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Improving Memory Retention in Mathematics: The Effectiveness of Digital Storytelling in Teaching Circle Geometry

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Abstract

This study examined the impact of digital storytelling on the retention of circle geometry concepts among secondary school students. Using a quasi-experimental pretest-posttest non-equivalent control group design, 132 senior secondary school students from four public schools in Nsukka Local Government Area, Enugu State, Nigeria, participated. Through multistage sampling, intact classes were assigned to either an experimental or control group. The experimental group received digital storytelling-based instruction, while the control group was taught using conventional methods. Data were gathered through the Geometry Achievement Test (GAT), administered as a pretest, posttest, and retention test four weeks post-intervention. The GAT demonstrated high internal consistency, with a Cronbach's Alpha reliability coefficient of 0.83. Data were analysed using SPSS (version 29), employing mean and standard deviation to address research questions and Analysis of Covariance (ANCOVA) to test hypotheses at a 0.05 significance level. Findings indicated that the experimental group achieved significantly higher retention than the control group, confirming the effectiveness of digital storytelling as a teaching tool in mathematics. Additionally, gender had no significant effect on retention outcomes. These results suggest that digital storytelling can enhance engagement and deepen understanding of complex mathematical concepts, providing a valuable method for educators. Based on the findings, recommendations were made, one of which is that educators should integrate digital storytelling into their instructional approaches to support student learning in mathematics.

Keywords: circle geometry, digital storytelling, mathematics performance, multimedia tools, retention, secondary school learners

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Introduction

The increasing integration of technology into education has opened new pathways for improving students' engagement and learning outcomes, particularly in subjects perceived as abstract and challenging, such as mathematics (Egara & Mosimege, 2023a, 2024a, 2024b). One of the persistent difficulties students face in mathematics is the inability to retain complex concepts, especially in areas like circle geometry (Nzeadibe et al., 2020; Osakwe et al., 2022), which require both spatial reasoning and an understanding of interrelated geometric properties. In Nigeria, as in many other countries, underachievement in mathematics remains a major concern due to the dominance of teacher-centred instructional approaches that often fail to promote active participation and long-term understanding (Mosia & Egara, 2024; Okafor, Enemuo, et al., 2023; Okafor, Nosike, et al., 2023; Okeke et al., 2025).

In response to these challenges, educators are exploring innovative teaching methods that blend pedagogy with digital technology to create more meaningful and memorable learning experiences (Egara et al., 2025; Egara & Mosimege, 2023b). One such method is digital storytelling, an instructional strategy that uses the elements of storytelling (such as characters, setting, conflict, and resolution) combined with multimedia tools like images, narration, music, animations, and videos to convey content in an engaging and relatable way. According to Guler and Duman (2021), digital storytelling allows learners to connect with abstract concepts by placing them within real-life or imaginative narratives that are easier to visualise, understand, and remember.

Digital storytelling is not just about storytelling using digital tools; it is a powerful educational approach that transforms traditional instruction into a dynamic and learner-centred experience (Nasir et al., 2024). For instance, in mathematics education, a teacher might use a digital story to introduce circle geometry through a scenario where characters solve real-life problems involving circular objects, such as designing a roundabout or calculating distances along arcs. This contextualisation can help students better grasp the relevance and application of mathematical concepts (Lawani, 2023; Tosun & Engin, 2023).

The benefits of digital storytelling in education are well-documented. It promotes active learning**,** stimulates interest**,** supports multiple learning styles, and enhances the retention of information by combining audio-visual stimulation with emotional and cognitive engagement (Büyükkarci & Müldür, 2022). It also encourages creativity, critical thinking, and communication skills among students who participate in creating or analysing digital stories (Tosun & Engin, 2023). However, challenges exist. These include the availability of technological infrastructure, especially in under-resourced schools, teacher competence and training in using digital tools, and the time-consuming nature of creating high-quality digital stories (Chaisriya et al., 2023). Additionally, without careful instructional planning, digital storytelling may risk shifting focus from learning objectives to entertainment, thus reducing its effectiveness in achieving educational outcomes (Robin, 2008). Despite these challenges, digital storytelling presents a valuable opportunity for addressing the limitations of conventional mathematics instruction. In Nigeria, where technological adoption in schools is still evolving, there is a pressing need for empirical studies investigating the practical effectiveness of digital storytelling in real classroom settings.

Several studies have examined digital storytelling's impact on students' retention, though mostly outside mathematics and at non-secondary levels. Dös (2015), working with

university students in Turkey, found that creating digital stories in various disciplines improved long-term knowledge retention, especially for complex topics. Similarly, Aktas and Yurt (2017) investigated digital storytelling in a university science course and observed improved achievement and retention compared to traditional methods. Özkaya and Coşkun (2019) studied 8th-grade students learning Turkish language concepts at the basic education level. Their findings showed that digital storytelling enhanced retention by simplifying abstract ideas. Using secondary school students in Thailand, Chaisriya et al. (2023) integrated digital storytelling into a language and communication course, emphasising its role in boosting metacognition and retention. Ginting et al. (2024) explored digital storytelling across disciplines in Indonesian universities and concluded that it improved retention and knowledge transfer.

While these studies affirm the benefits of digital storytelling, no known studies have investigated its application in mathematics, particularly in circle geometry at the senior secondary school level. Similarly, gender-based differences in retention outcomes within this context remain unexplored. This clear gap highlights the need for subject-specific and localised research, which the present study seeks to address. This study aims to investigate the effectiveness of digital storytelling in improving students' retention of circle geometry concepts and to determine whether gender plays a role in retention when this instructional method is employed. Thus, the study seeks to address the following questions:

1. What is the effect of digital storytelling on the retention scores of senior secondary school learners in circle geometry, compared to the conventional method?
2. What is the effect of gender on the retention scores of learners taught circle geometry using digital storytelling?

Based on the research questions, the study tested the following null hypotheses at a 0.05 level of significance:

1. There is no statistically significant difference in the retention scores between learners taught circle geometry through digital storytelling and those taught using the conventional method.
2. There is no statistically significant difference in the retention scores of male and female learners exposed to digital storytelling in learning circle geometry.

Theoretical Basis

This study is grounded in Richard E. Mayer's *Cognitive Theory of Multimedia Learning* (2009), which posits that learners understand and retain information more effectively when presented using visual and auditory channels. The theory is based on three key assumptions: that learners process information through two separate channels (dual-channel), each with limited capacity, and that meaningful learning occurs when learners actively engage with content by selecting, organising, and integrating information. Digital storytelling aligns well with this theory, combining narration, visuals, and text to stimulate both channels simultaneously. In the context of teaching circle geometry, this multimedia approach helps learners form mental models of abstract concepts, improving comprehension and long-term retention. Thus, the theory supports the study's focus on enhancing memory retention by integrating digital storytelling in mathematics instruction.

Methods

A quasi-experimental pretest-posttest non-equivalent control group design was adopted. The experimental group received instruction on circle geometry using digital storytelling, while the control group was taught conventionally. Pretests, posttests, and a retention test (administered four weeks later) were used to assess achievement and long-term retention. The population comprised all SSS 1 students in Nsukka LGA, Enugu State. Using multistage sampling, 132 students from four public secondary schools with requisite digital facilities were selected. Schools were randomly assigned to experimental (n = 68) and control (n = 64) groups using intact classes. Data were collected using a 30-item Geometry Achievement Test (GAT), covering key circle geometry theorems. A Table of Specifications guided item alignment with curriculum objectives. The GAT served as pretest, posttest, and retention test. Three experts validated the GAT and lesson plans; a pilot test produced a KR-20 reliability of 0.83.

The study followed a three-phase approach: pretest, intervention, and posttest (including a delayed retention test). Before the intervention, a two-week training was provided to participating teachers. Those in the experimental group were trained on digital storytelling tools (e.g., Canva, Sway, GeoGebra) and strategies like role-play, interactive storytelling, and gamified assessment. Control group teachers received a refresher on conventional teaching methods. All teachers held at least a B.Sc. (Ed) in Mathematics and had a minimum of five years of experience. Students first completed a GAT to establish baseline knowledge. During the five-week intervention, both groups were taught the same circle geometry topics across four weekly periods but with different methods. The experimental group used digital storytelling to introduce topics, engaged with interactive tools, created digital stories, and completed gamified assessments. The control group received traditional instruction using chalkboard explanations, textbook examples, and past WAEC questions. Each week focused on a specific concept in circle geometry, including theorems on angles at the centre and circumference, angles in the same segment, angles in a semicircle, cyclic quadrilaterals, and the alternate segment theorem. After the intervention, the GAT was re-administered as a posttest. Four weeks later, a delayed retention test (with reshuffled GAT items) assessed long-term retention. Data collected were analysed using SPSS version 29. Mean and standard deviation addressed research questions. ANCOVA at $\alpha = 0.05$ tested hypotheses, controlling for pretest scores. Shapiro-Wilk tests confirmed normality for achievement ($W = 0.98$, $p = .421$) and retention ($W = 0.97$, $p = .315$).

Results

The presentation of findings is in line with the research questions and hypotheses.

Research Question One

What is the effect of digital storytelling on the retention scores of senior secondary school learners in circle geometry, compared to the conventional method?

The analysis reveals that learners taught with digital storytelling (n = 68) achieved a higher mean posttest score (M = 93.37, SD = 5.87) and retention score (M = 95.97, SD = 3.67), with a mean gain of 2.6. In contrast, the conventional group (n = 64) had lower posttest (M = 64.70, SD = 6.85) and retention scores (M = 64.08, SD = 6.73), showing a slight decrease of

0.62. This indicates that digital storytelling positively affected learners' retention of circle geometry concepts. The test of Hypothesis 1 would ascertain this finding.

Hypothesis One

There is no statistically significant difference in the retention scores between learners taught circle geometry through digital storytelling and those taught using the conventional method.

The ANCOVA results reveal a significant difference in retention scores between students taught circle geometry using digital storytelling and those taught by the conventional method ($F(1, 127) = 77.976$, $p < .05$). This indicates that digital storytelling substantially improves retention compared to traditional instruction. With a moderate effect size (partial eta squared = .380), the instructional method accounts for 38% of the variance in retention scores. Consequently, the null hypothesis is rejected, confirming that the teaching approach significantly influences learners' retention.

Research Question Two

What is the effect of gender on the retention scores of learners taught circle geometry using digital storytelling?

Male learners taught circle geometry using digital storytelling had a posttest mean score of 93.30 (SD = 5.43) and a retention mean score of 95.39 (SD = 3.95), showing a mean difference of 2.09. Female learners scored slightly higher, with a posttest mean of 93.43 (SD = 6.33) and a retention mean of 96.51 (SD = 3.34), resulting in a mean difference of 3.08. Both groups demonstrated strong retention of the concepts, with females exhibiting a marginally greater improvement over time. The test of hypothesis two will confirm whether this observed difference in retention between male and female learners is statistically significant.

Hypothesis Two

There is no statistically significant difference in the retention scores of male and female learners exposed to digital storytelling in learning circle geometry.

The ANCOVA analysis revealed no significant difference in retention scores between male and female learners taught circle geometry through digital storytelling ($F(1, 127) = 0.524$, $p = .470$). This indicates that gender does not significantly impact students' retention of the material. Consequently, the null hypothesis is not rejected, affirming that retention scores are similar for male and female learners in this instructional context.

Discussion

The study examined the effect of digital storytelling on the retention of senior secondary school learners in circle geometry, compared to the conventional teaching method. As reported by the first hypothesis, the findings revealed that learners taught circle geometry using digital storytelling had significantly higher retention scores than those taught with the conventional method. This indicates that digital storytelling effectively enhances learners' retention of geometric concepts. This positive effect might be attributed to the multimedia nature of digital storytelling, which engages learners through visual, auditory, and narrative

components. Such multimodal learning helps simplify complex or abstract ideas, making them more relatable and easier to internalise. The narrative structure also promotes deeper cognitive engagement and motivation, which is essential for long-term retention.

The finding aligns with earlier research by Dös (2015) and Aktas and Yurt (2017), who found that digital storytelling enhanced retention among university students. Özkaya and Coşkun (2019) reported similar effects with 8th graders in language learning. Chaisriya et al. (2023) noted improved metacognition and retention at the secondary level, while Ginting et al. (2024) confirmed its effectiveness across university disciplines. Collectively, these studies support digital storytelling as a strong tool for enhancing student retention. The results align with the Cognitive Theory of Multimedia Learning (Mayer, 2009), which suggests that learning improves when information is presented through visual and auditory channels. Digital storytelling leverages this by integrating narrative and multimedia elements, facilitating effective encoding and retrieval of geometric concepts.

Regarding gender, the study found no significant difference in retention scores between male and female learners taught with digital storytelling. This suggests that the method is equally effective across genders, supporting inclusive pedagogy. Although no prior studies specifically explored gender differences in retention using digital storytelling, our findings align with the Cognitive Theory of Multimedia Learning (Mayer, 2009)**.** This theory posits that learners, regardless of gender, process information more effectively when content is presented through well-integrated verbal and visual channels. Digital storytelling leverages this principle by reducing cognitive overload and enhancing engagement, allowing all learners to retain complex mathematical concepts more efficiently. Thus, the instructional design, rather than gender, is the key factor influencing retention.

Conclusion

This study investigated the effect of digital storytelling on senior secondary school learners' retention in circle geometry. Findings revealed that learners taught with digital storytelling significantly retained the circle geometry concepts more than those taught with the conventional method. Additionally, gender did not significantly influence retention outcomes, suggesting that digital storytelling is an inclusive instructional approach. These results underscore the potential of digital storytelling to enhance conceptual understanding and long-term retention in mathematics, particularly in abstract topics like circle geometry. While the findings indicate that digital storytelling can effectively enhance retention in circle geometry across gender, these results should be interpreted cautiously. The study's focus on a limited geographic region and a single mathematical topic means the conclusions may not apply universally. Broader studies are needed to confirm these outcomes across varied settings and mathematical domains. Despite these limitations, the findings offer important educational implications. Teachers and curriculum planners should integrate digital storytelling into mathematics instruction as an evidence-based strategy for enhancing students' retention of complex concepts. Since retention supports long-term academic success, especially in abstract topics like circle geometry, embedding multimedia tools can improve learning outcomes. Educational stakeholders, including policymakers, should consider professional development programs that train teachers in digital storytelling techniques. Future research should explore a broader range of mathematical topics and include qualitative data to understand better how digital storytelling facilitates retention across diverse learner groups.

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Challenges and Determinants of Academic Performance in First-Year Physical Science Students: Evidence From a Secondary City University in Bangladesh

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Abstract

This study explores factors influencing the academic performance of first-year Bachelor of Science (B.Sc.) honors students in physical science departments at a public university in Bangladesh. It examines economic, socio-demographic, academic, environmental, and extracurricular factors to identify strategies for improving academic achievement and fostering inclusivity. Using a mixed-method approach, data were collected from 185 students through surveys and interviews, with statistical analyses conducted using chi-square tests, logistic regression, and ANOVA. The findings underscore the impact of evaluation systems within universities. Results indicate that gender, intended academic discipline, study habits, and regional disparities significantly influence academic performance. Male students and those from remote areas demonstrated lower academic achievement, while effective study habits and group study participation were associated with higher performance. Furthermore, the study highlights the necessity for effective curriculum and improved library resources. These offer actionable insights for policymakers and educators to reduce educational inequality and improve retention in public universities.

Keywords: academic performance, first-year students, physical science students, higher education, Bangladesh

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Introduction

Education is vital for national development, equipping individuals with the skills needed for societal advancement. In Bangladesh, higher education has seen notable growth in recent years, placing increased emphasis on student performance. Assessing this performance is crucial for evaluating institutional effectiveness and shaping students' future opportunities (Alam & Islam, 2022).

First-year students in any program frequently encounter challenges that can impede their academic success, as reflected in their cumulative grade point average (CGPA) (Kotzé & Kleynhans, 2013). Significant predictors of CGPA include students' interest in science, previous academic performance in school and college, perceptions of science's relevance to future employment, and availability of academic resources (Al Hazaa et al., 2021; Bhuia et al., 2016; M. A. K. Chowdhury et al., 2009). First-year students, especially in public universities, face challenges like adapting to diverse educational systems, financial strain, and reduced well-being. Their anxiety is heightened during the transition to university life, often resulting in lower well-being compared to others, underscoring the need for comprehensive support systems (Cooke et al., 2006; Hassel & Ridout, 2018).

The study of students' prior academic achievement, course knowledge, gender, and first-year performance is crucial for understanding how these factors shape academic trajectories (Ayala & Manzano, 2018). Previous research emphasizes students' objectives, expectations, and willingness as key influences on academic outcomes (Money et al., 2017; Ribeiro et al., 2019). The first year of higher education is critical for students' future success, retention, and resilience, emphasizing the need for targeted interventions during this transition. Students form academic attitudes, decide future engagement, and develop academic identities, influenced by socio-demographic factors (Hernández Pina et al., 2006; Merhi Auar et al., 2018).

The non-engagement factors may pose a risk to academic performance and are influenced by environmental and situational factors. First-year students often struggle with unrealistic expectations about class sizes, staff availability, and workload (Crisp et al., 2009; Hassel & Ridout, 2018). Older students often outperform younger ones, with personal history being a predictor of academic success (Alam & Islam, 2022; Kim et al., 2016). Additionally, gaps in subject understanding, linked to access to socio-academic resources, further hinder performance, as seen in South African first-year chemistry students (Marais & Mji, 2009). Students' motivation for choosing a subject or discipline, along with their preparation and expectations, can influence academic success and persistence, especially among first-year students (Baxter & Hatt, 2000; Byrne & Flood, 2008).

Besides, a high dropout rate during the first year, leading to both social and individual consequences (Aina, 2013). Dropout and adjustment challenges are prevalent across Europe, with financial and psychological impacts (Ayala & Manzano, 2018). Despite their strong capabilities, first-year physical science students with a science background face dropout risks due to environmental and situational factors, highlighting the need to explore challenges and determinants of academic performance (Casanova et al., 2023; Kocsis & Molnár, 2025), which have received limited attention in Bangladesh.

