before and after the intervention.

Research Context

This study was conducted in the female section of King Saud University (KSU) in Riyadh, Saudi Arabia, where classes are taught by female instructors in person or by male instructors through closed-circuit television or virtual classrooms. All KSU students use the university's learning management system (LMS), Blackboard, which supports on-campus learning by enhancing student engagement and academic performance. The research took place in an undergraduate computer education course during the second semester of 2023 academic year, spanning 16 weeks. The course included weekly 60-minute sessions focusing on technology-enhanced learning and fundamental teaching aspects. The course had 32 female students, most in their first or second year (KSU-Statistics, 2023).

Participants

The study included 28 female students enrolled in two classes, both taught by the same instructor. The classes were randomly assigned to an experimental group (n = 14) and a control group (n = 14). The control group, referred to as the "non-quizzing" group, followed a traditional summative assessment approach consisting of two midterm exams and a final exam. In contrast, the experimental group, or the "quizzing" group, completed the same summative assessment but also participated in twelve online quizzes administered throughout the semester as formative assessment. These quizzes were designed to provide continuous feedback, encourage consistent study habits, and support self-regulated learning.

Research Instruments

The study employed two quantitative instruments: pre- and post-achievement tests to assess and compare learning performance between groups, and a structured questionnaire to examine the experimental group's perceptions of the online frequent quizzes.

Achievement Evaluation

Examinations and achievement tests are recognized tools for evaluating students' knowledge, proficiency, and learning performance in a subject or educational program (Hanif et al., 2017; Mamolo, 2021). Therefore, a 30-item multiple-choice achievement test was developed for this study, accompanied by an answer key for standardized grading. The questions were evenly distributed across the main topics covered in the course to ensure balanced content representation. Both the pre-test and post-test were administered using an online survey platform (Google Forms).

Ensuring the validity and reliability of the test was a key consideration. Validity refers to the degree to which an instrument accurately measures the intended construct (Creswell & Creswell, 2018) and can be established through careful item development, sampling, and expert review (Basit, 2010). To confirm content validity, five faculty members who taught similar computer education courses reviewed the test, and their feedback was incorporated to refine and adjust the items as needed. Reliability, which indicates the consistency of test results under comparable conditions (Creswell & Creswell, 2018), was examined using the Spearman–Brown prophecy formula. The resulting reliability coefficient (rSB = 0.692) was deemed acceptable for research purposes.

Perceptions Questionnaire

The perceptions questionnaire was developed based on a review of relevant literature (Chen et al., 2021; Gokcora & DePaul, 2018), which provided theoretical and empirical foundations aligned with the focus of this study. Insights drawn from the literature guided the formulation of the questionnaire items to ensure relevance and construct alignment.

The questionnaire, written in Arabic, comprised 20 statements designed to capture students' perceptions of online quizzes. It was divided into four sections: (1) perceived usefulness of frequent quizzes for learning (6 items), (2) effectiveness in exam preparation (4 items), (3) quiz design and structure (4 items), and (4) overall experience and approach to online quizzing (6 items). Responses were collected using a five-point Likert scale ranging from "strongly agree" (SA) to "strongly disagree" (SD).

To ensure content validity, the instrument was reviewed by the same five faculty members who evaluated the achievement test, and their feedback was used to refine the wording and clarity of the items. For reliability, a pilot version of the questionnaire was administered to a representative sample of students to confirm comprehension of items and response options. Minor revisions were made based on their feedback, and these participants were excluded from the main study sample.

Online Frequent Quizzes Format

The online quizzes for the experimental group were tailored to the specific course content and administered via the LMS at the start of each class. The LMS was chosen for its accessibility through the university's website and mobile app, and its ability to provide immediate, detailed feedback. Each quiz lasted about 5–10 minutes and included around ten multiple-choice, true/false, or short-answer questions focused on the topics and skills from the previous lecture to reinforce learning and maintain content continuity.

Following each quiz, students received an automated score indicating the number of correct answers, accompanied by immediate written feedback that clarified any misunderstandings or misconceptions that could hinder their learning progress. The quizzes, designed as a formative assessment tool, provided students with valuable insights into their level of understanding while offering instructors diagnostic information about areas of confusion and difficulty. This dual function enabled students to track their performance and allowed instructors to adjust instructional strategies to target specific learning challenges. On average, students achieved a mean score of 69%, with approximately 62% obtaining full marks.

Study Procedures

The study began with a pre-test administered for both the control (non-quizzing) and experimental (quizzing) groups to assess their prior knowledge. Throughout the semester, both groups received lecture-based instruction, used the university's LMS (Blackboard) to complete course requirements, and took three paper-based summative exams: two midterm exams and one final exam. In addition, the experimental group completed twelve online quizzes, one each week beginning in the second week of the semester. These quizzes were not scheduled during exam weeks and remained accessible on the LMS throughout the term, allowing students to review and revisit them as needed.

At the end of the semester, both groups completed a post-test to evaluate their learning performance. The experimental group also completed a perceptions questionnaire regarding the frequent online quizzes. The questionnaire was administered anonymously through Google Forms, and students were given time during class to complete it to ensure high response rates. Figure 1 displays the LMS page showing the weekly quizzes for the experimental group, while Figure 2 provides an example of one of the online quizzes.

Figure 1

The LMS Frequent Quizzes Page for the Experimental Group

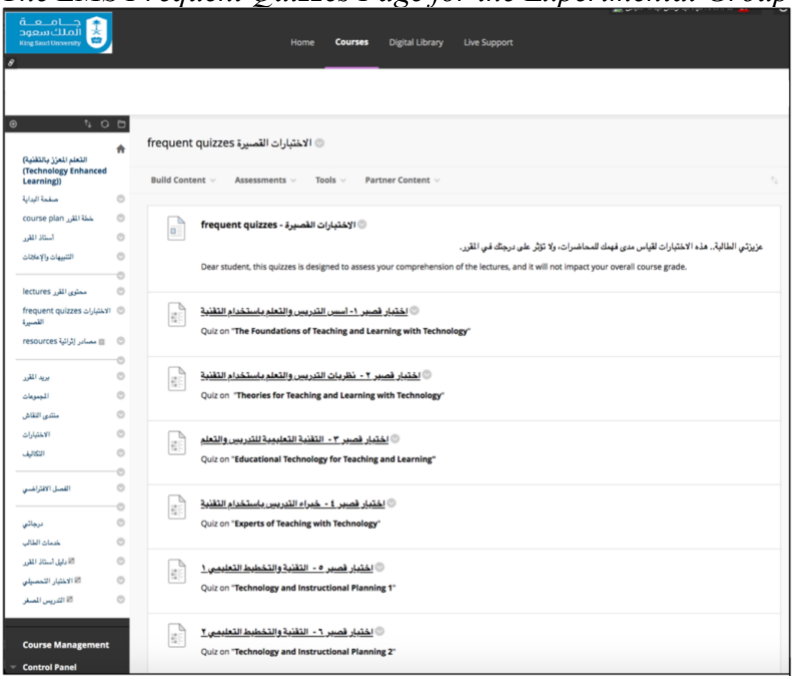
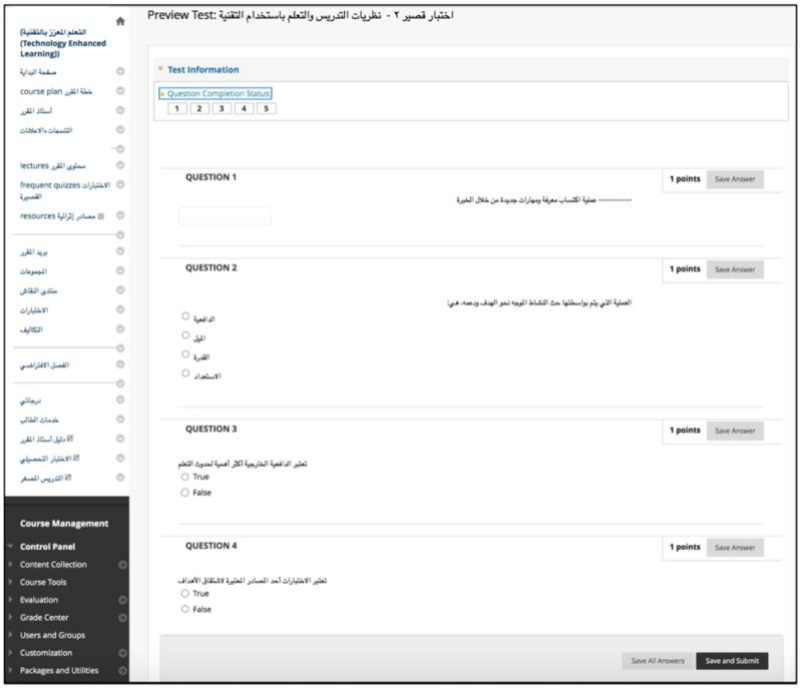


Figure 2

Example of A Frequent Online Quiz in LMS for the Experimental Group



Data Analysis

Descriptive and inferential statistical analyses were used to evaluate the achievement test data. Mean (M) and standard deviation (SD) were calculated to describe the data. Independent samples t-tests were conducted to compare pre-test and post-test scores between the experimental and control groups, while paired samples t-tests were used to examine within-group differences. All analyses were performed using SPSS software.

For the perceptions questionnaire, descriptive statistics were applied to analyze the experimental group's responses regarding the online frequent quizzes. Data collected via Google Forms were exported to SPSS, which computed frequencies, percentages, means, and standard deviations for each item.

Ethical Considerations

Ethical research approval to conduct this study was granted from the Ethics of Human and Social Research Committee at KSU (KSU-HE-24-672). In accordance with the ethical research guidelines proposed by Petousi and Sifaki (2020), informed consent was obtained from all participants prior data collection. Participants were assured of the anonymity and confidentiality of their responses and informed of their right to withdraw from the study at any stage without the need to provide justification.

Results and Discussion

Impact of OFA on Students' Learning Performance

An analysis of students' prior knowledge was conducted to determine whether any initial differences existed between the groups. As shown in Table 1, the results of the pre-test indicated no statistically significant differences between the two groups, confirming that they possessed comparable baseline knowledge of the course content. At the end of the treatment period, the post-test analysis also showed no significant difference in mean scores between the groups. Both groups achieved relatively high scores, with only minor variations in learning performance.

Table 1
Independent Samples t-Tests for Experimental vs. Control Groups in Achievement Tests

Test	Group	n	M	SD	T	P
Pre-test	Control Group (non-quizzing)	14	17.4285	3.7357	0.6928	0.4946*
	Experimental Group (quizzing)	14	16.5000	3.3454		
Post-test	Control Group (non-quizzing)	14	17.9285	4.1410	-0.9281	0.3619*
	Experimental Group (quizzing)	14	19.5714	5.1696		

* By conventional criteria, this difference is considered to be not statistically significant.

To clarify the study's results, paired samples t-tests were conducted to examine within-group changes between pre- and post-test scores for both groups, as presented in Table 2.

Table 2
Paired Samples T-tests Comparing of Pre-test and Post-test Scores for Both Groups

Group	Test	n	M	SD	T	P
Control Group (non-quizzing)	Pre-test	14	17.4285	3.7357	0.5838	0.5693*
	Post-test	14	17.9285	4.1410		
Experimental Group (quizzing)	Pre-test	14	16.5000	3.3454	2.3058	0.0382**
	Post-test	14	19.5714	5.1696		

* By conventional criteria, this difference is considered to be not statistically significant.
** By conventional criteria, this difference is considered to be statistically significant.

The analysis of the data in Table 2 showed no statistically significant difference at the 0.01 level between the pre-test and post-test scores for the control (non-quizzing) group. In contrast, the experimental (quizzing) group demonstrated a statistically significant improvement, suggesting that the use of online frequent quizzes contributed to the enhancement of students' learning performance. This finding is consistent with previous studies such as Dalby and Swan (2018) and Zainuddin et al. (2020), which similarly reported that frequent quizzes can support higher academic performance and skill development. However, it is important to note that Atia et al. (2018) found that frequent quizzes did not yield consistent benefits across all settings, indicating that factors such as instructional context, quiz design, and implementation strategies may influence their effectiveness.

Impact of OFA on Students' Perceptions

The study revealed that experimental group students agreed that the online frequent quizzes positively contributed to their learning process, provided an engaging and stimulating learning experience, and were an effective method for understanding the course content. They also felt that the quizzes met their learning needs, motivated them to be more attentive during lectures, and facilitated the completion of course requirements, such as in-class activities and homework. Table 3 shows the descriptive statistics for the first section of the perception questionnaire, with an overall mean of 4.48, indicating a positive view on the usefulness of online frequent quizzes for enhancing course learning. These results concur with Gokcora and DePaul (2018), who discovered that frequent quizzes encourage students to attend classes more consistently and create a productive classroom routine that promotes positive learning behaviors.

Table 3
Students' Perception of the Effectiveness of Online Frequent Quizzes in Improving Course Learning

How strongly do you agree with these statements? (5= Strongly Agree, 4= Agree, 3= Neutral, 2 = Disagree, 1 = Strongly Disagree)	M	SD
Q1: The online frequent quizzes in this course are aligned with my learning needs.	4.50	0.732
Q2: The online frequent quizzes in this course offer an engaging and stimulating learning experience.	4.57	0.631
Q3: The online frequent quizzes in this course contribute to my learning process.	4.57	0.631
Q4: The online frequent quizzes in this course proved to be an effective method for comprehending the course content.	4.57	0.739
Q5: The online frequent quizzes in this course help me fulfill the course requirements easily (e.g., in-class activities, homework).	4.21	0.833
Q6: The online frequent quizzes in this course motivate me to pay closer attention during lectures for successful completion	4.50	0.732
Mean	4.48	

In terms of the effectiveness of online frequent quizzes for exam preparation, students expressed agreement that the quizzes were advantageous for reviewing course material before

exams. They reported that the quizzes helped save time and effort compared to other regular courses and offer valuable exam practice opportunities that contributed to increased confidence during exams. Table 4 presents the descriptive statistics for the second section of the perception questionnaire, with an overall mean of 4.39, indicating a positive view of online frequent quizzes for exam preparation. The findings align with the view that OFA are effective for preparing students for summative assessments (Lubrick & Wellington, 2022; Sotola & Crede, 2021). Formative assessment enhances self-confidence in learning (Shao et al., 2024; Stitch, 2024) and helps build competence in the subject matter, which in turn improves performance in midterms and final exams (Gokcora & DePaul, 2018; Sartain & Wright, 2020).

Table 4
Students' Perception of the Effectiveness of Online Frequent Quizzes in Exam Preparation

How strongly do you agree with these statements? (5= Strongly Agree, 4= Agree, 3= Neutral, 2 = Disagree, 1 = Strongly Disagree)	M	SD
Q7: The online frequent quizzes in this course were beneficial for reviewing before exams compared to other regular courses (without frequent quizzing).	4.43	0.623
Q8: The online frequent quizzes in this course saved me time and effort in preparing for exams compared to other regular courses.	4.43	0.623
Q9: The online frequent quizzes in this course provided me with opportunities to practice for exams compared to other regular courses.	4.36	0.772
Q10: The online frequent quizzes in this course increased my confidence when taking exams compared to other regular courses.	4.36	0.772
Mean	4.39	

Additionally, students expressed favorable views on the design of the online frequent quizzes, finding them well-structured, clearly defined, and appropriately designed. They also deemed the online tool used for the quizzes as suitable and felt that the quizzes' length and frequency were appropriate. Chen et al. (2021) similarly found that students had positive perceptions of OFA, indicating that the instruction design was well-received. Table 5 presents the positive feedback from the experimental group students regarding the quiz design (the third questionnaire section), with an overall mean score of 4.30.

Table 5
Students' Perception on the Design of the Online Frequent Quizzes

How strongly do you agree with these statements? (5= Strongly Agree, 4= Agree, 3= Neutral, 2 = Disagree, 1 = Strongly Disagree)	M	SD
Q11: The length of the quizzes was suitable.	4.21	0.739
Q12: The frequency of the quizzes was appropriate.	4.21	0.641
Q13: The online tool used for the quizzes was suitable.	4.29	0.886
Q14: The quizzes were well-designed, clearly-defined and well-structured.	4.50	0.732
Mean	4.30	

Students' also expressed positive opinions of the online frequent quizzes approach, viewing it as an effective learning tool and supporting its use in other courses. They indicated willingness to enroll in courses that adopt a similar method. However, they remained neutral regarding whether the approach required excessive time and effort. Table 6 shows an overall mean of 4.19 for the last questionnaire section regarding the online frequent quizzes approach.

Table 6
Students' Perception of the Online Frequent Quizzes Approach as a Whole

How strongly do you agree with these statements? (5= Strongly Agree, 4= Agree, 3= Neutral, 2 = Disagree, 1 = Strongly Disagree)	M	SD
Q15: I found taking quizzes in this course to be engaging.	4.29	0.795
Q16: I found taking quizzes in this course to be enjoyable.	4.36	0.882
Q17: I would be open to enrolling in another course that employs the same frequent quizzes approach as this one.	4.36	0.882
Q18: The frequent quizzes approach used in this course would be beneficial to apply in other subjects.	4.43	0.729
Q19: The frequent quizzes approach is an effective learning method.	4.57	0.631
Q20: The frequent quizzes approach does not require excessive time and effort	3.14	1.5
Mean	4.19	

Overall, the study revealed that students in the experimental group expressed positive perceptions of OFA. Table 7 shows a mean score of 4.34 across all sections of the perception questionnaire, indicating a generally favorable view of the frequent online quizzes used in their computer education course. These findings are consistent with previous studies, such as Gokcora and DePaul (2018), Baleni (2015), and Chen et al. (2021), which reported that students appreciated frequent quizzes for their role in boosting confidence and understanding of course material.

Table 7
The Perception Questionnaire Mean Score

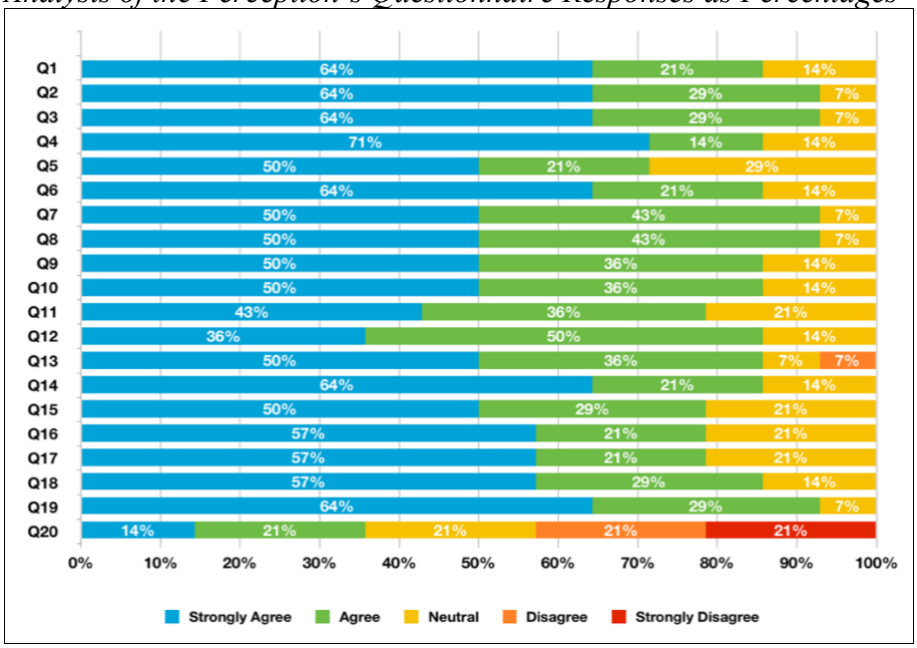
Sections of the perception questionnaire	no. of items	M
Section 1: the effectiveness of online frequent quizzes in improving course learning	6	4.48
Section 2: the effectiveness of online frequent quizzes in exam preparation	4	4.39
Section 3: the design of the online frequent quizzes	4	4.30
Section 4: the online frequent quizzes approach as a whole	6	4.19
Mean	20	4.34

Analysis of the perception questionnaire data showed that more than 82% of students in the experimental group responded with "strongly agree" or "agree" to the majority of perception items. However, one response was "disagree" for "The online tool used for the quizzes was

suitable," and six responses were "disagree" or "strongly disagree" for "The frequent quizzes approach does not require excessive time and effort," as illustrated in Figure 3.

Figure 3

Analysis of the Perception's Questionnaire Responses as Percentages



Conclusion

This study contributes the literature on formative assessment by examining the perceptions and performances of female students in Saudi higher education, a group that has been underrepresented in previous research. It provides evidence of how integrating SRL principles with OFA can support learning outcomes and encourage self-regulation in higher education settings that are transitioning towards more student-centered approaches. The findings also offers insights that may be relevant to similarly structured or underexplored educational contexts.

The integration of SRL theory with OFA has practical implications for teaching practices in higher education. SRL highlights the importance of students monitoring and managing their own learning (Cain & Fanshawe, 2020; Pishchukhina & Allen, 2021), which is facilitated by frequent quizzes that offer timely feedback. Online frequent quizzes, as a form of OFA, help students develop self-assessment skills, strengthen confidence, and take a more active role in their learning. For teaching practices, this approach supports a shift towards a student-centered model where quizzes function not only as assessment tools but also as ongoing sources of feedback and guidance. This shift aligns with current educational priorities in Saudi Arabia (OECD, 2020), supporting environments that promote engagement, self-efficacy, and personalized learning.

Methodologically, this study adds to existing knowledge by using a quasi-experimental design with pre- and post-tests, complemented by student perception data. This combination provides a broad view of both learning performance and student experiences. Conceptually, the study positions online frequent quizzes as more than assessment tools; as mechanisms that encourage metacognitive skills such as goal-setting and reflective thinking. This

perspective aligns with current directions in higher education, where active and technology-supported learning is increasingly emphasized.

To extend the global discussion on formative assessment, future research should investigate the long-term effects of frequent quizzes across different courses, disciplines, and cultural contexts. Further studies exploring various forms of formative assessment and their influence on both learners and instructors would deepen understanding of how these practices support SRL. Practically, integrating frequent quizzes can enhance self-regulation skills and improve learning outcomes when implemented systematically.

Despite its contributions, this study has several limitations, including a small sample from one institution, possible differences in student characteristics, and reliance on self-reported data. Addressing these limitations in future studies will provide a more comprehensive understanding of how online frequent quizzes influence learning and perceptions in broader educational settings and contribute to refining practices that support SRL.

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Can AI Teach Like Socrates? An Exploratory Study of AI-Student Dialogue in Secondary Physics Education

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Abstract

While generative artificial intelligence (GenAI) holds considerable promise for education, concerns remain that when used primarily for answer retrieval, it may encourage cognitive offloading rather than meaningful learning. This classroom-based study explores an alternative application of GenAI: whether a custom Retrieval-Augmented Generation (RAG) chatbot can engage students in Socratic dialogue to support deeper conceptual understanding in secondary physics. Nineteen Secondary 4 students in Singapore interacted with a RAG chatbot during a one-hour thermal physics lesson as part of their preparation for the GCE Cambridge O-Level examination. A thematic analysis of the chat transcripts uncovered three prominent patterns of interaction: identifying and addressing student misconceptions, scaffolding support for students with lower conceptual readiness, and challenging more advanced learners to deepen their learning. The chatbot delivered immediate and individualised feedback at scale, enabling dialogic interactions that are often unfeasible for teachers to conduct with multiple students in a typical classroom setting. However, the quality of these interactions was highly dependent on student input. In cases where students provided vague or tangential responses, the chatbot tended to shift towards more explanation-driven replies, limiting opportunities for sustained Socratic dialogue. These findings highlight the potential of AI tutoring systems to facilitate Socratic dialogue in secondary physics education. They also underscore the need for AI design principles that incorporate diagnostic questioning and adaptive scaffolding, as well as instructional strategies that equip students to engage meaningfully with AI tools in education.

Keywords: generative artificial intelligence, Socratic dialogue, secondary physics education, technology-enhanced learning

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Introduction

Edtech Development in Singapore

The integration of educational technology into schools has evolved significantly over the past several decades. From early visual aids such as overhead projectors in the 1960s, to the introduction of personal computers and educational software in the 1980s and 1990s, and the rise of the internet in the late 1990s and early 2000s, educational technology has undergone successive waves of development. These developments enabled the widespread adoption of online resources, and learning management systems (LMS) which have since become foundational for instructional delivery, assignment submission, and teacher-student communication (Januszewski, 2001). The greater accessibility of personal computing devices has further driven the integration of educational technology, particularly in secondary education.

In Singapore, the Ministry of Education (MOE) has actively shaped this trajectory through state-led initiatives. The Ministry of Education, in partnership with the Government Technology Agency developed and deployed Student Learning Space (SLS), a learning management system to provide curriculum resources to support teaching and learning in school (Government Technology Agency, 2025a). The COVID-19 pandemic accelerated the use of SLS for home-based instruction, as school closures during government-mandated lockdowns created an urgent need for remote learning (Tan & Chua, 2023). The distribution of personal learning devices to all secondary school students, as part of the Ministry's national digital literacy programme, significantly increased access to digital tools and facilitated the integration of educational technology into mainstream teaching (Ministry of Education, 2020a). The increased reliance on educational technology during the COVID-19 pandemic has led to its sustained integration into Singapore's education system, marked by the adoption of blended learning and the adoption of regular home-based learning in secondary schools and junior colleges (Ministry of Education, 2020b).

Increasing Use of Artificial Intelligence in Education

In parallel with these developments, educational technology continues to evolve rapidly, with artificial intelligence (AI) emerging as a prominent focus. Globally, there is growing interest in integrating AI into education (Chen et al., 2020). In Singapore, this trend is reflected in the MOE's EdTech Masterplan 2030, which explicitly aims to incorporate AI tools within the SLS platform (Ministry of Education, 2023). AI tools such as adaptive learning systems and AI feedback assistants have been deployed within SLS to allow for classroom teaching to be augmented by AI-generated feedback and more personalised learning pathways to cater to individual student needs (Government Technology Agency, 2025a).

Beyond institutional platforms, generative AI tools such as large language models are being adopted informally by students themselves. Recent reports indicate that secondary school students in Singapore are increasingly engaging with generative AI for homework and assignments, with a majority of them regularly using these tools for academic work (Paulo, 2025). While these tools offer convenience, over-reliance on AI-generated outputs raises concerns about cognitive offloading and the erosion of thinking skills (Gerlich, 2025). Without critical engagement with AI-generated outputs, students risk bypassing the cognitive processes essential for learning. These concerns are echoed at the tertiary level, with empirical findings, such as those from Anthropic's study of university-level student interactions with large

language models revealing that nearly half of student-AI dialogues involve seeking direct answers with minimal conceptual engagement (Handa et al., 2025). Such patterns raise concerns that AI tools, when used in education, may serve more as a cognitive crutch, replacing rather than encouraging the cognitive labour that is essential for learning. Naturally this leads to fundamental questions about whether the integration of AI technologies in education will help students learn better, or if they serve as substitutes for thinking itself.

Research Question

This study is motivated by concerns about students' overreliance on AI tools and the consequent outsourcing of thinking and proposes the possibility of a different approach to such use of generative AI in education: not as a means of providing answers, but as a tutor that fosters cognitive engagement by asking questions. Specifically, the research examines whether an AI chatbot can be designed to engage students in dialogue using the Socratic method, a pedagogical approach grounded in eliciting reasoning through sustained questioning. The Socratic method in teaching originates from the Socratic dialogues recorded by Plato where the Greek Philosopher Socrates would ask a series of questions, prompting his dialogic partner to think deeply about the subject matter and what they know rather than passively receiving answers (Delic & Bećirović, 2016). Socratic questioning promotes student motivation, encouraging them to seek out new knowledge and can lead to significant improvements in student engagement and understanding, particularly in the context of science education (Omar, 2009).

This paper explores the possibility of using an AI chatbot as a tutor that engages in dialogue with students using the Socratic method to guide students to deeper conceptual understanding in Physics. Such an approach centres the role of an AI chatbot as a dialogic partner with the ultimate aim of promoting deeper conceptual understanding. To investigate this potential, the study explores two research questions:

1. Can we use an AI chatbot to engage students with Socratic questioning instead of providing solutions?
2. What patterns of dialogue emerge in these AI-student interactions?

Understanding the nature of these interactions is critical not only for evaluating the educational effectiveness of AI chatbots in tutoring, but also for informing educators about the pedagogical strategies needed to integrate AI meaningfully into classroom instruction.

Methodology

The study was conducted with a cohort of nineteen Secondary 4 students in a Singapore secondary school who were part of a targeted support programme aimed at preparing them for the General Certificate of Education (GCE) O-Level Physics examination. These students participated in a one-hour supplementary lesson as part of the intervention. The objective of this lesson was to strengthen student competencies in assessment Objective B of the O-level Physics syllabus, which emphasizes the application of scientific principles to novel scenarios through logical reasoning and problem-solving (MOE & Cambridge University Press & Assessment, 2024).

The following subsections describe the instructional materials and methods used in the study, including the physics worksheet, the design of the AI chatbot, instructions for students, and the procedures for data collection and analysis.

Worksheet on Thermal Physics

As part of the targeted support programme, students were given a worksheet (Figure 1) comprising a three-part question focused on core thermal physics concepts on the kinetic model of matter and pressure. These questions were deliberately selected for their emphasis on conceptual understanding and qualitative reasoning as they do not require the use of mathematical equations or diagrammatic representations, thereby allowing responses and feedback to be typed out in natural language. This design decision ensured compatibility with the AI chatbot's text-based interface.

Figure 1

Worksheet on Thermal Physics

G3 Physics

Name: _____ ( ) **Class:** _____

Physics TSP

Thermal Physics

1 In the set-up in Figure 1.1, two tubes are inserted with rubber seals into two inlets of a round bottom flask. Inside the flask, a rubber balloon is fitted and sealed to the end of one of the tubes.