This study, therefore, aims to address the gap in research on first-year physical science students' academic performance in Bangladesh. By identifying key factors affecting

performance, it provides actionable insights for policymakers and educators to enhance performance and inclusivity, reducing educational inequality and improving retention. Unlike prior studies, it focuses on students persisting beyond their first year, particularly those in their final year of the B.Sc. program at a secondary city university.

Methodology

Research Design and Data Collection

The study was conducted at Shahjalal University of Science and Technology (SUST) in Sylhet, focusing on fourth-year bachelor's students from six departments in the Faculty of Physical Sciences. It aimed to examine the challenges and determinants of academic performance in their first-year B.Sc. honors program. Using a mixed-method approach, data were collected via an online questionnaire and in-depth interviews. Sylhet, with a population of 0.7 million, is a secondary city in northeastern Bangladesh. The research was conducted during the 2023 academic year.

Sample Selection and Questionnaire Design

A sample of 185 students was selected from the population of fourth-year physical science students at SUST, ensuring representation of at least 30 students from each of the six departments. Since a previous study found the interclass correlation coefficient based on socio-demographic covariates to be around 0.7 among groups of university students (Loong et al., 2017), the following formula (Ukoumunne, 2002) was used to calculate the minimum sample size:

$$E = \frac{1}{\sqrt{mk}} \sqrt{2(1-\hat{\rho})^2[1+(k-1)\hat{\rho}]^2 \Big/ k(k-1)m} \quad (1)$$

Where, k = the required sample size in each group, m = number of groups = 6 Zα/2 = the z score from standardized normal distribution at α% level of significance = 1.96 (with 5% significance level), $\hat{\rho}$ = the estimated interclass correlation coefficient = 0.7, and E = the margin of error = 0.05 (5% margin of error). Using these values, k was found to be approximately 7. Therefore, as with the previous studies (Rahman et al., 2021; Urmi et al., 2022), this current study used more than the minimum required sample size for the analysis.

The questionnaire covered ten domains related to academic performance, study habits, socio-demographic characteristics, and student challenges, identified through a literature review and pilot survey. Key variables were selected based on frequency and significance. Academic performance was measured using CGPA, with other factors assessed through Likert-scale questions and open-ended responses.

Data Analysis

Descriptive statistics summarized students' background characteristics. Chi-square tests explored relationships between first-year CGPAs (GPA for both semesters) and examined factors. Logistic regression models assessed the independent effects of various factors on academic performance, with odds ratios and confidence intervals quantifying these effects. In addition, ANOVA tested variable impacts. These methods provided insights for policymakers to enhance student performance and promote inclusivity in higher education.

Results

Background Characteristics of the Students

Demographics: The study survey reveals that students mainly hail from Dhaka (29.2%), Chattogram (19.5%), and Sylhet (13%). The majority are male (76.8%) and Muslim (84.3%). Most fathers (76.8%) and mothers (67.6%) of the students have completed secondary school or higher.

Financial Background: Around 51.9% of students rely on family financial support, while 37.3% manage their own expenses. A slight majority (40%) report a monthly family income between 30,001 and 60,000 Tk.

Academic Background: A significant dropout rate was observed, with 31.4% leaving in the first semester and 39.5% in the second semester. Of these dropouts, 20.5% received grades below 3.00 in their first semester, and 16.8% did so in the second semester. Overall, 20% of students experienced poor academic performance in their first year. Most students excelled in SSC (78.9% achieving A+) and HSC exams (68.6% earning A or higher).

Academic Choices and Intentions: More than half of the students (55.7%) intended to shift to Applied and Engineering subjects, with 58.9% citing unintentional admission into physical sciences and 29.2% choosing it due to personal interest.

Study Habits and Resources: Most students (77.3%) study only 0–2 hours daily, with time management (43.8%) and lack of resources (41.6%) being major challenges.

Social and Environmental Factors: Social media and internet usage negatively impacted 65.9% of students' academic performance. Furthermore, 63.8% expressed concerns over inadequate library resources.

Academic Support and Challenges: Though 50.3% engage in group studies, 61.6% felt their academic advisors were not helpful. Physical and mental health challenges affected 41.1% and 63.8%, respectively.

Lifestyle and Extracurricular Activities: Eating habits influenced academic achievement for 61.1%. A common challenge agreed upon (57.3%) is the difficulty experienced in navigating the new evaluation assessment systems at the university, which differ from those in schools and colleges. Low engagement in extracurriculars (47.0% sports, 44.3% organizations, and 19.5% politics) had mixed effects on performance.

Challenges and Barriers: The findings from this study highlight several remarkable challenges include an impractical curriculum (60.5%), English fluency issues (52.4%), poor exam routine management (41.6%), and financial strain. While ragging and exam retakes were not significant for most, they remain challenges for some.

Identification of the most significant factors is crucial, as it can inform targeted interventions and support mechanisms designed to improve the educational experience and outcomes for all students.

Factors Influencing First-Year Academic Performance

Outcome Variable

The study categorizes students into two groups based on their first-year CGPA: those with a CGPA ≥ 3 are deemed "good performers," while those with a CGPA < 3 are labeled as "not good performers." This binary outcome variable forms the basis of the analysis.

The Associations

Table 1 highlights only the most notable associations between academic performance and variables like economic status, environment, socio-demographics, and extracurricular factors. Significant findings include:

- Gender and Evaluation Systems: Gender and the diverse evaluation systems significantly affect first-year performance ($p < 0.05$). A higher proportion of male students (23.2%) score below CGPA 3.00 compared to females (9.3%). Moreover, 32.5% of students attribute their low CGPA to the adopted evaluation systems at university, with 3.2% strongly agreeing.
- Family Residence, Library access, and Study Hours: Family residence, library access, and study habits impact performance ($p < 0.10$). Students studying less than one hour daily show poor performance (28.4%).
- Regional Disparities: Students from Rangpur (40%) and Rajshahi (38.9%) divisions show CGPAs below 3.00. Students from distant locations consistently demonstrate unacceptable academic performance throughout their first year.

Table 1
Chi-Square Test of Academic Performance of Students According to Selected Background Characteristics

Characteristics	Category	1st Year Result < 3	1st Year Result ≥ 3	*Chi-square*	*p-value*
Division (Family Residence)	Barishal	0 (0.0%)	4 (100%)	12.43	0.087
	Chattogram	4 (11.1%)	32 (88.9%)		
	Dhaka	8 (14.8%)	46 (85.2%)		
	Khulna	2 (16.7%)	10 (83.3%)		
	Mymensingh	6 (27.3%)	16 (72.7%)		
	Rajshahi	7 (38.9%)	11 (61.1%)		
	Rangpur	6 (40.0%)	9 (60.0%)		
	Sylhet	4 (16.7%)	20 (83.3%)		
Gender	Male	33 (23.2%)	109 (76.8%)	4.01	0.045
	Female	4 (9.3%)	39 (90.7%)		
Academic discipline intended to study	Medical and Health Sciences	6 (27.3%)	16 (72.7%)	7.47	0.113
	Applied and Engineering	15 (14.6%)	88 (85.4%)		
	Social Sciences / Business Management	1 (8.3%)	11 (91.7%)		

Characteristics	Category	1st Year Result < 3	1st Year Result ≥ 3	*Chi-square*	*p-value*
	Agriculture Sciences	2 (33.3%)	4 (66.7%)		
	Others	13 (31.0%)	29 (69.0%)		
Study hours per day	< 1	23 (28.4%)	58 (71.6%)	7.43	0.059
	1-2	10 (16.1%)	52 (83.9%)		
	2-4	4 (11.1%)	3 (88.9%)		
	4+	0 (0.0%)	6 (100%)		
Seminar library satisfactory	No	29 (23.8%)	93 (76.2%)	3.18	0.074
	Yes	8 (12.7%)	55 (87.3%)		
Study resources	Strongly disagree	4(36.4%)	7(63.6%)	6.160	0.188
	Disagree	3(9.7%)	28(90.3%)		
	Neutral	12(28.6%)	30(71.4%)		
	Agree	14(18.2%)	63(81.8%)		
	Strongly agree	4(16.7%)	20(83.3%)		
Group studies	No	21(22.8%)	71(77.2%)	0.914	0.339
	Yes	16(17.2%)	77(82.8%)		
Classroom and environment	Strongly disagree	9(32.1%)	19(67.9%)	7.215	0.125
	Disagree	7(13.7%)	44(86.3%)		
	Neutral	12(27.9%)	31(72.1%)		
	Agree	7(13.0%)	47(87.0%)		
	Strongly agree	2(22.2%)	7(77.8%)		
Impact of student politics	Strongly disagree	1(50%)	1(50%)	7.714	0.103
	Disagree	2(22.2%)	7(77.8%)		
	Neutral	3(50%)	3(50%)		
	Agree	0(0%)	11(100%)		
	Strongly agree	1(12.5%)	7(87.5%)		
Different evaluation system	Strongly disagree	1(11.1%)	8(88.9%)	10.123	0.038
	Disagree	5(17.5%)	24(82.8%)		
	Neutral	8(19.5%)	33(80.5%)		
	Agree	22(29.3%)	53(70.7%)		
	Strongly agree	1(3.2%)	30(96.8%)		
Impractical curriculum	Strongly disagree	0(0%)	8(100%)	6.566	0.161
	Disagree	4(21.1%)	15(78.9%)		
	Neutral	5(10.9%)	41(89.1%)		
	Agree	18(23.4%)	59(76.6%)		
	Strongly agree	10(28.6%)	25(71.4%)		

Binary Multiple Logistic Regression Model

As in the previous studies (Asaduzzaman et al., 2023; Bhuia et al., 2015; M. Chowdhury et al., 2008), this study utilized a binary multiple logistic regression model to assess the independent effects of various predictors on first-year academic performance. Significant variables from the chi-square test included division, gender, intended discipline, study hours, library satisfaction, study resources, classroom environment, student politics, evaluation systems, and curriculum perceptions. A 20% significance threshold was established. Key findings are presented in Table 2.

Table 2
The Results of Binary Multiple Logistic Regression for the Effects of Selected Background Characteristics on the Academic Performance of the Students

Characteristics	Category	*Odds Ratio (OR)*	***95% CI***		*p-value*
			Lower	**Upper**	
Division (Family Residence)	Barishal	323094968.570	0.000	.	0.999
	Chattogram	1.600	0.359	7.130	0.538
	Dhaka	1.150	0.310	4.262	0.834
	Khulna	1.000	0.156	6.420	1.000
	Mymensingh	0.533	0.128	2.219	0.388
	Rajshahi	0.314	0.075	1.316	0.113
	Rangpur	0.300	0.068	1.331	0.113
	Sylhet	1.0			
Gender	Male	0.339	0.113	1.018	0.054
	Female	1.0			
Academic discipline intended to study	Medical and Health Sciences	1.195	.381	3.752	0.76
	Applied and Engineering	2.630	1.121	6.172	0.026
	Social Sciences / Business Management	4.931	.575	42.294	0.146
	Agriculture Sciences	.897	.145	5.528	0.906
	Others	1.0			
Study hours per day	< 1	0	0		0.999
	1-2	0	0		0.999
	2-4	0	0		0.999
	4+	1.0			
Seminar library satisfactory	No	0.466	0.199	1.092	0.079
	Yes	1			
Study resources	Strongly disagree	0.350	0.068	1.789	0.207
	Disagree	1.867	0.376	9.275	0.445
	Neutral	0.500	0.141	1.772	0.283
	Agree	0.900	0.266	3.048	0.866

Characteristics	Category	*Odds Ratio (OR)*	***95% CI***		*p-value*
			Lower	**Upper**	
Classroom and environment	Strongly agree	1.0			
	Strongly disagree	0.603	0.104	3.507	0.574
	Disagree	1.796	0.308	10.462	0.515
	Neutral	0.738	0.134	4.068	0.727
	Agree	1.918	0.330	11.158	0.468
Impact of student politics	Strongly agree	1.0			
	Strongly disagree	0.143	0.004	4.612	0.272
	Disagree	0.500	0.036	6.862	0.604
	Neutral	0.143	0.010	1.995	0.148
	Agree	230782120.407	0.000	.	0.999
Different evaluation system	Strongly agree	1.0			
	Strongly disagree	0.267	0.015	4.748	0.368
	Disagree	0.160	0.017	1.463	0.105
	Neutral	0.138	0.016	1.165	0.069
	Agree	0.080	0.010	0.626	0.016
Impractical curriculum	Strongly agree	1.0			
	Strongly disagree	646189937.140	0.000	.	0.999
	Disagree	1.500	0.399	5.640	0.549
	Neutral	3.280	1.005	10.708	0.049
	Agree	1.311	0.531	3.236	0.557
	Strongly agree	1.0			

Division: Regarding the impact of division on first-year academic performance, the odds ratios for students from Rajshahi (OR = 0.314, p = 0.113) and Rangpur (OR = 0.300, p = 0.113) are both below 1, suggesting that students from these more distant regions are less likely to perform well academically (CGPA $\geq$ 3) in their first year compared to those from Sylhet. However, this finding is only marginally significant ($p < 0.20$). In contrast, students from other divisions (Barishal, Chattogram, Dhaka, Khulna, Mymensingh) show no significant association with academic performance, as reflected by corresponding high p-values.

Gender: A gender-related disparity was observed, with male students having a lower odds ratio (OR = 0.339) compared to female students for achieving a CGPA above 3.00. This indicates that male students may be less likely to achieve higher academic performance than female students, although the difference is not strongly statistically significant. Further research is needed to explore the underlying causes of this gender-based variation in academic outcomes.

Academic Discipline: Students who initially aimed for applied and engineering sciences (OR = 2.630, p = 0.026) or social sciences/business management (OR = 4.931, p = 0.146) have

higher odds of superior academic performance than peers with different interests. The significant association for applied sciences highlights the need for targeted interventions.

Satisfaction with seminar library: Students who are satisfied with the seminar library are more likely to achieve better academic performance in their first year compared to those who are not, with the result being marginally significant (OR = 0.466, p = 0.079). This finding underscores the importance of considering various factors that influence academic success, rather than relying solely on resource satisfaction as a predictor.

Study Hours: Studying less than four hours daily associated with lower academic performance (odds ratios 0.0, p = 0.999), highlighting the need for increased study hours. Low odds and high p-values indicate possible data issues needing further review.

Impact of Evaluation Systems: Students who believed that different evaluation systems in the university impacted their performance had significantly lower odds of succeeding (OR = 0.080, p = 0.016) than those who viewed these systems as challenging. Adapting to new evaluation formats can be especially difficult for students with weaker academic skills, leading to potential academic setbacks due to unfamiliarity. Therefore, universities should provide additional support to help students navigate these systems and enhance academic performance.

Impractical Curriculum: Students neutral about the impracticality of the curriculum are more likely to achieve the outcome, and this result is statistically significant at $p < 0.05$. This suggests a possible misalignment between curriculum design and student needs, prompting further investigation into the curriculum's effectiveness.

Therefore, regional disparities, gender, intended academic discipline, perceived evaluation impacts, library satisfaction, and study hours significantly influence first-year academic performance. Other factors lacked statistical significance. Their combined effects and interactions warrant further investigation in comprehensive analyses.

ANOVA Model

To further explore the factors influencing academic performance among first-year students, a one-way Analysis of Variance (ANOVA) was conducted. The outcome variable for academic performance was constructed by multiplying the CGPA of the first-year students by 20 to create a continuous variable suitable for ANOVA testing.

The results from the ANOVA model are presented in Table 3. The p-values indicate that the variables “study hours per day” and “group studies” are statistically significant at the 5% level. Additionally, the variables “gender” and “division” are statistically significant at the 10% level.

The findings indicate that daily study time and participation in group studies significantly affect academic performance. Gender and regional division also influence outcomes, though at a lower significance level. Notably, while group studies were significant in the ANOVA test, they lacked significance in the chi-square and logistic regression analyses, emphasizing the need for varied analytical methods to understand academic performance fully.

Overall, the ANOVA results corroborate the logistic regression findings, emphasizing the critical role of daily study habits, gender, and regional differences in shaping the academic outcomes.

Table 3
ANOVA Table of The First Year Student Academic Performances

Characteristics	Category	Mean Score of First Year CGPA	Standard Deviation	*p-value*
Division (Family Residence)	Barishal	65.1017	1.56629	0.081
	Chattogram	65.4473	4.17934	
	Dhaka	64.6525	4.52895	
	Khulna	64.7774	4.22016	
	Mymensingh	61.8998	3.84764	
	Rajshahi	62.5998	5.47604	
	Rangpur	62.9103	4.78583	
	Sylhet	64.4574	4.88250	
Gender	Male	63.7952	4.54063	0.069
	Female	65.2414	4.57150	
Academic discipline intended to study	Medical and Health Sciences	64.2746	5.20828	0.835
	Applied and Engineering	64.3660	4.24465	
	Social Sciences / Business Management	64.5493	3.41625	
	Agriculture Sciences	63.1257	5.47817	
	Others	63.5051	5.26663	
Study hours per day	< 1	62.8721	4.41226	0.000
	1-2	64.5472	4.45066	
	2-4	65.1623	3.98738	
	4+	70.6473	4.45896	
Seminar library satisfactory	No	63.7533	4.60005	0.118
	Yes	64.8634	4.47609	
Study resources	Strongly disagree	63.4820	5.08630	0.136
	Disagree	66.0837	4.52995	
	Neutral	63.6265	4.48124	
	Agree	63.7279	4.15056	
	Strongly agree	64.0849	5.51993	
Group studies	No	63.2601	4.43059	0.01
	Yes	64.9932	4.57851	
Classroom and environment	Strongly disagree	63.0963	4.68277	0.332

Characteristics	Category	Mean Score of First Year CGPA	Standard Deviation	*p-value*
	Disagree	64.7391	4.58632	
	Neutral	63.4118	4.90020	
	Agree	64.7702	4.19597	
	Strongly agree	63.5120	4.63435	
Impact of student politics	Strongly disagree	61.8862	4.28240	0.685
	Disagree	63.5705	5.93009	
	Neutral	61.7568	6.63634	
	Agree	65.2375	3.13085	
	Strongly agree	63.8817	4.39898	
Different evaluation system	Strongly disagree	63.5845	2.76681	0.107
	Disagree	65.3248	5.15156	
	Neutral	64.1882	4.43080	
	Agree	63.1895	4.79072	
	Strongly agree	65.3771	3.68357	
Impractical curriculum	Strongly disagree	65.1627	3.23670	0.793
	Disagree	63.9613	5.69136	
	Neutral	64.5589	3.85098	
	Agree	64.1390	4.88140	
	Strongly agree	63.4092	4.48336	

Discussion

According to the findings, the transition to university assessment systems presents the major challenge for first-year students, contributing to suboptimal performance. Many students find it difficult to adapt to the differing evaluation methods used in universities compared to their previous educational experiences, such as in schools or colleges. This supports prior research emphasizing the importance of adequate orientation programs that help students adjust to new academic environments and evaluation standards (Hassel & Ridout, 2018). Consequently, universities need to offer extensive support systems, including orientation sessions and academic advising, to smooth this transition (López et al., 2023).

The study findings reveal that gender plays a crucial role, with male students more likely to experience lower academic performance compared to female students. This aligns with existing literature, which also reports gender disparities in academic outcomes (Ayala & Manzano, 2018). The gender gap suggests a need for targeted interventions to address the specific challenges faced by male students, thereby improving gender equity in academic outcomes.

Research has shown that dissatisfaction with library services, particularly in terms of study spaces and resources, can negatively impact academic performance (Scoulas & De Groote, 2019). This study also found that students dissatisfied with their library facilities are less likely to achieve high academic success.

A significant finding of this study is the influence of students' aspirations to study disciplines outside of physical sciences, particularly their preference for applied sciences and engineering. This highlights the importance of aligning students' interests with their academic programs to increase engagement and motivation, which, in turn, positively impacts academic performance. Prior studies corroborate this by stressing the role of student motivation and discipline selection in educational success (Money et al., 2017).

The perception of the curriculum's practicality also significantly impacts students' academic performance. Students who view the curriculum as relevant and applicable to their future careers demonstrate better academic results. This reinforces the need for continuous curriculum evaluation to ensure it meets student expectations and aligns with real-world demands (RESNICK & RESNICK, 1985). Universities, therefore, should regularly assess and update their curricula to ensure they remain practical and engaging for students, addressing not only academic but also professional development needs.

Another significant factor identified is geographical distance from the university, which affects students' ability to maintain regular study routines and engage fully with academic resources. According to an earlier study, this regional disparity highlights the need for targeted interventions to support students from remote areas (Cooper et al., 2017). Providing an environment that helps the students refrain from family emotion could mitigate the negative impact of geographical isolation.

Moreover, the involvement in student politics emerges as a notable non-academic factor affecting academic performance. This finding is consistent with earlier research (Hernández Pina et al., 2006), indicating that extracurricular activities, particularly those involving political engagement, can have both positive and negative impacts on students' academic trajectories. Thus, universities should establish a balance, promoting extracurricular involvement that complements academic responsibilities rather than hindering them.

Furthermore, study habits emerge as a critical determinant of academic success. Students who dedicate more hours to studying and participate in group study sessions consistently achieve better results. This finding aligns with existing research linking regular study practices to improved academic outcomes (Byrne & Flood, 2008). Effective time management and access to study resources are therefore essential to promoting better academic performance. Universities should prioritize fostering good study habits through workshops, academic support, and structured study schedules.

The pervasive issue of dropout due to university education adjustment in the first-year has been found, as also noted in an earlier (Vossensteyn et al., 2015), underscores the challenges faced by this cohort of students. High dropout rates among first-year students carry profound social and individual ramifications (Aina, 2013; Razouki et al., 2019).

In brief, this study reveals that a range of socio-demographic, environmental, and academic factors shape the academic performance of first-year physical science students. By addressing gender disparities, aligning academic programs with students' aspirations, balancing extracurricular activities with a relevant curriculum, and providing strong support for academic transitions, study resources, and study habits, while minimizing the impact of family-related emotional pressures, educational institutions can cultivate more inclusive and supportive environments that promote student success.

Conclusion

This study investigated the multifactorial determinants impacting the academic performance of first-year Bachelor of Science (B.Sc.) honors students in physical science departments at Shahjalal University of Science and Technology, Bangladesh. A comprehensive analysis revealed key socio-demographic, academic, environmental, and extracurricular factors affecting students' progress. Challenges identified included difficulties in transitioning from different evaluation systems, geographical distance from the university, and ineffective study habits, all contributing to academic struggles. Targeted interventions, such as orientation programs and improved resource access, are essential for enhancing student success. Furthermore, students' perceptions of curriculum relevance significantly impact their performance, emphasizing the need for ongoing curriculum reforms. Gender disparities were notable, with male students at greater risk of lower academic performance, highlighting the importance of tailored support strategies. Aligning students' academic aspirations with curricula could also boost engagement and retention rates. Overall, the findings provide valuable insights for policymakers and educators to develop context-specific strategies that enhance academic success for first-year physical science students in Bangladesh.

Authors' Contributions

This work was carried out in collaboration among all authors. MMI, along with other authors, took charge of study design, data collection, analysis, and manuscript drafting. KR made significant contributions by assisting in polishing the article and as a supervisor. All authors participated in the review and approved the final manuscript.

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Data Availability Statement

Regarding data availability, interested parties can obtain the dataset used in the study upon request by contacting the corresponding author.

Disclosure Statement

The authors report there are no competing interests to declare.

Ethics of Experimentation

Although there is currently no formal committee at SUST to approve the ethical issues of research, verbal approval was obtained from the corresponding authority.

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Theory to Practice: The Impact of an "Imported" Flipped Classroom Model on Second Language Learners

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Abstract

The flipped classroom model, designed to shift from lecture-based instruction to active learning, is examined in this paper via its recent adoption at a UAE higher education institute using an "imported" framework and pre-existing materials complicated by online delivery. The study examines the experiences of second-language learners *(n = 12)* through structured focus group discussions. Educators *(n = 3)* conducted 12 observations totaling 72 to 180 hours to evaluate the model's appropriateness. Findings highlight discrepancies between the model's theoretical foundations and its practical execution in this context, necessitating revisions to course materials, structure, and assessments to enhance inclusivity and equity for learners.

Keywords: flipped classroom model, active learning, second language learners, cultural context

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Introduction

The primary objective of this study is to investigate the challenges second language learners face when engaging with an "imported" flipped classroom (FP) model within a higher educational setting in the United Arab Emirates (UAE). This research specifically seeks to identify the barriers that language presents in the utilization and effectiveness of the flipped classroom model, which was originally developed in a Western context and later implemented in the UAE. Although the Flipped Classroom model promises to transform learning from lecture-based to student-centered, enacting active learning that helps students understand concepts (Al-Samarraie et al., 2020; Chen et al., 2018; Doman & Webb, 2017; Hamdani, 2019; Mehring, 2016), other studies reported that the flipped classroom (FP) encourages engagement and promotes discussion in class (Lee & Wallace, 2018; Moradi et al., 2020; Ramnanan & Pound, 2017). While this model promotes a shift from teacher-led instruction to a more student-centered approach, encouraging active learning and greater student responsibility, the effectiveness of this shift may be compromised in a context where English is not the learners' first language. Additionally, the FP model under investigation is Western developed with ready-made materials, which can present unique challenges, such as fully engaging with the FP model. This study examines these challenges, focusing on how language barriers affect the adaptation and success of flipped classroom strategies in a non-native English-speaking environment. The flipped classroom model in this context is facilitated online; the lessons are done on a platform, and the sessions are recorded. Furthermore, the students are expected to interact and engage fully in class by pre-reading the material and engaging in various activities online, like polls, breakout rooms, and verbal contributions. Additionally, the activities are graded weekly without the knowledge of students. The latter has been enacted in the hopes of a more dynamic classroom interactions. Thus, the study is guided by two main questions: (1) What are students' experiences in an online flipped classroom model? (2) Are there any challenges to learning in the online flipped classroom model? The insights gained aim to offer guidance on adapting flipped classroom models to suit diverse student populations' linguistic and cultural contexts, ensuring that educational innovations are inclusive, accessible, and effective across different linguistic backgrounds.

Theoretical Framework

This study uses the integration of Second Language Acquisition (SLA) Theory and Constructivist Learning Theory in the flipped classroom model to explore how these approaches can enhance educational outcomes for second language learners. SLA Theory, which emphasizes the importance of input, interaction, and contextual use of language, is particularly well-suited to the flipped classroom model, where pre-class activities are structured to maximize meaningful language exposure. This framework allows learners to engage with language content prior to class, facilitating a more effective use of class time for deeper understanding and interactive practice (Ellis, 2003; Gass et al., 2008).

Constructivist Learning Theory posits that learners build their own knowledge through experiences (Piaget, 1954). Supporting the flipped classroom methodology, this theory suggests that students should first encounter new materials outside of class, which then allows them to expand upon this initial engagement through in-class activities. This is particularly advantageous for second language learners, who can adjust to new linguistic materials at their own pace before participating in complex discussions and collaborative activities in the classroom setting (Vygotsky & Cole, 1978).

The synergistic use of these theories addresses several educational challenges faced by second language learners. For example, learners often suffer cognitive overload when new language material is presented too quickly. By processing material at their own pace outside the classroom, students experience enhanced comprehension and reduced cognitive load, as posited by cognitive load theory (Sweller, 1988). Additionally, active engagement is crucial for effective language learning and is maximized when students prepare before class, leading to more dynamic and participatory class sessions (Larsen-Freeman & Anderson, 2013).

Methods

This case study sought to explore the flipped classroom model enacted in a higher Educational Institution. The research site is a federal institution located in the United Arab Emirates (UAE) with two campuses, one in the Emirate of Abu Dhabi and the other in the Emirate of Dubai. The institute was founded in 1998 and serves Emirati and non-Emirati female and male students. Higher education in the UAE depends on English-Medium as the mode of instruction (Zoghbor, 2014), including this study.

The study employs two data collection methods: focus group discussions and observations. Utilizing several forms of data helps triangulate the results and fulfill credibility. The first stage of the study was the focus group discussion with ($n = 12$) students (Table 1) selected based on convenience sampling, which is best suited for case studies (Cohen et al., 2018). While this method facilitated efficient data collection, it may limit the generalizability of the findings. To overcome this, the researchers utilized maximal variation method to get richer data (i.e, students from both campuses, various nationalities, and genders). The focus group protocol was guided by an outline wherein, first, the moderator highlighted the ethical convention, the right to withdraw, and the anonymity of their names; second, students introduced themselves, and the moderator asked demographic questions and school background experience. Later, the moderator guided the discussion on the students' experiences with the flipped classroom model.

Table 1
Description of Student Participants (names are pseudonyms)

Name		Gender	Age	Campus	Nationality	Background of School Type
1.	Gelila	Female	20	Abu Dhabi	Ethiopian	Private
2.	Desta	Female	18	Abu Dhabi	Ethiopian	Private
3.	Abeba	Female	20	Abu Dhabi	Ethiopian	Private
4.	Omar	Male	21	Dubai	Emirati	Private
5.	Shamsa	Female	18	Dubai	Emirati	Private
6.	Ismail	Male	19	Dubai	Emirati	Public
7.	Zahra	Female	18	Dubai	Emirati	Public
8.	Salama	Female	18	Abu Dhabi	Emirati	Public
9.	Ahmed	Male	19	Dubai	Emirati	Private
10.	Bedoor	Female	18	Dubai	Emirati	Private
11.	Noora	Female	18	Dubai	Emirati	Private
12.	Meera	Female	18	Dubai	Emirati	Private

Due to the small number of participants, data saturation was not achieved for the focus group discussion but was accomplished from observation. Indeed, the second stage was the semi-

structured observation, employed to discover other missed information in interviews (Moyles, 2002). The observations consisted of twelve observations of class recordings that ran for 60 to 90 minutes; the total observed hours ranged from 72 to 180 hours. Three observers took part (Table 2) and provided detailed observation notes.

Table 2
Description of Observers

Observer Number	Background	Teaching Experience
One	Technology and pedagogical content knowledge (TPACK)	Twenty years
Two	Translation and English Teaching	Ten years
Three	Inclusive Education	Nine years

The data were analyzed using thematic analysis to identify recurrent themes and patterns (Figure 1&2). Furthermore, the researchers received ethical approval from the institution's institutional review board. To avoid any potential harm or negative consequences, the participation of students was completely voluntary, and the students had the freedom to withdraw from the study. Furthermore, the researchers cross-interviewed the participants so they had someone other than their instructor to whom they could express their thoughts freely. Moreover, the consent forms clearly assured the participants that this research aimed only to understand their experience with the flipped classroom approach.

Figure 1
Themes From Semi-structured Interviews

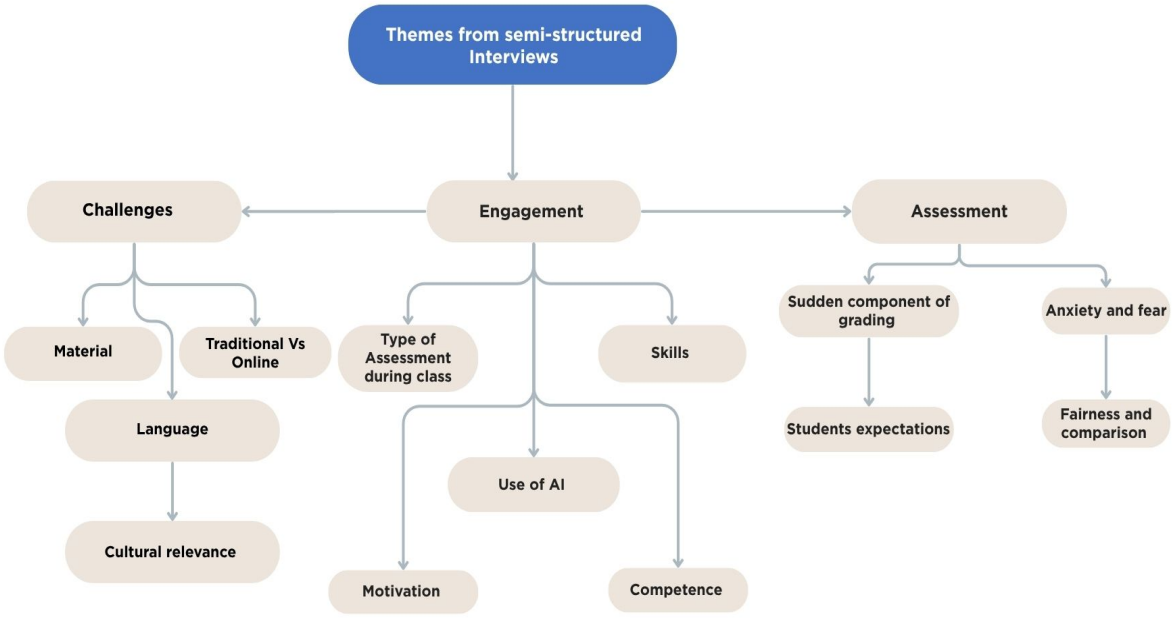
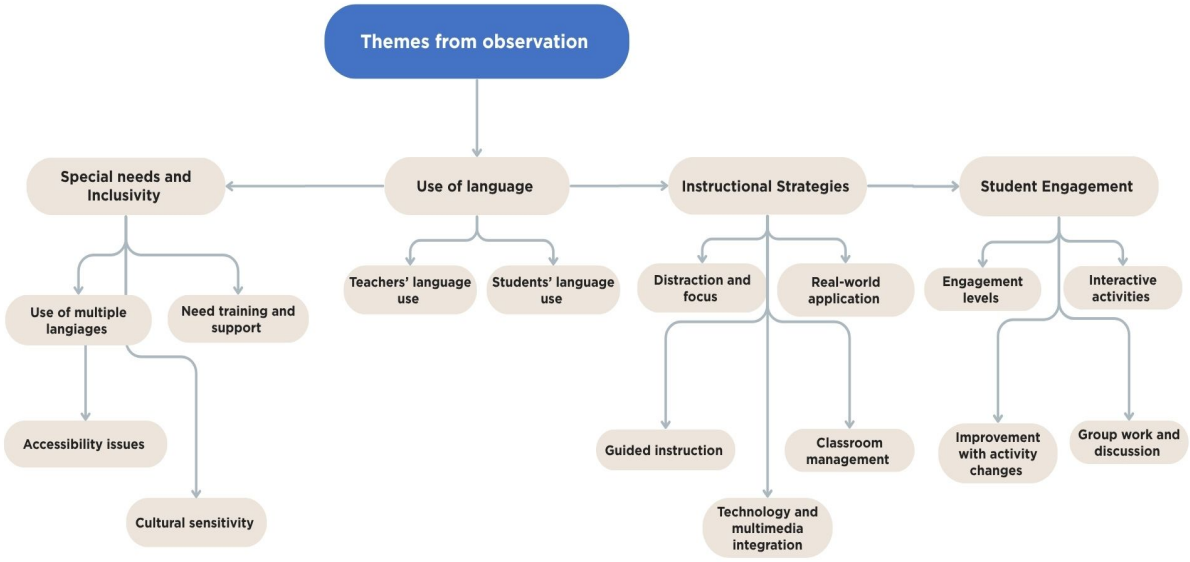


Figure 2
Themes From Observation



Data Sources and Materials

Four focus group discussions with *(n = 12)* students were recorded and transcribed. Some interviews were conducted in English or Arabic, and some in vernacular Arabic based on the participant's preference. The duration of the focus group discussions spanned, on average, 90 minutes. The transcripts were translated and shared with participants to validate or add additional information. Later, the data were analyzed, and to ensure trustworthiness, several techniques were used, such as member checking and confirming and disconfirming of evidence (Teddlie & Tashakkori, 2009). The process of creating themes and coding followed Ryan and Bernard (2003), which includes detailed steps and results on linking the themes to a theoretical model. The data has been triangulated to add multiple perspectives and a richer understanding of the researched topic (Creswell, 2014). The data from the focus group discussion guided the observation as it emerged with themes on language and engagement of the students in the online setting. The observers were randomly assigned recorded sessions of two courses out of the four assigned to students to be viewed at their own time and pace. The observation protocol followed a semi-guided method with two scopes to focus on: (1) the use of language during the teaching (teacher) and learning (students) session, (2) describing students' engagement during the teaching session, and a third section where the observer can freely highlight any other topic. Further, the observers were given a brief introduction to the purpose of the study with no further details from the focus group discussions to avoid attentional bias to the lesson's content. Two observers provided an etic perspective as they had not instructed students in the FP model, and one provided an emic perspective to the observations.