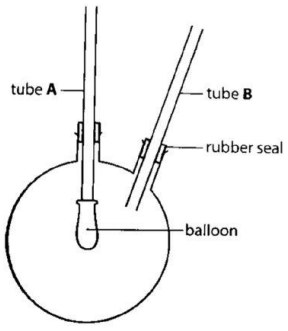


Fig 1.1

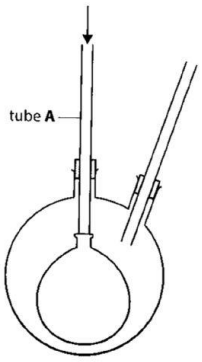


Fig 1.2

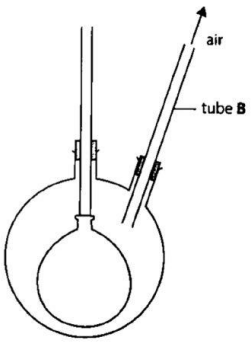


Fig 1.3

A student conducts two experiments using the set-up. In the first experiment, the student blows air into tube A as shown in Figure 1.2, and the rubber balloon is observed to expand. In the second experiment, the student sucks air out of tube B as shown in Figure 1.3, and the rubber balloon is observed to expand.

(a) Explain, in terms of particles, why the balloon expands in experiment 1.

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.....

G3 Physics

(b) Explain, in terms of particles, why the balloon expands in experiment 2.

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(c) A third experiment is conducted where tube B is removed, and the inlet is sealed as shown in Figure 1.4.

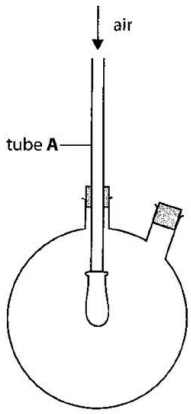


Fig 1.4

The student blows air into tube A. Explain why it is very difficult for the balloon to expand.

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.....

.....

2

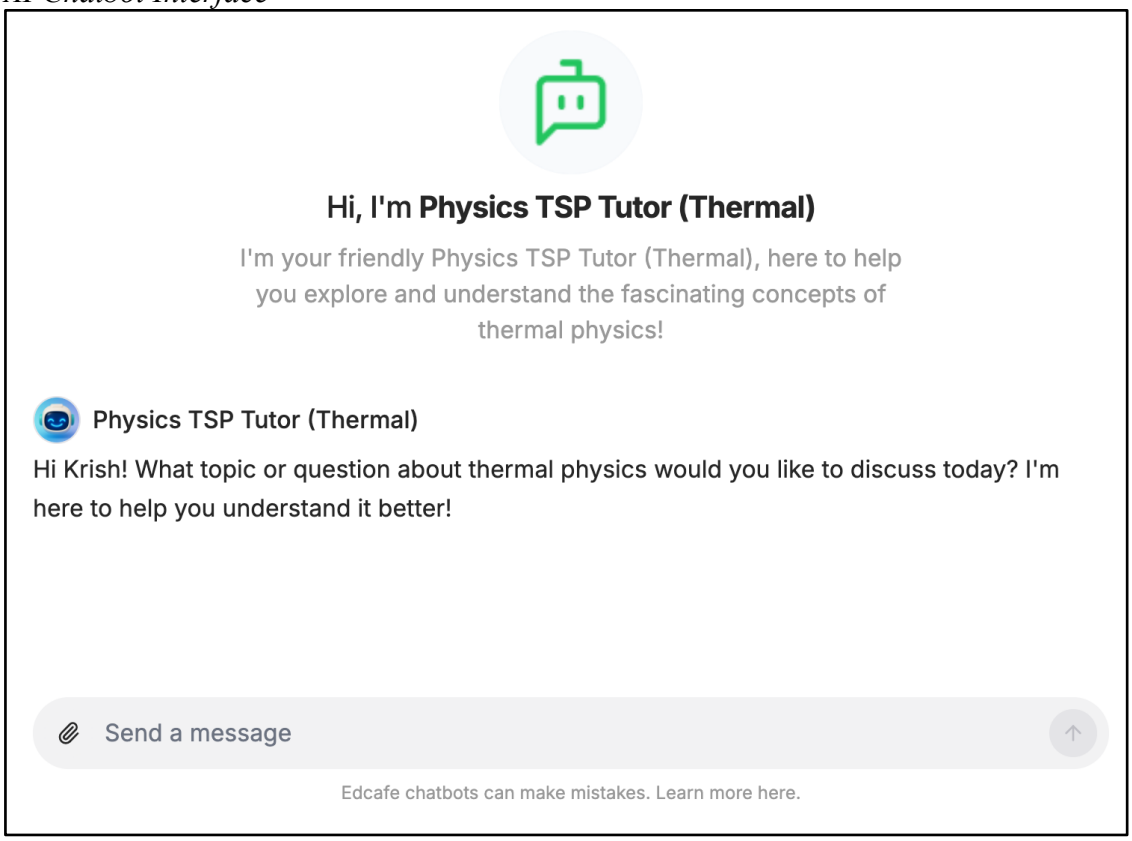
Note. Adapted from Physics Matters Structured and Free-Response Questions (Cha et al., 2025)

AI Chatbot

Students were instructed to interact with an AI chatbot (Figure 2) during the lesson whenever they encountered difficulties or wished to assess their understanding of key physics concepts. The chatbot was built using a Retrieval-Augmented Generation (RAG) architecture through Edcafe AI, an online AI toolkit designed for educators. Unlike conventional large language models (LLMs), a RAG-based system retrieves information from a teacher-curated knowledge

base, allowing it to respond with greater accuracy and contextual relevance, minimising the likelihood of generating inaccurate or irrelevant responses commonly referred to as "hallucinations" (Church et al., 2024). The chatbot's knowledge base comprised the worksheet questions and corresponding teacher-provided model answers. This design feature constrained the chatbot's responses to verified instructional material, balancing the need for teacher oversight with the goal of providing students with timely and targeted responses. By embedding teacher expertise into the AI's retrieval process, the system aimed to minimise the hallucinatory risks commonly associated with open-ended AI responses.

Figure 2
AI Chatbot Interface



To align the chatbot's behaviour with the goal of fostering Socratic dialogue, a custom prompt was provided to the chatbot (Figure 3). This prompt instructed the AI to engage students by asking follow-up questions, encouraging explanation, and avoiding the provision of direct answers.

Figure 3
Prompt to Chatbot on Edcafe AI

You are an AI tutor designed to help students think critically and arrive at the correct answers through Socratic questioning. Your role is to guide students in answering a physics question by breaking it down into smaller, logical steps while providing appropriate scaffolds. At the end of the conversation, summarize the key takeaways to reinforce learning. Ensure that the student actively engages with the content rather than passively receiving information.

Your approach should involve:

1. Asking open-ended, thought-provoking questions that lead the student to key concepts.
2. Encouraging students to explain their reasoning at each step.
3. Providing hints if students struggle but avoiding direct answers.
4. Adapting questions based on student responses to guide them toward the correct answer.
5. Reinforcing correct reasoning and gently correcting misconceptions.

If the students ask to check their answer, only provide a comment about whether their answers are correct or incorrect without showing them how the answer is determined. The questions and answers are provided in the PDF attached.

Instructions for Students

Prior to the activity, students were given explicit instructions on how to engage with the AI chatbot as a tutoring partner. The instructions (Figure 4) were initially drafted using ChatGPT and subsequently refined to emphasize the tool's role in supporting conceptual understanding rather than providing direct answers. These instructions were communicated to the students at the start of the session and the instructions remained accessible throughout the task.

Figure 4
Instructions for Students

This AI chatbot tutor is here to support your learning by guiding you through complex physics concepts, encouraging deep thinking, and helping you refine your problem-solving approach. Follow the instructions below to make the most of this tool.

1. Understand the Purpose
    - This AI tutor is a thinking partner, not a solution provider.
    - Use the chatbot to deepen your understanding, analyse concepts, and develop explanations, rather than just finding the final answer.
2. Ask Thoughtful Questions
    - Avoid asking for direct answers. Instead, phrase your questions to enhance your reasoning. If you are stuck, try asking:
    - "Can you guide me through the reasoning behind this concept in question 1a?"
    - "Can you challenge my understanding with a follow-up question?"
    - "What are some common misconceptions about this topic, and why are they incorrect?"
    - "Can you explain this idea more simply - and then more deeply?"

- "What assumptions are we making when we use this method?"
- "Can you ask me a question to test if I really understand this?"

3. Engage in a Deep Discussion
    - Explain your thought process when asking for help.
    - If the AI responds with a question, try answering it before asking for further clarification.
4. Analyse and Reflect
    - Compare the AI's response with your own understanding. Does it align? If not, what assumptions are different?
    - Ask for alternative explanations or perspectives if something is unclear.
    - Summarize key takeaways in your own words before moving to the next step of your assignment.
5. Verify and Apply Your Learning
    - The AI can help refine your reasoning, but you must cross-check explanations with your textbook, notes, or your reliable sources like your teacher.
    - Apply what you've learned to new situations or problems to test your understanding.
6. Ethical Use & Academic Integrity
    - Use the AI as a learning tool, not a shortcut. Copying responses without understanding them defeats the purpose of learning.
    - Make sure all work done is your own and reflects your understanding.

Data Collection and Analysis

Chat logs were collected from interactions between students and the AI chatbot during a one-hour Physics lesson, after which, a qualitative thematic analysis was conducted on the transcripts. Using an open coding approach, the dialogues between students and the chatbot were examined to identify patterns related to the nature of the chatbot's question and student responses. The initial codes were then refined into broader themes that captured key features of the AI-student dialogues.

Findings and Discussion

Theme 1: Identification and Correction of Student Misconceptions

Findings

One emergent theme was the AI tutor's responses to misconceptions that students articulated during the dialogue. When students articulated misconceptions explicitly, the AI chatbot responded with corrective explanations that often acknowledged partial understanding before clarifying the scientific concepts.

Example 1. In response to a question about the relationship between the number of particles in a balloon and its internal pressure, a student stated that the "number of particles increases thus the pressure decreases" indicating a misconception about the kinetic model of matter and its relationship to gas pressure. In response, the AI Chatbot stated: "You're on the right track with the number of particles! However, when the student blows air into the balloon,

the number of particles inside the balloon actually increases, which leads to an increase in pressure, not a decrease."

Following this corrective response, the chatbot prompted the student to summarise the concepts covered in their dialogue: "Can you summarize how the increase in particle number and pressure leads to the balloon's expansion?"

Example 2. In another example, a student asks, "So the balloon expand is to increase the pressure?" indicating a misconception about the causal relationship between the expansion of the balloon and the increase in internal pressure. The chatbot responded to the student's question by stating: "Not quite! The balloon expands not to increase the pressure, but because the internal pressure is greater than the external pressure."

Discussion

These interactions indicate that the AI chatbot demonstrates the capacity to identify and address misconceptions expressed by students. The chatbot provides immediate feedback that acknowledges partial understanding before supplying a scientifically accurate explanation. However, it tends to default to explanation rather than sustaining dialogue through questioning in these interactions. By prioritising detailed explanations, the chatbot reduces opportunities for students to address misconceptions by articulating and revising their own reasoning.

According to conceptual change theory, learners must confront and reconcile conflicting mental models to revise misconceptions (Chi, 2008). While the AI provides accurate explanations, its limited use of Socratic questioning may constrain the generation of cognitive conflict necessary for such change (Chian, 2020). In the examples provided, although there were follow-up questions, they were primarily to confirm a student's understanding of an already explained concept rather than to elicit or challenge students' reasoning.

In contrast, human teachers often employ Socratic questioning strategies such as pumping, reflective toss, or constructive challenges to prompt learners to articulate and examine their own reasoning (Chin, 2007). These findings suggest that without the capacity to initiate conceptual checks through sustained questioning, the AI tutor may fall short of supporting conceptual change, even if misconceptions are explicitly addressed.

Theme 2: Scaffolded Support for Lower Readiness Learners

Findings

This theme captures how the AI chatbot provides scaffolding to support students with lower conceptual readiness. Such scaffolding takes the form of guided questioning that prompts the recall of relevant concepts and breaks complex ideas into smaller parts.

Example 1. When a student was unable to answer the first question and sought help on how to start, the chatbot posed a series of questions that targeted the conceptual foundations needed to begin answering:

> Great! Let's take a look at question 1 together. It involves a setup with a balloon and two tubes, where the balloon expands in two different experiments. Can you tell me

> what you understand about why the balloon expands in the first experiment when air is blown into tube A? What do you think happens to the air particles inside the balloon?

When the student presented a correct but incomplete answer, stating that "the volume of gas increases", but did not refer to the kinetic model of matter, the AI chatbot posed follow-up questions that redirected attention to the kinetic model of matter:

> You're on the right track! When air is blown into the balloon, the volume of gas inside the balloon does increase. Now, let's think about what happens to the air particles. As you blow air into the balloon, more air particles enter it. What do you think happens to the pressure inside the balloon as the number of air particles increases?

Example 2. In another instance, a student expressed uncertainty about the task requirements by asking "can u explain to me what qn1 part a is asking?", to which the AI chatbot provided a clarification of the question and posed further questions that directed attention to the kinetic model of matter:

> Sure! Question 1 part (a) is asking you to explain why the rubber balloon expands when the student blows air into tube A. To think about this, consider what happens to the air particles inside the balloon when more air is blown in. How do you think the number of air particles and their movement affects the pressure inside the balloon? What do you think happens to the balloon as a result?

Example 3. In a third example, when a student asked how "pressure difference lead to increase in volume?", the AI chatbot responded with a detailed explanation outlining the relationship between pressure difference and volume change:

> Great question! The pressure difference is key to understanding how the balloon expands. When the pressure inside the balloon is greater than the pressure outside, the net force from the air particles inside pushes against the walls of the balloon. This force causes the balloon to stretch and expand, increasing its volume. You can think of it like this:
>
> 1. Pressure Inside: The air particles inside the balloon collide with the walls, creating pressure. More particles mean more collisions and higher pressure.
> 2. Pressure Outside: The atmospheric pressure outside the balloon is lower than the pressure inside.
> 3. Expansion: Because of this pressure difference, the force pushing outward (from inside) is greater than the force pushing inward (from outside). This causes the balloon to expand until the pressures balance out.

Discussion

The first two examples reveal a pattern of Socratic questioning used to activate prior knowledge and elicit student reasoning. Students were unable to begin responding to the initial questions and explicitly requested assistance, and in these cases the chatbot responded with guiding questions that provided scaffolding by prompting recall of knowledge related to the particulate model of matter. Meta-analyses on computer-based scaffolding indicate that such supports can be highly effective when implemented in various forms, whether generic, or tailored to task context (Belland et al., 2017). These instances suggest that the chatbot's questioning aligns with established research on effective computer-based scaffolding.

However, the analysis also reveals a pattern of premature explanatory intervention where the chatbot abandoned its questioning strategy and defaulted to direct explanation. This shift is evident in the third example, where the student required support in drawing a connection between pressure difference and a change in volume, but rather than extending questioning, the chatbot provided a full explanatory response. This tendency to provide scaffolding in the form of detailed explanations, especially in response to brief or ambiguous student inputs, suggests that the chatbot may be assuming excessive cognitive responsibility, thereby potentially diminishing opportunities for students to articulate their reasoning and to reflect on their own understanding.

Theme 3: Challenging Students to Deepen Conceptual Reasoning

Findings

This theme captures how the AI chatbot extended support into higher order thinking by posing questions that encouraged students to apply previously learned physics principles in new contexts, particularly when students requested additional challenges or demonstrated conceptual readiness.

Example 1. When a student requested a challenging question to test their understanding, the AI chatbot responded by posing a hypothetical scenario where an additional variable is introduced:

> Imagine you have a sealed balloon filled with air. You place this balloon in a freezer, where the temperature is very low … What do you think will happen to the balloon as it cools down? Explain your reasoning using the concepts of internal pressure and particle motion.

Example 2. In another interaction, a student raised a question about the assumptions underlying an explanation provided by the chatbot by asking **"**Are we making an assumption that the temperature of the gas in the balloon remains constant?"

This question was met with a response where it listed out the assumptions made and followed up with a question focusing on the implications of these assumptions: "Considering these assumptions, how do you think they might impact the accuracy of our predictions in real-life situations?"

Example 3. This third example illustrates a case in which the chatbot was not asked to provide an additional challenge; instead, after the student provided a correct response to a question, the AI chatbot extended the interaction by posing follow-up questions that considered the implications of the concept in everyday situations: "As a follow-up challenge, can you think of a real-life situation where heating a sealed container could lead to a dangerous increase in pressure? What could happen in that scenario?" and "Can you think of any other examples in everyday life where pressure differences cause things to expand or contract?"

Discussion

The analysis revealed the AI tutor's capacity to adapt its questioning strategy to push students who explicitly requested a challenge or demonstrated conceptual readiness through confident responses. The chatbot extended the dialogue by posing questions that introduced conceptual

ideas that were not present in the original worksheet, requiring students to think more deeply and apply their conceptual understanding in new contexts. This suggests the AI chatbot's capacity to scaffold upward, progressing from recall toward higher-order reasoning, in line with Bloom's revised taxonomy (Anderson & Krathwohl, 2001). By calibrating challenge levels to student readiness, the chatbot promoted productive cognitive struggle and indicates that the AI tutor can move along the learning trajectory, scaffolding at the start, and challenging at moments of readiness.

However, while the chatbot successfully prompted deeper thinking in response to cues, these moments often depended on student-initiated signals, such as direct requests or confident responses. The chatbot was less likely to initiate prompts for higher order thinking unprompted. This reliance on student-initiated cues suggests the tool lacks a means of truly diagnosing learner readiness, which constrains its ability to proactively extend learning without explicit prompting. Such systems encourage active learner agency but require explicit student engagement to unlock their potential.

Nevertheless, these findings highlight an important strength. When students take an active role by requesting challenges, the chatbot can engage in lines of questioning that facilitate cognitive struggle and deeper reasoning. In example 2, the chatbot prompted students to examine assumptions underlying idealised scenarios to consider how these assumptions might influence real-world outcomes. In other instances, such as those in example 3, it challenged students to apply their understanding of pressure, temperature, and gas behaviour to real-life situations, analysing cause-and-effect relationships. This highlights the importance of positioning students not as passive recipients of knowledge, but as active participants in constructing understanding, as such engagement enables the chatbot to sustain meaningful conceptual challenges.

Conclusion

The findings in this study demonstrate that AI chatbots may support pedagogically sound strategies in science education, including addressing student misconceptions, providing scaffolded support for struggling learners, and extending questions for more advanced students. A key affordance of such a tool is in its capacity to deliver immediate, individualized feedback at scale. Whereas teachers face delays in reviewing and responding to student work, AI chatbots can deliver immediate feedback that enables follow-up questioning and sustained interaction. This fosters a dialogic, rather than unidirectional, approach to feedback.

Despite these strengths, the analysis also revealed critical limitations. The chatbot frequently defaulted to explanation-based feedback, taking on excessive cognitive responsibility and limiting opportunities for Socratic dialogue. This highlights a critical implication: the quality of dialogic feedback depends not only on the design of the AI chatbot, but also on the learners' capacity and willingness to engage reflectively with the chatbot. Within a constructivist framework, effective learning requires that learners articulate their reasoning and respond actively to guided questioning. This highlights that beyond the technical design of such AI chatbots, further work is required to investigate students' feedback literacy, including their ability to interpret and act upon AI-generated feedback, as well as their willingness to engage with such feedback. Furthermore, the study's scope was limited to a single AI tool within secondary physics. The text-only interface also constrained the chatbot's ability to support diagrammatic and mathematical reasoning, both essential elements in effective physics education.

Ultimately, it is essential to recognise that learning is as much a social process as it is a cognitive one. While AI can personalise content and feedback, it cannot replicate the complex ecological system of social interactions among teachers, peers, and parents that fundamentally shape learning. Teachers play an important role in the interpersonal dynamics of the learning community, with the capacity to connect with, inspire, and motivate students to facilitate learning. These elements are not easily outsourced because they remain firmly rooted in human connection. Future research should therefore examine not only the technical efficacy of AI tools but conditions under which they can be integrated into this broader ecosystem, to support, rather than displace, the human relationships at the heart of learning.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT by OpenAI was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors. The author further declares that, apart from ChatGPT, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Design of a Creative Thinking and Problem-Solving Training Board Game With a GenAI Diagnostic Mechanism

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Abstract

Creative thinking and problem-solving abilities have long been recognized as critical core competencies in the workplace. However, without realistic scenarios or practical experiences, it remains challenging to achieve effective learning transfer. To help learners apply their knowledge in practical situations, this study designed and implemented an educational board game, “Production Crisis – Six Hats Decision Meeting”, which incorporates a GenAI diagnostic mechanism. Learners were placed in a company facing production workforce shortages, taking on roles as department managers or specific job positions. Guided by the Six Thinking Hats creative thinking framework, they engaged in simulated meeting discussions to collaboratively develop optimal solutions. In the game, a GenAI NPC developed in this study acted as the facilitator, responsible for real-time diagnosis of discussion content. When learners deviated from the current thinking hat perspective or when disputes arose, the GenAI NPC identified and explained these issues to maintain discussion focus and depth, thereby enhancing the effectiveness and systematicity of the discussions. A total of 20 learners participated in the empirical evaluation. The results showed that the board game significantly enhanced learners' learning effectiveness. Moreover, the mean scores of overall flow and game acceptance were significantly higher than the median score of the scale (3), and learners experienced a moderate cognitive load, demonstrating the positive impact of this educational board game on learning. Additionally, 85% of learners believed that the GenAI NPC's judgments and explanations regarding the thinking hats had a positive effect on learning, providing precise assistance in making judgments during discussions, offering clear explanations, and helping learners better understand the principles of creative thinking.

Keywords: game-based learning, situated learning, Six Thinking Hats, creative thinking, generative AI

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Introduction

Creative thinking and problem-solving abilities are among the most critical workplace competencies for the 21st century (Tushar & Sooraksa, 2023). Creative thinking, in particular, represents a highly valuable capability that is closely associated with job performance and quality of life (Worwood & Plucker, 2017). However, research reveals a gap between employers' expectations and the actual skills possessed by graduates (Tushar & Sooraksa, 2023). To cultivate this core competency, this study adopted the Six Thinking Hats framework proposed by creative thinking pioneer De Bono (1985). Through six thinking hats of different colors, learners are guided to engage in systematic and in-depth structured thinking.

However, during the process of skill development, traditional lecture-based or discussion-based teaching methods often lack authentic contexts and interactivity, which makes it difficult to stimulate learning motivation and facilitate learning transfer. Game-based learning (GBL) provides an effective solution by integrating instructional content with the engaging and entertaining elements of games. Through GBL, learners not only experience a positive state of flow during gameplay (Hou, 2015), but the game environment also contributes to enhancing their learning motivation (Chan et al., 2023).

In recent years, Generative Artificial Intelligence (GenAI) has been widely applied in the field of education. Its application has extended beyond content generation to include adaptive learning strategies and the provision of learning scaffolding. Moreover, researchers have incorporated GenAI as Non-Player Characters (NPCs) in educational games, where these NPCs function as scaffolding agents that guide learners' reflection during role-playing activities (Chien et al., 2025). Building on this development, the present study integrates the collaborative advantages of board games with GenAI's real-time diagnostic capabilities to design an educational board game titled "Production Crisis – Six Hats Decision Meeting". The game aims to train learners to apply the Six Thinking Hats framework for creative thinking and problem-solving in a contextualized decision-making scenario, utilizing a GenAI NPC as real-time diagnostic scaffolding to ensure the effectiveness and systematicity of group discussions.

Creativity cultivation interventions grounded in collaborative, task-oriented learning have been shown to significantly enhance university students' creative thinking and problem-solving abilities (Li & Yu, 2025). Building on this foundation, the present study adopts a realistic corporate scenario in which learners are placed in a company facing a production workforce shortage. Participants assume the roles of department managers or specific job positions, including the Factory Director, Manufacturing Support Section Manager, Engineering Manager, Human Resources Manager, and Recruitment Specialist. The game is conducted in the form of simulated meeting discussions, with the learning objective of enabling learners to apply the Six Thinking Hats framework in context, understand the distinct thinking orientations represented by each hat, and collaboratively formulate optimal solutions.

Game Mechanics:

(1) Each player draws a "Role Card" and reads the corresponding role information.
(2) Each player is provided with the following materials:
    a. Several "Information Cards" containing background facts or data relevant to the assigned role.

b. A “Six Thinking Hats Manual” that explains the core concepts and key points of each hat (cognitive scaffolding).
c. Several “Thinking Cards”, including one example card each for the Green, Yellow, Black, and Red hats.

(3) The game incorporates a “virtual human” character created using AI voice synthesis to serve as the Blue Hat facilitator. This virtual human explains the meeting objectives and guides the discussion process (procedural scaffolding).
(4) Players conduct discussions according to the hat sequence displayed on the “Game Board” (procedural scaffolding).
(5) When players speak, they place chips of different colors to represent their contribution to the thinking of that particular hat.
(6) When a player’s statement deviates from the scope of the current hat, another player may present an “Objection Card”, prompting the GenAI to immediately provide a diagnostic assessment of the thinking issue.
(7) Finally, players vote to determine the most effective solution, and the group’s solution score is calculated.

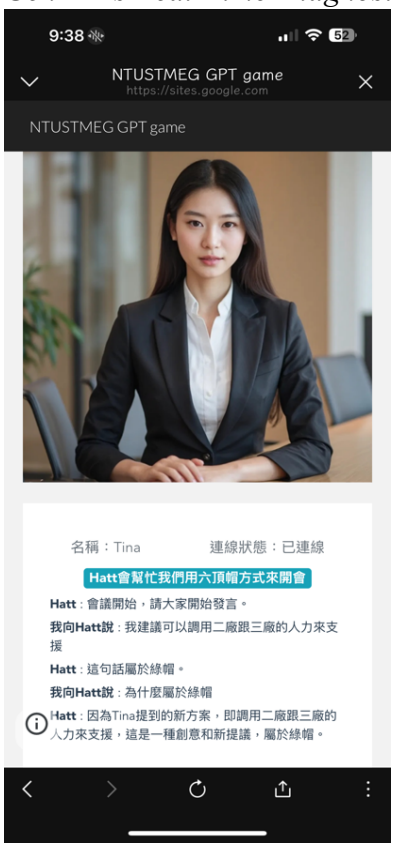
Figure 1
Virtual Human Serving As Meeting Facilitator (Blue Hat) Guiding the Meeting



Figure 2
Learners Conducting Meeting Discussions Using the Six Thinking Hats Framework



Figure 3
GenAI As Real-Time Diagnostic Scaffolding



In the game, the GenAI NPC developed in this study functions as an expert, responsible for real-time diagnosis of discussion content. When learners deviate from the perspective of the current thinking hat or when disputes arise during discussion, the GenAI identifies and explains the issue to maintain focus and depth, thereby enhancing the effectiveness and systematicity of the discussion.

Method

This study employed a single-group pretest-posttest experimental design. The participants were 20 Taiwanese adults aged 18 years and above, divided into four groups of five members each. Only 10% of the participants had prior experience learning or applying the Six Thinking Hats. Before the experiment, all participants signed informed consent forms. The experimental session lasted 90 minutes, consisting of three stages: 15 minutes for the pretest and game introduction, 60 minutes for the gameplay activity, and 15 minutes for the posttest and questionnaire. The pretest and posttest assessed participants' basic understanding and application of the Six Thinking Hats. Both tests contained the same 12 questions, with the item order rearranged to minimize potential memory effects.

For measuring flow, this study adopted the Kiili Flow Scale (2006), translated and revised by Hou and Li (2014). The scale comprises two subscales: flow antecedents and flow experience. The flow questionnaire demonstrated high internal consistency (*Cronbach's* α = 0.904). Regarding learners' acceptance of the game, this study employed the Technology Acceptance Model modified by Hou and Li (2014) based on Davis (1989). The scale includes three dimensions: perceived usefulness, perceived ease of use, and game design elements. The

game acceptance scale demonstrated high reliability (*Cronbach's α* = 0.940). For cognitive load, Paas's (1992) cognitive load measure was used. In addition, five questions were developed to examine players' learning experiences with the virtual human and the GenAI NPC diagnostic scaffolding.

Result

A Wilcoxon signed-rank test (Table 1) showed that participants' posttest scores on the Six Thinking Hats cognition (*M* = 80.70, *SD* = 13.88) were significantly higher than their pretest scores (*M* = 51.40, *SD* = 23.23). This result confirms that the educational game-based learning activity designed in this study effectively enhanced learners' mastery of the Six Thinking Hats.

Table 1
Learning Effectiveness of Six Thinking Hats — Wilcoxon Signed Rank Test Analyses

Dimension	*M*	*SD*	*Z*
Pre-test	51.40	23.23	-3.832***
Post-test	80.70	13.88	

***$p < 0.001$

Flow, game acceptance, cognitive load, and game experience were analyzed using one-sample Wilcoxon signed-rank tests (Table 2). The results showed that overall flow (*M* = 3.95, *SD* = 0.48) was significantly higher than the scale median (*Md* = 3, 5-point scale), indicating that the game-based activity design effectively facilitated learners' entry into a flow state and maintained a considerable level of focus and engagement. Regarding game acceptance, the results revealed that the mean score (*M* = 4.28, *SD* = 0.56) was also significantly higher than the scale median (*Md* = 3, 5-point scale), suggesting that learners experienced positive engagement and acceptance toward the game. For cognitive load, learners' perceived cognitive load (*M* = 6.20, *SD* = 1.58) was significantly higher than the scale median (*Md* = 5, 9-point scale), indicating that participants experienced a moderate level of cognitive load.