Results

Students' Experiences

The selection of "Language as the Steering Wheel" and "Engagement - a Double-Edged Sword" as primary themes for this study is rooted in their critical relevance to understanding

the experiences of second language learners in the flipped classroom model. Language proficiency, a vital element of student interaction with educational content, serves as a pivotal barrier impacting both comprehension and engagement. Additionally, examining engagement as a nuanced, multifaceted theme reveals how it varies among students and is influenced by language barriers and cultural differences. Together, these themes provide crucial insights into the challenges and dynamics of implementing flipped classrooms in linguistically diverse settings.

Language as the Steering Wheel

The students discussed the use of language in the flipped classroom as a challenge in two ways: (1) as part of the pre-class preparation material and (2) during class discussions. The first is important to be accomplished as the method of teaching depends on the learners' participation and engagement. Shamsa explains, "I do the readings but I get confused, and I don't understand, if only the material was summarized to one or two pages so I can digest it before class." Ismail has also added his point of view and compared the level to high school, "The vocabulary is bigger and stronger, unlike in school, I use Google Translate to understand the words." Noora had the same but added her personal feelings, "I don't understand what I read, but I just keep reading reading, reading to satisfy my conscience." Ahmed and Abeba both commented on the amount of reading required and Abeba elaborated, "One thing I would recommend is making the workload a bit less for students to be more engaged because sometimes the pre-class work are really a lot that it takes up attention to finish the readings rather than understanding those things." Bedoor voiced other students' experiences as she narrated, "From my experience, there were students that did not know English so much. So when they are struggling, they were coming to us as students."

Engagement – A Double-Edged Sword

Another important theme that is the essence of flipped classrooms is the students' engagement. Indeed, the latter is the drive of the pedagogy and the means of success in flipped classrooms. The students commended the online mode for helping them engage as they reported on the "emoji functions" and "breakout rooms," but they were less keen on verbal contributions and polls as they are connected to assessments. On the other hand, the observers noted the tardiness of students, lack of participation during "breakout sessions," and overall disparities in engagement in activities within the lesson. Salama added another angle by saying, "How do they compare the students to each other in terms of participation? I mean, we are different. We are not the same." When asked about improving his skills and performance in the flipped classroom, Omar answered, "No, my grade is not that great!" As for Meera, she described her engagement level as she said, "Maybe at first, I feel lost, but once the professor goes through them. Yeah, it makes sense to me."

Observers' Notes

Similar to the students' voiced concerns, the observers mentioned the language level. Observer three commended the use of the mother tongue to help ease the lesson and using videos and discussions during class to clarify concepts. Furthermore, observer One noted the following, "the need for the teacher to probe extensively to get answers suggests that some students may require additional support or motivation to participate actively." Observer three mentioned that students were more engaged when discussing real-life situations rather than rigid concepts. In fact, the comment is highly critical given that the observer witnessed two

courses, one that had topics such as “executive function, disorders, etc.…” and the second had concepts such as “heuristics, biases, deductive and inductive reasoning.”

The three observers noted another concern, which is inclusivity in the flipped classroom (see Figure 2). Observer one related it to cultural factors and the fact of lower participation by the female students. Observer Two noted higher productivity in writing tasks during lessons than in verbal communication. Verbal communication has been documented as a challenge for second language learners compared to other skills (Alrasheedi, 2020; Evans & Green, 2007; Hyland, 1997; Leong & Ahmadi, 2017). Observer three reported that the teaching mode was non-accessible for special educational needs students. Hence, this suggests a lack of engagement in the FP model; engagement is divided into three components: behavioral, emotional, and cognitive (Fredricks et al., 2004). The study's data, including students’ narratives and observers' notes, show challenges in both. Behavioral engagement includes the aptitude to participate in and execute tasks and coursework. Emotional includes the stress level reported by students as engagement is connected to their everyday assessment during the online flipped class. The cognitive engagement was reported in the coursework and language level (Table 3). The challenge of online teaching has been documented in several studies in the United Arab Emirates with a similar population of undergraduate students for whom English is not their mother tongue (Al Maktoum et al., 2024; Mohebi & Meda, 2021).

Table 3

Engagement Division Based on Fredricks, Blumenfeld & Paris (2004)

Type of Engagement	Students’ Views	Observer’s Note
Behavioral	Coursework – load Attendance–technology issues Participation – cultural and linguistic	Tardiness
Emotional	Amount of stress Satisfaction of course	Teacher mediating – low participation and involvement from students
Cognitive	Attention issues Heavy workload	Challenge of concepts

Discussion and Conclusion

The FP model was introduced to renew the traditional teaching method in the higher education institute under study to involve students better and engage them in learning. Hence, the data of this study shows that disparities have been added among learners, mainly in the shape of language and overall competence, far away from the true meaning of the FP class. The inadvertent consequences of importing a model have been documented in the same context when gender and culture have not been integrated (Wagner & Bogiages, 2020). Moreover, Michael (2006) states that active learning is bound to context, learners, and the teachers’ background and competence in teaching; he further adds, “Active learning doesn’t just happen” (p.164). Furthermore, the FP material, like videos, is a way to give simple aids for conceptual and complicated theoretical concepts (Agirman & Ercoskun, 2022). Gauging the material to the student’s level of English is an important factor in engagement and a way to have culturally responsive teaching (Banks & Banks, 2019; Gay, 2018; Villegas & Lucas, 2002); it is even more critical if the material is not relatable to the student’s context. Additionally, Butt (2014) stresses the importance of aligning the course material to the course

outcomes and cautions on the burden and time spent to prepare and deliver a flipped classroom, making it an unsustainable approach in education. The latter is especially relevant in this context, as two of the students in this study revealed their intention to return to the traditional route rather than the FP classroom model. Thus, decision makers need to use empirical studies to attune the model to students' needs better. As such, students can describe their experiences with tangible examples that can be revised; examples are the quantity of materials, and the language used. The institute can dedicate a team of educators, like the observers of the study, that can alter and adapt the material to make learning accessible for all.

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Cooperative Classroom Interaction as Predictors of Students' Academic Achievement in Chemistry

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Abstract

This study was conducted to determine the predictive power of cooperative classroom interaction on students' academic achievement in chemistry in Kogi East and West senatorial districts. two research questions and two null hypotheses guided the study. A correlational statistical research design was used. The population of the study was 7,617 with a sample size of 384 SS II Chemistry students. Multistage sampling procedure was adopted. Two instruments were used for data collection which were Chemistry Cooperative Classroom Interaction Inventory (CCCII) and Chemistry Achievement Test (CAT). Content validity of CAT was developed using table of specification, the construct validity of CCCII was determined using factor analysis and 15 items considered factorially pure were selected while the impure were rejected. The reliability indices obtained for CCCII was 0.87 while reliability index of 0.71 was obtained for CAT. Data collected were analysed using regression analysis, Analysis of Variance (ANOVA) and t-test. The findings showed that the Predictive power of Cooperative classroom interactions on students' Academic Achievement in Chemistry is moderate and significant; the Predictive power of Cooperative classroom interactions on students' academic achievement in chemistry as moderated by gender is moderate and significant. Based on the findings, it was recommended among others that Conferences, seminars and in-service training in chemistry should be organized by school administrators and government for teachers to enable them gain adequate knowledge and experiences on cooperative classroom interaction style and use it during chemistry instruction.

Keywords: predictive power, cooperative classroom interaction, chemistry

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Introduction

Science is the systematic study of our environment which builds and organizes knowledge in the form of testable explanation and predictions about the universe. Science is the most important and major channel in which knowledge is transmitted. Through the application of science nations are built, societal aspirations and goals are achieved. The benefits of science lie on building knowledge about the universe and constructing new ideas that illuminate the world around us. These ideas are inherently tentative, but as they cycle through the process of science again and again and are tested and retested in different ways, we become increasingly confident in them. Furthermore, through this same interactive process, ideas are modified, expanded, and combined into more powerful explanations. There are three major branches of science which includes biology, chemistry and physics.

Chemistry has been one of the cornerstones of science, technology, and industry. It is apparent that chemistry plays a greater role in National Development through the industries in the world (Ibrahim et al., 2017). Chemistry is a branch of science that deals with constituents of matter like atoms molecules, ions, etc.; and its properties, structure, behaviour, and interactions among them (Anne, 2019). Rocke and Usselman (2021) defined Chemistry as the science that deals with the properties, composition, and structure of substances (defined as elements and compounds), the transformations they undergo, and the energy that is released or absorbed during these processes. Chemistry is a branch of science that deals with the study of matter, its compositions, structural appearance, properties, and principles that govern the changes that take place within matter. Every substance, whether naturally occurring or artificially produced, consists of one or more of the hundred-odd species of atoms that have been identified as elements. These atoms, in turn, are composed of more elementary particles; they are the basic building blocks of chemical substances. Chemistry, therefore, is concerned not with the subatomic domain but with the properties of atoms and the laws governing their combinations and how the knowledge of these properties can be used to achieve specific purposes.

The knowledge of Chemistry has led to the creation of environmentally friendly chemicals, cosmetics, fine and heavy chemical for industrial production of goods for the happiness of mankind. Chemistry provided mankind with a large number of life-saving drugs. Also, we have environment-friendly chemicals that help us conserve nature. One such example is the replacement of Chlorofluorocarbons (CFCs) in refrigerators. Because of the advancements in science and the discoveries of chemistry, there is an increase in Comfort, Pleasure, and Luxury life styles today. Despite the numerous importance of Chemistry to mankind and the society at large, and Governments' efforts in making several provisions that will facilitate the teaching and learning of Chemistry in Senior Secondary Schools, Chemistry is still plagued with poor academic achievement. This is observed in the chemistry students results in West African Examination Council (WAEC) as reported by the Chief Examiner's report 2020 - 2023.

WAEC Chief Examiner's Report stated that students had problems in understanding the demands of the questions, exhibited poor communication skill, wrote trivial names instead of formulae, lacked adequate knowledge of chemical concepts, could not draw correct and workable diagram for the preparation of chlorine gas in the laboratory and could not write the correct formula of a compound. Students lacked understanding of simple concepts in chemistry, had poor communication skill, were unable to give proper definition of concepts, unable to write formula instead of names, unable to write correct IUPAC names of organic

compounds among others. These attested to poor Students' academic achievement at senior secondary school Chemistry.

Students' academic achievement in Chemistry has always been a concern of the Nigerian government, researchers, teachers, school administrators and parents. Many researches have been carried out and some factors which contributed to the poor academic achievement on students were identified to include; poor teaching pedagogy and class size, school and class environment, teacher's attitude, qualification, teaching style, as well as lack of instructional and learning materials and low instructional supervision. Also reported that students with dysfunctional characteristics such as lack of confidence, low self-esteem, lack of self-control, and high anxiety are said to have low emotional intelligence, and this may affect their academic achievement (Michael & Ismail, 2016). The academic achievement of students can be enhanced using cooperative classroom interaction.

Cooperative classroom interaction is a learning strategy employed in the classroom where students work in subgroups and interact effectively. Members of each subgroup work towards mutual goals and complete class assignment or exercise together during teaching/learning processes. The teacher's job here is providing the enabling environment with varieties of learning activities as to improve students' understanding of the subject. According to Johnson et al. (2014) cooperative learning is instructional method in which teachers organize students into small groups, who then work together to help one another learn academic contents. Using this strategy, the goals of separate individual are linked together and that there is a positive correlation among the group members in other to achieve success. Cooperative classroom interaction is a process involving people working together and having an influence on each other. This is always observed in the way students behaves, work together, relate with people at home and in school (peer group and home). The relationship between the learner and the teacher forms an integral part of the teaching-learning process. Cooperative classroom interaction is a learning strategy that organizes students in small groups so that they can work together to maximize the learning of others. In particular, cooperative classroom interaction is a learning strategy in education where students are organized in pairs or in small groups to help each other in learning the assigned material (Ajaja & Eravwoke, 2012).

The tasks of cooperative classroom learning are usually intellectually demanding, creative, open, and involve higher-order thinking tasks. Cooperative learning can therefore allow weak students to learn and achieve the maximum (Ajaja & Mezieobi, 2018). Brady and Tsay (2010) opined that students who fully take part in group activities, provide useful feedback and positive behaviour which is essential for their academic carrier. According to Jacobs et al. (2016) cooperative classroom interaction involves principles and techniques for helping students work together more effectively. Cooperative classroom interaction is a student-centered pedagogy in which the teacher's role changes from being the teacher to facilitator of students' learning thereby making them acquire new knowledge themselves, also illustrated that the scope of Cooperative classroom interaction extends beyond simply grouping students and assigning them tasks. Rather, Cooperative classroom interaction requires students to cooperate among themselves and depend on each other to perform classroom tasks. According to Gillies (2016) learners can exchange ideas and knowledge to achieve shared goals in a Cooperative classroom interaction environment. This implies that social interaction fosters positive learning that results in greater achievement for all class or group members. Er et al. (2014) revealed from studies that majority of students preferred cooperative classroom interaction to individual learning because cooperative classroom interaction helped to better

understanding of their study contents and participate in classroom activities. Jacobs et al. (2016) stated that cooperative classroom interaction, improves collaboration skills, student attitudes towards learning, creates opportunities for teachers to assess student learning, and influences student's academic achievement. Bareerah (2014) found that Cooperative classroom interaction promotes students' participation and achievement in learning. The findings of Murad (2015) indicated that students had both positive and negative opinions regarding cooperative classroom interaction.

Some students preferred cooperative classroom interaction since positive collaboration among group members helped them learn from each other and finish their tasks in a short period. On the other hand, some students preferred not to share their ideas with others, and others disliked group work and considered it a time for relaxation. Students achieve more in learning when they negotiate their understanding through class discussion, interaction with peers, and exchange of thoughts and ideas (Oviawe et al., 2016). Kalu (2009) conducted a study on classroom interaction patterns and students' learning outcomes the findings of the study showed a significant positive relationship that exists between interaction pattern and students' post-instructional attitude and achievement. Ajaja and Eravwoke (2012) in their research "effects of cooperative learning strategy on junior secondary school student's achievement in integrated science" revealed that cooperative classroom interaction learning when used as an instructional strategy brings significant improvement on students' academic achievement. Can this positive observation be seen in other science subject especially Chemistry? This present study seeks to find the predictive power of cooperative classroom interaction on students' academic achievement in chemistry irrespective of their gender.

Gender bias and misconceptions has remained the main focus and of great concern in the field of science education. It is the socially and culturally constructed characteristics and roles that are ascribed to males and females in any society. It is a major factor that influences the career choice, subject interest, and academic performance of students; women are hindered from progressing through discrimination based on gender, early marriage, and childbearing, and as a result, they are deprived of sound education, job opportunities and incapacitated, and rendered passive generally in the society.

There has been a great interest by researchers into whether there is relationship between gender and Chemistry Cooperative Classroom Interaction Inventory (CCCII). Although opinions and findings vary, it seems that Cooperative Classroom Interaction differs between the sexes. These variations could be a result of social and biological influences. Some features are viewed as desirable for one gender but not the other, for example, assertiveness is a "typical" masculine trait whereas empathy is viewed as a desirable female trait. Gender has been regarded as an essentially social phenomenon (Meshkat & Nejati, 2017). According to their study, males and females are socialized differently – females are encouraged to be cooperative, expressive and tuned in to their interpersonal world, whereas males are encouraged to be competitive, independent and instrumental.

Researchers have expressed diverse views about gender and academic achievement, especially in sciences including chemistry. Some researchers opined that male students do better than female students while others like Ogunleye and Babajide (2011) disagree with this view, arguing that achievement is a factor dependent on several factors such as socio-economic background, teaching method, among others. Ezeudu and Obi (2013), also showed that male students achieved significantly better than the female students in both urban and rural schools. Daniella et al. (2014) put forward that the more masculine characteristic that

young adults had, the more they are attracted to a masculine career such as engineering or mechanic and the less attracted to a feminine career such as teachers or social worker. Arsaythamby et al. (2015) in their research disclosed that male students obtained significantly higher achievement in chemistry when measure up with the female counterparts between Malay and Chinese students. Oviawe et al. (2016) reported that gender has no significant effect on students' academic achievement. In the report of Ndirika and Ubani (2017), there is no significant difference in the mean scores of male and female students' academic achievement.

Statement of the Problem

The consistent decline in students' academic achievement in external examinations in Chemistry has been an issue of great concern in Nigeria especially in Kogi State. This is evident in the report of WAEC Chief Examiner from 2020-2023This issue of consistent decline in the academic achievement of students in Chemistry has raised concerns and worries among educational stakeholders. Researchers have identified several factors that may be responsible for this consistent poor achievement of students in Chemistry. These factors among others include; poor teaching methods, poor study habit, lack of qualified teachers, stress, pressure tolerance for ambiguity, anxiety, interest, lack of finance to pay fees, motivation and experience factors like age, and more. Gender has also been identified to be factor that could influence students' academic achievement in chemistry.