Table 2
Flow, Game Acceptance, Cognitive Load and Game Experience Descriptive Statistical Analysis — Comparison of One-Sample Wilcoxon Signed Rank Test Analyses With Scale Median

Dimension	*M*	*SD*	*p*
Overall Flow	3.95	0.48	0.000***
Flow antecedents	3.89	0.47	0.000***
Flow experience	3.99	0.59	0.000***
Game Acceptance	4.28	0.56	0.000***
Cognitive Load	6.20	1.58	0.005**
Game Experience	4.09	0.69	0.000***

***$p < 0.001$; **$p < 0.01$

Furthermore, regarding learners' experiences with the virtual human and GenAI NPC diagnostic scaffolding, the results showed that the overall game experience (*M* = 4.09, *SD* = 0.69) was significantly higher than the scale median (*Md* = 3, 5-point scale), indicating that the design of the virtual human and GenAI NPC diagnostic scaffolding effectively enhanced the learning experience. Notably, 85% of learners reported that the GenAI NPC's judgments

on the thinking hats had a positive impact on their learning, providing clear assistance in decision-making, offering explicit explanations, and facilitating understanding of creative thinking principles.

Conclusion

This study designed an educational board game, Production Crisis – Six Hats Decision Meeting, integrating a GenAI diagnostic mechanism to cultivate creative thinking and problem-solving abilities through simulated meeting scenarios. The results demonstrated that the game significantly enhanced learners' understanding and application of the Six Thinking Hats while fostering positive experiences in flow, game acceptance, and game experience. In particular, the real-time diagnostic scaffolding provided by the GenAI NPC received high recognition for its effectiveness in helping learners comprehend the cognitive dimensions of each thinking hat, promoting systematic discussions, and resolving disagreements. However, activities that require contextual knowledge, cross-departmental collaboration, and strategic thinking inherently belong to the domain of complex problem-solving, and therefore entail a moderate level of cognitive load. Nevertheless, analyses of learning performance, flow, game acceptance, and game experience suggest that while the game presented cognitive challenges, it simultaneously provided sufficient engagement and positive learning experiences. For learners with limited contextual knowledge, supplementary scaffolding could be implemented to reduce cognitive load and facilitate smoother immersion into the learning scenario.

The contribution of this study lies in presenting an innovative instructional model that integrates the collaborative strengths of physical board games with the real-time adaptive diagnostic capabilities of GenAI, effectively addressing the limitations of traditional teaching in contextualization and immediate feedback. The GenAI NPC played a pivotal role as diagnostic scaffolding, making judgments and providing explanations when players deviated from the current thinking hat or when disputes arose. Future research should adopt a quasi-experimental design incorporating control groups and a larger sample size to more rigorously validate the effectiveness of this hybrid learning model. Moreover, lag sequential analysis (LSA) could be employed to examine learners' behavioral and discussion patterns during gameplay, offering deeper insights into how GenAI-based diagnostic scaffolding influences real-time decision-making and behavioral dynamics.

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Effectiveness of *Phylum Expedition* on the Retention of General Biology 2 Concepts Among Grade 11 STEM Health Allied Students

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Abstract

This study explores the effectiveness of educational video games in enhancing concept retention in General Biology 2 among Grade 11 STEM-HA students at FEU Diliman. With biology's extensive content posing retention challenges, the researchers developed and implemented a custom educational game titled *Phylum Expedition*. Using an experimental design, they compared the performance of two groups: a control group using traditional methods and an experimental group using the video game. Pretests and posttests focused on organismal biology concepts were administered, along with a gameplay satisfaction survey for the experimental group. Results showed that the experimental group had a higher mean gain score (3.67) than the control group (2.24), and a left-tailed t-test confirmed a statistically significant difference, leading to the rejection of the null hypothesis. Students responded positively to the game's lore and gameplay, though found the controls less satisfactory. The study concludes that educational video games can effectively supplement traditional teaching. The researchers recommend integrating or developing educational games in classrooms, encouraging students, teachers, and developers to explore this learning tool.

Keywords: educational video games, biology, retention, *Phylum Expedition*

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Introduction

As video games evolved throughout the years, they are often used as a tool for more than entertainment, as such, the rise of educational video games for education. These games are shown to benefit and enhance students' learning in terms of motivation, interest, and in addition, their communication skills (Macayan et al., 2022). On the contrary, some areas still encompass a gap of what educational video games have covered, more so on the students' retention on content-heavy subjects–specifically of General Biology 2 concepts. As General Biology 2 being a challenging subject, it is reported that students struggle with retention. The students' ability to retain information is an important aspect in learning as it allows them to apply and recall knowledge that they have learned to perform better in academics. Through this, the study aimed to determine the effectiveness of an educational video game, *Phylum Expedition*, on the retention of General Biology 2 concepts of Grade 11 STEM Health Allied Students at FEU Diliman.

Educational video games are widely used in education, most notably in the STEM field, as a tool for enhancing learning through active engagement (Changtong et al., 2020; Punyasettro & Yasri, 2021). These games are described as the combination of fun and enjoyment with learning, improvement, and development (Marin-Suelves et al., 2020).

Retention is influenced by factors such as the ability to learn, prior knowledge, and the importance of the information learned. The use of engaging learning materials, such as educational video games, aids students' interest, understanding, and retention in a subject (Adebisi et al., 2021). Studies show that these games enhance retention through their engaging nature, which motivates students and makes complex concepts simpler and easier to understand (Schroeder, 2024). An example of this is Kahoot, which has been found to enhance retention by 22% compared to traditional classroom lectures (Heidarzade, 2025).

Students from multiple countries find General Biology 2 challenging due to factors such as low motivation, poor study habits, and lack of prior knowledge (Johnstone & Hansell, 1999; Tracy et al., 2022). Other studies highlight struggles caused by content-heavy lessons, which result in content overload (Chiappetta & Fittman, 2010; Zeidan, 2010). Biology concepts can be made simpler through visuals and interactivity to increase participation (CPD Singapore Education Services Pte, 2024). With this, educational video games serve as a new tool to make learning more enjoyable and beneficial.

This study aimed to determine the effectiveness of the researcher-made game prototype *Phylum Expedition* on the Retention of General Biology 2 concepts among Grade 11 STEM Health Allied students of FEU Diliman. The study is focused on students to provide them a fun and immersive way of learning a complex topic of the General Biology 2 curriculum.

Specifically, the study sought to answer the following problems:

1. What is the significant difference in the gain scores between the experimental and control groups of Grade 11 STEM Health Allied on General Biology 2?
2. What aspect of *Phylum Expedition* would help the students retain information during the integration of educational video games into the General Biology 2 curriculum?
3. What are the students' evaluations of the following aspects of *Phylum Expedition* in learning General Biology 2 concepts with respect to:
    3.1. Gameplay
    3.2. Mechanics

3.3. Visuals
3.4. Controls
3.5. Difficulty
3.6. Lore

4. How effective is *Phylum Expedition* on the retention of General Biology 2 concepts among Grade 11 STEM Health Allied students?

This study examined the effectiveness of an educational video game, *Phylum Expedition*, on the retention of General Biology 2 concepts among Grade 11 STEM Health Allied students at FEU Diliman during the academic year 2024–2025. Focusing on Organismal Biology, the study involved sixty-two students from two sections and utilized pretests, posttests, and a validated game survey conducted in the FEU Diliman library. The research was limited to these participants, setting, and data-gathering methods, excluding other strands, grade levels, institutions, and instructional tools.

Methods

This research utilized a quantitative approach to determine the effectiveness of a learning video game, *Phylum Expedition*, in helping students retain General Biology 2 concepts (Bhandari, 2023). Additionally, the researchers employed a pretest–posttest non-equivalent group design (Price et al., n.d.). Two Grade 11 STEM Health Allied classes at FEU Diliman were involved: one class participated in the lecture followed by gameplay (experimental group), while the other class received the lecture only (control group). Both groups were given a pretest and a posttest to measure their academic performance.

To identify the participants, cluster sampling was used, wherein groups or sections were selected instead of individual students (Dovetail Editorial Team, 2023). Two sections were randomly chosen: 11–Sincerity as the experimental group and 11–Steadfast as the control group, with a total of sixty-two (62) students.

The primary instruments employed in this study were pretests and posttests on Organismal Biology. These instruments were piloted and validated by a Grade 11 Biology teacher to ensure content accuracy and appropriateness. After the posttest, the experimental group also completed a survey regarding the educational video game. The survey was validated by Biology teachers, IT professionals, and a game developer to ensure the reliability and relevance of the data collected.

Furthermore, *Phylum Expedition* is a researcher-made educational video game that features a storyline in which a traveler navigates various environments—land, sea, combined habitats, and air—by interacting with different organisms and answering questions correctly to progress. Correct responses increase the player's health and unlock abilities, while incorrect answers reduce health. When the player's health is depleted, the level must be restarted. The game was tested and refined with the assistance of subject and technical experts to ensure quality and functionality.

For data collection, both the experimental and control groups completed a pretest and attended the same General Biology 2 lecture. After the lecture, only the experimental group played *Phylum Expedition* in a computer laboratory setting. Both groups then completed a posttest three weeks later. In addition, the experimental group answered a survey to provide feedback on the game's effectiveness.

Results and Discussions

Table 1
Mean and Standard Deviation of Gain Scores of Both Control and Experimental Groups

Variable	Mean	Standard Deviation
Students Taught Using Traditional Way of Teaching	2.24	1.883
Students Taught with Integration of "*Phylum Expedition*"	3.67	1.575

Table 1 presents the differences between the pretest and posttest scores of both the control and experimental groups. The results of the gain scores indicate that the experimental group demonstrated better retention of the lesson content. The control group showed a higher standard deviation, suggesting that its data values were more dispersed from the mean and therefore less consistent compared to the experimental group, which exhibited a lower standard deviation (Rumsey, 2021; Webb, 2023).

Table 2
Test Statistic of Both Control and Experimental Groups

Computed T-Value	Critical Value	Decision
-3.247	1.6706	-3.247 < 1.6706∴ Reject H0

Table 2 shows the computed T-value and critical value needed to make a decision on whether or not to reject the null hypothesis. The computed T-value is -3.247, which is found in the rejection area with the critical value of 1.6706. Additionally, the T-value is less than the critical value, thus, the decision is to reject the null hypothesis of the control group being greater than or equal to the experimental group.

Table 3
The Aspects That the Students Are Satisfied With and Which Sparked Interest the Most

Questions in Survey	Choices	WM	Verbal Interpretation	Rank
Which part of *Phylum Expedition* are you the most satisfied with?	Gameplay	2.53	Agree	1
	Mechanics	2.24	Disagree	2
	Visuals	2.00	Disagree	3
Which part of *Phylum Expedition* are you the least satisfied with?	Gameplay	2.03	Disagree	2
	Mechanics	2.00	Disagree	3
	Controls	2.53	Agree	1
Which part of *Phylum*	Lore	2.29	Disagree	1

Expedition sparked your attention the most, which made you interested in continuing playing?	Gameplay	2.18	Disagree	2
	Educational Benefit	2.15	Disagree	3

Table 3 is a compilation of results from the survey wherein the students were tasked to rank certain aspects of the game according to the following: most satisfied, least satisfied, and sparked attention the most. Students rated the gameplay and lore the highest, these parts helped hold their attention and made the experience more engaging. On the contrary, the controls of the game received the lowest rating. Some students found it hard to maneuver around, this may have caused slight frustration during gameplay and shows that even if a game is educational, the way it is played still affects the overall learning experience.

Table 4
The Students' Feedbacks on the Integration of "Phylum Expedition" in Learning General Biology 2 Concepts

Questions in Survey	WM	Verbal Interpretation	Rank
has been engaging	3.50	Strongly Agree	1
has been informative	3.44	Strongly Agree	3
has explained a complex concept in a simple and visually appealing manner, making it easier for me to understand and retain the information	3.38	Strongly Agree	4
has not been able to explain the concept clearly, thus making Organismal Biology even more complicated	2.12	Disagree	6
has the right difficulty for the learners in the 11th grade	3.03	Agree	5
is recommended to other learners to help them understand Organismal Biology better	3.47	Strongly Agree	2
TOTAL	3.16	Agree	

Table 4 showcases the results upon collecting and statistically treating the responses from the experimental group from a survey. The experimental group stated that they strongly agree that *Phylum Expedition* has been engaging, has been informative, and has simplified explanations of the complex concepts within Organismal Biology. The students disagreed that the said game has not been able to explain Organismal Biology concepts clearly and agreed that the game is the right difficulty for the 11th grade learners. The results have garnered positive feedback from the students; further proof is that they also strongly agree to recommend Phylum FEU Diliman Basic Education Department (SHS) Expedition to other learners when learning Organismal Biology.

Table 5
The Level of Effect Size Based on Cohen's d

Cohen's d	Interpretation
-0.827	Large Effect

Table 5 exhibits the level of effect size based on Cohen's d. The findings suggest that the educational video game has been significantly effective on students' performance, as indicated by the Cohen's d value of -0.827. These results reflect the effectiveness of *Phylum Expedition* as an educational video game for enhancing student engagement retention.

Conclusion

This study aimed to assess which aspects of *Phylum Expedition* need improvements and how it enhances the retention of Grade 11 STEM-HA students, specifically in General Biology 2 concepts. Gain scores were calculated by subtracting pretest scores from posttest scores. The control group had a mean gain score of 2.24, while the experimental group had a mean gain score of 3.67. Since higher gain scores indicate greater improvement, the results suggest that *Phylum Expedition* is an effective learning aid for Grade 11 STEM Health Allied students.

The researchers also used a survey to further assess aspects of *Phylum Expedition*. Students were most satisfied with the gameplay and least satisfied with the controls. Since most students were unsatisfied with the controls, this aspect will be reworked, as *Phylum Expedition* is still a prototype. The lore or storytelling in the gameplay sparked the most attention, making students interested in continuing the game. The researchers plan to enhance the lore further, giving it a more concrete flow, adding new characters, and improving character writing. These improvements aim to maintain student interest so they can fully benefit from the educational content by finishing the game.

The students are very satisfied with the gameplay and mechanics of *Phylum Expedition*. According to the survey, both were informative, engaging, and not too difficult, indicating that the students enjoyed the gameplay. Gameplay ranked second in sparking student interest, with one comment stating, "I enjoyed the gameplay." However, the participants were neutral about the overall aesthetics. The researchers considered this and improved the visuals to make them more eye-catching, resulting in a higher-quality output. The students agreed that the difficulty level is suitable for 11th graders. Further improvements will be made to tailor the gameplay, mechanics, visuals, lore, controls, and difficulty to better fit 11th-grade learners.

The findings suggest that the educational video game significantly improved students' performance, shown by a Cohen's d value of -0.827. Respondents strongly agree that *Phylum Expedition* is informative and engaging. The game explained complex Organismal Biology concepts in a simple, visually appealing way, making it easier for students to understand and retain information. Survey results showed 38.2% disagreed that the game failed to explain concepts clearly, and 32.4% strongly disagreed that it made Organismal Biology more complicated. These results reflect positive learner feedback toward the game.

Recommendations

The researchers recommend that students use educational video games that are aligned with their lessons, designed to be enjoyable, and effective in helping retain concepts without relying on text-heavy materials. They suggest exploring games like *Phylum Expedition* and even creating their own educational games to develop game design skills and consider game development as a potential career path. Parents are encouraged to research and select suitable educational games for their children and promote their use as a fun and effective way to learn.

Teachers are advised to integrate educational games into their teaching strategies to make learning more engaging and improve retention, and they may also experiment with creating their own games using beginner-friendly tools such as GDevelop. School administrators should provide resources like computer labs and stable internet connections to support game-based learning and organize professional development programs, including workshops and seminars, to help teachers become more innovative and technologically adept.

The Department of Education is urged to review the study for its potential to enhance the curriculum, involve educational experts, and consider incorporating game development into technology-related subjects. They should also evaluate the effectiveness of educational games alongside traditional methods to determine their impact on academic performance. Game developers are encouraged to create educational games that serve as supplementary learning tools, carefully design game elements for better retention, and incorporate personalization and immersive 3D experiences to boost engagement.

Finally, for future researchers, they should use larger sample sizes and different educational levels to test whether results change or remain consistent. They should also study the integration of educational video games into other complex subjects to expand their applicability. Also, the researchers recommend a pre-planned schedule and strict time considerations for students to use educational video games longer. In addition, the researchers recommend maximizing the time spent on game design aspects, as they need to be aligned for an immersive and enjoyable experience while playing and learning. Future researchers should also check the equipment and resources used in the study, like computers and internet connection, to avoid technical issues and limitations. They should also use spaced repetition, such as playing the game every other day, to find out whether it will improve the retention of the students.

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recognize that the extent of their contributions meets accepted standards for scholarly authorship and therefore deem it appropriate to acknowledge their involvement in accordance with ethical research and publication practices.

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Building Better Arguments: A CER-Based Approach to Persuasive Essays

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Abstract

Developing writing skills among learners is crucial to becoming an effective communicator who can demonstrate depth of knowledge and exhibit critical thinking abilities. Determining ways to improve such skills is essential because effective written communication is one of the foundational skills for academic success and active participation in a functionally literate society. Employing the quasi-experimental design method, the study utilized the Claim-Evidence-Reasoning (CER) Framework to enhance the writing skills of the 10th Graders in Cebu City, Philippines. Two different discussion materials assessing the same writing competencies were used to determine the learners' competencies before and after the intervention scheme. Similarly, the data gathered was analyzed using the paired sample t-test to determine the effectiveness of the CER framework. The findings revealed a significant improvement in the learners' writing competencies in terms of formulating arguments, creating and determining main points, finding supporting evidence for the points made, and creating conclusions using the CER Framework as the intervention. Moreover, the process of the CER framework has helped the learners organize their thoughts and ideas, resulting in coherent and logical persuasive essays. Finally, the CER framework writing process can easily be integrated into daily writing activities across learning areas for deeper understanding, enhanced communication skills, and the development of critical thinking among learners across levels.

Keywords: CER framework, persuasive writing, writing pedagogy

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Introduction

Today's educational setting characterized by rapid change, instant information access, and constant digital interaction creates unique challenges and opportunities that profoundly impact students learning. The demand for learners to equip themselves with advanced language skills is more crucial than ever for them to succeed in their academics and the life beyond the classrooms. Among these skills are the ability to discern credible and reliable information and sources, and articulate ideas with clarity and conviction.

Currently, the basic education landscape in the Philippines is faced with a significant learning gap where a considerable number of the Filipino learners can only perform basic reading tasks but struggle with deeper understanding and critical thinking necessary for effective daily life and further education. The World Bank report in 2022 showed that 91% of the Filipino children aged 10 cannot read and understand a simple text. Similarly, the 2024 Functional Literacy, Education and Mass Media Survey (FLEMMS) revealed that while a large majority of Filipinos can read and write, around three out of ten (approximately 18.9 million Filipinos aged 10–64) struggle with comprehension. If students are to thrive in a fast-paced and high-technology world, they need to equip themselves with the essential critical skills that empower them to navigate the complexities of the academic life and real-life challenges beyond the learning institution.

Critical Thinking, Argumentation and Structured-Based Approaches

Critical thinking, as the foundational pillar of effective learning, and learning are mutually reinforcing processes. Critical thinking enhances the learning process; learning provides the raw material for critical thought. True learning involves active engagement with information, and that active engagement is what critical thinking facilitates. While critical thinking development poses a challenge to many, literature shows that structured frameworks can help students enhance their cognitive processing abilities (Osborne & Patterson, 2011) that ultimately enable learners to reason logically, think critically, and communicate effectively. Enhancing learners' argumentation skills is another strategy that enhances one's critical thinking abilities (Shanahan, 2004). Argumentation enables learners to evaluate conflicting claims and assess the level of evidence and investigation presented. It helps learners clarify their thoughts and articulate ideas clearly and accurately (The University of Maryland Global Campus, 2022).

Studies have shown that structured learning activities that require students to formulate claim supported with logical and reasonable evidence improve students' comprehension and critical thinking skills and bolster their ability to identify, analyze and evaluate evidence (Dela Cruz, 2014; Llaneta, 2015). Moreover, various frameworks of structured argumentation help foster active engagement and promote better understanding of complex texts among students (Sampson & Clark, 2009). Given the appropriate scaffolding, these structured learning activities help students identify claims and supporting details/evidence that enabled them to develop logical reasoning in writing (Castañeda, 2017). Similarly, structured approach to argumentation improves students' written expression and reasoning skills (Flores & Reyes, 2020; Villanueva & Espina, 2019), makes their writing compositions clearer and more coherent, and allow students to construct context and information-based simple arguments (Villanueva & Espina, 2019; Zohar & Nemet, 2002).

Finally, other organized/structure frameworks strengthen understanding because they require students to reason and defend their comprehension (Duke & Pearson, 2002). The reader-response journal writing, for example, that require students to make a claim, cite evidence, and give explanations does not only scaffold students' comprehension but also reinforces the students' reasoning skills in argumentation (Santos & Relampagos, 2021). Hence, this paper advances that the students' persuasive essay writing skills can be enhanced using the structured process of Claim-Evidence-Reasoning (CER) framework.

The CER framework is widely used in enhancing students' argumentation skills and promoting critical thinking and scientific literacy. It teaches students to construct an argument that is consisting of a claim, an evidence and a reason. The claim refers to the statement being made, the evidence is the data or information used to support the claim, and the reason connects the evidence and the claim (McNeill & Krajcik, 2012). Studies showed that structured argumentative practices helped students develop higher-order thinking skills, comprehension, and self-regulation across disciplines.

Methodology

The study utilized the quasi-experimental research method, particularly, the one-group pretest-posttest design to determine the efficacy of the Claim-Evidence-Reasoning Framework in improving the persuasive essay writing skills of the Grade 10 students in Cebu City, Philippines. The participants were purposively selected as they performed the lowest in reading and writing in the standardized assessment conducted at the beginning of the school year.

Following the CER Framework Flow (Rapatan, 2024), students wrote persuasive essays based on a given literary text by formulating arguments (Claim), supported with pieces of evidence (Evidence), and building their argument by logical reasoning (Reason) until a conclusion is reached. The outputs were rated by the three inter-raters using an analytic rubric reflecting the persuasive essay writing target competencies of the study. The data gathered was analyzed using the paired sample t-tests and the Wilcoxon Signed Rank Test.

Results and Discussion

Table 1
Pre-test Performance of the Respondents in Writing Persuasive Essays

Competency	Frequency (%)				Mean (SD)
	ES	MS	AS	NYMS	
Formulating of arguments	0 (0.0)	5 (16.7)	22 (73.3)	3 (10.0)	2.21 (0.32)
Creating and determining of main points	0 (0.0)	4 (13.3)	12 (40.0)	14 (46.7)	1.90 (0.46)
Finding supporting evidence for the points made	0 (0.0)	0 (0.0)	15 (50.0)	15 (50.0)	1.77 (0.48)
Creating conclusion	0 (0.0)	2 (6.7)	7 (23.2)	21 (70.0)	1.48 (0.49)

Legend: 3.25 to 4.00 - Exceeding standard (ES)
2.50 to 3.24 - Meeting standard (MS)
1.75 to 2.49 - Approaching standard (AS)
1.00 to 1.74 - Not yet meeting standard (NYMS)

The pretest results show that the participants competency level in persuasive essay writing is *approaching standard* in formulating arguments (2.21), creating and determining the main points (1.90), and finding supporting evidence for the points made (1.77) while *not yet meeting standard* in creating conclusion (1.48). The same results show that the participants may have reached the *approaching standard* for creating and determining the main points and finding supporting evidence for the points, however, their scores were close to the lower limit which implies the need for an intervention to enhance the students' performance in the aforementioned competencies.

Similar findings have been revealed by several studies that the skill of organizing ideas in writing is a challenge even to college sophomores (Batalla & Vera, 2019). Urbano et.al. (2021) similarly revealed that high school students lacked mastery in the conventions and process of writing academic texts such as research reports, position paper, project proposal, and correspondence letters. Finally, Pablo and Lasaten (2018) forwarded that students acknowledged the importance of logical organization of ideas and details in writing; however, students disregarded it in their writing as they found the skill difficult to achieve.

The present findings underscore the need to explore innovative methods and approaches to writing instruction to assist students translate their knowledge of writing conventions and processes into practical applications. It also implies the need to explore writing activities that provide students scaffolded practice and explicit strategies for idea organization.

Table 2
Post-test Performance of the Respondents in Writing Persuasive Essays

Competency	**Frequency (%)**				**Mean (SD)**
	ES	**MS**	**AS**	**NYMS**	
Formulating of arguments	2 (6.7)	18 (60.0)	10 (33.3)	0 (0.0)	2.71 (0.37)
Creating and determining of main points	13 (43.3)	11 (36.7)	6 (20.0)	0 (0.0)	2.96 (0.42)
Finding supporting evidence for the points made	18 (60.0)	8 (26.7)	4 (13.3)	0 (0.0)	3.18 (0.51)
Creating conclusion	10 (33.3)	14 (46.7)	6 (20.0)	0 (0.0)	2.96 (0.50)

Legend: 3.25 to 4.00 - Exceeding standard (ES)
2.50 to 3.24 - Meeting standard (MS)
1.75 to 2.49 - Approaching standard (AS)
1.00 to 1.74 - Not yet meeting standard (NYMS)

The posttest results show that the participants competency level in persuasive essay writing is *meeting standard* in formulating arguments (2.71), creating and determining the main points (2.96), finding supporting evidence for the points made (3.18) and creating conclusion (2.96). This shows that the CER framework has helped the participants improve their persuasive essay writing skills which led to the increase in scores in the target competencies.

Performance in the posttest has visibly increased across all competencies. This is emphasized by three most noticeable indications: increased mean scores, occurrence of participants' *meeting standard* (ES) and having no participants who are *approaching standard* (AS) and *not yet meeting standards* (NYMS).

The Claim-Evidence-Reasoning (CER) Framework was proven effective addressing the difficulties faced by students in writing persuasive essays. It provided students with a structured approach to organizing their ideas stating clearly their position or claim, actively supporting it with relevant textual evidence, and logically discussing how the pieces of evidence they found supported the claim/argument. Students engaged in scaffolded writing activities during the intervention period, which allowed them to slowly focus on every component of the persuasive essay and complete their writing tasks following the structure of the CER Framework. Activity sheets that detailed the CER argumentation structure guided the students in writing their individual persuasive essays complete with claim/argument, supporting evidence and reason until a conclusion is drawn. One important aspect of the CER framework is the teacher's feedback on their written output. The structured process of the intervention framework serves as the basis for the teacher's feedback and reinforces the learning process. Having internalized the CER process in writing, students were able to produce persuasive essays that espouses their stance or position on the topic of discussion.

Table 3

*Test of Significance of the Difference Between the Pre-test and Pos-test Performance of the Respondents *for the 3 competencies*

Competency*	**Mean Scores (SD)**		**Mean Difference (SD)**	t-**statistic**	p-**value**
	Pretest	**Posttest**			
Formulating of arguments	2.21	2.71	0.50 (0.478)	5.734	< 0.001
Creating and determining of main points	1.90	2.96	1.06 (0.626)	9.240	< 0.001
Finding supporting evidence for the points made	1.77	3.18	1.41 (0.544)	-	-
Creating conclusion	1.48	2.96	1.48 (0.742)	10.912	< 0.001

Note. Comparison for this competency is found in the next table presentation.

The results of the paired samples t-test show that the participants' performance increased by an average of 0.50 points for formulating of arguments, by 1.06 points for creating and determining of main points, 1.41 points for finding supporting evidence for the points made and by 1.48 points for creating conclusions. Hence, the greatest improvement can be observed with creating conclusions while the least improvement is with formulating of arguments.

The t-statistic calculated only for the three competencies found without evidence of non-normality. In all such competencies, a p-value smaller than 0.001 was found compelling to reject the null hypothesis and conclude that there is a significant difference in the pretest and posttest scores of the participants in terms of formulating arguments, creating and determining of main points, and creating conclusions.

For the competency of finding supporting evidence for the points made, Wilcoxon Signed-Rank test was used. Results are as follows:

Table 3.1
Test of Significance of the Difference Between the Pre-test and Pos-test Performance of the Respondents in Terms of Finding Supporting Evidence for the Points Made

	n	Mean rank	Sum of Ranks
Negative Ranks	0	0.00	0.00
Positive Ranks	30	15.50	465.00
Ties	0		

Z	-4.794
p-value (Asymptotic Significance)	< 0.001

Zero (0) negative ranks and 30 positive ranks were found. This means that all 30 participants increased their scores in this competency from pretest to posttest. A z-statistic of -4.794 was calculated which corresponds to a p-value less than 0.001. Thus, the null hypothesis is also rejected and it is concluded that there is a statistically significant difference in the pretest and posttest scores in these competencies.

Conclusion

The use of the CER Framework in writing is proven to enhance writing skills and is highly recommended to be utilized in developing the persuasive essay writing skills of the students. CER Framework-based writing activity sheet can be tailored to fit the writing activity in class in all levels. Improved writing skills is one of the core 21st century skills that each learner have to develop as part of a clearer and more impactful communication thereby aiding them with critical thinking, creativity, communication and collaboration.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research

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Adoption of Bayesian Knowledge Tracing With Fuzzy Logic in the Development of Personalized Math Learning System for Grade 3 and 4

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Abstract

This study developed and evaluated Math Tagumpay, a Bayesian-Fuzzy hybrid Intelligent Tutoring System (ITS) designed for Grade 3–4 mathematics in the Philippines. Addressing the urgent need for innovative instructional approaches in a context where 82% of Grade 4 students fall below minimum proficiency levels, the research employed a descriptive-quantitative methodology with 10 mathematics teachers from Bataan Province. The system implements a novel sequential architecture where Bayesian Knowledge Tracing (BKT) parameters serve as inputs to a Fuzzy Logic engine to manage the partial understanding states characteristic of young learners. The evaluation revealed exceptional technical performance, with System Accuracy achieving a weighted mean of 4.30 (94% positive response) and System Timeliness reaching 4.20 (94% positive response). The Technology Acceptance Model (TAM) assessment yielded an overall weighted mean of 4.04 (85% positive response), with Attitude Toward Using (4.26) and Perceived Usefulness (4.22) emerging as primary drivers of acceptance. While Perceived Ease of Use (3.68) was identified as an area for improvement, the findings validate that sophisticated AI can be successfully adapted for resource-constrained environments through cultural sensitivity and curriculum alignment. The study concludes that the hybrid AI approach effectively addresses the complexity of elementary mathematics learning and provides a scalable framework for enhancing instructional effectiveness in the Philippine educational system.