Despite the numerous government efforts through its agencies and schools in making several provisions that could facilitate students' academic achievement in chemistry, it is still plagued with poor academic achievement. The implication of the foregoing is that students' academic achievement in Chemistry may continue to decline if further investigations are not sought. The researchers believe that lack of cooperative classroom interaction could be factors responsible for this poor achievement of students in Chemistry. Therefore, it is imperative to find out if Cooperative classroom interactions could predict students' academic achievement in chemistry while considering the moderating role of gender in Kogi East and West senatorial districts of Kogi State. Therefore, this study looks forward to ascertaining how students' academic achievement relates to their level of cooperative classroom interactions, with regards to gender.

Scope of the Study

The study "cooperative classroom interaction as predictors of student's academic achievement in chemistry" was conducted among SS II Students in the two senatorial districts of Kogi State. The study sought specifically to find the predictive power of cooperative classroom interaction on students' academic achievement based on gender. The choice of the senatorial districts is due to student's poor academic achievement as viewed in the WAEC Chief Examiners' Report 2020 to 2023 and the SS II termly results of students from the few schools in the area of study. SS II Chemistry students were selected because they have sufficiently experienced enough classroom teaching/learning of chemistry and their next class is SSCE year. The study was conducted in both public and private secondary schools to ensure co-educational uniformity.

The content scope that was covered in this study were standard separation techniques for mixtures, acid-base reactions, chemical industries, organic chemistry and periodic table of elements. This is because students showed poor understanding of simple concepts in the

above topics in chemistry, poor application of the knowledge of the periodic table, could not give proper definition of concepts when required, inability to write formula instead of names, inability to write correct IUPAC names of organic compounds among others as noted by WAEC chief examiner's report.

Research Questions

The following research questions guided the study;

1. What is the predictive power of Cooperative classroom interactions on students' academic achievement in Chemistry?
2. What is the predictive power of cooperative classroom interactions on students' academic achievement in chemistry as moderated by gender?

Hypotheses

The hypotheses were tested at 0.05 level of significance:

HO_1: Cooperative classroom interaction is not a significant predictor of students' academic achievement in chemistry.

HO_2: The predictive power of cooperative classroom interactions on students' academic achievement in chemistry as moderated by gender is not statistically significant.

Research Methods

This study employs a correlational research design. Correlation is the statistical technique for establishing the extent of relationship, association, or co-variation between two or more variables (Nworgu, 2015). This research design was considered appropriate because the researcher is interested in establishing the relationship between cooperative classroom interaction and students' academic achievement in chemistry.

The population of the study consists of all the 7,617 SS II Chemistry students in Kogi East and West senatorial districts [Source: Kogi State Ministry of Education 2021]. This population is made up of 4182 males and 3435 females SS II chemistry students. The sample for the study consists of 384 SS II chemistry students. This was determined using Taro Yamen formula.

Disproportionate stratified random sampling technique was used to draw one LGA each from the three selected educational zone. This will give a total to three LGAs. The choice of disproportionate stratified random sampling technique is to make sure that all the zone is present in the final sample. Disproportionate stratified sampling technique was used to draw four (4) schools each from the three LGAs made up of Igala, Bassa and Okun. This will give a total of (12) schools in all. Also, disproportionate sampling technique was used to stratify the students in each sampled school based on gender and 32 students comprising 16 males and 16 females was drawn. This gives a total of 384 SS II chemistry students made up of 192 males and 192 females.

Two Instruments were used for data collection in the study, which are Chemistry Cooperative Classroom Interaction Inventory (CCCII) and Chemistry Achievement Test (CAT). Chemistry Cooperative Classroom Interaction Inventory (CCCII) consist of 15 items adapted from Achurra, Lourdes and Calvete, (2015) which was originally 44 items on cooperative learning application scale. The CCCII is divided into two sections A and B which was filled

by the respondents. Section A provided personal data of the respondents such as gender, while section B measures students' cooperative classroom interactions. The instrument has 4-point rating scale of Strongly Disagreed (SD) = 1, Disagreed (D) = 2, Agreed (A) = 3, and Strongly Agreed (SA) = 4. The Chemistry Achievement Test (CAT) which consist of 30 multiple-choice items was developed by the researcher. CAT has two sections, A and B which was filled by the respondents. Section A provided their personal data; identification, gender and tribe while section B measure their achievement in chemistry.

To determine the face validity of the instruments; CCCII and CAT together with the study title, purposes of study, research questions, hypotheses, marking guide for CAT and table of specification was sent to three experts from the Department of Science Education, University of Nigeria Nsukka. Two of the validators were from Chemistry Unit and one from the Measurement & Evaluation Unit. The researcher requested the assistance of the validators for constructive criticism with respect to the; appropriateness of the instrument, suitability of the instrument for the respondents, clarity of language of the instrument, structure of the instrument and suggestions that will improving the instrument. The face validation of these instrument was done to ensure that; the items were clearly stated and unambiguous, no spelling errors, proper numberings were done, no item was double-barrelled, suitability of the items relate to the class of the students. The corrections and inputs made by the experts were used to modify and draft the final copy of CCCII and CAT.

To estimate the reliability of instruments, a trial testing was conducted on a group of students with similar characteristics to the intended sample of students; 20 SS II chemistry students in Otutu Community Sec. School Otutu Okene Kogi central senatorial district were used for trial testing since this place are outside the sampled senatorial districts for the main study. The data for the reliability estimate were collected using the various instruments (CCCII and CAT).

The estimate of internal consistency of the instrument CCCII was determined using Cronbach alpha method. The choice of Cronbach-alpha was because it is the most suitable method of estimate internal consistency reliability for instruments that are polytomous scored (that is, instrument with no right/wrong responses). The reliability indices for CCCII was 0.874.

The internal consistency reliability for CAT instrument was established using Kudder-Richardson (K-R) formula 20. This method was used because it is highly suitable for estimating internal consistency reliability for instruments that are dichotomously scored (i.e., instrument with no right/wrong responses). A reliability index of 0.71 was obtained for CAT.

The data collected from the field was analysed using regression analysis. Regression analysis was used because it is most suitable statistical technique used for predicting the relationship between two or more variables. This analysis technique is chosen because the study seeks to find the predictive power of cooperative classroom interaction on students' academic achievement in chemistry. Essentially, research questions 1 was answered using linear regression while research question 2, was answered using multiple regression. The predictive power of cooperative classroom interaction on students' academic achievement in chemistry were determined using regression coefficient (R) and coefficient of determination (R2). Correlational coefficients (R) was classified into low (0 – 0.3), moderate (0.31 – 0.80) and high (0.81 -1) (Nworgu, 2015). ANOVA was used to test hypotheses 1 while hypotheses 2 was tested with the t-value and the associated probability value obtained using process Macro, all at 0.05 level of significance.

Results

Research Question One

What is the predictive power of cooperative classroom interactions on students' academic achievement in Chemistry?

Table 1
Regression Analysis for the Predictive Power of Cooperative Classroom Interactions on Students' Academic Achievement

Model	N	R	R^2
1	384	.654[a]	.426

a. Predictors: (Constant), C_C_Int

Table 1 above shows the regression analysis for the predictive power of cooperative classroom interaction on students' academic achievement in Chemistry. The result shows that a correlation coefficient (R) of 0.65 was obtained. This means that there is a moderate positive relationship between cooperative classroom interaction and academic achievement of students in Chemistry. The coefficient of determination (R^2) is 0.43. This means that cooperative classroom interaction has a predictive power of 43% of the academic achievement of students in Chemistry.

Hypothesis One

Cooperative classroom interaction is not a significant predictor of students' academic achievement in Chemistry.

Table 2
ANOVA Result of the Predictive Power of Cooperative Classroom Interaction on Academic Achievement

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	12812.179	1	12812.179	284.961	.000[b]
	Residual	17175.153	382	44.961		
	Total	29987.332	383			

The result in Table 2 shows the ANOVA result of the significant of the predictive power of cooperative classroom interaction on academic achievement of students in Chemistry. The result shows that an F-ratio (1, 382) = 284.961, p = 0.000 was obtained. Since p = 0.000 is less than 0.05 level of significance, the null hypothesis is rejected. Inference drawn is that, cooperative classroom interaction is a significant predictor of students' academic achievement in Chemistry.

Research Question Two

What is the predictive power of cooperative classroom interactions on students' academic achievement in Chemistry as moderated by gender?

Table 3

Multiple Regression Analysis of the Predictive Power of Cooperative Classroom Interaction on Students' Academic Achievement As Moderated by Gender

Model	N	Interaction	R	R^2	SE	Df	t	p
1	384	Gender x Cooperative classroom interaction	.6700	.4489	.0761	382	3.6141	0.0003

Table 3 reveals the predictive power of cooperative classroom interactions on students' academic achievement as moderated by gender. The result shows that a correlation coefficient (R) of 0.67 was obtained. This is an indication that there is a moderate positive relationship between cooperative classroom interactions and academic achievement as moderated by gender. The coefficient of determination (R^2) of 0.45 shows that 45% of the predictive power of cooperative classroom interactions on the academic achievement of students is moderated by gender.

Hypothesis Two

The predictive power of cooperative classroom interactions on students' academic achievement in Chemistry as moderated by gender is not significant.

Table 3 above shows the significant of the predictive power of cooperative classroom interactions on the academic achievement of students in Chemistry as moderated by gender. The result revealed a t-value of 3.6141 at 382 degrees of freedom with an exact probability value of 0.0003. This probability value of 0.0003 is less than 0.05 level of significance, hence, the null hypothesis is rejected. Conclusion drawn is, the predictive power of cooperative classroom interactions on students' academic achievement in Chemistry as moderated by gender is significant.

Discussion of the Findings of the Study

The discussion of the findings is presented under the following sub-headings:

1. The predictive power of Cooperative classroom interactions on students' academic achievement in Chemistry
2. The predictive power of cooperative classroom interactions on students' academic achievement in chemistry as moderated by gender

The Predictive Power of Cooperative Classroom Interactions on Students' Academic Achievement in Chemistry

The findings of the study revealed that the predictive power of cooperative classroom interaction on students' academic achievement in Chemistry is moderate. Further analysis revealed that the predictive power of cooperative classroom interaction on students' academic achievement in Chemistry is significant. This result implies that cooperative classroom interaction is highly accountable for students' academic achievement in chemistry. The significance of the predictive power of cooperative classroom interaction on students'

academic achievement in Chemistry could be due to the fact that cooperative classroom interaction opens chemistry students up for intellectual involvement, creativity, and higher-order thinking tasks. It also increases cooperation and more well-developed social skills, motivation, retention of knowledge, positive interdependence, interaction and collaborative skills which are all needed for improving academic success.

The findings above are in line with the findings of Ajaja and Eravwoke, (2012), Ajaja and Mezieobi, (2018) who found that cooperative classroom interaction is a significant predictor of students' academic achievement in Chemistry. Cooperative classroom interaction helped students to better understanding of tasks, contents and active in classroom activities which leads to a better academic achievement. The findings of this present study disagree with the findings of Murad (2015) which indicated that students have negative opinions regarding cooperative classroom interaction. This disagreement may be due to location of the study and participants' characteristics.

The Predictive Power of Cooperative Classroom Interactions on Students' Academic Achievement in Chemistry As Moderated by Gender

The result from data analysis shows that Cooperative classroom interaction as moderated by gender on students' academic achievement in Chemistry is positively moderate. Further analyses reveal that the predictive power of cooperative classroom interaction on students' academic achievement in Chemistry is significant.

This result directly means that the level of cooperative classroom interaction between male and female students in respect to their academic achievement in Chemistry is different. This indicates that the relationship between cooperative classroom interaction and achievement in chemistry for males is different from that of female students. The difference could be that the levels of their involvement in teamwork, study habits, solving problems together, facilitating the completion of their tasks, guiding and assisting themselves in order to achieve common goal in chemistry classes differs. That students are allowed to study and solve problems together does not mean that their preferences or choices could be the same with respect to males and females. The differences with respect to males and females could be due to their levels of participation or involvement in group work or teamwork.

Conclusion

The study set out to investigate the predictive powers of cooperative classroom interaction on students' academic achievement in chemistry in Kogi East and West senatorial districts. Based on the findings of the study, the following conclusions were made.

The study in accordance with its findings concluded that cooperative classroom interaction has a significant predictive power on students' achievement in Chemistry. This is because ccooperative classroom interaction helps chemistry students in class participation, creativity, and higher-order thinking tasks which leads to a better academic achievement. Cooperative classroom interactions are highly accountable for students' academic achievement. High level of their cooperative classroom interaction or learning styles leads to students' high academic achievement in chemistry. This study in accordance with its findings also concludes that the predictive power of cooperative classroom interaction on students' academic achievement in chemistry as moderated by gender is significant. Also, level of cooperative classroom interaction between male and female students in respect to their academic achievement in

Chemistry as moderated by gender is different. It may be as a result of differences in their levels of self-awareness, self-regulation, social skills, empathy and motivation.

Recommendations

Based on the findings of the study, the following recommendation were made;

1. Government and school administrators should be organizing conferences, seminars and in-service training from time to time to enable teachers gain adequate knowledge and experiences on emotions intelligence in order to apply them appropriately.
2. Chemistry Teachers should encourage gender equality and should encourage the use of techniques that build confidence in both males and females alike. Teachers should be gender sensitive to encourage both male and female students alike in developing chemistry skills in respective of their ethnicity.
3. Government should train and employ Chemistry Teachers who understand impact of emotions intelligence in order to achieve societal goal and aspiration.

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Evaluation of the Alignment of Branches in a Private Education Network: A Process Modeling (BPMN) and Key Performance Indicators (KPIs)-Based Approach

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Abstract

This article presents a study on the alignment of branches in a private education network with the foundational project. Using a BPMN and KPI-based approach, data were collected on student retention, graduation rates, average grades, and parent satisfaction. The results revealed a positive correlation between higher KPI scores and stronger alignment with the foundational project. The findings emphasize the importance of KPIs in monitoring and improving branch alignment. Strategies such as sharing best practices and providing ongoing training can enhance alignment across all units. This study contributes to understanding branch alignment in a private education network and underscores the value of KPIs and the BPMN approach.

Keywords: organizational alignment, private education network, key performance indicators (KPIs), business process modeling (BPMN)

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Introduction

The efficient management of branches within a private education network is a fundamental component to ensure a high standard of education and maintain competitiveness in an increasingly globalized and competitive educational environment. However, this is a complex task that requires efficient tools and management methods. In this context, the Business Process Model and Notation (BPMN) and Key Performance Indicators (KPIs) emerge as effective strategies to evaluate and improve the alignment between branches, contributing to the overall effectiveness of the education network.

BPMN is a standardized graphical notation that allows the modeling and visualization of business processes. It is a powerful tool to understand, communicate, and improve processes within an organization, as demonstrated by Evangelista et al. (2024). In the context of an education network, BPMN can be used to map educational and administrative processes, identify bottlenecks and inefficiencies, and suggest improvements.

KPIs, on the other hand, are quantifiable measures that help assess an organization's performance in relation to its strategic objectives. In the educational sector, KPIs can address a variety of aspects, including teaching quality, student satisfaction, operational efficiency, among others (Parmenter, 2015). Combined with BPMN, KPIs offer a comprehensive approach to evaluating and improving the alignment between branches of a private education network.

The importance of this research lies in exploring how BPMN and KPIs can be combined to assess the alignment of branches in a private education network. Although both are widely used across various sectors, their application in the educational sector is still underexplored. Therefore, this research fills an important gap in the existing knowledge and provides valuable insights for education institution managers and researchers interested in this field.

Importance of Research

Ensuring consistency and quality in education across branches of a private education network is a critical issue that directly impacts the organization's reputation and overall effectiveness. This alignment involves not only the curriculum and teaching methodology but also administration, organizational culture, teacher training, and student satisfaction. However, it is a complex and challenging task due to the diversity of variables involved and the lack of effective management and evaluation processes (Davenport, 1993).

The adoption of efficient process and performance management tools, such as BPMN and KPIs, emerges as a promising solution to this issue. BPMN is a standardized graphical notation for describing business processes. It allows for the modeling and visualization of business processes in an intuitive way, facilitating the understanding, communication, and analysis of complex processes (Moura et al., 2022). In the context of an education network, BPMN can be used to map teaching and administrative processes, identify inefficiencies, and suggest improvements.

On the other hand, KPIs are quantitative indicators used to evaluate an organization's performance concerning its strategic objectives (Parmenter, 2015). They provide an objective and measurable way to monitor progress and identify areas needing improvement. In the

educational sector, KPIs can be adapted to measure various aspects, such as teaching quality, student satisfaction, operational efficiency, and the effectiveness of educational processes.

The combined use of BPMN and KPIs, therefore, offers a comprehensive and effective strategy for evaluating and improving alignment among branches of a private education network. This research aims to explore this approach in-depth, providing a practical guide for its implementation and contributing to the existing knowledge in the field.

Academic Relevance

In the current academic landscape, the application of business process management techniques and performance indicators in the educational sector represents a developing field of study. This study, therefore, fills a significant gap in the existing literature by exploring the application and effectiveness of BPMN and KPIs in the specific context of private education networks (Davenport, 1993; Parmenter, 2015).

The existing literature has largely focused on the application of BPMN and KPIs in sectors such as manufacturing, logistics, and healthcare (Parmenter, 2015; Silver, 2011). However, the dynamics and specific challenges of the educational sector—such as teaching quality, student satisfaction, and operational efficiency—require an adapted approach. This study offers exactly that, by proposing a new model to evaluate and improve the alignment between branches of an education network using BPMN and KPIs.