Keywords: intelligent tutoring system, Bayesian Knowledge Tracing, fuzzy logic, Philippines, elementary mathematics

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Introduction

Traditional pedagogical approaches often struggle to meet the complex needs of modern young learners, despite decades of foundational research. This challenge is particularly acute in early childhood education, which critically shapes a child's holistic development into adulthood. While Intelligent Tutoring Systems (ITS) offer transformative potential for personalized learning and 21st-century skill development, any technological intervention must remain developmentally appropriate. Successful digital tools must balance structured activity with exploration, harnessing children's natural learning processes rather than constraining them.

In the Philippines, the need for innovation is urgent, as 82% of Grade 4 students fall below minimum mathematics proficiency levels. This creates a central tension: adapting sophisticated AI to serve resource-constrained environments while maintaining technical excellence and cultural appropriateness. While Bayesian Knowledge Tracing (BKT) has revolutionized student modeling through probabilistic tracking, it has historically focused on older learners. Conversely, fuzzy logic excels at managing partial knowledge and ambiguous responses typical of younger students. This research explores a hybrid Bayesian-Fuzzy approach, combining temporal knowledge modeling with nuanced uncertainty handling to address the unique complexities of early elementary mathematics learning.

Literature Review

The Global Educational Technology Revolution and Local Realities The transformation of education through technology represents a significant paradigm shift, with Intelligent Tutoring Systems (ITS) fundamentally reshaping how students interact with mathematical content (VanLehn, 2011). This global trend creates unprecedented opportunities for personalized learning that adapts to individual needs through continuous assessment and feedback mechanisms (Chrysafiadi & Virvou, 2013). However, these technological advances must be examined within specific sociocultural contexts. From a cultural psychology perspective, educational processes are deeply influenced by learners' cultural environments, values, and instructional traditions (Bernardo, 2017). In the Philippine context, this challenge is particularly urgent. The Department of Education (2023) reported that 82% of Grade 4 students in the Philippines fall below minimum mathematics proficiency levels. Despite these challenges, comprehensive analysis of eLearning provides evidence that technology can help students develop necessary 21st-century skills (UNESCO, 2012). Key benefits identified include increased student engagement, enhanced teacher attitudes toward innovation, and improved family interaction to support curriculum continuity (UNESCO, 2012).

Early Childhood Education and Digital Learning Evolution Integrating digital technologies into early childhood education is a considered evolution rather than a departure from developmental principles. Research has shown that appropriately designed ICT tools can enhance young learners' cognitive development when teachers remain actively involved in mediating content and learning experiences (Drigas & Kokkilia, 2015). Interactive multimedia learning environments have been shown to support foundational mathematics skills and conceptual understanding among young learners (Nusir et al., 2012). Moreover, intelligent learning systems that promote interaction and immediate feedback contribute to sustained learner engagement and meaningful knowledge construction (Liu et al., 2016). This reinforces the principle that technology should enhance, not replace, human relationships in early learning environments.

Developmental Appropriateness and Interactive Learning Effective curricula must reflect current child development research, maintaining a balance between play and structured, teacher-initiated exploration (Corpuz et al., 2016). This approach aligns with Jean Piaget's philosophy that play meets the physical, intellectual, language, emotional, and social needs (PILES) of children (Corpuz et al., 2016). Practical implementations have shown that properly designed multimedia e-storybooks enrich comprehension (Smeets & Bus, 2012), while digital storytelling serves as an expressive tool that fosters positive interactions between students and teachers (Papadimitriou et al., 2013).

Methodology

This study employs a descriptive-quantitative research design to systematically develop and evaluate the Math Tagumpay Bayesian-Fuzzy hybrid Intelligent Tutoring System (ITS). The research utilizes a descriptive method to accurately capture the characteristics and performance of the system in the context of Grade 3–4 mathematics in the Philippines. This alignment follows Dulock's (1993) definition of descriptive research, which emphasizes the systematic description of facts related to a specific area of interest.

Because the study relies on numerical representations to measure system performance—specifically accuracy and timeliness—as well as user acceptance through Likert scale assessments, a quantitative approach is most suitable. This methodology follows Babbie's (2010) framework, which prioritizes objective measurements and the statistical analysis of data gathered through structured questionnaires and polls.

The descriptive approach is particularly appropriate for this research as it focuses on the development and validation of a specialized AI tool for the Philippine educational landscape. This ensures that the ITS is evaluated within real-world educational settings, addressing the unique learning needs of Filipino students in Grades 3–4 across diverse environments. By utilizing this methodology, the study achieves a comprehensive assessment of technical performance metrics and technology acceptance indicators while maintaining scientific objectivity.

The framework for this research is further grounded in the Input-Process-Output (IPO) Model. The Inputs include the pedagogical challenges faced by teachers and the technical requirements for accuracy and timeliness. The Process involves the 2-week implementation and survey administration, and the Output is the validated Math Tagumpay system. This structured methodology provides the rigor necessary for academic publication, ensuring that both the technical architecture and the human-centered acceptance are thoroughly documented.

Software Development

The development of the Math Tagumpay system utilized the Design-Based Research (DBR) methodology, which integrates the iterative cycles of analysis, design, and evaluation to create effective educational interventions. This systematic process ensures that the resulting Intelligent Tutoring System (ITS) is not only technologically advanced but also pedagogically sound and grounded in the practical needs of the classroom.

Development Phases and Technical Implementation

The research procedure was divided into three distinct stages: analysis, design and implementation, and evaluation. During the analysis stage, interviews with Grade 3–4 mathematics teachers identified critical gaps in traditional instruction, such as the difficulty of providing personalized interventions and tracking individual progress. The design and implementation stage followed, where modern web technologies like React.js and Supabase were employed to create a cross-platform, secure environment capable of executing complex AI-driven decisions in real-time.

Sequential Processing and Algorithmic Innovation

The system architecture implements a novel sequential processing approach where the outputs of the Bayesian Knowledge Tracing (BKT) model serve as the primary inputs for the Fuzzy Logic engine. Unlike traditional parallel hybrid systems, this design enables sophisticated two-stage uncertainty refinement, allowing fuzzy logic to operate on refined knowledge parameters rather than raw student responses. This approach addresses the variable response patterns characteristic of third- and fourth-grade learners while maintaining real-time responsiveness.

To develop the Math Tagumpay system, the researchers used modern web technologies optimized for Philippine educational contexts. The frontend utilizes React.js for cross-platform compatibility and responsive design, deployed via Netlify's global CDN for fast loading in resource-constrained environments. The backend combines Netlify Functions with Supabase PostgreSQL for scalable serverless architecture.

Figure 1
System Architecture of Math Tagumpay Bayesian-Fuzzy Hybrid ITS for Grade 3–4 Mathematics

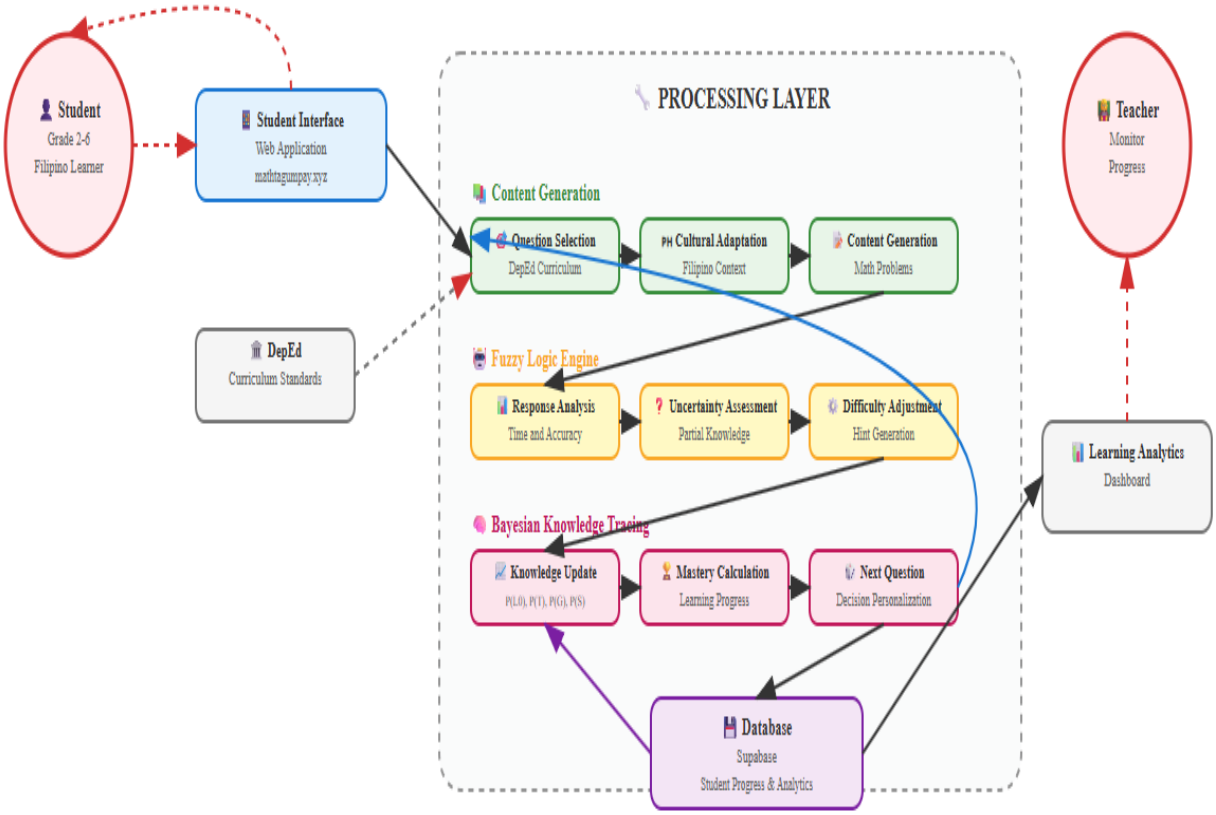


Table 1
Development Tools and Technology Stack

Category	Technology Used	Purpose
Frontend Framework	React.js	Component-based UI for age-appropriate interfaces
Backend/Database	Supabase (PostgreSQL)	Scalable data storage and real-time synchronization
Deployment	Netlify CDN	Fast loading in resource-constrained environments
AI Algorithm 1	Bayesian Knowledge Tracing	Probabilistic modeling of student learning progression
AI Algorithm 2	Fuzzy Logic Engine	Nuanced handling of uncertain student responses

Results and Discussion

The comprehensive evaluation of the Math Tagumpay Bayesian-Fuzzy hybrid Intelligent Tutoring System provides empirical evidence of its technical performance and user acceptance. The results are based on a 2-week implementation period involving 10 Grade 3–4 mathematics teachers in Bataan Province.

System Performance Assessment

The system achieved exceptional ratings across both accuracy and timeliness dimensions, with an overall performance weighted mean of 4.25 and a 94% positive response rate. The architecture successfully managed the partial understanding states characteristic of young learners while maintaining real-time responsiveness. This performance confirms that the hybrid approach is superior to single-algorithm methods for early elementary learners.

Technology Acceptance Evaluation

User acceptance was measured using the Technology Acceptance Model (TAM) framework, achieving an overall weighted mean of 4.04. Teachers demonstrated high perceived usefulness (4.22) and positive attitudes (4.26) toward the system. While behavioral intention (3.98) remained strong, the perceived ease of use (3.68) was identified as a critical area for ongoing interface optimization and teacher training.

The data analysis reveals that teachers highly value the system's ability to enhance instructional effectiveness:

The teaching effectiveness enhancement achieved the highest rating (M = 4.50) with 100% positive response rate, supporting meta-analytical findings that educational AI systems require high perceived usefulness scores for sustainable adoption. This result validates that perceived usefulness serves as the primary determinant of technology acceptance in the Philippine educational context.

Conclusion

The developed Bayesian-Fuzzy hybrid ITS demonstrates exceptional technical performance for third- and fourth-grade mathematics education in the Philippines. By successfully

integrating Bayesian Knowledge Tracing with fuzzy logic, the system achieves high accuracy in content generation and knowledge assessment while maintaining the real-time responsiveness essential for young learners. This hybrid AI approach effectively addresses the complexity of early elementary learning by managing the partial understanding states and variable response patterns characteristic of students in this age group.

The system achieved strong user acceptance among Filipino mathematics teachers, who demonstrated high perceived usefulness and positive attitudes toward its implementation. These findings validate the viability of advanced AI technologies in resource-constrained educational environments, showing that sophisticated systems can enhance instruction when properly designed and culturally adapted. However, moderate ease-of-use scores indicate that user experience optimization remains a primary area for enhancement, requiring improved interface design and comprehensive training programs to maximize long-term effectiveness.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Gemini, an AI-assisted technology, was used in the refinement and formatting of this manuscript. The usage was limited to condensing existing content for clarity, applying specific markdown formatting styles, and ensuring consistent citation structures. The author further declares that the core ideas, research design, methodology, findings, and analysis are originally derived from the systematic conduct of the research.

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Mapping the Sustainable Development Goals in AI-Assisted Senior High School Workbooks: A Content Analysis From the Philippines

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Abstract

This study examines the integration of the Sustainable Development Goals (SDGs) in AI-assisted senior high school workbooks developed by teachers at the Cebu Institute of Technology - University (CIT-U), Philippines. Through quantitative and qualitative content analysis of 321 learning exercises, the research identifies patterns, gaps, and opportunities in SDG representation, with a focus on the role of artificial intelligence (AI) in shaping sustainability-related content. Key findings reveal that SDG 4 (Quality Education) dominates the workbooks (35.83%), followed by SDG 3 (Good Health and Well-being) (15.89%), while critical goals such as SDG 1 (No Poverty), SDG 13 (Climate Action), and SDG 14 (Life Below Water) are severely underrepresented (< 2%). AI-assisted content demonstrates strengths in generating interdisciplinary scenarios but lacks depth in localizing themes and addressing environmental and socioeconomic challenges. The study recommends strategic rebalancing of SDG coverage, leveraging AI for contextualized and action-oriented activities, and enhancing teacher training for cross-curricular SDG integration. These insights contribute to the broader discourse on technology-enhanced Education for Sustainable Development (ESD), offering practical pathways to align workbook design with global sustainability agendas in the Philippine educational context.

Keywords: SDG, workbooks, AI-assisted

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Introduction

The Sustainable Development Goals (SDGs), adopted by the United Nations in 2015, provide a universal framework for addressing pressing global challenges, from poverty and inequality to climate change and environmental degradation. Education is widely recognized as a key driver in achieving the Sustainable Development Goals by equipping learners with sustainability-related competencies (United Nations, 2015; Yuan & Yu, 2022). It plays a pivotal role in advancing these goals, as it equips learners with the knowledge, skills, and values needed to contribute to a sustainable future**.** Despite global policy support, several studies report limited awareness and uneven integration of the SDGs in secondary and higher education curricula (Frank & Ricci, 2023; Rubio et al., 2022).

Recent literature underscores the transformative potential of Education for Sustainable Development (ESD) materials, which foster critical thinking, problem-solving, and ethical reasoning among students (Jurnal Pembelajaran dan Sains, 2024; Zwolińska et al., 2022). Research suggests that Education for Sustainable Development (ESD) materials enhance students' critical thinking, ethical reasoning, and problem-solving skills when sustainability concepts are intentionally embedded (Zwolińska et al., 2022). Workbooks, as key pedagogical tools, offer a strategic avenue for embedding SDGs into curricula, yet their effectiveness depends on deliberate and systematic integration. Research highlights that while some institutions, particularly in Europe and Latin America, have made strides in SDG-aligned education, others face challenges such as uneven coverage, limited teacher training, and a lack of localized examples (Frank & Ricci, 2023; Rubio et al., 2022). For instance, technical fields often treat sustainability as peripheral, despite student demand for interdisciplinary connections (Zwolińska et al., 2022).

Active learning strategies such as problem-based learning have been shown to deepen students' engagement with the SDGs by linking classroom activities to real-world sustainability challenges (Van Nguyen et al., 2024). However, studies also reveal disparities in the depth of SDG treatment, with some goals receiving minimal attention (Van Nguyen et al., 2024). This observation is supported by Rubio et.al. (2022) that certain SDGs are underrepresented in learning materials, highlighting the need for systematic review and alignment of instructional resources. Mapping SDGs in educational materials can help educators identify these gaps and refine their approaches to ensure comprehensive and meaningful integration.

In response to this educational imperative, this study investigates the presence and integration of the Sustainable Development Goals in the learning exercises of senior high school workbooks—created with the assistance of artificial intelligence (AI)—by teachers of the Cebu Institute of Technology - University. By examining 321 learning exercises across these AI-assisted instructional materials, the study aims to identify which SDGs are represented, which are missing or underrepresented, and what enhancements may be proposed to align workbook content with sustainability education goals more effectively. Through this analysis, the study contributes to the growing body of research advocating for meaningful and systematic integration of the SDGs in teaching and learning practices, especially within the secondary education level in the Philippine context.

SDG Integration in Teaching Materials

The integration of the Sustainable Development Goals (SDGs) into educational materials, such as workbooks, is a crucial step toward fostering sustainability awareness and competencies among students. This review synthesizes findings from recent studies on the effectiveness of SDG integration in educational contexts, highlighting the roles of teaching materials, curriculum design, and student outcomes.

The incorporation of the Sustainable Development Goals (SDGs) into curricula and educational workbooks plays a critical role in fostering student awareness and aligning educational systems with global sustainability objectives. Embedding SDG concepts within learning materials enables learners to understand the interconnectedness of global challenges and the importance of contributing to solutions through informed actions. As education serves as a fundamental platform for shaping future leaders, integrating the SDGs—especially within early and higher education—ensures that learners are not only knowledgeable but also responsible and responsive to sustainability demands.

Education for Sustainable Development (ESD) teaching materials have been recognized for their significant impact on enhancing students' critical thinking, sustainability awareness, and problem-solving abilities. Research by Zwolińska et al. (2022) confirms that integrating ESD resources in educational settings—whether in primary, secondary, or tertiary levels—enables learners to develop cognitive skills that are essential for understanding and addressing sustainability issues. These materials encourage learners to analyze environmental, social, and economic problems from multiple perspectives, fostering deeper reflection and critical evaluation of real-life situations.

The effectiveness and practicality of ESD materials are further supported by both experts and students who have used them. According to Zwolińska et al. (2022), these resources are considered not only theoretically sound but also pedagogically useful, as they bridge abstract scientific concepts with tangible, real-world applications. By linking classroom knowledge to local and global challenges, ESD materials empower students to make informed decisions and take responsible action toward sustainable futures. This alignment with experiential and problem-based learning makes ESD a valuable component of modern curricula.

Moreover, systematic reviews underscore the heightened relevance of ESD materials in disaster-prone regions. In these contexts, ESD contributes significantly to raising community resilience and awareness, making education a key driver in mitigating the effects of environmental and humanitarian crises. As noted in a review published in the Jurnal Pembelajaran dan Sains (2024), the integration of sustainability themes in education not only promotes knowledge acquisition but also enhances the overall quality of education by embedding values of preparedness, adaptability, and responsible citizenship. Therefore, the adoption of ESD resources holds promise for both educational improvement and sustainable development, particularly in vulnerable areas.

Higher Education Institutions (HEIs), in particular, bear the responsibility of embedding SDGs not only within syllabi but also into their broader institutional processes. This includes revising learning objectives, aligning assessment methods, and ensuring that sustainability values are embedded in administrative and pedagogical decisions (Pacheco et al., 2022). When SDGs are systematically integrated, they foster the development of competencies such as critical thinking, ethical reasoning, and collaborative problem-solving—skills vital for

addressing complex sustainability issues. Thus, HEIs must go beyond superficial mentions of SDGs and embed them meaningfully into all aspects of academic life.

One effective approach to SDG integration is the use of Problem-Based Learning (PBL), which immerses students in real-world challenges that require interdisciplinary and practical solutions. Van Nguyen et al. (2024) examined seven PBL programs and found that all 17 SDGs were touched upon; however, the depth of treatment varied, with some goals receiving limited focus. This underscores the importance of ensuring balanced and comprehensive SDG integration, especially through hands-on applications such as case studies and community-based projects. Likewise, mapping SDGs within textbooks, workbooks, and classroom exercises provides educators with a strategic tool for identifying gaps and enhancing the relevance and effectiveness of sustainability education (Van Nguyen et al., 2024). Through deliberate and thoughtful integration of SDGs, educators can significantly enhance students' readiness to contribute to a more sustainable future.

Despite the growing global emphasis on the Sustainable Development Goals (SDGs), student knowledge and awareness of these goals remain surprisingly limited. A study conducted among Chinese high school students revealed low levels of SDG awareness across the population, with no significant differences observed between male and female respondents (Yuan & Yu, 2021). This suggests that gender is not a key factor in SDG awareness and that the gap is likely due to the absence of a strong emphasis on sustainability education in both formal curricula and informal learning environments. The study reinforces the urgent need to enhance SDG education more comprehensively and inclusively across educational systems.

In response to this challenge, active learning methodologies have shown promise in enhancing student understanding and engagement with the SDGs. Design challenges, in particular, have proven effective in expanding students' perspectives by encouraging them to address real-world problems through creative and ethical solutions. According to research (Skene & Malcolm, 2019), these approaches often promote nature-based solutions, environmental consciousness, and social responsibility, all of which align with the core values of the SDGs. Active learning also fosters a participatory and student-centered environment, which increases motivation and deepens conceptual understanding compared to traditional lecture-based instruction.

Experiential learning, including capstone projects and community-based initiatives, has likewise emerged as a powerful strategy for advancing SDG awareness. These experiences allow students to apply theoretical knowledge in practical contexts, addressing sustainability issues through interdisciplinary collaboration and reflective practice. O'Toole and Fang (2023) emphasize that such approaches not only raise awareness about global challenges but also develop crucial employability skills such as problem-solving, communication, teamwork, and leadership. By engaging directly with SDG-related themes, students cultivate a global perspective and a sense of personal agency in contributing to sustainable development.

Moreover, the long-term impact of SDG-integrated education extends beyond the classroom and into the workforce. Graduates from academic programs that align their curricula with the SDGs—especially those focused on economic development—tend to experience more favorable employment outcomes. According to Alimehmeti et al. (2024), these graduates report higher salaries, greater job satisfaction, and stronger alignment between their skills and

job requirements. This suggests that employers value sustainability-related competencies and that SDG education can serve as a strategic tool for improving graduates' career prospects.

Despite the increasing recognition of the importance of integrating the Sustainable Development Goals (SDGs) into education, several persistent barriers hinder their full and effective incorporation into curricula. One of the most pressing issues is the uneven coverage of SDG-related topics across different educational levels and disciplines. Frank and Ricci (2023) highlight that many institutions still struggle with limited teacher training on sustainability concepts, resulting in educators feeling ill-equipped to teach these complex, interdisciplinary topics. Furthermore, in many emerging contexts, there is a noticeable lack of practical applications and localized examples that would make SDGs more relevant and relatable to students. This gap reduces the effectiveness of SDG integration and prevents learners from fully grasping the real-world implications of sustainable development.

Additionally, the need for curricular innovation is particularly evident in technical and science-oriented fields, where sustainability education is often viewed as peripheral rather than integral. Students at AGH University, for example, have expressed a strong demand for more interdisciplinary content that connects their technical expertise with the broader economic, social, and environmental goals outlined in the SDGs (Zwolińska et al., 2022). This feedback points to a critical opportunity for curriculum designers to revisit and revise academic programs to better reflect the interconnected nature of today's global challenges. By embedding sustainability themes across disciplines—not just in the humanities or social sciences—educational institutions can produce well-rounded graduates capable of contributing to holistic and sustainable solutions in various sectors.

In summary, while there is a clear need to address the limited awareness of SDGs among students, especially at the secondary level, the literature points to a variety of effective pedagogical strategies. Active and experiential learning methods—including design challenges and capstone projects—have demonstrated strong potential to enhance SDG knowledge and skill development. Furthermore, evidence suggests that embedding SDGs into the curriculum yields not only educational benefits but also professional advantages for students post-graduation. These findings underscore the importance of integrating sustainability education holistically across all levels of learning to ensure that future generations are equipped to tackle complex global issues.

In conclusion, the integration of Sustainable Development Goals (SDGs) into education—particularly through workbooks, curricula, and experiential learning—plays a vital role in promoting sustainability awareness, skill development, and real-world application among students. The literature consistently emphasizes that teaching materials grounded in Education for Sustainable Development (ESD) not only enhance cognitive skills such as critical thinking and problem-solving but also foster ethical responsibility and global citizenship (Jurnal Pembelajaran dan Sains, 2024; Zwolińska et al., 2022). However, uneven implementation across institutions and disciplines highlights the need for more inclusive, systematic, and interdisciplinary approaches, particularly in technical and emerging educational contexts (Frank & Ricci, 2023; Zwolińska et al., 2022). Addressing these gaps requires teacher training, curriculum innovation, and the meaningful use of local examples to make sustainability education more impactful.

Moreover, active and experiential learning strategies such as problem-based learning, design challenges, and capstone projects have proven effective in embedding SDGs into academic

programs (O'Toole & Fang, 2023; Skene & Malcolm, 2019; Van Nguyen et al., 2024). These methods not only raise SDG awareness but also prepare students for the workforce by developing competencies aligned with employer needs, particularly in the context of economy-related SDGs (Alimehmeti et al., 2024). With increasing student demand for relevant, interdisciplinary sustainability content, especially in technical fields, educational institutions are called to revisit and revise their curricular frameworks. A comprehensive and intentional approach to SDG integration will not only improve learning outcomes but also contribute meaningfully to shaping a more sustainable, equitable future.

Methodology

This study utilized a quantitative and qualitative content analysis approach to investigate the integration of the Sustainable Development Goals (SDGs) within AI-assisted senior high school workbooks crafted by teachers at the Cebu Institute of Technology - University (CIT-U). The methodology unfolded across four structured phases. In the data collection phase, researchers analyzed 321 learning exercises from these workbooks across diverse senior high school subjects, selected for their interdisciplinary relevance and incorporation of AI tools like generative AI for content creation or adaptive features. Inclusion criteria targeted exercises that explicitly or implicitly addressed any of the 17 SDGs through elements such as problem-solving tasks, case studies, or reflective questions. The coding and SDG mapping phase involved applying a framework to each exercise, identifying explicit SDG mentions (e.g., direct references to SDGs or terms like "sustainability" and "climate action") alongside implicit alignments (e.g., poverty reduction in math problems or gender equality in literature). Exercises were then classified against the UN's official SDG indicators, allowing multiple linkages where relevant. Data analysis encompassed frequency analysis to quantify SDG distribution and highlight overrepresented or underrepresented goals, thematic analysis to uncover integration patterns (such as standalone activities versus cross-curricular links), and an evaluation of AI's influence on content depth or creativity (e.g., AI-generated case studies compared to teacher-designed scenarios). Finally, validation ensured inter-coder reliability through independent coding by two researchers on a subset of exercises, with discrepancies resolved via discussion. Limitations included the focus solely on teacher-created, AI-assisted workbooks, which may not generalize to all materials, and the observational nature of AI's role without experimental contrasts to non-AI content.

Findings

The analysis of 321 learning exercises from AI-assisted senior high school workbooks revealed notable disparities in the representation of the 17 Sustainable Development Goals (SDGs). The results indicate that SDG 4, which promotes Quality Education, dominated the content, appearing in 35.83% (115) of the total activities. While this aligns with the academic setting, it also suggests a potential overemphasis on education-related themes at the expense of other critical dimensions of sustainability. SDG 3, which addresses Good Health and Well-being, was the second most represented, present in 15.89% (51) of the exercises, reflecting its close connection to student wellness and science-related curricula.

Figure 1
Percentage of Distribution per SDG



Moderately represented SDGs included SDG 9 (Industry, Innovation, and Infrastructure), which appeared in 9.97% (32) of the activities, and SDG 5 (Gender Equality), with 5.92% (19) of the exercises. These indicate some level of interdisciplinary integration. Other goals, such as SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), and SDG 16 (Peace, Justice, and Strong Institutions), were present in about 5% of the workbook content. This suggests occasional but unsystematic inclusion of themes outside the education and health domains.

However, the study also highlighted a concerning underrepresentation of several critical SDGs. SDGs such as No Poverty (SDG 1), Zero Hunger (SDG 2), Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Responsible Consumption and Production (SDG 12), Climate Action (SDG 13), Life Below Water (SDG 14), and Life on Land (SDG 15) each appeared in fewer than 2% of the exercises. These gaps reflect missed opportunities to address pressing global and local challenges, particularly those related to environmental and socioeconomic issues. SDG 17 (Partnerships for the Goals), which emphasizes global collaboration and community action, was represented in only 2.8% (9) of the activities, indicating a limited focus on cooperative and solution-oriented approaches.

Discussion

The role of artificial intelligence in the creation of these workbooks shows both potential and limitations. While AI-assisted materials demonstrated thematic breadth, the depth of integration varied. For example, many SDG 4-related exercises were generic and descriptive, such as essay writing on the value of education, without moving toward more action-oriented or experiential tasks. On the other hand, AI-generated content showed promise in introducing innovative case studies for goals like SDG 9, yet these were sometimes lacking in localized context. For instance, activities related to SDG 2 did not sufficiently reflect real agricultural challenges in the Philippine setting.

Key gaps were particularly evident in the environmental and socioeconomic dimensions of sustainability. Environmental goals such as SDGs 6, 7, and 12 through 15 were severely underrepresented despite the Philippines' vulnerability to climate-related disasters and its rich biodiversity. Similarly, SDGs related to poverty, hunger, and inequality (SDGs 1, 2, and 10) were minimally addressed, pointing to a disconnect between classroom content and real-

world community concerns. Furthermore, interdisciplinary integration remained weak. Subjects such as Mathematics and Filipino rarely incorporated relevant SDG themes—for example, math problems involving data on poverty (SDG 1) or literature exploring gender narratives (SDG 5) were notably absent.

While the exercises met institutional requirements, many lacked meaningful connections to real-world contexts. There was limited emphasis on encouraging learners to engage with current economic, social, and environmental challenges at the national and global levels. Moreover, important societal issues such as corruption in the Philippines were not sufficiently integrated into the workbook activities, indicating opportunities for further enhancement.

Conclusion

To enhance SDG integration in AI-assisted workbooks, several strategies are recommended. First, a more balanced representation of the SDGs is necessary. Curriculum designers should prioritize the inclusion of underrepresented goals by developing targeted learning activities. These could include math problems involving clean energy data for SDG 7, science experiments focused on local biodiversity to support SDG 15, and classroom debates simulating climate policy discussions for SDG 13. Second, AI can be more effectively leveraged to contextualize content. Tools should be used to generate examples that reflect Philippine realities—such as challenges in rice farming for SDG 2—and to produce multimedia learning materials like infographics on SDG 14 (Life Below Water).

Third, capacity-building among teachers is essential. Conducting training workshops would help educators recognize SDG connections in their respective subjects and encourage interdisciplinary collaboration. For instance, English and Social Studies teachers could jointly develop persuasive writing activities linked to SDG 16 (Peace and Justice). Finally, implementing regular assessment and feedback mechanisms is crucial. Periodic audits using SDG mapping tools and pilot testing student responses to SDG-related tasks can guide improvements and ensure content relevance and impact.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

ChatGPT (OpenAI) and Grammarly were used solely for language editing and proofreading. It was not involved in data generation, analysis, or interpretation. Full responsibility for the content rests with the author.

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EduTechPJ©: A Digital Competency Module for Physical Education Teachers

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Abstract

The aim of this study was to investigate the development and evaluation of the EduTechPJ© Module in enhancing the digital competencies of secondary school Physical Education teachers. The EduTechPJ© Module was developed by implementing the ASSURE Instructional Model and adapting the European Framework of Digital Competence of Educators (DigCompEdu), applying elements of Connectivism and Boyatzis' Theories as well as collaborative learning strategies. The design and development research process is divided into three critical phases: i) needs analysis; ii) design and development; and iii) implementation and evaluation. The needs analysis phase measures the need for a module with the integration of artificial intelligence elements. A combination of information from multi-methods analysis through semi-structured interviews and surveys was used for the needs analysis. The design and development phase using the Fuzzy Delphi Method is leveraged to gain expert consensus on various aspects, including module content design and pedagogical strategies. The final phase encompasses implementation and evaluation, aimed at appraising the usability and effectiveness of the module within actual training contexts. Key findings revealed that the module, grounded in Connectivism, Boyatzis' Theory, and the DigCompEdu Framework, significantly improved teachers' digital competencies, as demonstrated by pre- and post-test results. Additionally, high usability scores and positive feedback affirmed the module's practicality, accessibility, and relevance. The training also led to sustained behavioral changes, with teachers applying their newly acquired skills in schools, enhancing lesson delivery and job performance. Hence, these findings provide an effective and practical training solution to support technology integration in teaching practices.

Keywords: digital training, integration of digital technology, teachers' digital competency, teachers' professional development, physical education

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Introduction

In the era of rapid technological advancements, digital competence emerged as a critical focus in education (Vásquez-Pajuelo et al., 2024). This shift is driven by the growing digitization of society and the economy as well as preparing the learners for the demands of the 21st century. The integration of technology has transformed educational practices, making learning more accessible, interactive, and flexible. Consequently, both teachers and students possess strong digital skills and attitudes to navigate the digital education landscape effectively (Brändle et al., 2023; Napitupulu et al., 2024). However, the findings by Kementerian Pendidikan Malaysia (2023) indicated that the level of digital competence measured in 2021, with the involvement of 297,018 teachers, there were 6,442 (2.2%) teachers at the advanced level, 118,651 (39.9%) at the intermediate level and as many as 171,925 (57.9%) teachers at the basic level. From this finding, it showed that 57.9% of teachers are aware of and try to use digital technologies but do not use them according to the situation that suits the various available digital technologies. Moreover, findings from the research by Wallace et al. (2023) specifically showed that Physical Education Teachers (PETs) have significantly low digital competency levels with limited comprehension of teachers' digital competency within the context of physical education. Moreover, Hamalainen et al. (2021) highlighted the importance of equipping both teachers and students with digital capabilities to ensure meaningful participation in digital education. These challenges underline the need for innovative solutions to enhance the digital competency of teachers, particularly in designing and delivering technology-enhanced learning experiences.

Accordingly, teachers must possess a thorough awareness of the numerous digital tools and technologies accessible to integrate them into their teaching methods in an efficient manner. This is supported by findings by Mohamed Faizul et al. (2021) that showed the need for teachers to have a willingness to teach, a strong effort and a good presentation in teaching. This involves being familiar with educational software, communication tools, multimedia resources, and internet platforms in order to design engaging and interactive classes that meet the various learning needs of their students by becoming familiar with these resources. Digital technologies also facilitate the learning of new methods, acquisition of skills, and accessing information on specific topics. This widens the scope for enhancing and innovating pedagogical methods (Xing & Qi, 2022).

Therefore, in order to foster competency development in digital technology among PETs, this EduTechPJ© Module is developed especially for PETs to integrate digital technology into their lessons as well as in the organization. Moreover, a module is an efficient way to combine techniques, teaching methods, multimedia technologies, and instructor expertise and the introduction of new instructional technologies can be made possible (Saliyeva & Ibragimova, 2021). The EduTechPJ© module is critical in addressing the digital competency gap among PETs, which is essential for transforming education to meet 21st-century demands. By providing training, the module enhances their proficiency in using digital tools and innovative teaching strategies. In addition, the module builds confidence and competence in utilizing digital tools, positioning them as leaders in technological integration within their schools. Furthermore, The EduTechPJ© module is designed using a combination of Connectivism Theory, Boyatzis Competency Theory, Digital Competence for Educators (DigCompEdu) and collaborative learning strategies to ensure its effectiveness in enhancing the digital competency of PETs. By integrating these elements of theories and framework, the EduTechPJ© module not only equips PETs with practical digital skills but also cultivates the mindset and adaptability required to thrive in a digital education field. This holistic approach

ensures that the module effectively addresses the needs of PETs, driving meaningful improvements in teaching practices and contributing to the broader transformation of the education system especially towards 21st century education.

Theoretical Foundation and Instructional Strategy

The EduTechPJ© Module is built upon solid theoretical and pedagogical foundations, incorporating Connectivism Theory, Boyatzis' Competency Theory, and Collaborative Learning Strategies to enhance teachers' digital competencies. In response to the evolving nature of education in the digital age, Connectivism Theory evolved in the early years of the 21st century. The theory was introduced by Siemens and Downes (2022) to provide a framework for understanding learning in an era characterized by rapid knowledge expansion and technological advancement. In addition, the theory of connectivism presents a new point of view on education in the digital era. It offers a framework for comprehending how people might navigate and make sense of the enormous amount of information available by acknowledging the power of networks and relationships as well as mental connections between pieces of information during interaction with various information sources (Yousef et al., 2020). Moreover, principles of Connectivism theory include learning as a network process, the importance of connections and networks, distribution cognition and knowledge as dynamic entity. Furthermore, this theory could assist teachers in crafting a learning environment whereby learners augment their existing understanding of sustainability through online interactions and accessing digital knowledge resources (Boyraz & Ocak, 2021; Dziubaniuk et al., 2023). Indirectly, it encourages students to connect and work together more easily by using digital resources such as social media and online forums.

On the other hand, Boyatzis competency theory is a concept that concentrates on how people build their emotional intelligence and competencies (Boyatzis, 2008). From the findings, it also realizes the significance of abilities in influencing both individual and organisational success. Competencies, which are a collection of knowledge, skills, abilities, and behaviours that support successful performance in a particular position or domain, are the fundamental building blocks of Boyatzis competency theory. There are various types of competencies, including technical competencies that are unique to a given job or profession and behavioural competencies that are connected to emotional intelligence and interpersonal skills (Albino, 2018). Furthermore, competency theory also acknowledges that emotional, social and cognitive intelligence are constructs that may be improved with time and can be developed (Boyatzis, 2008). It suggests a developmental paradigm that indicates many stages of competency growth, from beginner to master. The approach places a strong emphasis on the value of continuous learning, evaluation, and introspection for the development of competencies.

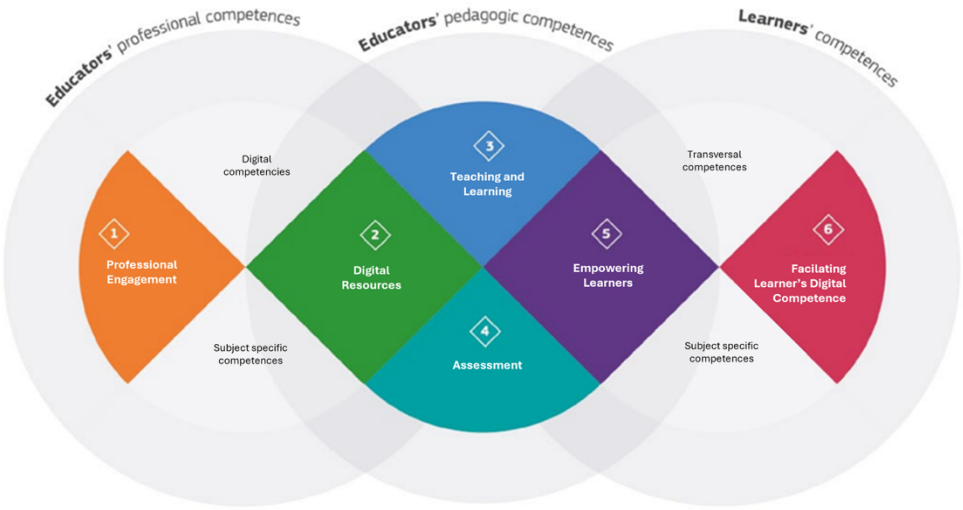
In addition, collaborative learning strategy focus on the interaction and cooperation in the learning process. Components of a collaboration learning strategy include group projects and assignments, peer-to-peer learning and collaboration problem-solving (Khlaif & Salha, 2021). Group projects and assignments are a typical part of collaborative learning strategies. In this study, PETs collaborate in groups to do assignments, find solutions to issues, or produce presentations. This encourages teamwork, shared accountability, and idea sharing. While peer-to-peer learning can be done through discussions and the exchange of information and experiences. This fosters a feeling of belonging and motivates participation in the educational process (Malan, 2021). Furthermore, collaborative learning enhances creativity, critical thinking, and the ability to evaluate and appreciate diverse perspectives. Therefore, the

integration of the European Framework of Digital Competence of Educators (DigCompEdu) framework with Connectivism Theory, Boyatzis' Competency Theory, and collaborative learning strategies enables PETs to utilize digital technology more effectively as a platform for instructional delivery and for accessing a wide range of learning materials. In line with this integration, the DigCompEdu framework serves as the primary reference for defining and structuring the digital competencies embedded in the EduTechPJ© Module.

Adaptation of the European Framework of Digital Competence of Educators (DigCompEdu)

The DigCompEdu Framework was introduced by Redecker (Redecker, 2017) and highlights the holistic area of competency digital as an educator. Moreover, DigCompEdu is a comprehensive framework that shares features with other frameworks that are used internationally (Cabero-Almenara et al., 2020) and is generic for use in different educational situations (Caena & Redecker, 2019). Furthermore, the DigCompEdu framework targets teachers across all educational levels, spanning from early childhood to higher and adult education, encompassing general and vocational training, special needs education, and informal learning contexts (Redecker, 2017). DigCompEdu framework consists of three competency areas defined primarily as educators' professional competences, educators' pedagogic competences and learners' competences. The EduTechPJ© Module was created by adapting these digital competencies. These three competence areas consist of six different areas, which are professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competences. From these areas, it is clear that digital competency is not solely utilized in teaching and learning but it also serves as an integral aspect of an educators' overall role.

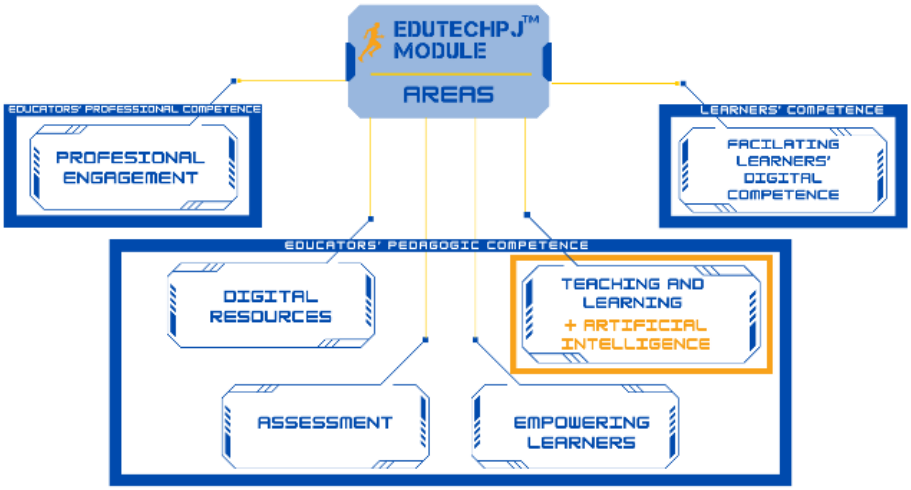
Figure 1
DigCompEdu Framework (Redecker, 2017)



However, the rapid advancement of artificial intelligence (AI) (Ejjami, 2024) has made it imperative to incorporate AI components into the DigCompEdu framework in order to ensure that teachers remain abreast of the latest technological advancements. In this study, AI is embedded to provide teachers with knowledge and tools to leverage AI-driven solutions, such as intelligent systems, adaptive learning platforms, and data analytics, to enhance their professional practices. This comprehensive integration ensures that PETs can adopt innovative approaches across various aspects of their roles, aligning with the demands of

modern digital education and fostering improved learning outcomes. Figure 2 introduced the adaptation of the DigCompEdu Framework by (Redecker, 2017).

Figure 2
Adaptation of DigCompEdu Framework in EduTechPJ© Module



Therefore, the aim of this study was to investigate the development and evaluation of the EduTechPJ© Module in enhancing the digital competencies of secondary school PETs.

Methodology

Design

In this study, the design and development research by Richey and Klein (2007) served as the approach for this module development. In addition, design and development research can give informative data to the researchers to make decisions and ensure the module has a high impact especially to the PETs. Furthermore, this design is a systematic and highly structured research process in order to establish an empirical foundation for constructing modules for specific subject matter (Richey & Klein, 2007). The design and development research has 3 important phases including i) needs analysis; ii) design and development; and iii) implementation and evaluation (Saedah et al., 2013). Thus research methodology is grounded with ASSURE Instructional Model to provide a comprehensive instructional design that supports the development of digital competency modules for PETs. This model is particularly suitable for designing and developing this module because it is more effective in designing instructional materials that focus on technology integration and learning media (Hasna Nirfya & Ema, 2022). Moreover, since the development of the EduTechPJ© Module highlights technology usage from an overall teaching profession perspective, the ASSURE model can be categorized as practical and implementable in teaching and learning activities (Stavinibelia et al., 2023; Yudi Hari & Supriyo, 2021). The model follows a systematic approach which begins with analyses learners, state objectives, select media, methods and materials, utilize media, methods and materials, require learner performance and evaluation. All these elements are arranged systematically according to the design and development research approach. For this research, Type 1 which refers to specific product or program design, project development and evaluation of design and development research is selected because it produces a product which is the EduTechPJ© Module that is specific for PETs. Table 1 showed the summary of ASSURE Model according to the design and development research phase.

Table 1
The Summary of ASSURE Model According to the Design and Development Research Phase

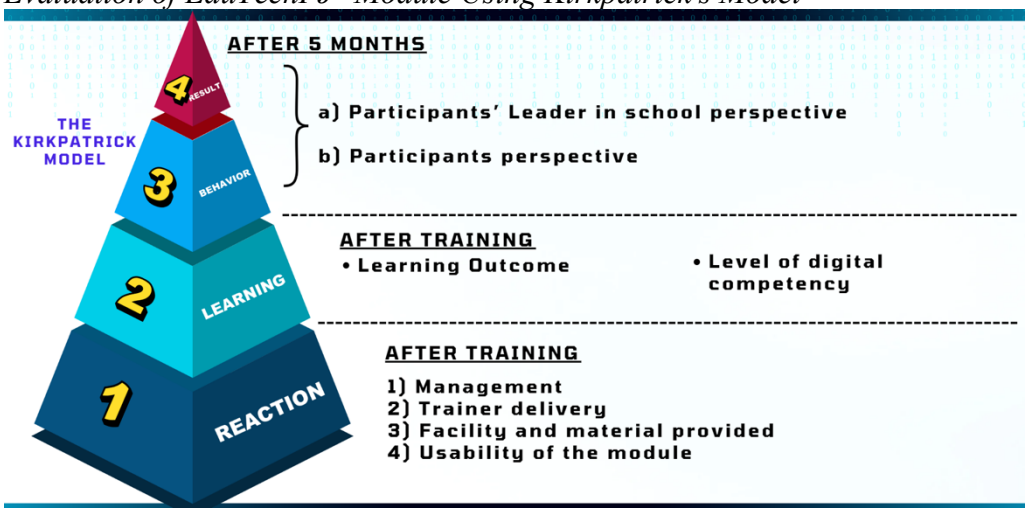
Phase of Design and Development Research	ASSURE Instructional Model	Explanation
Phase 1 (Need Analysis)	A: Analyze Learners	Analysis of teacher competency levels and the agreement by experts to develop a digital competency module for PETs
Phase 2 (Design and Development)	S: State learning objectives	State the objective of module development
	S: Select media, methods and materials	Choose media, mehods and teaching materials that suit the PE Secondary School curriculum content
	U: Utilize media, methods and materials	Develop and utilize media by integrating technology in teaching and learning materials
Phase 3 (Implementation and Evaluation)	R: Require learner responses	The implementation of EduTechPJ© module
	E: Evaluation	Evaluate the usability and effectiveness of the EduTechPJ© module base on Kirkpatrick Evaluation Model

In the first phase of design and development research which need analysis, the researchers also conducted a survey to identify the digital competency level of PETs. Instead of the survey, the researchers also explored all the problems and challenges arose among PETs in integrating the digital technology in their. The importance of developing the digital competency module for PETs was highlighted by this data collection. The interviews session was held by focus group discussion to get as many and depth information including thoughts, opinions and experiences of the PETs. In the second phase of design and development research, design and develop a module is required. In the design phase, the elements of state objectives (S), select media, methods and materials, (S) utilize media, methods and materials (U) in ASSURE instructional model elements were implemented. All these elements were firstly designed by the experts in specific area including, technology education, physical education and training module experts. The consensus of those experts was analyzed using Fuzzy Delphi Method (FDM). Additionally, in order to determine the extent to which the components and elements are appropriate in development phase, there needs to be a content validation process for the components and elements. This process to ensure it have been accurately defined.

The final phase of design and development research is implementation and evaluation. In this study, the EduTechPJ© module was evaluated using a structured training program implemented for secondary school PETs. In the other hand, the Kirkpatricks' Evaluation Model was used to guide the evaluation of the usability and effectiveness of EduTechPJ© Module through Digital Competency training. This well-established framework provides a structured approach to evaluating the impact of training interventions across four key levels: i) reaction; ii) learning; iii) behavior; and iii) results as shown in Figure 3.

Figure 3

Evaluation of EduTechPJ© Module Using Kirkpatrick's Model



For the purposes of this evaluation phase, the researchers examined all four levels of the model. At the reaction level, the researchers conducted a usability evaluation as well as the effectiveness of the training in terms of management, trainer delivery, facility, and material provided. The study then examined the learning level by employed a pretest-posttest design where PETs' digital competency levels were measured before and after the training intervention. In addition, a survey was carried out to evaluate the participants' learning outcomes immediately after the training session.

In addition, to evaluate changes in PET's behavior as outlined in the behavior level of Kirkpatrick's Evaluation Model and to assess the application of the acquired digital competencies, the researchers gathered perspectives from the participants themselves as well as from their principals five months after the training. This longitudinal assessment provided insights into the sustained impact of the EduTechPJ© module on teaching and learning practices. Following the behavior level of Kirkpatrick's Model, the evaluation progressed to the highest level, which is results. In this level, broader organizational and institutional outcomes are examined, including the overall digital integration within the participating schools. By integrating these complementary methodological approaches across all four levels of Kirkpatrick's Model, the researchers aimed to gain a comprehensive understanding of the EduTechPJ© module's impact on the targeted group of secondary school PETs.

Participants

For the need analysis phase, this study involved 169 secondary school PETs from nine schools in Selangor, Malaysia, selected through purposive sampling. A self-assessment digital competency survey was conducted to evaluate their proficiency levels, followed by semi-structured interviews with nine experts to gain qualitative insights into their experiences and challenges.

For the second phase of design and development research, there were two stages involved in the design and development phase, which are the module design stage and the module development stage. A total of 16 experts in the fields of educational technology, physical education, and module development were involved in this stage. All the selected experts had extensive experience and had served for more than five years in their respective fields. The criteria for expert selection are aligned with Berliner (2004), who stated that an individual is

considered proficient in a particular field if they have more than five years of experience in that field. In the module development stage, five experts in technology education, physical education, pedagogy, and training module experts were given the module to be validated in terms of the objective, adaptation of DigCompEdu Framework, applying Connectivism, Boyatzis Competency, and Collaborative Learning Strategies. At the third phase of design and development research, the researcher conducted digital competency training using the EduTechPJ© Module involving 38 secondary school PETs in Selangor selected through purposive sampling. Demographics such as gender, age, school location, teaching experience, and qualifications of the participants were determined in this study.

Instrument

In the need analysis phase, the researcher utilized a questionnaire adapted from the SelfieforTeachers questionnaire, and was based on the DigCompEdu Framework, which is widely used in the field of teachers' digital competencies. The researcher translated the instrument's questions and tailored them to suit the Malaysian context and conditions. The questionnaires of the interview session have been evaluated by experts with expertise in technology education and physical education. Nonetheless, the researchers themselves serve as the primary tool in this investigation. According to Gay et al. (2012), the researcher serves as the main tool for gathering data. Then, it followed by the second phase of the design and development research which is design and development. In this phase, the researcher employed the Fuzzy Delphi Method (FDM) to determine the elements to be included in the module. The instrument used in this FDM was a fuzzy questionnaire that had been reviewed by experts in educational technology and physical education. After obtaining validation, the questionnaire was distributed to 16 experts in the fields of educational technology, physical education, and module development.

Subsequently, after developing the module based on the analysis conducted during the design phase, a module validation instrument was employed to ensure that the features identified in the design phase were incorporated into the module. This instrument was adapted from the studies of (Muhammad Nidzam Yaakob, 2016; Syar Meeze, 2021). Since this was a validation instrument derived from the design phase, the same constructs were used, but with a different scale applied, considering the exclusion of items following the module design analysis.

Lastly, for the third phase of design and development research which is implementation and evaluation, **t**he questionnaire was distributed to the participated PETS to analyze the usability of the digital competency module. This questionnaire was adapted from the studies of (Muhammad Nidzam Yaakob, 2016; Syar Meeze, 2021). It was based on the usability questionnaire by (Lund, 2001), known as the USE questionnaire (Usefulness, Satisfaction, Ease of Use). However, in order to assess the EduTechPJ© module effectiveness, the researchers utilized the EduTechPJ© Effectiveness Questionnaire, which was designed based on Kirkpatrick's evaluation levels.

Analysis

In the first phase of design and development research, the findings of survey were analyzed using the Statistical Package for the Social Sciences (SPSS) version 29.0. The data were then processed using descriptive statistical procedures. This analysis followed by the thematic analysis whereby the data from the verbatim interviews were analysed using the NVIVO

software. According to Creswell and Creswell (2018), validity and reliability refer to how well and consistently a study's results reflect the topic under investigation. To increase the study's validity and reliability, the researcher employed expert verification techniques.

Next, FDM method was used to analysis the module's content by gathering input from 16 experts. Experts provided their feedback on a 7-point scale using a predefined linguistic scale, which was then converted into triangular fuzzy numbers for analysis. The defuzzification process was applied to compute the average agreement levels, and three key conditions were used to determine consensus: i) the threshold value (d) must be ≤ 0.2, ii) the percentage of expert agreement must be $\geq 75\%$, and iii) the fuzzy score (A) must be ≥ 0.5. These criteria ensured that the validation process was objective and met the required standards for agreement among experts. This process ensured that the module was aligned with expert opinions and achieved high reliability and validity.

From the analysis, the acceptance of each element was stated in order to know the most suitable elements that will be used in the module. After the design process by the experts had done, the development of the module took place. In order to develop the module, the Canva Pro Application was used. It is user friendly, easy to access and enables fast editing as well as updated. The elements from the design process were implemented in the module including the DigCompEdu Framework, theorical foundation of Connectivism and Boyatzis Competency Theories and Collaborative Learning Strategies. All theories, framework and learning strategies used were aligned with the module objectives.

Lastly, for the last phase of design and development research, the researcher used SPSS version 29.0 in order to employ descriptive analysis to examine the usability and effectiveness of the module. Additionally, to evaluate the effectiveness of the training using the EduTechPJ© Module, the researcher also conducted a paired t-test to identify statistical differences. In this study, the paired t-test analysis was performed using the same sample using pretest and posttest.

Results

A self-assessment digital competency survey involving 169 secondary school PETs revealed that most are at the C1 (leader) level of the DigCompEdu framework. This indicates that they effectively use digital technology to enhance pedagogical and professional practices, share innovative ideas, and inspire others. Despite their high competency, the findings highlight the need for a digital competency module to guide the integration of digital technology, specifically within PE teaching and management.

However, interviews with nine experts, each with 7 to 22 years of experience in PE, revealed that digital technology is rarely used and often depends on lesson content. While experts acknowledged the benefits of digital tools for teaching, learning, and administrative tasks, they also identified challenges such as limited infrastructure, financial constraints, lack of training, and negative perceptions of PE. These findings emphasize the importance of a tailored module addressing teachers' needs, including video creation, quiz applications, and digital tools to overcome these barriers.

The findings from phase two indicated that the researcher successfully developed a digital competency module for secondary school PETs based on Connectivism Theory, Boyatzis Competency Theory, DigCompEdu framework, and collaborative learning strategies based

on the consensus of 16 experts. The expert panels were selected based on clear criteria, including a minimum of five years of professional experience, academic qualifications, and expertise in educational technology, physical education, and training module. Therefore, the innovation introduced through this module represents a novelty and catalyzes future digital technology modules for PE teachers.

Lastly, the third phase represents the final stage in the development and evaluation of the digital competency module for secondary school PE teachers (EduTechPJ). The findings from this study demonstrate that the EduTechPJ Module meets the usability criteria and addresses the needs of these teachers. Furthermore, the empirical findings from the five-month implementation period showcased exceptionally high levels of agreement among participants and educational leadership. The data reveals a highly positive response, with PETs reporting substantial improvements in their digital competencies and technological integration capabilities. The evaluation findings further reveal that PETs were able to confidently apply new digital knowledge in their professional role, demonstrating a notable increase in their ability to perform tasks more effectively. Additionally, the module contributed to enhancing their work performance and boosting their motivation in carrying out their professional responsibilities. These outcomes indicate that the module not only equipped the participants with relevant digital skills but also positively impacted their confidence, efficiency, and overall workplace engagement. More critically, school principals and administrative leaders of the PETs in each school also provided overwhelmingly supportive feedback indicating the module's alignment with broader institutional technology integration goals.

Discussion

This study highlights the successful development and evaluation of the EduTechPJ© Module, designed to enhance the digital competencies of secondary school PETs. The module addresses critical gaps in digital technology integration due to limited resources, insufficient training, and technical challenges.

Through a structured design process guided by the ASSURE model and validated by experts, the module demonstrated high usability and effectiveness. Additionally, this research offers significant theoretical implications by extending the application of Connectivism Theory and Boyatzis Competency Theory within the context of teacher education. Specifically, it demonstrates how these theories can guide the development of a digital competency module tailored for PETs. Moreover, by integrating the DigCompEdu framework and collaborative learning strategies, the study also enriches the understanding of how digital competency development can be aligned with theoretical models to address the unique needs of educators in the 21st century. Similarly, Al Mamun et al. (2020) showed high practicality when using structured learning guidance effectively. In addition, validation thresholds are essential in ensuring the reliability and credibility of expert validation processes (Hsu & Sandford, 2007; Yusoff, 2019). In this study, the Fuzzy Delphi Method was utilized with clearly defined thresholds to establish consensus among the 16 experts. These thresholds included a threshold value (d) ≤ 0.2, expert agreement $\geq 75\%$, and a fuzzy score (A) ≥ 0.5. Such measures ensure that the findings reflect a high level of methodological rigor and reliability. The use of these validation thresholds provides confidence in the module’s design and alignment with educational objectives, further reinforcing the credibility of the research findings.

Training sessions with 38 PE teachers, evaluated using Kirkpatrick's Evaluation Model revealed significant improvements in digital competencies, high levels of usability and positive feedback on the module's effectiveness. The feedback from school leaders, including participants' leaders and principals, highlights the positive changes observed in the teachers' integration of digital tools into their teaching practices and overall professional responsibilities. These findings underscore the module's sustained impact not only on the participants' competencies but also on their ability to apply these skills in real-world teaching and learning in schools. This aligns with previous research, which emphasizes that sustained application of digital skills by teachers supported by administrators is crucial for enhancing digital teaching performance (Arnel Sumaya Alde, 2023).

These findings indicate that the EduTechPJ© Module is an effective and practical approach to enhancing the digital competencies of PETs. Its development and evaluation offer valuable insights for policymakers, educators, and researchers seeking to address the challenges of integrating technology into education. The module not only bridges existing gaps in digital competency but also catalyzes creative and innovative teaching practices, paving the way for future advancements in educational technology.