Furthermore, the study has the potential to influence academic practice and future research. By establishing a connection between business process management techniques, performance indicators, and the management of education networks, it paves the way for new lines of investigation and academic discussions (Moura et al., 2025a). The findings of this study can serve as a starting point for future research, which could explore, for example, how to adapt and implement the proposed model in different educational contexts or how to enhance it with the use of emerging technologies.

Model to Evaluate and Improve the Alignment of School Branches

The proposed model in this study seeks to combine the application of BPMN and KPIs in the educational context to evaluate and improve the alignment of branches within a private education network. The proposal consists of the following steps:

I. Process Mapping: We use BPMN notation to map the main educational and administrative processes of each branch. This includes processes such as curriculum planning, teacher training, student assessment, staff recruitment, inter-unit communication, and financial management.
II. Identification of KPIs: Relevant KPIs adapted to the educational sector are selected to assess the performance of each branch in relation to strategic objectives. Examples of KPIs include student approval rates, parent satisfaction, classroom occupancy rates, average response time to student requests, and resource allocation efficiency.
III. Data Collection and Analysis: Data related to the selected KPIs for each branch is collected. A comparative analysis among the branches is conducted to identify patterns, strengths, weaknesses, and areas with the greatest need for improvement.
IV. Identification of Bottlenecks and Opportunities: BPMN process mapping and KPI analysis are used to identify bottlenecks and opportunities for improvement in the educational and administrative processes of the branches. Improvement areas are

prioritized based on their potential impact on branch alignment and the quality of education.

V. Implementation of Improvements: Improvement strategies are developed and implemented based on the identified opportunities. These may include adjustments to processes, organizational structure, inter-branch communication, or staff training and development.

VI. Continuous Monitoring and Adjustments: The progress and impact of the implemented improvements are monitored using the selected KPIs. Adjustments are made as necessary, aiming to maintain a continuous process of evaluation and improvement of branch alignment.

The application of this model in the context of private education networks can significantly contribute to improving branch alignment, increasing operational efficiency, and enhancing the quality of education offered. Additionally, the model is flexible and can be adapted to the specific needs of each network, allowing for its application in different educational contexts.

Related Works

Although the existing literature on BPMN and KPIs does not specifically focus on the educational sector, there is a body of work that provides applicable insights. (Dumas et al., 2013) highlight the utility and versatility of BPMN in modeling and improving business processes across a variety of sectors, indicating its potential application in the educational context. Similarly, the discussion by (Cardoso et al., 2009) on the importance of aligning KPIs with business strategic objectives serves as a crucial reminder for educational institutions in their pursuit of performance improvement.

The integration of BPMN and KPIs in business process management was explored by Sinur et al. (2013). This integration can be particularly useful in the educational sector, where process efficiency is vital to ensure the delivery of quality teaching and learning.

Turetken et al. (2019) provided valuable insights into the adoption of BPMN in medium-sized companies, emphasizing the capability of these tools to foster more efficient and adaptive organizations — ideas that are equally relevant to the educational sector.

Complementing this perspective, addressed the role of automation and data analysis in BPMN implementation, suggesting a potential increase in the effectiveness of business process modeling with technological support.

When viewed together, these works suggest a convergence of ideas on the importance and value of BPMN and KPIs in optimizing business processes, with significant implications for the educational sector. However, there remains considerable room for research directed toward the alignment of branches within a private education network, which is precisely where this study aims to contribute.

The innovation brought by this research lies in the proposal of a detailed and specific model to evaluate and improve the alignment of branches within a private education network using BPMN and KPIs. This approach goes beyond existing studies by directly addressing this challenge, offering a practical strategy adaptable to the specificities of the sector and the needs of each education network.

Data Analysis

In this chapter, we conducted an analysis of the data collected to evaluate the alignment of branches within a private education network with the foundational project. The data collection was carried out in three distinct stages, aiming to obtain a comprehensive and in-depth view of the branches' alignment.

Initially, we conducted an interview with the education network's maintainer. The purpose of this interview was to understand the vision and fundamental objectives of the foundational project, providing a solid basis for our analysis. Based on the information obtained from this interview, we established the main evaluation criteria and identified the relevant Key Performance Indicators (KPIs) for the analysis.

Next, we conducted individual interviews with the management of each branch. These interviews sought to gather specific information about pedagogical practices, challenges faced, and initiatives implemented at each unit to promote alignment with the foundational project. These interviews were essential to understanding the reality of each branch and identifying possible gaps between the guidelines and practical implementation.

Following these steps, we collected KPI data related to student retention, graduation rates, average student grades, and parental satisfaction for each branch. This data was obtained through the education network's internal records, academic reports, and parent feedback. The collection of these KPIs enabled a quantitative and comparative analysis of the branches' performance concerning the foundational project.

Based on these different data sources, we conducted a comprehensive analysis to evaluate the alignment of the branches with the foundational project. This analysis allowed us to identify strengths and areas for improvement, as well as propose recommendations and strategies to enhance alignment and strengthen the implementation of the foundational project across all units of the private education network.

Interview With the Educational Sponsor

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Conclusion

This study aimed to assess the alignment of the branches of a private educational network with its foundational project, using an approach based on BPMN and KPIs. By conducting interviews with the sponsor and branch principals, as well as collecting KPI data, it was possible to obtain a comprehensive view of the performance and alignment of each school unit in relation to the goals and objectives established by the foundational project.

The results revealed that, overall, the branches demonstrate satisfactory adherence to the foundational project. However, specific challenges were identified that require attention and action from educational management. Student retention and graduation rates were mentioned as areas that need improvement in order to ensure the continuity of students in the school and their successful completion of studies. Additionally, ongoing teacher training emerged as a necessity to strengthen pedagogical practices and ensure the delivery of quality education.

On the other hand, the branches showed significant strengths. The formation of students within the framework of Christian Anthropology, the development of individual autonomy, and the promotion of a sense of family within the school community were highlighted as well-integrated principles in educational practices. Moreover, the concern with supporting families in vulnerable situations and the respect for alternative forms typical of contemporary times demonstrate the branches' commitment to inclusion and respect for diversity.

In this context, it is essential that educational management establishes specific strategies to address the identified challenges (Moura et al., 2025b). Student retention programs, enhancement of academic and career guidance, investment in ongoing teacher training, and strengthening partnerships with families can contribute to improving performance and alignment with the foundational project.

To ensure effective management and continuous monitoring, the use of performance indicators proves to be essential. KPIs such as student retention, graduation rates, parent satisfaction, and students' average grades provide objective and measurable data that allow for accurate and well-grounded analysis of the branches. These metrics can serve as evaluation tools, identifying areas in need of improvement and assisting in setting goals for continuous development.

For future work, it is suggested that the monitoring and evaluation of branch performance continue, using KPIs as the basis for analysis. Furthermore, it is important to carry out more

in-depth studies on the factors that influence student retention and graduation rates in order to develop effective strategies to improve these indicators.

The analyses conducted allowed for the identification of strengths and challenges, providing a foundation for the implementation of improvement measures and the optimization of educational processes. The combination of the BPMN-based approach and KPIs proved to be an effective tool for performance evaluation and the pursuit of educational excellence. By implementing the recommended strategies and fostering a culture of continuous improvement, greater alignment with the foundational project can be achieved, ensuring quality education and promoting student success.

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EFAL Teachers' Experiences in Teaching Listening Comprehension Skills to Grade 4 Learners

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Abstract

Listening comprehension is a crucial skill in language learning, deeply interconnected with speaking, reading, and writing. Effective listening enhances speaking through conversation, supports reading by improving decoding skills, and refines writing by strengthening language processing. This study examines the challenges Grade 4 English First Additional Language (EFAL) teachers face in teaching listening comprehension, a key skill for early language acquisition. The transition from home language instruction to English as the language of learning and teaching presents unique challenges for Grade 4 learners, many of whom struggle with understanding spoken English, impacting overall proficiency. Using a qualitative case study approach, guided by Schema Theory, data were gathered through classroom observations and semi-structured interviews with seven female EFAL teachers. The study identifies several challenges, including overcrowded classrooms, limited vocabulary, poor student concentration, and inadequate access to audio-visual resources. These obstacles hinder effective teaching, especially when English is introduced as the language of instruction. The paper concludes with recommendations for the Department of Education to prioritise providing essential resources, particularly in under-resourced schools, to enhance teaching and learning in the foundational years of English language education. This research offers valuable insights into the complexities of teaching listening comprehension in primary schools and provides actionable recommendations for improving language education outcomes.

Keywords: listening comprehension, EFAL, grade 4, schema theory, teaching challenges

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Introduction

Listening comprehension is the cornerstone of second language acquisition, enabling learners to engage meaningfully with spoken language and develop other language skills. In South Africa, Grade 4 learners face a significant transition from being taught in their home languages to learning in English as the Language of Learning and Teaching (LoLT). For many, this shift makes mastering listening comprehension particularly daunting, as English is often unfamiliar and not spoken outside the classroom (Wildsmith-Cromarty & Balfour, 2019).

While much attention has been given to instructional techniques for teaching listening comprehension (Mzobe, 2023), there remains a limited understanding of the lived experiences of EFAL teachers who navigate the complex realities of fostering listening skills in resource-constrained settings. Teachers are at the frontline of addressing challenges such as limited learner vocabulary, overcrowded classrooms, and inadequate teaching resources (Gilakjani & Sabouri, 2016). Their experiences provide valuable insights into the dynamics of teaching listening comprehension beyond instructional methods.

This study shifts the focus to explore EFAL teachers' experiences, specifically in Grade 4 classrooms, highlighting the challenges they encounter and the strategies they employ to overcome them. By addressing these gaps, this research aims to contribute to a deeper understanding of the contextual and practical realities shaping listening comprehension instruction in multilingual classrooms.

Literature Review

Listening comprehension is a cornerstone of language acquisition and essential for effective communication (Gilakjani & Sabouri, 2016). In EFAL classrooms, it is particularly challenging as it involves both decoding auditory input and integrating prior knowledge (Masalimova et al., 2016; Swan & Walter, 2017). Studies have emphasized that effective listening comprehension strategies include pre-listening activities to activate prior knowledge, during-listening strategies for attention and focus, and post-listening discussions for reinforcement (Farrell & Jacobs, 2020).

In South Africa, EFAL learners face additional barriers such as limited exposure to English outside the classroom, insufficient vocabulary, and the abrupt transition to English as the Language of Learning and Teaching (LoLT) in Grade 4 (Wildsmith-Cromarty & Balfour, 2019). Teachers often employ strategies like repetition, storytelling, and questioning to address these issues, but challenges such as overcrowded classrooms and limited resources persist (Mzobe, 2023).

While there is a wealth of research on listening comprehension strategies and their effectiveness (Cao & Lin, 2020; Kim, 2022), there is limited exploration of how EFAL teachers in resource-constrained environments, such as South African schools, experience and address these challenges. Existing studies often focus on learners' difficulties rather than the pedagogical strategies and lived experiences of teachers. Moreover, few studies have examined how teachers use Schema Theory to support listening comprehension in multilingual classrooms.

This study is grounded in Piaget's Schema Theory, which posits that learners understand new information by relating it to existing cognitive structures (Piaget, 1976). In listening comprehension, this involves activating learners' prior knowledge (schemas) to interpret spoken language. For EFAL learners, their schemas are often rooted in their home language, which can both support and hinder their understanding of English. Teachers play a crucial role in helping learners assimilate and accommodate new linguistic information, creating schema equilibrium.

Given the limited research on teachers' experiences in addressing listening comprehension challenges in EFAL classrooms, this study seeks to fill a significant gap. By focusing on Grade 4 teachers in South Africa, it explores their strategies, challenges, and reflections, particularly in resource-constrained settings. Understanding teachers' perspectives is crucial for developing targeted interventions, professional development programs, and policy recommendations to enhance listening comprehension instruction.

Methodology

This study employed a qualitative case study approach, which is well-suited for exploring the complex and context-specific experiences of teachers in EFAL classrooms (Yin, 2018). Data were collected through classroom observations and semi-structured interviews with seven Grade 4 EFAL teachers from four primary schools in South Africa. The participants were purposefully selected based on their experience in teaching EFAL and their willingness to share their practices and challenges. Classroom observations provided direct insights into the strategies teachers used to facilitate listening comprehension and how they navigated resource constraints. Semi-structured interviews allowed teachers to reflect on their experiences, including the obstacles they faced and the techniques they employed to support learners. The data were analysed using thematic analysis, as described by Braun and Clarke (2006), which involved identifying patterns and themes related to teaching practices and challenges. Ethical considerations were carefully addressed, with informed consent obtained from participants and assurances of confidentiality maintained throughout the study.

Results

This section presents the findings of the study, which sought to explore Grade 4 EFAL teachers' experiences in teaching listening comprehension. The results revealed multiple challenges that directly impacted teachers' abilities to effectively teach listening comprehension. These findings reflect the complex realities of teaching in resource-constrained classrooms in rural South Africa.

Overcrowded classrooms emerged as a significant obstacle. Teachers expressed that large class sizes made it difficult to provide individual attention, manage noise levels, and ensure all learners remained focused during listening activities. Some teachers conducted lessons in multipurpose halls, where learners sat back-to-back, and noise from other groups disrupted learning. In such settings, learners positioned at the back often disengaged, resorting to unrelated activities like drawing, due to their inability to hear or follow the lesson being taught.

The limited English vocabulary of learners was another major concern. Teachers shared that many learners lacked foundational vocabulary, which severely affected their listening comprehension abilities. One participant, Anisha, noted that she had to dedicate considerable

time to teaching vocabulary and spelling before engaging learners in listening tasks. This vocabulary gap hindered learners' understanding of spoken English, making it difficult for them to follow instructions or grasp the content of listening texts.

A critical challenge identified was the lack of teaching resources, particularly audio and visual aids. Many schools did not have access to basic tools such as speakers, recorded materials, or projectors. Consequently, teachers relied heavily on reading aloud to the learners, which limited exposure to authentic listening experiences, including varied accents and pronunciation. This shortage of resources impeded the development of effective listening skills in EFAL classrooms.

Learners' poor concentration during listening comprehension tasks was a recurring issue. Teachers observed that learners often struggled to maintain focus, especially when listening materials were lengthy, complex, or presented without engaging methods. External factors such as classroom noise, overcrowding, and personal challenges like hunger further affected learners' ability to concentrate. Additionally, some learners relied on their home language schemas, which did not correspond with English structures, creating further barriers to comprehension.

These findings highlight the multifaceted challenges EFAL teachers face in promoting listening comprehension, emphasizing the need for better resources, support, and instructional strategies tailored to multilingual and resource-poor contexts.

Discussion

The findings of this study illuminate the complex challenges faced by Grade 4 EFAL teachers in teaching listening comprehension, particularly in rural South African schools. Overcrowded classrooms, limited learner vocabulary, poor concentration, and the lack of essential resources emerged as recurring themes. These challenges underscore the systemic barriers that hinder effective listening comprehension instruction, consistent with observations from Wildsmith-Cromarty and Balfour (2019), who noted similar constraints in multilingual classrooms.

Overcrowded classrooms, as reported by teachers, impede individual attention, making it difficult to cater to diverse learning needs. This aligns with Schema Theory (Piaget, 1976), which emphasizes the role of prior knowledge in comprehension. Large class sizes limit the opportunity for teachers to activate and build learners' schemas effectively, as personalised engagement is crucial for assimilating new linguistic information. The lack of sufficient vocabulary further compounds the issue, echoing Gilakjani and Sabouri's (2016) assertion that listening comprehension requires both decoding and meaningful integration of words.

The absence of audio and audio-visual materials remains a critical barrier, consistent with Mpofu and Moyo's (2021) findings that under-resourced classrooms limit exposure to authentic language inputs. Teachers in this study highlighted their reliance on traditional methods, such as reading aloud, which, while valuable, cannot replicate the immersive experience provided by recorded or multimedia content. These findings point to the urgent need for systemic interventions to address resource disparities, particularly in rural and underprivileged schools.

While the lack of resources poses significant challenges, teachers can adopt creative strategies to enhance learning outcomes within these constraints. Contextualized listening tasks, visual aids, and collaborative group activities have been shown to improve engagement and comprehension (Farrell & Jacobs, 2020). However, these strategies require support in the form of professional development programs to equip teachers with innovative methods tailored to large and diverse classrooms.

Addressing these challenges demands action from the Department of Education, particularly in resource allocation. The provision of audio-visual materials, such as recorded stories, interactive listening programs, and teacher training workshops, could significantly enhance listening comprehension instruction. As emphasized by Kim (2022), integrating technology into teaching practices not only facilitates learning but also bridges the resource gap in underprivileged schools.

Teachers exhibit remarkable resilience and adaptability, systemic changes are essential to overcome the barriers identified in this study. Prioritising resource provision and professional development would empower teachers to create inclusive and effective listening comprehension environments, ultimately improving learners' outcomes in EFAL classrooms.

Recommendations

To address the challenges identified in this study, several actionable steps can be taken to improve the teaching and learning of listening comprehension in Grade 4 EFAL classrooms. The Department of Education should prioritise providing schools, particularly those in rural and under-resourced areas, with adequate resources such as audio and audio-visual materials. These tools are essential for exposing learners to authentic English input and enabling teachers to implement effective listening comprehension strategies. Professional development programs should be designed to equip teachers with innovative techniques for teaching listening comprehension in multilingual and resource-limited classrooms. Training should focus on maximizing available resources and incorporating alternative methods, such as group work and interactive listening tasks, to enhance learner engagement.

The curriculum also requires careful review to ensure it includes meaningful listening tasks that promote comprehension. Authentic listening materials, such as recorded stories, podcasts, and educational broadcasts, should be integrated into teaching practices to make learning more relevant and immersive. Furthermore, classroom management strategies need to be strengthened to address the challenges posed by overcrowded classrooms. Peer-assisted learning, where more advanced students support their peers, can be an effective approach to fostering collaboration and improving listening skills. These combined efforts would significantly enhance the teaching and learning of listening comprehension, ultimately supporting both teachers and learners in achieving better outcomes.