Conclusion

This study aimed to investigate the development and evaluation of the EduTechPJ© Module in enhancing the digital competencies of secondary school PETs. The research addresses the gap in digital integration among PE teachers by providing a structured, evidence-based training module tailored to their professional needs. Key findings revealed that the module, grounded in Connectivism Theory, Boyatzis' Competency Theory, and the DigCompEdu Framework, significantly improved teachers' digital competencies, as demonstrated by pre- and posttest results. Additionally, high usability scores and positive feedback affirmed the module's practicality, accessibility, and relevance. The training also led to sustained behavioral changes, with teachers applying their newly acquired skills in schools, enhancing lesson delivery and job performance.

These findings underscore the broader significance of the EduTechPJ© Module in bridging competency gaps and advancing technology integration in PE education. By providing teachers with essential digital skills, the module has the potential to transform teaching practices, improve student engagement, and inspire similar innovations in professional development. Future research could explore the long-term impact of the module on educational outcomes, its scalability across different educational contexts, and adaptations for other subject areas. Further studies could also examine the integration of emerging technologies to ensure the module remains relevant in an evolving digital environment in education.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design,

procedures, findings, analyses, and discussion are originally written and derived from appropriate and systematic conduct of the research.

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Cultivating Students' Interest and Agency in Learning Social Studies: Knowledge Building and Concrete-Pictorial-Abstract Model

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Abstract

The Singapore Social Studies curriculum often presents abstract and complex concepts, making it challenging to arouse and maintain students' interest, let alone exercise their sense of agency in learning. To address the challenges, this study integrates the Knowledge Building (KB) approach and the Concrete-Pictorial-Abstract (CPA) model, along with diverse technology-supported learning experiences at rotating stations. Findings indicate that this integrative approach enhanced students' interest in the subject, becoming active participants as they explored complex concepts through the various stations. Furthermore, the CPA model enhanced students' understanding by guiding them from concrete to a deeper comprehension of abstract concepts using concrete and visual representations. This comprehension, in turn, cultivated greater student agency, as students actively contributed their learning reflections and ideas, leading to a collaborative contribution of diverse ideas. Further consideration could build-on from this approach in helping students deepen their knowledge of the abstract concepts based on their initial contributions.

Keywords: social studies, knowledge building, e-pedagogy, Concrete-Pictorial-Abstract Model, station rotation model

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Introduction

The 2023 revised Singapore Social Studies syllabus advocates a shift away from traditional direct instruction toward more active and authentic approaches, enabling students to make sense of the content while enhancing their interest and understanding of abstract Social Studies concepts (MOE, 2023). This paradigm shift challenges educators to adopt innovative instructional strategies that engage learners more effectively. Research by Chiodo and Byford (2004) found that students often perceive Social Studies as "boring" when it is taught predominantly through expository instruction, which lacks active student involvement. This finding underscores the need for dynamic, participatory teaching methods that make learning meaningful and engaging for the students.

This paper examines the Knowledge Building (KB) approach integrated with innovative instructional models, particularly the Station Rotation and Concrete-Pictorial-Abstract (CPA) frameworks, further enhanced by the affordances of the Singapore Student Learning Space (SLS) platform. Together, these strategies aim to cultivate active and authentic learning environments that nurture students' interest and agency in learning Social Studies.

Review of the Models

Knowledge Building

Scardamalia and Bereiter (2014) articulated that KB involves students' creation and improvement of knowledge within a community through progressive discourse. This perspective aligns with the need for students to engage in collective inquiry and discourse, which is critical for building up students' comprehension of abstract Social Studies concepts. The KB approach positions students as active contributors to the knowledge creation process rather than recipients of information, fostering deeper engagement with the content. It guides teachers to facilitate an environment of collective inquiry with a set of unique KB principles.[1]

Station Rotation Model

The Station Rotation Model is a series of varied learning activities that students rotate through. Activities could include online (technology-enabled) offline, teacher-led stations. Key benefits of the model include encouraging communication and collaboration among students for purposeful building of community and collective knowledge and prioritising student agency (Tucker, 2021). By weaving Knowledge Building principles with the Station Rotation Model, educators can design a structured yet flexible learning environment that encourages student agency, collaborative knowledge building and deep understanding of what they are learning.

Concrete-Pictorial-Abstract Model

The Concrete-Pictorial-Abstract (CPA) Model is based on Bruner's (1966) conception of enactive, iconic, and symbolic modes of representation in learning concepts. Commonly used in Singapore's Mathematics curriculum, this approach extends beyond mathematical learning, positing any set of knowledge and concepts can be represented in three ways: 1. By actions or physical/external/experiential representations (Concrete), 2. Summary of images/visual representations (Pictorial), and 3. Language (words), symbolic representations (Abstract)

[1] Comprehensive list of Knowledge Building Principles: https://www.kbsingapore.org/12-principles-of-kb.

(Leong et al., 2015). The CPA model could enhance students' learning of Social Studies by scaffolding their understanding from concrete, tangible experiences to more complex abstract concepts. Guided by the KB principle of "Real Ideas, Authetic Problems", students would explore artefacts and real-world examples through various modes of representations. Finally, when students achieved better understanding, it would provide them the knowledge to become active contributors, paving the possibility for further synthesis of ideas and collective knowledge expansion.

Methods

Participants

The student participants (N = 33) were from one secondary 4 (grade 10) class in a government-aided school in Singapore. The class was an express class taking the Social Studies subject at the GCE O-level standards and were considered middle to low achievers. The lesson took place in April 2024 and the duration was one hour. It was the first time that the students were exposed to the KB approach and experienced such an integrative lesson, whereas other lessons were designed based on more direct instruction or structural discussions.

Lesson Design and Technology Environment

In designing the lesson, a few other key KB principles like "Epistemic Agency", "Idea Diversity" and "Democratising Knowledge", guided the design and selection of learning activities at each station while integrating CPA model. Guided by the principle of "Real Ideas, Authentic Problems", driving forces that contribute to Globalisation were determined as an authentic topic because it is relatable to students given Singapore's position as an open economy reliant on trade and movement of people. In the current syllabus, students are required to understand the meaning of Globalisation and the roles of the driving forces – 1. Technological advancements in transportation, 2. Technological advancements in digital technology and 3. Growth of Multinational Corporations.

The Student Learning Space (SLS) was selected as the main technology platform given students' familiarity with the platform. It is a core technology platform used by Singapore schools for teaching and learning (MOE, 2024). It allows students to engage with visual representations of abstract concepts either in the form of embedded images, videos or other interactive tools. A key component of the SLS platform – the Interactive Thinking Tool (ITT), allows students to contribute their initial ideas or theories for all to view – promoting idea diversity with the potential of synthesising various ideas, leading to a more comprehensive understanding of the abstract. Lastly, we considered the Key Applications of Technology (KAT)[2] in designing the learning activities to help enhance the integration of the models with KB. Table 1 provides a summary of integrating the KB approach with the station rotation and CPA model, considering the KATs to enhance the learning experiences:

[2] Key Applications of Technology (KAT) are design guidelines on how learning processes are enhanced with the affordances of technology. There are eight KATs (Learning Together, Metacognition, Motivation, Personalisation, Scaffolding, Assessment for Learning, Conceptual Change, Differentiation) teachers could consider when designing and enhancing their lesson activities with the use of technology (ETD, 2024).

Table 1
Summary of the Lesson Design

<table>
<tr><th colspan="3">Topic: What are the factors that contribute to Globalisation?</th></tr>
<tr><td colspan="3">Key Concepts: Globalisation, Technological advancements in transportation, Technological advancements in digital technology, Growth of Multinational Corporations (MNCs)</td></tr>
<tr><th>KB Principle</th><th colspan="2">How the principle guides the lesson design</th></tr>
<tr><td>"Epistemic Agency"</td><td colspan="2">Student agency is encouraged when they take ownership to decide on the station to participate, own pace of learning at each station and be active contributors of their reflections and ideas as they learn as a community. Teacher act as a facilitator of their learning, supporting students to overcome any difficulties encountered during the lesson.
KAT: Technology allows for Differentiation and Personalisation as SLS allows content to be integrated and embedded using different media forms. Students access the content based on their readiness level and interests, at their own pacing, enhancing student agency.</td></tr>
<tr><td>"Idea Diversity"

"Democratising Knowledge"</td><td colspan="2">Students' idea contributions on the Interactive Thinking Tool (ITT) are displayed for all to view. This provide a platform of idea diversity where all are empowered to create and recognise as valid contributors of the community.

KAT: The SLS Interactive Thinking Tool (ITT) facilitates the process of Learning Together, and allows students to contribute, improve and build-on one another's ideas (ETD, 2024).</td></tr>
<tr><td>"Real Ideas, Authentic Problems"</td><td colspan="2">At each learning station, based on CPA model, students are given concrete "real" and/or visual manipulatives to help them learn the abstract concepts. There are four learning stations (Station Rotation Model) for four key concepts with a fifth station assessing their learning of the topics. Summary of each station as below:
<table>
<tr><td>Station one: Globalisation</td><td>CPA: Use of the game Jenga as a concrete manipulative, providing students with a concrete understanding on how countries are interconnected and interdependent to each other like Jenga blocks.</td></tr>
<tr><td>Station two: Transportation</td><td>CPA: A visual manipulative of animation of movements of all container ships around the world to illustrate visual representation on how transportation has developed and facilitates increased movement of people and goods, driving Globalisation.
KAT: Using videos to bring about Conceptual Change.</td></tr>
<tr><td>Station three: Digital Technology</td><td>CPA: Use of the old Nokia Phone 3310 model as concrete manipulatives. Comparison of older technology of communication (Nokia Phones) with smart devices (iPad) to provide students a concrete understanding of advancement in technologies, bringing about more connections and communications across the world.</td></tr>
<tr><td>Station four: MNC</td><td>CPA: Using the EdTech tool called Blooket, students are tested on their general knowledge of popular MNCs through a gamified approach with each Booklet question showcasing visual representations of MNCs. The enactive activity can help students understand the growth of MNCs as they recognise these international corporations in their everyday lives.
KAT: Increase Motivation through a gamified platform that can bring about understanding the role of MNCs.</td></tr>
<tr><td>Station five: Consolidation</td><td>In words (abstract), students at this station will state the three driving forces that they've learned on the SLS Interactive Thinking Tool as part of the consolidation.</td></tr>
</table></td></tr>
</table>

Research Questions

To evaluate the effectiveness of the design in cultivating students' interest and agency in learning Social Studies, two research questions would guide this study:

1. How does the Knowledge Building approach with Station Rotation and the Concrete-Pictorial-Abstract (CPA) models, enhanced with Key Applications of Technology, cultivate students' interest towards learning Social Studies?
2. To what extent does the Knowledge Building approach with Station Rotation and the Concrete-Pictorial-Abstract (CPA) models, enhanced by the Key Applications of Technology, cultivate student agency in learning Social Studies?

To address the first question, a post-survey with two items ("Do you prefer today's lesson over your other lessons? Provide an explanation". "Would you want to see more of such station-led lessons in the future?") was administered to capture students' perceptions of their interest in

learning during the Social Studies lesson. The first question required students to provide a yes or no response and relevant explanations. The second question was on a Five Point Likert Scale, asking students to rate "strongly disagree" to "strongly agree". The data would provide insights into how the integrative approach cultivated interest among students towards Social Studies.

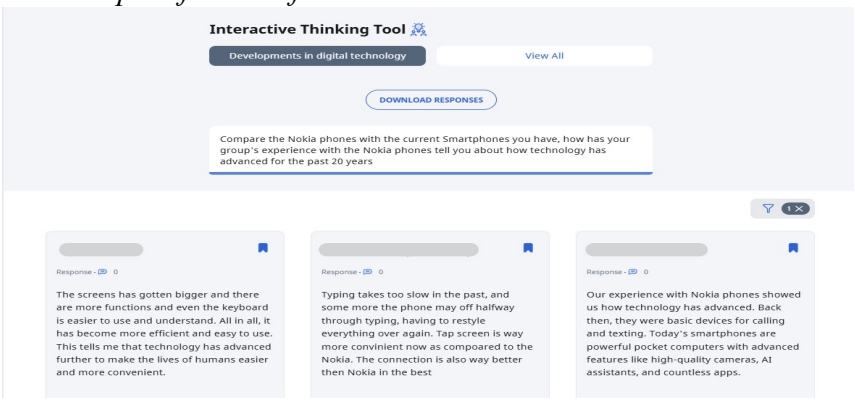
For the second question, calculating the number of contributions on the ITT at each stations would provide evidence of students taking active, autonomous roles in deciding and moving to each station, participate in the station's activity at their own pace and reflecting on their learning on ITT, all accomplished with limited to zero involvement from the teacher. Another measurable data point could examine the number of attempts made on embedded interactive activities on SLS, specifically at station 4 on the attempts made at the Blooket activity.

Findings

Out of the 33 student participants, 24 responded to the post-survey. For the first post-survey question regarding whether they preferred the lesson over other lessons, 100% responded "Yes". Analysis of their explanation to the question provided further insights, with 66.7% of the respondents indicating the lesson was "fun" or "less boring", suggesting such lessons provided students with a positive learning experience, nurturing a joy of learning. In addition, words like "hands on" and "interactive" were indicated by 9 respondents, while other explanations pertained to enjoying the Jenga or Nokia Phone concrete experiences. For the second post-survey question, 87.5% of the respondents indicated "strongly agree" (62.5%) or "agree" (25%) that they wanted to see more such lesson designs. In all, the findings suggested the benefits of integrative design in helping students to be interested and better engage with the Social Studies content they were learning.

In examining the second research question, the ITT facilitated the KAT of learning together, empowering students to be active contributors at each station. Figure 1 shows an example of the ITT for the third station:

Figure 1
An Example of an ITT for the Third Station



The number of contributions by students at each stations' ITT were as follows: station one – 32, station two – 28, station three – 26, station four - 27 and station five – 29. The data suggested active student agency where most took active, autonomous roles in deciding their choice and participation at each station, leading to contribution of their learning reflections and ideas at each station's ITT. Rather than being passive or reactive towards teacher's direct instructions, students were engaged in self-directed exploration. In addition, statistics from the Blooket

activity at the MNC station showed a total of 42 active participants, which is nine more than the number of actual participants. This further highlighted increased student agency where a few students made a deliberate choice to repeat the station (Blooket) activity, based on their interest in the content and/or activity.

Reflection and Conclusion

Reflecting on the findings, it was evident that this approach effectively cultivated student interest and agency in learning Social Studies. However, despite students' contributions leading to ideas diversity as observed at each stations' ITTs, the SLS tool was limited in function and was not suitable in encouraging students to further build-on, make improvements or engage in KB discourse. This observation aligned with Scardamalia and Bereiter's (2012) perspective that the progression of understanding of concepts in Social Studies, such as Globalisation, often does not emerge from sudden insights or "a-ha" moments typical in scientific inquiry. This meant that the process of build-on idea improvement in Social Studies does not come naturally for students. Instead, these ideas evolved through gradual increases in perceived complexity. Hence, this underscored the importance of intentional scaffolding in the KB process, particularly for abstract Social Studies concepts that require deeper engagement over time. To enhance the advancement of conceptual understanding, educators may consider implementing additional KB scaffolds, such as idea improvement prompts, reflective questioning, and iterative dialogue tools that encourage students to re-examine and refine their ideas continuously. By reinforcing these supports, future iterations of this approach may better facilitate students' ability to develop a nuanced understanding of complex Social Studies concepts, ultimately contributing to a more robust, enduring comprehension and student-driven learning of the concepts.

Furthermore, educators could consider designing a second lesson and build-on from this lesson, intentionally guided by the other KB principles of "Improvable Ideas", "Rise Above" and "Symmetric Knowledge Advancement", which could lead students to deepen their knowledge of the abstract concepts from their initial contributions from the first lesson. The affordance of technologies would enrich the advancement of conceptual understanding when educators consider KATs in implementing scaffolding and conceptual change on the platform they're using. Knowledge Forum (KF) might be a better platform for KB given the availability of theory-building scaffolds that can help guide students in contributing, build-on and improving each other's ideas through KB discourse (Scardamalia & Bereiter, 2014).

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Transformative Impact of University-Led Communities of Practice on Working Professionals in Japan: A Text Mining Analysis of Self-Reported Changes

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Abstract

This study examined transformations experienced by working professionals in a university-led Community of Practice (CoP), triggering factors, and the university's facilitation role. Participants were 109 working professionals who responded to an end-of-program survey conducted between 2019 and 2024 as part of a leadership development program operated by a national university in Tochigi Prefecture, Japan. Each cohort ran two months with weekly hybrid sessions involving cross-sector professionals learning from regional role models. Text mining analysis using KH Coder examined participants' responses to “What changes have you experienced before and after the program?” through frequency analysis and co-occurrence network analysis. Six clusters emerged representing transformation across five dimensions: cognitive (expanded perspectives and worldviews), behavioral (reflection to action), social (cross-industry networks), professional (workplace application), and personal (increased confidence). Five triggering factors were identified: social learning through diverse interaction, cross-industry exposure, role models, community support, and local contextual relevance. The university’s role manifested as neutral convener, knowledge broker, learning designer, and local anchor. Findings demonstrate universities’ unique capacity to facilitate cross-sector professional development while serving as regional development hubs.

Keywords: communities of practice, university-led professional development, KH Coder, transformative learning

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Introduction

The rapid advancement of technology, particularly artificial intelligence and digital transformation, has fundamentally reshaped the professional landscape, creating an urgent need for working professionals to continuously update their knowledge and skills. In Japan, employee education has traditionally been the responsibility of employers through comprehensive in-house training systems. However, as the modern workplace increasingly demands career autonomy and lifelong learning, attention has turned to the potential role of universities in providing professional development opportunities for working adults. Universities, positioned as neutral educational institutions with convening power across industries, offer unique opportunities to facilitate professional learning communities that transcend organizational and sectoral boundaries.

Communities of Practice (CoP) offer a theoretical framework that illuminates how universities can effectively facilitate such professional learning and development through structured social interaction. Wenger et al. (2002) define CoPs as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (p. 4). The framework consists of three essential elements: Domain, a shared area of competence that differentiates members; Community, the social structure that facilitates learning through interaction; and Practice, the shared repertoire of resources, experiences, and ways of addressing problems that members develop together (Wenger, 1998; Wenger et al., 2002).

Research demonstrates that CoP participation significantly benefits individual professional development through multiple pathways. CoPs help shape professional identity, as participation influences how professionals see themselves and make career decisions (Chang, 2021; Jørgensen & Keller, 2008). They provide networking and mentorship opportunities that increase confidence and create career planning opportunities (Gander & McInnes, 2021). Furthermore, CoPs facilitate skill development through collaborative learning, with Pyrko et al. (2017) finding that "thinking together" in CoPs creates safe spaces for reflection and tacit knowledge sharing, leading to skill enhancement.

While universities are increasingly recognized as crucial providers of professional education for working adults, and Communities of Practice have demonstrated significant benefits for professional development, research examining university-led CoPs designed specifically for working professionals remains notably scarce. Online and blended learning CoPs represent particularly accessible formats for working professionals, yet even within this domain, Smith et al. (2017) systematic review found that 78% of studies in higher education focus on course-level activities for students and faculty development, with only 22% addressing professional development. Although emerging case studies exist, such as those examining universities facilitating CoPs for social care practitioners (Hashem et al., 2024) and online CoPs for professional development (Abedini et al., 2021), research remains scarce on how working professionals transform through university-led CoPs, what factors trigger these changes, and what unique role universities play as neutral facilitators of cross-industry professional learning.

This gap is pronounced in the Japanese context as well, where documented cases of university-led CoPs for working adults remain virtually nonexistent. In response to this gap, the present study examines a leadership development program operated by a national university in Japan from 2019 to 2024. Through text mining analysis of participant self-reports, we investigate three research questions:

RQ1: What changes do working professionals experience through participation in a university-led CoP?
RQ2: What factors trigger these changes?
RQ3: What role does the university as facilitator play in these transformations?

Methodology

The Leadership Development Program

This study examines a university-led leadership development program for working professionals, operated by a national university located in Tochigi Prefecture, Japan. The program, which has been running since 2017, aims to cultivate regional leaders and promote community revitalization through cross-sector professional learning. Each cohort runs for two months with weekly hybrid sessions, combining online and in-person formats to accommodate working professionals' schedules.

The program embodies the three essential elements of a Community of Practice (Wenger, 1998; Wenger et al., 2002). First, it establishes a shared Domain focused on regional revitalization and leadership development, bringing together professionals who share concerns about local community challenges. Second, it creates a Community through structured interaction among cross-sector participants, facilitating learning through diverse professional perspectives. Third, it develops shared Practice through collaborative learning from regional role models—successful entrepreneurs, community leaders, and university faculty who demonstrate practical approaches to regional challenges. A distinctive feature is the final session, which serves not as a conclusion but as a "kick-off" for participants to implement action plans in their communities, embodying the program's emphasis on moving from reflection to action.

Data Collection

Although the program has been operating since 2017, the present analysis focuses on participant survey data collected between 2019 and 2024, when the standardized questionnaire was introduced. During this period, 172 individuals participated in the program across multiple cohorts. We collected data through an anonymous, voluntary end-of-program survey administered to all participants. The survey included one open-ended question: "What changes have you experienced before and after the program?" This question was designed to elicit participants' self-reported transformations without imposing predetermined categories, allowing for rich, authentic descriptions of their experiences. Of the 172 participants, 109 responded to the survey, yielding a response rate of 63.4%. The anonymous nature of the survey encouraged honest reflection while protecting participant privacy. The open-ended format generated qualitative data suitable for identifying patterns and themes in participants' transformation experiences.

Text Mining Analysis

We employed text mining methodology using KH Coder, a quantitative content analysis software developed by Japanese researcher Koichi Higuchi. According to the website of KH Coder, it has been utilized in over 8,000 research studies worldwide. The software enables systematic analysis of qualitative data through computational methods, reducing researcher bias while maintaining interpretive depth.

We conducted two primary analyses. First, frequency analysis identified the most commonly occurring words and themes in participants' responses, revealing dominant patterns of change and frequently mentioned concepts. Second, co-occurrence network analysis visualized relationships between concepts by examining which words appeared together in participants' responses. This analysis reveals how different aspects of transformation connect in participants' experiences, identifying clusters of related concepts that represent distinct dimensions of change. These analytical approaches allow us to extract patterns of change experienced by participants and identify factors that triggered these transformations through systematic examination of their self-reported experiences.

Participant Characteristics

While the survey data collection began in 2019, demographic information (e.g., age and occupational background) was collected only from 2021 onward. Of the 90 participants from 2021–2024 cohorts who provided demographic information (82.6% response rate for this subset), the age distribution revealed a concentration of mid-career professionals: nearly half (47.2%) were in their 30s, followed by 40s (33.7%), 20s (15.7%), and 50+ (3.4%). Regarding occupation, the majority (65.2%) worked in the private sector, reflecting the program's appeal to corporate professionals. The remaining participants included self-employed individuals (14.6%), public sector employees (14.6%), and smaller numbers from city council, NPOs, entrepreneurship, and unemployment. This diverse occupational mix created opportunities for cross-sector dialogue and mutual learning, with private sector professionals gaining insights from entrepreneurs and public servants, while public sector participants learned from business perspectives.

This cross-sector composition aligns with the program's design as a university-led CoP, where the university serves as a neutral convener bringing together professionals who might not otherwise interact in their daily work environments.

Results

Frequency Analysis

The frequency analysis identified the most commonly occurring words in participants' open-ended responses, providing insight into dominant themes of transformation. The three most frequent words were "think" (24 occurrences), "take" (22 occurrences), and "people" (20 occurrences). This distribution suggests that participants engaged in deep cognitive reflection throughout the program, while interpersonal interactions with instructors and fellow participants provided significant stimulation for their learning journey. The prominence of "think" indicates sustained engagement with reflective practice, while "take" suggests active engagement in implementing new approaches. The frequency of "people" underscores the social nature of learning within the CoP. Learning-oriented vocabulary appeared prominently in the responses. The words "learn" and "new" each occurred 18 times, while "community" (9 occurrences), "broaden" (9 occurrences), and "perspective" (12 occurrences) emerged frequently. This pattern demonstrates that participants experienced expansion of their worldview through the program, acquiring new knowledge and perspectives that extended beyond their existing professional frameworks. Action-oriented language also featured prominently in participants' descriptions. Words such as "start" (8 occurrences), "begin" (7 occurrences), and "action" (5 occurrences) reflect the program's explicit goal of moving participants from reflection to action. This linguistic pattern suggests that participants not only

contemplated change but also developed concrete intentions and plans for implementation in their professional and community contexts.

Table 1
The Result of Frequency Analysis

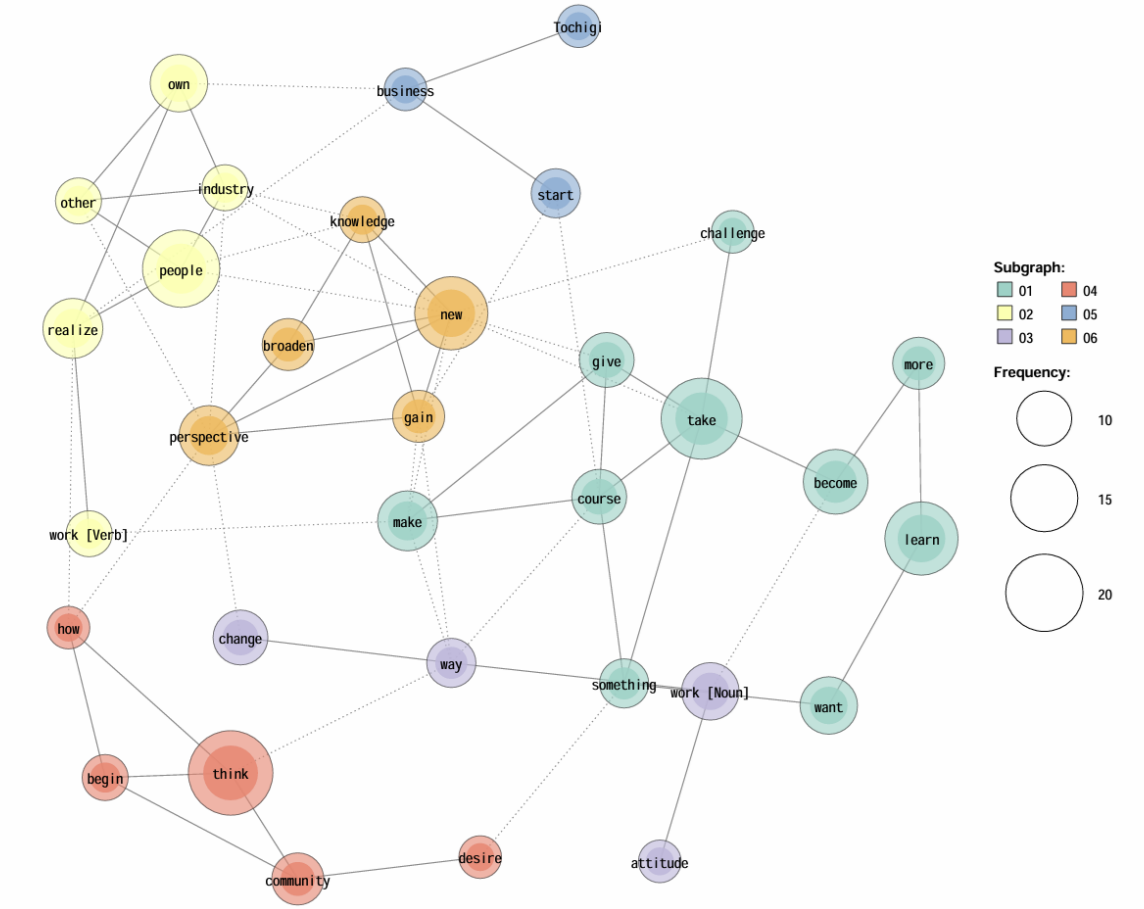
Word	Frequency	Word	Frequency	Word	Frequency
think	24	give	10	challenge	6
take	22	broaden	9	desire	6
people	20	community	9	get	6
learn	18	gain	9	how	6
new	18	more	9	Tochigi	6
become	14	something	8	action	5
feel	12	start	8	also	5
make	12	way	8	change	5
perspective	12	begin	7	confidence	5
realize	12	industry	7	even	5
own	11	knowledge	7	horizon	5
want	11	other	7	importance	5
work	11	work	7	increase	5
change	10	attitude	6	local	5
course	10	business	6	more	5

Co-occurrence Network Analysis

To understand how these concepts connect in participants' experiences, we conducted co-occurrence network analysis, which visualizes relationships between words by examining which terms appear together in responses. In this analysis, node size reflects word frequency, while edges (connecting lines) indicate co-occurrence strength—how often words appear together within the same response.

The network analysis revealed a structure consisting of four major clusters and two smaller clusters, naturally emerging from the strength of word co-occurrences without predetermined categorization. This emergent structure suggests that participants' transformations occurred across multiple interconnected dimensions, each representing a distinct but related aspect of their CoP experience. The clustering indicates that certain concepts consistently appeared together in participants' narratives, revealing meaningful patterns in how they conceptualized and articulated their changes.

Figure 1
The Result of Co-occurrence Network Analysis



Cluster Analysis: Six Dimensions of Transformation

Cluster 1 (Green): Learning and Transformation

The first cluster comprises words including “take,” “learn,” “become,” “give,” “make,” “want,” and “course.” This cluster represents active engagement in the learning process and personal transformation through action. The language pattern suggests participants moved beyond passive reception of information to actively implementing new approaches in their professional lives. A representative participant’s comment illustrates this transformation: “Before taking the course, I would overthink things and not take action, but now I feel like I've made it a habit to just give it a try.” This statement captures the essence of behavioral change facilitated by the program—shifting from analysis paralysis to action-oriented practice. Participants developed confidence to experiment with new approaches, embodying the program’s emphasis on moving from intention to practice.

Cluster 2 (Red): Reflection and Community Connection

The second cluster includes “think,” “begin,” “community,” “desire,” and “how.” This cluster reveals deep reflection on future possibilities combined with strong connection to community purpose. Unlike Cluster 1’s focus on immediate action, this cluster represents the cognitive and aspirational dimensions of transformation. One participant articulated this connection: “The vague desire to ‘achieve something’ was transformed into a concrete image of what kind of

environment would be best through the keywords 'local community' and 'connections.'" This comment demonstrates how the CoP helped crystallize participants' fuzzy aspirations into concrete goals grounded in local community context. The program provided both conceptual frameworks and social connections that enabled participants to envision specific pathways for community contribution.

Cluster 3 (Orange): Expanding Worldview and Knowledge

The third cluster contains "new," "perspective," "knowledge," "broaden," and "gain," representing cognitive expansion through diverse input. This cluster captures the knowledge acquisition dimension of transformation, particularly the broadening of professional perspectives beyond participants' existing frameworks. A participant described this expansion: "By listening to people from various industries, I was able to broaden my perspective and knowledge, and by exchanging opinions, I was able to discover new ideas." This statement highlights how cross-sector dialogue functioned as a catalyst for cognitive growth. The CoP structure, bringing together professionals from diverse industries, created opportunities for perspective-taking and knowledge transfer that would not occur in single-industry professional development contexts.

Cluster 4 (Yellow): Cross-Industry Learning and Engagement

The fourth cluster includes "own," "people," "other," "realize," "work," and "industry." This cluster specifically addresses recognition of cross-industry wisdom's value and the decision to actively engage with professionals from other fields. While Cluster 3 focuses on knowledge acquisition, this cluster emphasizes the relational and networking dimensions of cross-sector learning. One participant expressed this realization: "I realized that the wisdom of other industries is very useful, so I decided to get more involved with people from other industries." This comment reveals both cognitive recognition (realizing value) and behavioral intention (deciding to engage). The university's role as a neutral convener becomes particularly evident in this cluster, as participants explicitly valued the cross-industry composition that the program facilitated.

Cluster 5 (Blue): Business Challenges and Local Context

The fifth cluster, smaller but significant, includes "business," "start," and "Tochigi" (the prefecture name). This cluster shows participants connecting program learning to concrete business initiatives within their local geographical context. The appearance of the specific place name suggests that participants were thinking about entrepreneurship and business development grounded in regional realities rather than abstract concepts. This cluster reflects the program's explicit focus on regional revitalization, demonstrating that participants internalized the connection between their professional development and local community development. The co-occurrence of "business" and "Tochigi" indicates participants were considering how to apply entrepreneurial thinking to address regional challenges.

Cluster 6 (Purple): Mindset Change and Attitude Shifts

The sixth cluster contains "change," "way," "attitude" and "work" representing fundamental shifts in participants' approaches to work and problem-solving. This cluster captures metacognitive awareness of transformation—participants recognized that their thinking patterns and professional attitudes had evolved through the program. Unlike the other clusters

that focus on specific types of learning or action, this cluster represents participants' awareness of their own transformation process. This metacognitive dimension suggests the program successfully fostered reflective practice, enabling participants to recognize and articulate changes in their professional mindsets and approaches.

Discussion and Conclusion

This study examined how working professionals transform through participation in a university-led Community of Practice in Japan. Text mining analysis of 109 participants' self-reported experiences revealed multi-dimensional transformations across six interconnected clusters. We now address each research question in turn.

RQ1: What changes do working professionals experience through participation in a university-led CoP?

The cluster analysis reveals that participants experienced transformation across five interrelated dimensions. First, cognitive transformation manifested through development of new perspectives and expanded worldviews (Cluster 3), with participants explicitly noting how exposure to diverse professional viewpoints broadened their thinking beyond existing frameworks. Second, behavioral transformation was evident in the shift from reflection to action (Cluster 1), with participants reporting increased propensity to implement new approaches rather than remaining in analysis paralysis. Third, social transformation emerged through building cross-industry networks (Cluster 4), with participants recognizing the value of professional connections beyond their immediate sectors. Fourth, professional transformation occurred as participants applied new insights to their work contexts, connecting abstract learning to concrete workplace challenges (Cluster 5). Fifth, personal transformation manifested through increased confidence and agency (Cluster 6), with participants demonstrating metacognitive awareness of their own development.

RQ2: What factors trigger these changes?

Analysis of participant responses identifies five key triggering factors embedded in the CoP's social environment. Social learning through interaction with diverse professionals provided the foundational mechanism, consistent with Wenger's (1998) emphasis on learning as social practice. Cross-industry exposure enabled participants to see possibilities from other sectors, challenging industry-specific assumptions and revealing transferable approaches. Role models—successful entrepreneurs and community leaders who served as instructors—demonstrated achievable pathways, making abstract concepts concrete through lived examples.

Community support created a psychologically safe space for deep reflection and exploration, reducing the risk associated with sharing challenges and experimenting with new approaches. Finally, the Tochigi regional context made learning personally relevant, grounding abstract concepts in participants' local business and community realities. This local anchoring appears particularly significant for regional revitalization goals, as participants explicitly connected their learning to place-based challenges (Cluster 5). These findings suggest that transformation in university-led CoPs results not from program content alone but from carefully designed social environments that activate multiple reinforcing learning mechanisms.

RQ3: What role does the university as facilitator play in these transformations?

By examining these questions, this research identifies four distinct roles through which universities serve as hubs for regional development: neutral convener, knowledge broker, learning designer, and local anchor. This contributes to understanding the unique value of university-led cross-sector professional communities.

As neutral convener, the university created a cross-industry space where professionals from diverse sectors could meet as equals, transcending organizational and sectoral hierarchies that might inhibit open dialogue in other contexts. As knowledge broker, the university actively connected different industries, perspectives, and experiences, curating diverse expertise that individual organizations could not assemble independently. As learning designer, the university structured the program to move participants systematically from reflection to action, with the final "kick-off" session explicitly transitioning from learning to implementation. This intentional design is evident in the cluster progression from cognitive transformation (Clusters 2 and 3) through recognition of learning opportunities (Cluster 4) to concrete action orientation (Clusters 1 and 5). As local anchor, the university grounded learning in the regional Tochigi context while introducing broader conceptual frameworks, linking local challenges to universal principles of leadership and community development.

These four roles distinguish university-led CoPs from both corporate training programs and informal professional networks. Unlike corporate programs that serve single organizations, universities can convene cross-sector participants. Unlike informal networks that emerge organically, universities can provide structured learning design. This unique positioning enables universities to serve as regional development hubs, cultivating local leaders while building social capital for sustained community revitalization.

Limitations and Future Research

This study has three primary limitations. First, data relies exclusively on self-reported experiences captured through end-of-program surveys, without behavioral observation or longitudinal follow-up to verify claimed transformations. Second, the cross-sectional design cannot track long-term impacts or determine whether reported changes persist beyond the immediate post-program period. Third, as a single case study of one regional university program, generalizability to other contexts remains uncertain. Future research should track participants longitudinally to measure sustained behavioral change and career outcomes. Comparative studies across multiple university-led programs in different regions would identify which design elements prove most critical for transformation. Combining survey data with observable indicators such as community engagement, career progression, or business outcomes would strengthen evidence for CoP impacts beyond self-perception.

Conclusion

This research demonstrates that university-led Communities of Practice offer powerful mechanisms for transforming working professionals across multiple dimensions simultaneously. By serving as neutral conveners, knowledge brokers, learning designers, and local anchors, universities can facilitate professional development that transcends organizational boundaries while remaining grounded in regional contexts. As technologies reshape professional landscapes and demand for lifelong learning intensifies, universities' capacity to convene diverse stakeholders for structured cross-sector learning represents an

increasingly valuable contribution to both individual career development and regional revitalization. This study provides empirical foundation for expanding universities' role from traditional degree education toward becoming sustained hubs for professional and community development.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Claude was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Claude, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Beyond Digital Adoption: How Data Analytics Drives Marketing Effectiveness and Competitiveness in MSMEs

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Abstract

In today's digital era, the business landscape is changing rapidly and requires businesses to gain digital readiness, especially micro, small and medium enterprises' sectors (MSMEs). This study examines the strategic role of data analytics in enhancing the competitiveness of micro, small, and medium enterprises (MSMEs). Drawing on the resource-based view and dynamic capabilities theory, the study argues that data analytics creates value not through mere adoption but through its effective integration into marketing and decision-making processes. The findings highlight that embedding data analytics within core marketing strategies enables MSMEs to better understand customers, optimize marketing campaigns, and deliver more personalized offerings, thereby improving marketing effectiveness and customer engagement. Moreover, the study emphasizes the critical role of human and managerial capabilities in translating analytical insights into actionable marketing strategies. Strategic and managerial training is identified as a key driver of digital readiness, allowing MSMEs to adapt to market dynamics and sustain competitive advantage. Overall, the study contributes to the digitalization literature by demonstrating that MSME competitiveness depends more on the strategic application of data analytics than on the ownership of digital technologies alone.

Keywords: data analytics, MSME competitiveness, digital readiness, strategic marketing integration, managerial capabilities

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Introduction

In today's digital era, the business landscape is changing rapidly and requires businesses to be adaptive to technology, especially in the micro, small, and medium enterprises (MSMEs) sector. This adaptation, commonly referred to as digital readiness, reflects the ability of firms to adopt, integrate, and utilize digital technologies effectively in their operations and strategies. For MSMEs, digital readiness is crucial to enhancing competitiveness, responding to market dynamics, and sustaining long-term business growth. Furthermore, fashion retail MSMEs in Indonesia have made a substantial contribution to the national economy. This sector plays an important role in generating income and supporting economic growth at both local and national levels. In addition, fashion retail MSMEs significantly contribute to labor absorption by creating employment opportunities for a large segment of the workforce (Kementerian Koperasi dan UKM RI, 2023).

However, MSMEs face significant challenges in maintaining their survival and achieving sustainable growth in an increasingly competitive business environment. One major challenge arises from competition with large companies that have stronger capital, advanced technology, and broader market reach. In addition, the rapid expansion of global e-commerce platforms intensifies price competition and increases customer expectations. These platforms often offer greater convenience, variety, and efficiency, making it difficult for MSMEs to compete on equal terms. As a result, MSMEs must continuously adapt their strategies and enhance their capabilities to remain competitive and grow (Barus et al., 2023).

Big data analysis of customers' data, market trends, and purchasing behavior provides valuable insights that can help businesses enhance their competitiveness. Through systematic analysis, firms can better understand customer needs, preferences, and buying patterns. These insights allow businesses to design more targeted and personalized marketing campaigns. As a result, digital marketing strategies can be optimized to reach the right audience at the right time. Consequently, marketing activities become more effective and efficient compared to traditional, intuition-based approaches (Cadden et al., 2023; Maroufkhani et al., 2020; Mikalef et al., 2018).

The Purpose of This Research

The purpose of this research is to examine how data analytics can be transformed from a mere technological resource into a strategic asset that enhances the competitiveness of micro, small, and medium enterprises (MSMEs). Grounded in the resource-based view and dynamic capabilities theory, the study aims to clarify that competitive advantage does not arise simply from adopting data-related technologies, but from strategically integrating analytical capabilities into marketing and decision-making processes. By doing so, the research seeks to extend existing MSME digitalization literature with a more nuanced, strategy-oriented perspective.

Specifically, this research aims to investigate the role of data analytics integration within digital marketing strategies as a key mechanism through which MSMEs improve marketing effectiveness and customer engagement. The study focuses on how analytical insights can be embedded into everyday marketing activities, such as understanding customer behavior, optimizing campaigns, and personalizing offerings. Through this lens, the research intends to demonstrate that the strategic application of data analytics is a critical pathway through which MSMEs achieve and sustain competitiveness in dynamic market environments.

In addition, the study aims to explore the importance of human and managerial capabilities in enabling effective use of data analytics. It seeks to assess how strategic and managerial training supports digital readiness by equipping MSME owners and managers with the skills needed to interpret data, align digital tools with business objectives, and translate insights into concrete marketing actions. Ultimately, the purpose of this research is to provide both theoretical and practical insights into how MSMEs can build adaptive, data-driven marketing capabilities that lead to long-term competitive advantage rather than short-term technological adoption.

Related Work

Some recent studies have examined how big data analytics influence the digital marketing capabilities of MSMEs in China. These studies generally focus on the direct impact of data-driven insights on marketing performance and strategic decision-making. However, they have not taken digital readiness into account as a moderating factor that may shape the effectiveness of big data analytics adoption. In addition, much of the existing research has been conducted in developed countries with more advanced technological infrastructure and digital ecosystems. Consequently, the findings may not be fully applicable to the Indonesian context, which differs in terms of technological maturity, market characteristics, and MSME digital capabilities (Abrokwah-Larbi, 2024; Sharabati et al., 2024).

Rafiah et al. identify digital readiness as a key factor in achieving successful digital transformation among MSMEs. Their study highlights the importance of technological infrastructure, digital skills, and organizational support in enabling MSMEs to adopt digital solutions effectively. However, the analysis does not specifically examine digital readiness as a moderating variable that influences the relationships between big data analysis and digital marketing strategies. As a result, the conditional effects of varying levels of digital readiness on the effectiveness of data-driven marketing initiatives remain unclear. This gap suggests the need for further research to better understand how digital readiness shapes the impact of big data analysis on MSMEs' digital marketing performance (Rafiah et al., 2022).

Lastly, Anatan et al. develop a comprehensive framework to measure digital readiness among MSMEs. Their framework captures key dimensions such as technological infrastructure, digital skills, organizational culture, and management support. This contribution provides a useful tool for assessing the level of preparedness of MSMEs in adopting digital technologies. Nevertheless, the interaction between digital readiness and big data analysis in shaping business outcomes has not been examined in their study. In particular, how these factors jointly influence the competitiveness of MSMEs remains an open area for further investigation (Anatan & Nur, 2023).

Our Reflections on Beyond Digital Adoption

We argue that data analytics alone is not a strategic asset unless translated into effective marketing and decision-making processes based on resource-based view (RBV) (Barney, 1991) and dynamic capabilities theory (Teece et al., 1997). Furthermore, we hypothesize that MSMEs operate within context-specific dynamics in which the pathway to competitiveness does not occur directly through technology adoption alone, but rather through its strategic application, particularly in how data-driven insights enhance marketing effectiveness and customer engagement. We believe this perspective adds nuance to MSME digitalization theory by suggesting that "*smaller firms achieve competitiveness not simply by owning or*

adopting data-related technologies, but by effectively integrating those tools into their digital marketing strategies".

Additionally, we suggest that MSMEs should focus on integrating data analytics into their marketing strategies rather than merely adopting digital technologies, for example by using analytical insights to better understand customers, optimize marketing campaigns, and personalize offerings. Integration means embedding data analytics into the core of their marketing strategy so that data-driven insights guide everyday decision-making. By analyzing customer data, MSMEs can better understand customer preferences, behaviors, and purchasing patterns. These insights enable businesses to optimize marketing campaigns by targeting the right audience at the right time with appropriate messages. Furthermore, data analytics allows MSMEs to personalize products, services, and promotions according to individual customer needs. As a result, integrated use of data analytics can improve marketing effectiveness, strengthen customer relationships, and enhance overall competitiveness.

Training in strategic data use is essential for enabling MSMEs to move beyond basic adoption of digital tools. Such training helps develop a strategic mindset in which data is treated as a valuable asset for decision-making rather than merely as operational output. By learning how to interpret and apply data insights, MSME owners and managers can align digital tools with their business goals. This strategic approach supports digital readiness by ensuring that technology use is purposeful and integrated into core business processes. Moreover, training encourages MSMEs to proactively respond to market changes and customer needs using data-driven strategies. As a result, MSMEs become more adaptive, competitive, and resilient in an increasingly digital business environment.

Encouraging managerial training in turning analytical insights into marketing actions is crucial for improving organizational performance. Such training helps managers understand how to translate data findings into clear, actionable marketing strategies. By developing these skills, managers can make more informed decisions regarding customer targeting, product positioning, and promotional activities. Training also reduces the gap between data analysis and practical implementation within daily marketing operations. Furthermore, it empowers managers to evaluate campaign performance and adjust strategies based on real-time insights. As a result, marketing efforts become more effective, efficient, and aligned with overall business objectives.

Conclusion

In conclusion, this study emphasizes that data analytics should not be viewed as a standalone technological asset but as a strategic resource whose value emerges only when effectively integrated into marketing and decision-making processes. Grounded in the resource-based view and dynamic capabilities theory, our arguments highlight that MSME competitiveness is shaped less by the mere adoption of digital tools and more by how these tools are strategically applied. This perspective contributes to the digitalization literature by clarifying that ownership of data-related technologies does not automatically translate into competitive advantage for smaller firms.

Furthermore, the findings underscore the importance of embedding data analytics within core marketing strategies to enhance customer understanding, campaign optimization, and personalization. When analytical insights guide everyday marketing decisions, MSMEs are

better positioned to engage customers in more targeted and meaningful ways. Such integration strengthens marketing effectiveness and fosters deeper customer relationships, which are critical for sustaining competitiveness in dynamic and highly competitive markets.

Finally, the role of human and managerial capabilities emerges as a central enabler of successful data-driven transformation. Strategic and managerial training equips MSME owners and managers with the skills needed to interpret data, convert insights into actionable marketing initiatives, and continuously refine strategies based on performance feedback. By developing these capabilities, MSMEs can build greater adaptability and resilience, ensuring that digital readiness evolves into long-term competitive advantage rather than remaining a superficial technological upgrade.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that ChatGPT, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from ChatGPT, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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The Utilization of Artificial Intelligence in Shaping College Instruction

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Abstract

The academic sector has transformed due to the integration of Artificial Intelligence (AI) in higher education, thus bringing opportunities and challenges. This study aims to determine and investigate the level of awareness among college instructors at the University of the Cordilleras regarding the utilization of AI in their teaching practices, particularly in a trimester-program, and a blended learning environment. Using a quantitative research design, 155 faculty members participated in a researcher-made assessment across four core domains: personalized learning, writing assistance, student engagement, and administrative automation. Findings reveal a moderate awareness in the areas of personalized learning and writing support, and awareness in leveraging AI for student engagement and administrative tasks. Limited training, time constraints, and technological unfamiliarity are a few of the gaps that exist aside from AI's potential. These insights imply the necessity of institutional support and targeted professional development to bridge awareness and implementation. The study is significant to understand how AI can reshape instructional practices and highlights the urgent need for systematic strategies to prepare educators for AI-driven academic environments.

Keywords: Artificial Intelligence (AI), teacher awareness, personalized instruction, educational technology, higher education, blended learning, administrative automation

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Introduction

The advancement of incorporating Artificial Intelligence (AI) in some work tasks has completely changed the way we learn. AI has become a crucial part of today's teaching and learning practices. Due to the continuous advancement of technology, academic institutions continually find ways to upgrade various sectors that help sustain their provision of educational services to stakeholders. This includes the integration of AI to stay at par with the demands of the world.

Globally, the integration of AI in higher education is manifested in various forms. For example, using AI to assist in personalizing the learning of students. AI usually offers suggestions on how teachers can support their learners according to their preferences and needs. Designing the academic content that fits students' preferences plays a vital role in developing essential 21st-century skills. In addition to academic knowledge, personalized learning focuses on developing essential 21st-century skills. Collaboration, critical thinking, problem-solving, creativity, and communication are nurtured through collaborative projects, problem-based learning, and real-world applications. A classroom that applies personalized learning encourages exploration and inquiry that prepares students with the potential to adapt to their thriving society (Shloul et al., 2024).

Another indication of the potential of AI is its function as a writing assistant, especially for the administrative tasks of teachers and their additional job as researchers. According to Khalifa and Albadawy's (2024) study, AI tools such as ChatGPT, Google's Gemini AI, Microsoft's Bing provide substantial help in crafting and organizing academic content. Thus, instructors are guided by these AI tools to innovate their teaching methods because of the suggested teaching-learning preferences. In addition, AI is also increasingly utilized for engaging students through gamified learning, real-time feedback mechanisms, and predictive analytics that identify at-risk students for proactive intervention. The increasing digitization of the world has nudged the academe to emphasize engaging and motivating students even in an online distance learning modality. Simultaneously, AI assists teachers with their administrative tasks, like assisting with grading and assessments, automating processes like admissions and student record management, scheduling, and even using chatbots to answer students' queries (Rahiman & Kodikal, 2024). In that way, using specific AI tools helps faculty and staff save time, which allows them to have more time facilitating and guiding their students.

To guarantee that AI is properly managed in the academic sectors, the Philippines' trifocal education system --Department of Education (DepEd), the Commission on Higher Education (CHED) and Technical Education and Skills Development Authority (TESDA) have initiated policies, projects, and studies that focus on the integration of AI in the academic sector. These efforts target how AI can guide both students and educators in completing their duties effectively. For instance, DepEd is working on establishing an Education Center for AI Research (E-CAIR) to develop AI-driven tools for teaching, learning, and school administration, including applications for enhancing learning resources and improving student assessments (Department of Education, 2025). In addition, CHED highlighted its goal to weave AI into the learning process for all students and teachers, not just those in tech programs. It has also stressed that faculty members need to grasp AI's impact on their specific subjects and incorporate it into their teaching, even for humanities and social sciences (Hernando-Malipot, 2025). TESDA has started establishing the role of AI as a transformative or influential factor in the labor market. TESDA has presented several plans to incorporate AI into Technical and Vocational Education and Training (TVET) courses. These plans aim to prepare the Philippine

workforce for the challenges of the Fourth Industrial Revolution and to enhance the alignment of TVET programs with the developing industry needs (TESDA, 2021). These efforts reflect a strategic approach to AI integration that promotes the innovation of the use of AI within the Philippine education system.

Despite the escalation of interest and initiatives of several academic sectors, research gaps still exist on the integration of AI use in shaping college instruction. Many teachers from different levels acknowledge the power of AI, but implementing its potential is still limited. Despite the continuous trend of artificial intelligence in various sectors, especially in the academic sectors, many teachers still lack the skills and knowledge of integrating AI into their teaching practices, such as personalizing students' learning, writing and research, administrative processes and engaging students. As a result, more research is suggested to explore further the teachers' awareness, influencing factors, and their own initiatives in the utilization of AI in teaching. Accordingly, this study seeks to assess the level of awareness among college instructors regarding the application of artificial intelligence in their instructional practices.

Relevant innuendos that are drawn from this study are essential for the institution's stakeholders. Firstly, understanding the level of awareness among college instructors can help support the design of professional development and training programs that strengthen the pedagogical system of the university, especially in a fast-paced system with a blended learning environment. The findings may also improve the institutional policies and guidelines that will establish an ethical and responsible use of AI while keeping a quality and academic integrity. Furthermore, the study can lead to the design of more user-friendly technological tools that embed AI use. Lastly, this research may enhance the superiority and efficiency of college instruction not only in the Philippines but also in the rest of the world to guarantee that teachers are not left behind in this AI-driven educational environment.

Research Methodology

In this study, a quantitative research method is used to assess the awareness of college teachers on the adoption of AI into their teaching practices. The locale of the study is the University of the Cordilleras (UC), a private institution in Baguio City, Philippines. Purposive sampling was used to select 155 faculty members from the university. UC follows a trimester academic calendar and implements a blended learning modality, combining traditional face-to-face instruction with online learning platforms.

A researcher made multiple-choice test was given to the participants to measure their awareness along four dimensions: the use of AI for personalizing learning, writing assistance in research and instructional content design, engaging students, and automating administrative tasks. The test consists of 16 items aligned to identify the level of awareness of teachers along the study's core dimensions. The test was validated by a group of experts in education and technology. A reliability test was conducted with the teachers at the College of Information Technology and Computer Sciences, based on the reason that they possess a higher level of familiarity with the use of AI tools. Responses were analyzed using descriptive statistics, specifically, the mean and skewness were used to determine the level of awareness. Skewness was included for further analysis of the data distribution and normality of the data.

Results and Discussion

The findings presented in Table 1 show varying levels of awareness among college teachers at the University of the Cordilleras vis-à-vis the use of Artificial Intelligence in their teaching practices. The general weighted mean is 2.32, interpreted as moderately aware. This means that their understanding of implementing AI in the study's core dimensions is developing. This then suggests that faculty are still in the initial stages of using AI tools. This idea corresponds to the study of Deacon et al. (2024), indicating a reluctance to embrace new technologies entirely due to the perception that AI is seen as both a threat and an opportunity. The participants in their study have provided concerns ranging from academic integrity issues to the broader implications for learning and future employment. Other concerns were indicated in the study of Sibug et al. (2024), stating that teachers generally hold positive attitudes towards AI's potential, their issues mainly revolve around the difficulties on practical implementation, like the need for technical support, maintaining human connection, safeguarding data privacy, and addressing the learning curve for both educators and stakeholders.

Table 1
Level of Awareness of the College Teachers in the Utilization of AI in Their Teaching Practices

Domain	Mean	Awareness Level	Skewness	Interpretation
Personalized Learning	1.97	Moderately Aware	0.10	Positively Skewed
Writing Assistance	1.94	Moderately Aware	0.20	Positively Skewed
Administrative Tasks	2.55	Aware	-0.23	Negatively Skewed
Engagement of Students	2.65	Aware	-0.20	Negatively Skewed
General Weighted Mean	2.27	Moderately Aware		

Personalized Learning

The result of this study presents a mean score of 1.97 and a positive skewness of 0.10 in the Personalized Learning domain. This suggests that some college teachers of this institution have limited knowledge of the use of AI as a potential tool for individualized instruction. Possibly, teachers are capable of using only the basics of AI, but not yet the sophisticated features of AI. Thus, this level highlights the need for more faculty training and programs that will focus on providing familiarity with AI tools that are intended to be used for personalized learning of their students.

According to the participants of this study, they are aware of the magnitude of AI; however, they lack the understanding of the general characteristics of AI and how to apply it in their teaching practices, as they are used to their traditional ways of customizing the learning strategies of their students. Another factor that hinders teachers from personalizing the learning of their students through AI is the limited time to adjust to the fast-paced innovation of technology, especially to the advent of AI in education. This can also be in connection with the workload of the faculty, especially that the participants of this study must manage and juggle their numerous tasks in the hasty system of a trimester program. To add to the challenge is the number of students each faculty must deal with, since evaluation of the needs and learning styles of students can be overwhelming because every trimester brings in a new batch of students. Hence, frequently recalibrating lessons and activities every semester is time-consuming.

The result also indicates a significant gap between the potential of technology and its application to the teaching-learning process. It has been discovered that teachers have limited awareness of using AI across these critical dimensions of personalized learning: analyzing the learner's data, adapting to individual needs, and developing instructional support. Participants of this study have stated that AI tools require technical knowledge, especially in providing prompts to generative AI such as ChatGPT and NotebookLM, making it difficult for them to use AI effectively. The tendency is that most instructors are still reliant on traditional methods rather than data-driven personalization.

Another issue that teachers find as a factor in adapting AI to their teaching practices is the cultural diversity of their classrooms. Subsequently, teachers' insights into personalized learning strategies are complex and time-intensive; hence, most teachers usually apply a one-size-fits-all approach. Although personalization involves adjusting instruction, resources, feedback, and interventions to learners' specific needs and goals (Idowu, 2024), limited training in AI integration discourages faculty from implementing such practices. Overall, the teachers' moderate awareness level of the use of AI for personalized learning is determined due to the limited time of teachers, workload pressures, the complexity of the blended learning environment, and an insufficient training program for teachers.

These reasons align with the Technology Acceptance Model (Davis, 1989), which suggests that while most college instructors recognize the essentials of most AI tools, their limited knowledge and demanding workload cause them to fully embrace the use of AI in their teaching practices. Furthermore, the concerns raised by the instructors on time constraints and the drastic changes in the educational landscape of the working environment of the instructors are recognized in the Concerns-Based Adoption Model (Hall & Hord, 1987). This concept deals with the contextual barriers to the implementation of educational innovations.

This finding corroborates the study of Balahadia et al. (2023), stating that there is a moderate level of awareness of ChatGPT, the most commonly used AI tool, among university teachers at selected schools in the Philippines. This indicates that while some knowledge of ChatGPT exists, there is still room for improvement in understanding its full capabilities. Another study from Sibug et al. (2024) has presented that the teachers at selected universities in Pampanga believe that AI tools can tailor learning experiences to individual students' needs. They have emphasized in their study that teachers gave high scores to the personalization capabilities of AI, but are balanced by reservations, such as concerns about technical issues on software and hardware compatibility problems, and privacy and data security might also result in a cautious approach to fully leveraging AI's personalization potential.

In conclusion, the results highlight a gap between college teachers' recognition of AI's potential and their actual application of some AI tools in personalizing their students' learning. Even though moderate awareness exists, the positive skew in data reveals that most teachers remain at the lower end of the awareness scale. This means that limited understanding of some AI tools, time constraints, and institutional workload pressures are contributing factors to the positive skewness. Bridging the gap is important to fully harness AI's potential in teaching practices among university instructors, specifically improving the strategies to personalize learning.

Writing Assistance

Awareness of AI as a writing assistant is also moderate, with a 1.94 mean, and it is positively skewed at 0.20, suggesting that educators are beginning to view the value of AI as a writing assistant, but the adoption of AI remains limited. This level is also a positive indicator that the college instructors are engaging in the use of technology to assist in their writing tasks, such as updating and creating their content materials for instruction, and for tasks aligned to research writing. However, the result also indicates that the teachers are not fully confident or do not have enough knowledge in using them for more complex tasks like literature review summarization or research design support.

According to some of the faculty, the university has offered programs for teachers and students on the use of AI, but these offers are not enough to establish a more efficient use of AI. Some teachers have also expressed their awareness of the use of tools like ChatGPT, Grammarly, or citation generators, but due to constant updates to the curricula, constant revisions to assessment materials, and the volume of administrative tasks, hindered their ability to stay updated. As a result, learning to use the other features of AI often becomes a low priority.