Conclusion

The study reveals significant challenges encountered by Grade 4 EFAL teachers in developing learners' listening comprehension skills, particularly in under-resourced contexts. Key issues include limited access to teaching resources, inadequate professional development, and a curriculum that does not fully accommodate the complexities of teaching listening as an active, cognitive process. Addressing these barriers requires interventions grounded in educational theory, such as constructivist approaches to learning, robust teacher

training programs, and a resource-rich environment. By implementing these strategies, education systems can better equip teachers to foster learners' listening skills, which are foundational to language acquisition, critical thinking, and lifelong learning.

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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The Design of Thailand's Online Teacher Development Center

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Abstract

This action research aimed to 1) design and 2) investigate the effective design of Thailand's Online Teacher Development Center (OTDC) enhancing Thai teachers' empowerment. Six teachers from two secondary schools in different provinces were purposively selected to participate in a one-month Deming's Plan-Do-Study-Act (PDSA) course. Qualitative data, gathered through observation, in-depth interviews, and focus group discussions, focused on participants' self-development performances and perspectives. The findings revealed three key features - Community Network, Database Catalog & Search Engine, and Web/Online Workshops - that played crucial roles in fostering empowerment. Specifically, the Community Network supported professional confidence and knowledge sharing, while the Database Catalog & Search Engine enhanced self-confidence through user-friendly and practical design. The Web/Online Workshops provided real-time guidance and consultation, contributing to self-assurance. Additionally, nine essential attributes were identified, including accessibility, interactivity, quality of content, and ease of use, which were instrumental in promoting satisfaction and self-improvement. The study underscores the positive impact of integrating online technology into teacher development, aligning with previous research on empowerment and creativity. It recommends scaling OTDC by adopting technology-centered approaches that emphasize collaboration, accessibility, and personalized support, addressing potential challenges to ensure broader implementation. This approach can guide institutions in fostering professional growth and teacher empowerment, ultimately enhancing educational quality.

Keywords: online, teacher development, center

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Introduction

Teachers play a central role in shaping educational quality, directly influencing student learning outcomes. In Thailand, however, the effectiveness of teachers is increasingly compromised by an overwhelming workload that extends far beyond classroom instruction. In addition to teaching responsibilities, teachers are often burdened with administrative tasks such as financial management, organizing community and ceremonial events, and coordinating student cooperatives. This added workload limits their capacity for professional development, reducing opportunities for reflective practice, innovation in pedagogy, and engagement with emerging educational paradigms (Huang et al., 2021; Stavroulia & Lanitis, 2017).

While various countries have restructured educational systems to separate instructional duties from administrative functions, such reforms have yet to gain full traction in Thailand. However, the proliferation of digital technology offers a promising alternative for addressing these challenges. Online platforms, particularly in remote areas, provide teachers with access to resources, collaborative networks, and professional learning opportunities that transcend geographical barriers. Over the last two decades, numerous studies have demonstrated the effectiveness of such platforms in enhancing teacher competencies and transforming professional learning practices (Luo et al., 2021; Perkins Coie, 2020).

This study aimed to design and evaluate the Online Teacher Development Center (OTDC) for Thailand using the Plan-Do-Study-Act (PDSA) framework. It employed a design-based research approach to develop a context-responsive, user-centered platform tailored to the unique needs of Thai educators.

Literature Review

Lifelong Learning Theory

Lifelong learning encompasses the continuous, voluntary pursuit of knowledge for both personal and professional purposes. It reflects a holistic approach to education that supports learners at all stages of life. This perspective emphasizes adaptability, inclusivity, and the capacity for individuals to continually refine their knowledge and skills in response to changing societal and economic demands. Lifelong learning includes formal, non-formal, and informal modalities. Formal learning is structured and institutionalized, typically occurring in schools and universities. Non-formal learning, by contrast, is organized but outside traditional institutions, such as online training and professional development workshops. Informal learning is unstructured and arises through daily activities, workplace experiences, and self-directed exploration. Together, these modes contribute to personal agency, social mobility, and workforce readiness in the 21st century (Field, 2006; Jarvis, 2007; UNESCO, 2009).

Online Technology and Lifelong Learning Skill Development

The digitalization of education has revolutionized access to learning, enabling flexible and scalable professional development. Online platforms have become vital in supporting lifelong learning by offering on-demand resources, interactive content, and collaborative environments that accommodate diverse learner needs. These platforms allow educators to engage in self-paced learning while also facilitating synchronous and asynchronous interactions with peers and experts. Tools such as Zoom, Facebook Groups, and LINE are

particularly relevant in educational contexts. They provide channels for communication, resource sharing, and community building. The integration of such tools not only supports individualized learning paths but also cultivates digital literacy and professional confidence among educators (Gomezelj & Čivre, 2012; Urdan & Weggen, 2000).

Functional Features of Online Platforms

Zoom, a synchronous communication tool, is widely used for its capabilities in real-time interaction. Features such as breakout rooms, screen sharing, and recording functions enhance collaborative learning and instructional delivery. Facebook Groups offer an asynchronous, community-based platform that supports continuous engagement through discussions, multimedia sharing, and notifications. LINE provides a hybrid interface, enabling instant messaging, group chats, and automation for educational content dissemination. These platforms offer practical, scalable options for educators to access professional development opportunities without the limitations of time and place.

Methodology

This study utilized a case study approach structured into three main phases: Planning, Doing, and Study-Action. The objective was to identify the most effective design elements for an online professional development platform customized for Thai educators.

The research engaged six secondary school teachers from Chiang Mai and Chiang Rai provinces. Selection criteria included teachers under the age of 35, with English proficiency and a willingness to participate in the study. The participants represented a range of subject areas, including science, mathematics, and languages, to ensure diverse input.

Chiang Mai was selected as a representative of a large, geographically extensive province with remote districts, while Chiang Rai was chosen due to its status as a highland province with scattered populations and limited infrastructure in some areas. Both provinces are considered peripheral compared to central Thailand. The rationale for selecting these areas was to ensure that the Online Teacher Development Center (OTDC) could be tested in conditions that reflect typical barriers faced by rural teachers, including varying degrees of internet coverage. This approach helps verify that the platform is accessible across diverse topographies and technological environments, thereby ensuring its scalability and applicability throughout the country.

In the planning phase, participants attended a three-day workshop that included brainstorming sessions, discussions, and in-depth interviews. This phase aimed to gather insights into the specific needs, challenges, and expectations of teachers regarding an online development platform. Data from this phase informed the initial design of the Online Integrated Platform (OIP).

The second phase involved the implementation of a mockup OTDC within a closed Facebook group. Participants interacted with digital content including articles, videos, and educational tools. Feedback was collected through interviews and focus group discussions to refine the platform.

In the final phase, teachers joined Zoom-based professional exchanges with both local and international experts. LINE was used for meeting coordination and supplementary

communication. A RECAP process - Reflection, Evaluation, Feedback, and Finalization—was applied to synthesize findings and finalize the platform design. Content analysis techniques were employed to analyze qualitative data collected across the phases.

Results

The study findings indicated that teachers expressed positive attitudes and high levels of satisfaction with the effectiveness and appropriateness of the OTDC characteristics, particularly the core and essential attributes. Data analysis from individual and group observations, in-depth interviews, and focus group discussions on the three core characteristics and seven essential features of OTDC revealed the following.

Teachers identified three primary characteristics - community networks, database catalogues and search engines, and web/online workshops - as the most impactful for their self-development. These characteristics were perceived as pivotal in enhancing their professional growth. The findings highlighted teachers' satisfaction with these attributes, as supported by statements from the in-depth interviews and focus groups.

Regarding online community networks, participants agreed that connecting teachers and experts through these networks was vital for improving daily work. These networks facilitated feedback, built confidence, and supported effective performance. Most participants expressed satisfaction with the knowledge exchange and Q&A sessions during the OTDC service simulations. They emphasized the importance of professional networks and suggested developing the OTDC in a Virtual Reality (VR) format to enhance realism and engagement. Additionally, participants recommended incorporating real-time consultation features into the online platform to improve decision-making processes.

The focus group discussions further underscored the value of online knowledge exchange in guiding professional practice and providing timely, relevant information. Online networks were also seen as effective in building trust and streamlining access to personal resources. Participants highlighted the need for continuous feedback and evaluation to support ongoing professional development. They proposed that offering certifications for consultations would increase the credibility and value of the outcomes, particularly when dealing with challenges related to a lack of experience. Furthermore, participants recommended further research into integrating VR into OTDC platforms to foster more immersive learning experiences and enhance engagement in professional development activities.

The “Database Catalog & Search Engine” feature is a crucial component of the system, serving as a comprehensive repository of diverse and accessible data, such as academic journals, newspapers, and specialized databases. The information is well-organized into categories, making it easy to access and use. Participants in the research highlighted that the system effectively meets their informational needs, especially for those lacking prior experience with similar platforms. They noted that the database is user-friendly and uncomplicated, with reliable content and clear references, ensuring tangible results. The categorization of data was praised for enabling quick access to valuable information, streamlining the search process. Overall, the system's design was widely appreciated for its accessibility, with feedback suggesting further enhancements to the “Search Engine” feature. These insights confirm that the system's organization and ease of use significantly contribute to its effectiveness, offering a practical and efficient solution for users seeking reliable information.

In addition, the majority of participants expressed satisfaction with the system's structured approach, noting that the categorized database saves time and enhances productivity by providing quick access to relevant materials. The clear organization of content into distinct categories allows users to find the information they need without unnecessary delays. Participants also emphasized that the database's reliability, coupled with its user-friendly interface, makes it a valuable resource for academic and professional purposes. The system's ability to efficiently manage and deliver trusted information was seen as a key factor in improving the overall research experience, further supporting the call for expanding its search engine capabilities in future updates. This feedback highlights the system's potential for continued improvement and its ability to meet the evolving needs of its users.

The feedback from participants on the "Online Workshop/Webinar" format, specifically in the OTDC model, reveals that the platform facilitated a valuable opportunity for professional networking and real-time exchange of experiences with peers and experts. The majority of participants expressed that the service provided them with direct access to expert advice, which they found particularly beneficial for making informed decisions. They emphasized the importance of real-time consultations, highlighting that these interactions, conducted through the Zoom platform, were essential in refining their decision-making processes. Participants also appreciated the opportunity to engage with well-known experts, whom they previously knew only by reputation, adding credibility to the sessions. These experts, both domestic and international, contributed significantly to participants' confidence in their work and professional development.

The majority of responses also indicated that the virtual workshops helped overcome geographic barriers, allowing participants to connect with professionals from across the country and internationally. The ease of communication through real-time Q&A with experts was highlighted as an important feature, as it fostered a sense of confidence, especially when engaging in discussions in English. Many noted that the advice they received during these consultations helped them make more informed decisions, particularly in lesson planning and overall professional development. Furthermore, participants felt that the feedback they received not only supported their own growth but also positively impacted their students' development.

The study revealed that OTDC model significantly enhanced teacher self-development, particularly in remote areas, by offering nine essential attributes: (1) accessibility and interactivity; (2) ease of use; (3) personalized options; (4) diverse and systematic categorized data, (5) access to hard-to-reach resources, (6) quality of content or reliable content fostering creativity, (7) real-time information updates, (8) modern service system for easy access and time savings, and (9) user-friendly services. Teachers expressed positive attitudes towards these attributes, highlighting the OIP's ability to provide tailored, efficient, and accessible services that facilitated their professional growth.

Specifically, the OTDC's Database Catalog & Search Engine, Community Network, and Web/Online Workshops were highly valued for their user-friendly design, accessibility, and real-time support. Teachers appreciated the platform's ability to provide diverse resources, foster collaboration, and enhance creativity through reliable content. These findings align with previous research, confirming that online technologies can effectively support self-development by offering flexible, personalized learning environments. The OIP's success in addressing the unique needs of teachers in remote areas underscores its potential as a transformative tool for professional growth and educational improvement.

Additionally, the findings underscore OTDC model's significant role in promoting equitable access to learning resources, particularly for teachers in remote regions. By providing personalized and comprehensive data, real-time updates, and easy access to hard-to-reach resources, OTDC facilitates continuous professional growth and fosters a sense of community among educators. Teachers expressed a high level of satisfaction with OTDC's ability to streamline their learning processes, reduce barriers to information access, and enhance their creativity and academic work. These outcomes reflect the model's effectiveness in overcoming geographical and infrastructural challenges, ultimately contributing to the enhancement of educational quality and teacher self-development across diverse contexts.

Discussion

The findings of this study reinforce the foundational principles of lifelong learning, emphasizing the importance of continuous, self-directed skill development among educators. As outlined by Field (2006) and Jarvis (2007), lifelong learning supports not only professional adaptability but also social inclusion and economic participation. In the context of this study, the OTDC's features facilitated such development by creating opportunities for informal and non-formal learning through collaborative online environments.

The community networks supported via OTDC exemplify the role of informal learning as described by Livingstone (2001). Teachers engaged in meaningful peer-to-peer interactions that led to knowledge co-construction, professional reflection, and increased confidence in applying new pedagogical strategies. These interactions mirror the informal learning processes that naturally occur in professional communities but were enhanced here through technological mediation.

The database catalog and search engine embody the functional application of non-formal learning mechanisms, enabling educators to access structured, yet flexible content (OECD, 2000). This aligns with Gomezelj & Čivre's (2012) findings on how digital platforms provide adaptive learning paths. The feedback from participants in this study underscores that user-friendly design and organized content categories significantly reduce barriers to resource utilization, particularly for less digitally fluent teachers.

The real-time webinars and online workshops hosted on platforms like Zoom further align with Urdan and Weggen's (2000) observations on the impact of synchronous e-learning environments. These sessions offered real-time consultations and interactive dialogue with national and international experts, fostering both cognitive and affective engagement. Participants reported enhanced teaching practices and increased professional agency, echoing Jarvis's (2007) assertion that lifelong learning must foster not only skill acquisition but also learner empowerment.

Overall, the OTDC platform demonstrated its capacity to fulfill the multidimensional demands of lifelong learning - providing formal content through webinars, non-formal access through structured databases, and informal collaboration through digital communities. Its success highlights the importance of integrating technology into teacher development in a way that complements and enhances each dimension of lifelong learning.

Conclusion

This study demonstrated that the OTDC model offers an effective framework for teacher professional development, especially in remote or underserved areas. Features such as Community Networks, Database Catalogs, and Online Workshops provided accessible, flexible, and reliable support for educators' growth. Teachers expressed high satisfaction with the platform's ability to promote collaboration, enhance resource access, and support informed instructional practices.

The OTDC serves as an innovative alternative to traditional teacher development models by offering a dynamic, user-centered platform that responds to the real-world challenges of Thai educators. Its success in fostering lifelong learning and enhancing teaching capacity indicates strong potential for broader implementation and continued evolution.

Suggestions

Future platform improvements should focus on integrating immersive technologies such as VR to deepen engagement. Enhancing the search engine function would support more nuanced information retrieval. Additionally, expanding the scope of online workshops and professional networking opportunities could strengthen peer-to-peer and expert collaboration. To ensure inclusivity, OTDC services should be tailored for deployment in rural and underserved areas.

Routine evaluations are necessary to ensure the platform evolves alongside changes in educational policy and teacher needs. Longitudinal studies could explore the impact of OTDC participation on student learning outcomes and instructional effectiveness. Further research comparing OTDC with traditional professional development formats would offer valuable insights into its scalability and adaptability across diverse educational contexts.

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

This paper used AI-assisted technologies in the writing process before submission to improve the language and readability of the paper and with the appropriate disclosure.

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Enhancing Meaning-Making for Student Teachers in Early Childhood Education With Visual Techniques

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Abstract

Student teaching is a "critical phase of preparation for teaching [which] requires pre-service teachers to master a wide array of complex skills" (Gursel-Bilgin, 2023, p. 63). Student teachers often struggle to engage with complex theoretical concepts, highlighting a gap in strategies that bridge theory and practice while catering to diverse learning needs. This study addresses this challenge by exploring how Sketchnotes, integrated into lesson plans, can enhance meaning-making and retention. Lesson plans were reimagined as visual maps using Sketchnotes featuring "containers" (key concepts in boxes) and "connectors" (arrows showing relationships) to simplify content into manageable chunks. A cohort of 25 third-year early childhood student teachers participated, with feedback gathered through an anonymous qualitative survey of two questions. Results revealed that students found Sketchnotes helpful for understanding and applying theoretical concepts. Participants noted increased confidence and engagement, while the visual and non-linear structure accommodated a variety of learning preferences. Educators also reported improved efficiency and clarity in lesson preparation. This study underscores the potential of Sketchnotes to address the challenges of teaching complex concepts in higher education, offering an accessible, student-centered approach that fosters deeper comprehension. Future research could explore the adaptability of this method across disciplines and its long-term impact on teaching practices.

Keywords: visualisation, sketchnoting, teacher education

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Introduction

Every student has unique needs to be able to learn successfully. This includes using text, spoken dialogue, visual aids, experiential activities, music, or other support systems, with each individual student relying on a single style or a blend that suits their exclusive learning requirements (Paolini, 2015). Creating classrooms that meet these diverse needs yet maintaining the core essence of the content can create complex demands for teachers in preparation time and easy flow. In responding to these needs, this research project explores how re-creating the lesson plan for each classroom session could better support sense-making and understanding. The question posed was "Can sketchnotes integrated into lesson plans increase sense-making and understanding for early childhood student teachers?" Rather than relying on the traditional, heavily textual, time-bound approach to lesson plans, this project investigates the possibility of using sketchnotes - visual maps that break the content down into more manageable 'chunks' of information.

Background and Context

The group comprised of 25 early childhood student teachers in two cohorts. They came from a range of demographics but all were working in early childhood centres in the local area. Their varied experiences of education shaped their approach to learning. Some spoke openly about struggles with text-heavy, reading-focused teaching methods, while others felt more confident with these traditional approaches. Many of the group did not speak English as their first language and responded positively to substituting drawings, symbols or meaningful doodles into the sketch notes.