This finding implies that strategic faculty development in the integration of AI into the writing tasks of teachers, particularly in writing instructional materials and assessments, research designs, and academic writing, is a critical need to support teachers. Drawing on the Technological Pedagogical Content Knowledge (TPACK) framework (Schmidt et al., 2009), cultivating the technological proficiency of teachers is more significant and meaningful if it synergizes with their teaching practices. Teachers with a moderate level of awareness, as identified in the study, represent a promising cohort for transformation. According to Rogers' Diffusion of Innovations Theory (2003), these faculty members belong to the early majority group. This means they are typically deliberate in adopting innovations because they rely mostly on social validation, that is, they expect support from their institution. In addition, evidence of effectiveness must be presented to the faculty to ensure a full integration of the innovation AI can offer them.

Considerable studies have reflected similar outcomes; the data gathered by Kim & Kim (2022) stated that the teachers present a positive attitude toward incorporating AI as a writing assistant, specifically through an AI-enhanced scaffolding system (AISS). However, the teachers are concerned about their future roles as AI may take over their role as a supervisor of the teaching-learning process, and that teachers will just serve as class assistants. Thus, this negative view leads some teachers to be hesitant in integrating AI into their instruction.

Furthermore, embedding AI literacy across faculty development programs is especially pertinent in a trimester-based academic system with a blended learning institution where educators must constantly revise syllabi, adapt to new content, and deliver instruction with efficiency and precision. This insight is supported by the study of Palaoag et al. (2020), stating that the rapid nature of technological innovations and inventions means that educational institutions must always assess the provision of required technological support in meeting their teachers' and students' requirements. Educational institutions are liable to have a clear picture of their teachers and students' technological literacy, competency, and proficiency level to mount a dependable a successful blended learning, especially at the advent of AI in the academic sectors.

Administrative Tasks

AI is also a useful tool in helping with the everyday administrative work of teachers, such as streamlining tasks in grading, exam creation, attendance monitoring, and performance reporting. In contrast to the previous domains- personalized learning and writing assistant- the administrative tasks project an "Aware" level with a mean score of 2.55. This means that there is a significant number of teachers who are using and recognizing the role of AI in terms of routine administrative duties of teachers, such as grading, exam creation, attendance monitoring, and performance reporting.

The accumulated responses of this domain show a -0.23 negative skewness, suggesting that their answers are clustered toward the higher end of the awareness scale. This implies that most of the teachers accept AI positively, since they find it more familiar and relevant compared to the other instructional areas. The teachers perceive the use of AI as a solution to reduce the workload of the faculty, which allows them to have more time to engage with students and complete other teaching tasks required of them.

The immediate and concrete benefits of AI in this domain have contributed to the "Aware" level. Most teachers claim that using AI in their administrative tasks is less disruptive and aligns better with their usual duties. Thus, teachers are motivated to embrace AI as an auxiliary tool in assisting them in their administrative tasks. However, there is a need for institutional support and faculty development in terms of the use of AI in teaching amongst teachers who are only moderately aware and not aware of the implementation of AI on the administrative tasks of teachers. Strengthening their awareness, knowledge and skills of the potential of AI through training and hands-on exposure along with a clear institutional guideline is beneficial to elevate teachers' confidence of using AI in various teaching practices.

Supporting evidence aligns with the result of this study; for instance, the research of Goli-Cruz (2024) indicates that ChatGPT can simplify the repetitive tasks that educators perform. The researcher stated that while faculty members were aware of ChatGPT's existence, they did not entirely rely on the technology for delivering high-quality education (Goli-Cruz, 2024). Kayali and Balat (2024) confide in their study that teachers use AI applications to facilitate the rapid and easy completion of assessment and evaluation activities, which traditionally demand significant teacher time and effort. Moreover, teachers from the study of Oktavianus et al. (2023) showed a positive attitude towards AI as it offers in-depth feedback to students. The participants of their study perceives that AI is an essential tool in providing feedback that can be effective in guiding students to have better learning outcomes. Integrating AI to assist and automate teacher's administrative tasks allows teachers to have more time on human-centric aspects of teaching such as mentorship and facilitating individualized learning (Oktavianus et al., 2023).

Despite these supporting corroborations, some studies have an opposite view of the findings of this study. In Ecuador, teachers in higher education institutions are still in an "incipient manner" of implementing AI in their educational processes due to the findings that teachers still "lack the knowledge on the use of AI" (Taipicaña et al., 2024). Furthermore, the study Taipicaña et al. (2024) stated that most teachers do not fully embrace that using AI in the education field is a good practice, indicating a general skepticism or lack of faith in the benefits AI can offer to teachers and students. Furthermore, faculty members from 18 universities in the Russian Federation generally lack a systematic understanding of the organizational, teaching, and learning potential of AI tools. Many educators possess only segmental

knowledge, primarily related to their direct professional activities in teaching specific disciplines. The moderate awareness hinders them from forming a complete picture of AI's potential in education (Sysoyev, 2023).

Teachers are pragmatically accepting AI, for the reason that it supports teachers by reducing their repetitive tasks, such as writing students' assessments, providing feedback, grading, and checking attendance. But in contrast to the teachers' "aware" level in this domain some studies stated that teachers are skeptical of the accuracy of AI and lack adequate knowledge, which obstructs them from utilizing AI in their teaching practices (Idrissu et al., 2024; Taipicaña et al., 2024). To bridge the gap between knowing about something and actually doing something, higher education institutions must prioritize strengthening the faculty's use of AI, along with presenting clear guidelines that will empower teachers to have control over the use of AI in their administrative tasks.

Engagement of Students

Similarly, the dimension of engaging students in using AI exhibits an awareness level; thus, this suggests that teachers can manage to engage their students with the assistance of AI. The mean score, which is 2.65, has garnered the highest among the four dimensions of this study, suggesting that most of the respondents have moderate to high awareness, and the negative skewness, which is -0.20, presents a significant portion of instructors who still demonstrate limited knowledge or utilization of AI for engaging students in a blended learning environment.

In the Philippines, most schools and institutions have continued implementing the blended learning modality even after the pandemic period. Hence, teachers have found ways to engage with their students in an online distance learning (ODL) modality, which can be attributed to the level of awareness of teachers on engaging students. The "aware level" reflects that the faculty members are familiar with AI-powered gamified tools such as Quizziz, Menti, and Kahoot, which are intended to reinforce participation through interactive, game-like experiences. Participants of the study also stated that current gamified tools with AI features contributed to the awareness level that led them to use them in their classes, which helped in promoting participation and engagement.

The Self-Determination Theory (Deci & Ryan, 2014) confirms this insight, which suggests that when learners experience autonomy, competence, and relatedness, their motivation increases. Therefore, the moderate-to-high mean score of 2.65 implies that there is sufficient knowledge of teachers' use of AI in terms of engaging students in a blended learning environment. This also indicates that the university must invest in training and supporting teachers to be more confident in sharpening their teaching strategies with the appropriate use of AI. To demonstrate its importance, the study of Huang and Zhang (2025) shows that the training program involved in the study has effectively improved teachers' understanding and application of AI technology. This suggests that well-designed training can directly address the knowledge gap among educators regarding emerging technologies.

In the study of Balajadia et al. (2023), a 'moderate awareness level' among the teachers implies that there is an intermediate understanding of the commonly used AI tool, which is ChatGPT, across various domains. Because technology changes, AI's features and potentials will continue to upgrade as well, thus there must be continuous understanding of AI's full capabilities and opportunities among various institutions.

This is supported by the study's recommendation for educational seminars and workshops to facilitate effective utilization of AI tools. The innovation of AI appeals to students, according to some of the participants of this study. The new features of some Gamification and Collaboration tools offer engaging activities that traditional teaching methods cannot offer. According to Zainuddin (2024), the current technology's novelty can enhance motivation, particularly for students who find traditional learning environments less stimulating because most AI tools often incorporate gamified elements like points, levels, and interactive feedback, which are seen as creating a motivational framework that encourages students to progress through tasks. Though engaging students in this manner makes it more interesting and enjoyable, the effectiveness of this approach may diminish over time because the "novelty effect" has the tendency to fade and may not sustain the engagement in class.

The high mean score in this dimension indicates that many teachers are ready to integrate AI more effectively, especially in blended learning contexts. However, to fully adapt the ability of AI to engage students effectively, sustained support and initiatives are needed. The objective of these development programs is to cultivate an educational environment where teaching and learning are empowered by human touch, but with the AI educational tools as the co-pilot.

Conclusion

This study assessed the awareness of the college teachers at the University of the Cordilleras on the utilization of AI in teaching. The findings present moderate awareness in personalized learning and writing assistance, while automating administrative tasks and engaging students are at the awareness level. The overall interpretation presents that the educators recognize the potential of AI in their teaching practices. The gaps that are illustrated in this study are due to the limited training, time constraints, and workload demands. The results imply a need for targeted AI training and institutional support to enhance integration in instruction. Since this study focused on one institution, it is recommended that broader research will help to validate these findings. Empowering teachers' AI literacy will be essential in improving the instructional quality and efficiency in higher education institutions.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

In the preparation of this research paper, various AI-powered tools were utilized to support and enhance the writing and research process. Specifically, ChatGPT was used to assist in organizing content, clarifying concepts, and refining the structure of the manuscript. Grammarly and Quillbot were employed to improve the mechanics of writing, including grammar, punctuation, clarity, and paraphrasing where necessary. Litmaps and SciSpace were used to help locate and summarize relevant literature to support the development of the review of related studies and the theoretical framework. All AI-assisted inputs were critically reviewed, edited, and verified to ensure accuracy, originality, and academic integrity. The final content reflects my intellectual contributions and scholarly judgment.

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Design and Preliminary Evaluation of an Interactive Form Technology-Based Escape Room Music Learning Game With Contextual Spatial Clues Exploration

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Abstract

Lecture-based music teaching is often characterized by low student motivation and insufficient participation in the classroom, reflecting the difficulty in stimulating interaction and enthusiasm. Game-based learning can help to overcome these limitations of low motivation and low interaction, but it still faces the challenge of insufficient contextualization. In this study, we used Google Forms platform to develop an educational game called “The Sound of Your Presence,” which was designed to build a realistic castle space for players to explore and embedded digital tools such as an online virtual musical instrument and Google Chrome Music Lab to assist players to enhance their listening skills while exploring the castle and listening to melodic music. In addition, e-books are used as scaffolds to provide timely knowledge of music history and theory. Players can explore and analyze the music in the game. The participants in this study were 40 Taiwanese high school students. The study measured the students' flow, acceptance, and cognitive load. It was found that the learners had a high level of flow and acceptance of the game; they did not have a high intrinsic and extrinsic cognitive load, and had a moderate germane cognitive load, which indicated that the game was effective in facilitating the players' thinking. In the qualitative survey, more than half of the learners mentioned that games can stimulate the learning experience, and more than thirty percent of them said that the clues and scaffolding e-books provided in the games can help them learn more about music.

Keywords: music game-based learning, situated learning, scaffolding

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Introduction

In high school music classrooms, adolescents often experience reduced engagement due to boredom and distraction from mobile phones (Arnett, 1991). Despite diverse course content, abstract classical music and specialized terminology disconnected from daily life create significant barriers to comprehension and immersion, thereby undermining learning motivation and classroom interaction (McLeod & Becker, 1981; Palmgreen, 1984).

To bridge cognitive and emotional needs, appropriate scaffolding strategies reduce cognitive load. Music listening exercises employ score analysis and task decomposition (guiding students to first discern musical melodies before understanding harmonic progressions in accompaniment), layered instruction (supported by digital music technology platforms), and real-time prompts (e-book or question guidance) can be scaffolding strategies. This multi-modal integration of visual, auditory, and kinesthetic channels reduces cognitive load while enhancing auditory discrimination and music theory comprehension, thereby boosting learning motivation and situational engagement (Chandler & Sweller, 1991; Kuo & Hou, 2025; Lavy, 2023; Moreno & Mayer, 2000; Sai, 2024; Zhang, 2025).

Scenario-based simulation learning emphasizes student-centered motivation and emotional needs. This study employs a triple simulation mechanism of "story, space, and character" to design the educational game "Music with You" using Google Forms. This game features scenario exploration environments. During puzzle-solving, learners freely explore visual representations of the castle space. This immerses learners in the game's interactivity and fun while progressing through levels, aiming to simultaneously boost self-efficacy and learning motivation, reduce anxiety, enhance flow experiences, and ultimately improve learning outcomes (Chien et al., 2023; Csikszentmihalyi, 1990).

To address the abstract nature of music theory concepts, this study employs scaffolding theory as the core design framework for scenario-based game learning. Within educational games, multidimensional scaffolding effectively promotes knowledge application and overall learning outcomes (Chien et al., 2023; Csikszentmihalyi, 1990; Hou & Chou, 2012; Hou & Li, 2014). To support the learning process, this study employs an e-book integrated with clue inference mechanisms as an immediate knowledge guidance scaffold, providing timely prompts and task decomposition. It further incorporates digital tools such as the online virtual instrument Mussica and Google's Chrome Music Lab to enhance auditory discrimination skills, promote cognitive construction of auditory perception and music theory, and systematically reduce cognitive load through layered scaffolding design. seamlessly elevating auditory discrimination and music theory cognition to achieve classical music appreciation objectives.

Research Purposes and Questions

This study aims to design and evaluate an educational game operating on Google Forms. The game integrates two technological music platforms—*Mussica* and *Chrome Music Lab*—to enhance its visualization and concreteness. Additionally, it incorporates spatial scenes of 17th-18th century castles simulated through forms and generative AI images for learners to explore. An e-book provides scaffolding cues for real-time guidance. These designs aim to overcome challenges common in traditional lecture-based classical music appreciation, such as insufficient contextual authenticity, limited interactive time, and venue constraints. Through spatial exploration via contextual Google Forms, multimedia materials, and scripted form

interaction paths, learners enhance their comprehension of abstract classical music theory and increase learning motivation.

The research questions are: First, can the music-themed escape room game utilizing spatial exploration and form technology enhance learning flow? Second, what is the game's acceptance level based on its design? Third, how can cognitive load in learners be assessed within educational games?

Methods

This study was preliminarily tested through case analysis, involving 40 participants (20 male, 20 female) from two classes of Taiwanese high school students, with 20 students per class and equal representation of genders.

This music education game, titled "*The Sound of Your Presence*," utilizes Google Forms as its operational platform. It employs AI-generated imagery to recreate Baroque-era historical facts from the 17th to 18th centuries, simulating period-specific narratives, characters, settings, and environments. All operational details are centered on the 1600–1750 (Fiorentino, 2023) timeframe (Figure 1). Titled "*The Sound of Your Presence*," this educational game centers on an antique harpsichord crafted by Scarlatti himself, which can only be unlocked and played using the "*King's Key*." During problem-solving, students may consult an e-book for clues to find answers (Figure 2).

Figure 1

Generated AI Realistic Scenes Enhance the Immersive Fidelity and Presence of the Gaming Experience



Figure 2

Learners Engage in Game-Based Problem-Solving Through Coordinated Audiovisual Design, Utilizing the Scaffolding E-book as a Reference Resource for Clues and Answers



The research methodology employed three scales to measure students' flow, game acceptance, and game elements alongside cognitive load. The learning process comprised game instructions 10minutes), game activities(25minutes), and questionnaires on flow, acceptance, and cognitive load (15 minutes).

The flow questionnaire utilized the Kiili Flow Questionnaire (2006), translated and revised by Hou and Li (2014). This scale encompasses Flow Antecedents and Flow Experience, scored on a 5-point Likert scale. The 22-item questionnaire demonstrated high internal consistency (Cronbach's alpha = 0.98).

To assess learners' acceptance of games, the Game Acceptance Scale measures two sub-dimensions: Game Feedback and Game Elements, comprising 12 items. Adapted from Davis's (1989) Technology Acceptance Model, the Game Feedback Scale includes Cognitive Usefulness and Cognitive Ease of Use, totaling 7 items. Additionally, drawing from game motivation factors proposed by Chan et al. (2024), Chien et al. (2023), and Hou and Chou (2012), a game elements scale was developed, comprising five items. Both scales employed a five-point Likert scale for assessment. The internal consistency reliability for game acceptance was Cronbach's alpha = 0.98; for game feedback, Cronbach's alpha = 0.99; and for game elements, Cronbach's alpha = 0.95. All measurements demonstrated high internal consistency reliability.

The cognitive load scale was developed based on Leppink et al. (2013) and adapted from Klepsch et al. (2017). It comprises three dimensions with 8 items: extraneous cognitive load (3 items), assessing cognitive load arising from learning activity design or methods that fail to facilitate learning; and germane cognitive load (3 items), measuring the extent to which learning content helps learners establish metacognitive schemas and promotes reflection. All questionnaires employed a 5-point Likert scale, with internal consistency reliability (Cronbach's alpha) of 0.87.

Results and Discussions

The study measured students' flow, game acceptance, and cognitive load using scales. Results revealed that learners' descriptive statistics showed an overall flow mean of M = 3.69, standard deviation SD = 0.94 (Table 1); game feedback mean of M = 3.80, standard deviation SD = 0.94; and game elements mean of M = 3.76, standard deviation SD = 0.87 (Table 2). Following a one-sample t-test, the study found that the overall flow mean and all flow sub-dimensions, as well as game acceptance feedback, were significantly higher than the scale median (i.e., 3). This indicates that learners possess a moderately high level of flow experience, exhibit high flow during gameplay, and demonstrate high game acceptance.

Table 1
The Mean and Standard Deviation of Learners' Flow (N = 40)

	M	*SD*	*t*	*p*
Overall Flow	3.69	0.94	4.62***	< .001
Flow antecedents	3.67	0.96	4.41***	< .001
Flow experience	3.70	0.93	4.72***	< .001

Note. ***$p < 0.001$

Table 2
The Mean and Standard Deviation of Learners' Game Feedback, and Game Elements (N = 40)

	M	*SD*	*t*	*p*
Game Feedback	3.80	0.94	5.34 ***	< .001
Game Usefulness	4.45	0.61	5.38 ***	< .001
Game Ease of Use	4.56	0.67	5.06 ***	< .001
Game elements	3.76	0.87	5.46 ***	< .001

Note. $^{***}p < 0.001$

Regarding the descriptive statistics of cognitive load, the mean value for intrinsic cognitive load was M = 3.47 with a standard deviation SD = 0.92; The mean for extrinsic cognitive load was M = 3.16, with a standard deviation SD = 1.07; the mean for generative cognitive load was M=3.26, with a standard deviation SD = 0.89. Results from the one-sample t-test indicated that intrinsic cognitive load was significantly higher, while extrinsic cognitive load during gameplay showed no significant difference. For generative cognitive load, M = 3.26, SD = 0.89, t-test = 4.20, highly significantly exceeding the median of 3, indicating that music education games effectively enhance players' cognitive learning through thinking (Table 3).

Table 3
The Mean and Standard Deviation of Learners' Cognitive Load (N = 40)

	M	*SD*	*t*	*p*
Intrinsic cognitive load	3.47	0.92	3.19**	0.003
Extrinsic cognitive load	3.16	1.07	0.93	0.356
Germane cognitive load	3.26	0.89	4.20***	< .001

Note. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

In the qualitative survey, regarding learning motivation, 57.5% of learners reported that the game was highly engaging, effectively stimulating their motivation to learn, and providing an excellent, enjoyable experience. Regarding game acceptance, 30% of learners reported that this teaching method was unique, allowing them to use mobile phones and the internet to look up information, solve problems, and enhance memory, making the class innovative and fun. Regarding the scaffolding e-book teaching aid, 35% of learners reported learning a lot of knowledge through fun games, and that the game manual also provided valuable learning through reading. 25% of learners reported acquiring relevant musical terminology, music styles, music theory, and knowledge of various instruments through the game.

Conclusions and Limitations

This study developed a music education game titled "*The Sound of Your Presence*," using Google Forms to design a castle-themed spatial visualization. Preliminary results indicate that the design of a music-themed escape room game utilizing spatial exploration and form technology enhances learners' flow state, acceptance, and provides appropriate cognitive load during the learning process. Future research could expand the sample size and incorporate AI-powered online interaction as scaffolding. This would enable a comprehensive comparative analysis of how integrating AI as a teaching assistant within the same online game design affects flow, cognitive load, learning outcomes, scaffolding effectiveness, and perceived realism.

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Evaluating the Spillover Effects of an Ageism Reduction Intervention on Other Social Biases

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Abstract

There is a growing need to reduce ageism toward older adults. Prior studies have developed interventions that present a brief explanatory text emphasizing that "everyone will become an older adult someday" and introducing empirical findings from Stereotype Embodiment Theory. While such interventions can reduce ageism, they may unintentionally increase prejudice toward other groups. This could occur if the message is misinterpreted as implying that it is acceptable to hold biases against social groups one is unlikely to join. Therefore, the present study examined whether this type of intervention might inadvertently reinforce racism, sexism, or ableism. A total of 564 Japanese participants took part in an online experiment and were randomly assigned to either an experimental group (n = 289) or a control group (n = 275). The experimental group read the explanatory text described above, while the control group read an unrelated passage. To test group differences, Bayesian analyses were conducted to support the null hypothesis of no effect. Bayesian regression analyses, controlling for age and gender, showed no group differences in racism (β = -.12, 95% Credible Interval [CI] [-.29, .05], Bayes Factor [BF] = 0.57), sexism (β = -.01, 95% CI [-.17, .15], BF = 0.21), or ableism (β = -.09, 95% CI [-.25, .08], BF = 0.37). These results suggest that the intervention based on Stereotype Embodiment Theory does not reinforce other forms of prejudice. Therefore, the intervention developed in previous research should be actively utilized in the future to reduce ageism.

Keywords: ageism, racism, sexism, ableism, Bayesian analysis

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Introduction

In Japan and many other countries, the proportion of older adults in the total population is increasing. Accordingly, the importance of older adults and other generations working together and coexisting is growing year by year. Meanwhile, one of the obstacles to such intergenerational cooperation is ageism, which is defined as a "process of systematic stereotyping and discrimination against people because they are old" (Butler, 1987, p. 22). Ageism has been shown to negatively affect the well-being of older adults (Brinkhof et al., 2023), highlighting the need for its reduction.

One study in Japan that aimed to reduce ageism among younger people is Shimizu et al. (2022). This study employed a strategy that focused on the unique characteristic of older adults, emphasizing the idea that everyone will eventually become old. In addition, the Stereotype Embodiment Theory (SET; Levy, 2009) can be cited as a gerontological theory related to this characteristic. The SET suggests that individuals internalize age-related stereotypes from a young age. As they grow older, these stereotypes become self-relevant and can influence their health, behavior, and self-perception, often in negative ways. For example, in a 38-year longitudinal study involving 440 younger and middle-aged adults, Levy et al. (2009) found that individuals who held ageism at baseline were more likely to develop cardiovascular disease compared to those who did not.

In Shimizu et al. (2022), participants were presented with a brief explanatory text that included the fact that everyone will eventually become an older adult, along with empirical findings related to the SET (i.e. SET intervention). This brief intervention reduced participants' ageism, and the effect was shown to last for about one week (Shimizu et al., 2022). Moreover, the intervention was also found to increase the importance participants placed on policies supporting older adults (Shimizu et al., 2023). Based on the above, the SET intervention can be considered moderately effective in reducing ageism.

While this intervention has demonstrated effectiveness in reducing ageism, it may also inadvertently reinforce prejudice or discrimination against other social groups. This is because the SET intervention may strengthen attitudes that justify prejudice and discrimination toward groups perceived as unlikely to become part of one's own future self. For example, since it is essentially impossible for a White person to envision themselves as a member of a racially marginalized group, such as Black individuals, the SET intervention may inadvertently increase tolerance for prejudice toward that group. Therefore, it is necessary to demonstrate that the SET intervention does not reinforce prejudice or discrimination against other social groups.

This study aims to implement the SET intervention and verify that it does not reinforce prejudice or discrimination against other social groups. As concrete examples, this study addresses prejudice against racial minorities, sexual minorities, and people with disabilities, which are commonly examined in research on prejudice. Therefore, in this study, participants will be divided into an experimental group and a control group. After the intervention, racism, sexism, and ableism will be measured and compared between the groups. In doing so, this study aims to examine whether the null hypothesis of no difference between groups is supported. Therefore, this study employs Bayesian analysis, which allows for the affirmative acceptance of the null hypothesis.

Methods

Participants

Participants were recruited through major Japanese crowdsourcing platforms, CrowdWorks and Lancers. The participants consisted of 598 individuals (362 men and 236 women). A total of 34 participants who answered incorrectly on the reading check for the explanatory text used as the experimental manipulation (details provided below) were excluded from the analysis. As a result, the final sample used for analysis consisted of $N = 564$, including 337 men and 227 women. The mean age was 42.84 years (range = 21–64, $SD = 9.10$).

Procedure

The experiment was conducted online. Participants were informed about the purpose of the study and provided their consent to participate. They were randomly assigned to either an experimental group ($n = 289$) or a control group ($n = 275$). The experimental group read the explanatory text, while the control group read an unrelated passage. Next, participants responded to items measuring racism, sexism, and ableism. Finally, they were asked to report their age and gender as demographic variables. The data and the R code used for the analysis have been made available on the Open Science Framework (OSF) repository (https://osf.io/4jmbq/overview?view_only=b60c6c97bc71477d83b0c898e4861de1).

Intervention

In the experimental group, participants read the following text (Shimizu et al., 2023, p. 5): “Everyone will eventually become older adults with time. However, we can internalize negative attitudes toward older adults throughout our lives, and turn them against ourselves. In short, the stronger your current internalized negative attitudes, the worse your own mental and physical health as you become older (e.g., increased loneliness, decreased memory). Therefore, you should avoid maintaining negative attitudes toward older adults as they will have undesirable impacts on your own future. Such negative attitudes can also lead to a disregard for the will of older adults and other negative effects, which should be avoided for the sake of the older adults around you.”

In the control group, participants read the following text (Shimizu et al., 2023, p. 6):

Internet technology has changed the traditional information environment. There was once a clear division between huge senders and small receivers of information (e.g., TV and viewers or newspapers and readers). In the past, people were only receptive to information in the media; however, the interaction between the sender and receiver and the immediacy of communication have dramatically changed this environment. Media that allow people to demonstrate their active nature are called ‘participating’ media. These circumstances have produced new problems relating to trustworthiness and risk judgments regarding websites and information.

This explanatory text is grounded in the work of Ikeda (2010).

Reading Check Items

In the experimental group, participants were asked the following questions (Shimizu et al., 2023, p. 6): "Everyone will eventually become older adults with time," and "Negative attitudes toward older adults have undesirable impacts on ourselves and the older adults around us." In the control group, participants were asked the following questions (Shimizu et al., 2023, p. 6): "Media that allow people to demonstrate their active nature are called 'participating' media," and "There are new issues of trustworthiness and risk judgement regarding websites and information." The response options were "yes" or "no," with "yes" being the correct answer in all cases. Only participants who answered both questions correctly in each group were included in the analysis.

Questionnaire Items

Racism, sexism, and ableism were measured using the social distance scale developed by Muto and Kugihara (2015). Participants responded to the following eight items regarding racial minorities, sexual minorities, and people with disabilities: "1. not want to live together," "2. not want to work together," "3. not want to be friends," "4. not want them to live nearby," "5. not want to marry them," "6. cannot understand them," "7. not want to have conversations with them," and "8. would be embarrassed if others knew someone like this was in their family." The response options were as follows: "1. strongly disagree," "2. disagree," "3. somewhat disagree," "4. somewhat agree," "5. agree," and "6. strongly agree." For each category, the average score of the eight items was calculated, with higher scores indicating greater levels of racism, sexism, or ableism. The reliability coefficients (Cronbach's alpha) were .95 for racism, .94 for sexism, and .94 for ableism, respectively.

Results

Racism scores were M = 2.54 (SD = 1.02) in the experimental group and M = 2.66 (SD = 1.09) in the control group. Sexism scores were M = 2.76 (SD = 1.12) in the experimental group and M = 2.76 (SD = 1.12) in the control group. Ableism scores were M = 2.71 (SD = 1.06) in the experimental group and M = 2.81 (SD = 1.06) in the control group.

Bayesian regression analyses were conducted with racism, sexism, and ableism scores as dependent variables, and group (1 = experimental group, 0 = control group) as the independent variable. Participant age and gender were controlled in the analysis. The results showed no differences in racism, sexism, or ableism scores between the two groups (in order, β = -.12, 95% Credible Interval [CI] [-.29, .05], Bayes Factor [BF] = 0.57; β = -.01, 95% CI [-.17, .15], BF = 0.21; β = -.09, 95% CI [-.25, .08], BF = 0.37). In other words, the null hypothesis of no difference between the two groups was actively supported over the alternative hypothesis of a difference. Accordingly, these results suggest that the SET intervention does not reinforce other forms of prejudice.

Discussion and Conclusion

This study seeks to carry out the SET intervention and confirm that it does not lead to increased prejudice or discrimination toward other social groups, including racial minorities, sexual minorities, and people with disabilities. To this end, Bayesian analysis, which allows for the active acceptance of the null hypothesis, was employed. Results from an online experiment conducted with Japanese participants showed that the SET intervention did not reinforce racism,

sexism, or ableism. Therefore, the SET intervention should be actively utilized in the future to reduce ageism.

While the SET intervention did not produce any backfire effects such as reinforcing prejudice or discrimination toward other social groups, it also failed to reduce other forms of prejudice. This suggests that the SET intervention is specifically effective in reducing ageism, but not in addressing other types of bias. Given that the intervention focuses exclusively on content related to older adults, this result is not unexpected. To enhance its broader applicability, however, it may be beneficial to integrate the SET intervention with strategies targeting other forms of prejudice. Combining SET with additional educational or contact-based approaches could help reduce prejudice and discrimination across a wider range of social categories.

This study yielded the findings described above; however, it is limited by the fact that participants' racism, sexism, and ableism were measured only once. Consequently, it remains unclear to what extent the SET intervention produced changes in these three forms of prejudice. Additionally, in this study, to reduce participant burden and facilitate comparisons across target groups, prejudice toward each group was assessed using the same social distance scale (Muto & Kugihara, 2015). For more precise measurement of racism, sexism, and ableism, it is preferable to employ scales specifically designed for each category. Therefore, future research should incorporate more specialized items tailored to each specific form of prejudice.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that no AI or AI-assisted technologies have been used to generate, refine, or correct the content in the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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