In this context, the decision was made to use Sketchnotes (Rohde, 2013) to create visual maps of the content of the session. Sketchnotes focus on "ideas not art" (Rohde, 2013, p. 17) and are thus deeply invested in the sense-making processes of the classroom. However, one draw-back of sketchnotes is that students often express apprehension about drawing, as they equate it with artistic skill rather than viewing it as a tool to help them understand concepts and ideas. This reflects a wider issue in education where visualisation is not a skill that is widely encouraged in schools or tertiary environments (Brown, 2014).

Each three-hour session was broken up into 5-8 "chunks" visually presented in the Sketchnote. This approach created a non-linear pathway through the Sketchnote that enabled space for discussion, questions and moments of deconstruction.

The initial lay out of the Sketchnote lesson plan was provided to the students on the white board and students contributions, connections and reflections were added as they happened making an organic, collaborative map of what they understood.

Literature Review

Definition

Visual thinking, sketchnoting, and doodle noting are three of the terms used to describe the integration of drawing for better understanding across a range of learning experiences. In what is described as the seminal work on sketchnotes, Rohde (2013) describes them as "rich visual notes" (p. 2) which capture ideas in a visually active manner. He argues that sketchnoting is universally accessible as they are about "ideas, not art" (Rohde, 2013, p. 18).

It must be said that this broad statement does not fully address potential barriers, such as learners' apprehension about drawing. The deeply ingrained perception that drawing belongs to the artistic realm rather than as a tool for cognitive processing (Qvarnström, 2019) can make it difficult for students to adopt this approach for making meaning of class content. In many cases this reticence to use drawing is due to a lack of explicit instruction in visualisation skills in educational contexts that more often focus on text and verbal approaches (Brown, 2014). As a result, drawing and sketching are synonymous with art rather than a way to make sense of ideas (Qvarnström, 2019).

However, some studies have found that sketchnoting was seen by the students as novel and intriguing but did not necessarily create a more significant impact than traditional note-taking (Bratash et al., 2020). In contrast, Dimeo (2021), described visual notetaking as "more than simply highlighting or underlining text; it involves active engagement with the content" (p. 306). This assertion aligns sketchnoting as a process of personal knowledge construction through interaction. However, it does not, fully engage with the issue of cognitive or cultural constraints.

DeWaard et al. (2024) indicate the importance of "ensur[ing] that sketchnotes intended for wider academic audiences address issues of power and hegemony by honouring diverse voices" (p. 141). This suggests that some adaptations to sketchnotes are needed to ensure they honour diverse voices and different ways of knowing. Arzaga (2023), in part, answers this point as he reinforces the individualized nature of sketchnoting, emphasizing that the pieces and their eventual makeup are dependent on the interpretation of the learners through the lens of their previous experiences. A participant in his study wrote "I can see how the pieces are connected and organised which helps me remember the sequence" (p. 79). This reinforces the idea that sketchnotes support and strengthen individual learning.

Understanding how sketchnotes operate as a process for making sense of complex ideas requires a closer examination of visualisation — the ability to create mental images and external representations that support learning. The following section explores how this visual approach functions and its significance within our learning environments.

Visualisation

Visualisation is a process of being able to create a mental picture of something yet it is rarely encouraged in traditional school environments where drawing is seen as a distraction rather than a valid way of mapping out learning (Fernández-Fontecha et al., 2018). Nørgaard (2017, as cited in Baff, 2020, p. 370) explains that sketchnotes "can be thought of as a "hand-drawn visualization made on paper or tablet, created within a short time frame" highlighting their role in capturing ideas quickly and making them accessible.

The physicist Albert Einstein is quoted as saying, "If I can't picture it, I can't understand it" (Horgan, 1991, pp. 36–37), underscoring the vital role that mental imagery can play in understanding abstract or complex ideas. In this context, sketch notes support this by enabling learners to create visual and textual representations based on how the listener sees and understands the content. An important point about creating a sketchnote is that complex concepts and ideas can be deconstructed into their contingent parts. This makes it much easier to understand them and the way they fit together. However, such simplification also carries a risk because when complex ideas are deconstructed too far or taken out of context, important nuances may be lost.

Gansemer-Topf et al. (2021) suggest that sketch notes can "break down the complexity of an image or concept into basic visualisations" (p. 306). Similarly, Arzaga (2023) discusses how visualisations can reflect individual understanding. Nørgaard (2017) also describes sketchnotes as a "genre of visualisation" (p. 2) rooted in making abstract ideas concrete.

Dual Coding Theory and Cognitive Load

Sketchnotes are theoretically positioned within Dual Coding Theory which suggests that the human brain encodes words and pictures using two separate systems. Csachová and Kidonová (2022) explain that these channels can work independently but can also interact with each other to form associations. When both channels are engaged, information is effectively captured twice, enhancing memory and recall (Paivio & Csapo, 1973). Mayer (2005) agrees with Paivio and Csapo (1973) that the brain processes words and pictures separately, but adds that as each system has a limited amount of storage, using both systems reduces the possibility of cognitive load in one or both of them. However, an overly complex sketch note can have the opposite effect and cause overwhelm in the listeners (Baff, 2020; Fernandez-Fontecha et al., 2018).

Beyond dual coding, sketchnoting also involves resemiotisation. This refers to the process by which meaning can change when information is displayed in different semiotic modes (Iedema, 2003). In the context of sketchnoting, this involves transforming spoken or written information into text, symbols, and visuals, to create a multimodal depiction of the content.

Unlike traditional note-taking, sketchnoting invites continuous revisiting and reorganisation of ideas as learners deconstruct, reconstruct and often re-story concepts as they create new representations (Arzaga, 2023). As Zhou (2024) explains, "knowledge and sense-making are constantly re-built by dynamic interplays between students' existing knowledge and the new knowledge" (p. 512). This dynamic interplay enables deeper engagement, but can also introduce cognitive challenges as learners integrate new and prior knowledge. This is not simply moving from one semiotic code to another but entails an active meaning-making process that deepens comprehension (Bezemer & Kress, 2016).

Design of the Study

The study was influenced by the co-constructive nature of the classroom where understanding was created in group discussion and questioning by all the class members. The main research question was: *Can sketchnotes integrated into lesson plans increase sense-making and understanding for early childhood student teachers?*

There were two sub-questions to focus on particular elements of the project:

1. What kinds of visual elements do students find most helpful for understanding complex ideas or concepts?
2. How does my own planning and delivery of content change when I use visual strategies?

The study used a two-question anonymous survey of the students at the end of each semester. The questions asked were: a) *In what ways (if at all) has this approach aided you to understand the class content better?*; b) *Are there particular parts of the text-visuals approach that you found particularly helpful for your understanding? Why was this so?*

The survey was embedded in the LMS page for the final session of the class. Responses were then analysed thematically looking for recurring patterns, similarities and differences.

Methodology and Methods

This qualitative project aimed to capture the stories of the way the students interacted with the sketchnotes and the associated deconstruction processes. Within this approach it was also important for the teacher to position herself as a teacher-researcher and acknowledge her realisation that the students were struggling to synthesise what they were learning and to look at it through critical lenses. The visual language of sketchnotes, combining pictures and words, became a response to this challenge by offering a more multimodal, accessible way of making sense of ideas.

This presentation was not just an investigation into sketchnotes but also a reflection on the teacher's own pedagogical choices and evolving practice. It aligns with constructivist and interpretivist methodologies aiming to make clear links with theory and practice through the students' own lived experiences. Learning was seen as an active process building on the student's previous personal and professional knowledge. In other words, it was not about simply assessing the effectiveness of sketchnotes as visual maps but as an alternative to text-based, linear approaches in supporting learners in processing, evolving, and deepening their understanding over time.

The visual map of the class empowered the students and teacher to challenge assumptions and try out new ideas and co-construct conclusions. In this way, the sketchnotes and the interactions around them were both the site of the research and a foundation for a growing pedagogy. Finally, this approach depends on relationality and trust in the classroom aligning with Māori and Pacific cultural values and supporting individual stories and sense-making through multimodal expression.

Findings

The thematic analysis revealed three themes in the data:

Increased Engagement

The participants reported the Sketchnote helped them understand what the session was about and stay focused**.** One student commented that it "Helps to understand what our focus is and what we need to think about from each topic so we can explain our suggestions in detail." Another student suggested that "I have a really good understanding of what we are going to cover, it is simple to understand and only takes one glance to get an overview." Similarly, "It has made it more understandable. Seeing step by step is helpful for my learning." Another suggested the sketchnote "showed the content is interesting and motivates me to focus better."

Cognitive Load, Non-linearity, and Visual Memory

Students described how sketchnotes reduced feelings of overload and helped them process information in manageable ways. One student suggested "Because I learn better visually. To have visuals is a better way for me comprehend sentences and intake the assignments given." Another suggested "It has really helped me to understand my course better and helped me visualise the things that I am planning to write for my assignment." Similarly, "It helps me

understand better and it's easy to revisit again and again" and "I like it when it is in boxes with arrows pointing from each point to the next."

Discussion

Increased Engagement

Participants reported that the Sketchnote made the session easier to understand (Dimeo, 2021). This supports DeWaard et al.'s (2024) idea that diagrams give students a framework to work within. While it could be argued that visuals effectiveness could be due to novelty the research project spanned 17 weeks negative comments beyond reminders like "don't forget, not everyone is a visual learner." Crucially, sketchnotes blend both visual and textual elements, and align with Paivio's dual coding theory, which suggests that the brain processes visual and verbal information in separate systems. Although dual coding theory has faced critique (Bright et al., 2004; te Linde, 1982) the value of including visuals remains widely accepted.

Reduced Cognitive Load, Non-linearity, and Visual Memory

Another theme that emerged from the findings was the reduction in the cognitive load of the sessions. Gansemer-Topf et al. (2021) suggest that this can be achieved through using "language, space, frames & connectors, people, and objects" (p. 306). Instead of using a text-heavy approach the layout of a sketchnote can encourage questions, reviewing, returning to explanations and reconstructing the story, mimicking the way the human brain naturally learns. However, in the same way that heavily textual approaches can cause cognitive overload, a badly designed sketchnote can have the same impact. (Sweller, 2020). Fernandez-Fontecha et al. (2018) suggest that "visual thinking permits certain options in spatial organization that cannot be found in language (p. 11).

Conclusion: Future Research

Although this study was small in scale, several conclusions have begun to emerge. First, sketchnotes supported student's sense-making by enabling them deconstruct and follow complex content more easily. The process of chunking information and dividing it visually with containers, connectors, and space helped students clarify their understanding and see relationships between ideas. This approach was particularly valued by students who commented on the way it reduced overload compared to traditional text-heavy content structures.

Second, the combination of text and simple visuals made the material accessible to a diverse group of learners. Multilingual students, those who preferred physical or visual engagement, and those comfortable with text all found ways of making the learning their own. In this way, sketchnotes functioned as both a pedagogically sound and culturally responsive tool, aligning with inclusive, multimodal principles.

Third, the literature's assertion that sketchnoting is about "ideas, not art" shifted the focus from creating art to creating memory aids — practical visual structures that support retention and understanding.

Sketchnotes are more than just a visual aid. They represent a way of thinking, reflecting, and making meaning together. This approach not only supports understanding but honours diverse ways of knowing and invites both students and teachers into a more relational, reflective learning space.

The next step in this work is to explore how sketchnoting might help students reflect more deeply by breaking down and working through practice scenarios. It will also be valuable to collect data over time and across different student groups to see whether their responses shift as they grow in confidence with this method.

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Navigating the Essence of Effective Professional Development for Thai University Teachers

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Abstract

This study explores university teachers' preferences for professional development (PD) types, perceptions of PD, and the characteristics of effective PD within the Thai higher education context. Conducted at a science and technology research university, the study involved teachers who had completed the mandatory PD program for faculty members. The research participants included 32 faculty members (33%) who completed an online survey and 28 (29%) who participated in both the survey and in-depth interviews. In the survey, teachers rated their preferences for diverse types of PD, which reflected characteristics that support professional learning according to prior literature. Findings revealed a strong preference for workshops, teaching and learning scholarships, and educational conferences. However, the single-item questions assessing teachers' perceptions of PD indicated a disconnect: while many faculty members expressed high interest in PD and acknowledged its role in improving teaching skills, they perceived it as less critical to their teaching careers. This discrepancy may be influenced by institutional policies regarding pedagogical qualifications and their perceived relevance for academics in research-focused universities. Thematic analysis of semi-structured interviews identified four key characteristics of effective PD: a focus on pedagogical and technological knowledge, reflective observation of exemplary practices, job-embedded activities, and relevance. The study recommends addressing cultural challenges associated with the hierarchical structure of Thai academia while recognizing teacher professional learning in various formats and platforms.

Keywords: professional development, professional learning, university teachers, university teaching

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Introduction

Faculty members face a variety of challenges in delivering quality teaching that is responsive to societal changes, as well as the need to develop 21st-century student competencies. In countries where pedagogical qualification is not necessarily required at universities, attending pedagogical development is often dependent on teachers' own initiative and interest (Murtonen et al., 2024). Promoting professional teachers in higher education typically involves a structured and intentional process of planned activities, experiences, or professional development (PD) programs. In recent years, PD for university teachers has increasingly strived for recognized standards in teaching and learning in higher education (Hibbert & Semler, 2015). Institutions increasingly offer their academic staff formal pedagogical training or teaching preparation programs, potentially linked to performance evaluations or job requirements (Noben et al., 2020). Whether being compulsory or voluntary, the pedagogical training of university teachers, Vermunt et al. (2019) interestingly noted that many models of teacher PD assume that participating in a well-designed initiative would lead to teacher outcomes, without consideration of how teachers learn.

In Thai higher education, many Thai universities have established directives and initiated changes from conventional content-based to output-based education. Nationwide, outcome-based education (OBE) has been adopted as an education reform strategy to depart from competency-based learning, and internationalization has been implemented in several aspects. Through the implementation of the Thailand Qualification Framework for Higher Education (TQF) initiated by the Office of the Higher Education Commission, faculty members are expected to be a key element in developing and improving teaching quality. In line with the diffusion of OBE into mainstream teaching, competency-based professional development is implemented to ensure that the teaching performances of faculty members meet quality criteria. Many institutions delegate a Professional Standards Framework (PSF) for teaching and learning to faculty members to ensure that teachers receive proper preparation and competence development at each career stage.

Studies on professional development for Thai teachers primarily focus on the adoption of related innovations in education, aiming to address challenges where teachers' previous knowledge of teaching methods may not be suitable for the current educational situation. For example, many training programs for educators involve STEM education to meet the demands of a nation's STEM-educated workforce. Although PD did not originate in the university's teaching landscape, its emergence reflects some common concerns among teaching staff at the primary and higher education levels. For instance, a recent study by Pojanapunya et al. (2024) examined the impact of a large-scale training program in Thailand and provided recommendations focusing on fostering collaboration and broader educational initiatives in order to sustain continuing professional development. Another study by Meesuk et al. (2021) found the substantial impact of the implementation of the PLC on both teachers and students, and suggested that extraneous procedures such as financial processes and documentation that go beyond the teacher's responsibilities could pose challenges in executing the PD.

This study aims to identify teachers' perspectives on effective PD that could reflect their intention to learn through structured learning experiences. Then, the research question was posed: What are the characteristics of effective professional development for university teachers? Furthermore, teachers may seek more targeted forms of PD for specific purposes, taking into account the variety of teaching experiences they may encounter at different stages

of their career. Therefore, additional research questions included: How do university teachers have preferences for PD types and perceptions of PD, and how do their perceptions of PD vary across different teaching experience ranges?

Literature Review

Definitions of professional development (PD) vary. However, all are concerned with the education and learning of adults and aim to produce positive change in participants' beliefs, knowledge, skills, or behaviors (Nguyen, 2022). In education, Doyle et al. (2018) defined PD as "structured professional learning that results in changes in teacher practices and improvements in student learning outcomes." Different perspectives on teacher PD result in articulating its effectiveness differently. Scholars agree that effectiveness depends on the internal connection between various elements of instructional development (e.g., duration and goals), needs to improve the teaching practice and ultimately impact students' learning. and that results are strongly context-dependent (Ilie et al., 2020).

Some studies that examined the elements of effective PD included a review by Doyle et al. (2018), which identified five key characteristics of PD programs that increase teacher knowledge and skills. The components include a focus on the subject matter and how students learn it; active teacher participation; coherence with reforms and policies; program duration; and collective participation of teachers from the same school, grade, or department. In Hubers et al.'s study (2020), essential characteristics of PD include five characteristics related to the program's content, such as focusing on pedagogical content knowledge and student learning processes, and three characteristics related to the context, such as organizational and individual factors. Other reviews by Darling-Hammond et al. (2017) identified specific components of high-quality professional learning for teachers, including a content focus, active learning, collaboration, modeling of effective practices, coaching and expert support, feedback and reflection, and sustained duration. Stevens et al. (2023) suggest that PD integrate research-based learning and evidence-informed innovation. The approach would enhance the sense of ownership among teachers, utilize their practice-based knowledge, and lead to educational innovations.

Other studies, particularly those focusing on novice teachers, have accounted for the influence of teaching experiences when designing professional development for teachers. In the study of six Swedish universities, Ödalen et al. (2018) found that teachers with different levels of previous teaching experience perceived that the pedagogical training course they had completed had different relevance to their teaching. Teachers with between one and three years of teaching experience said the training had a large or very large relevance for them, while the least satisfied group was teachers with more than three years of teaching experience who might perceive that PD courses offer the necessary skills they already have. A recent study by Kálmán et al. (2019) found that novice teachers (with two years or less experience) had a low participation rate in formal pedagogical training but a high preference for informal ways of sharing teaching practices. While more experienced teachers prefer PD activities for experimenting with approaches or trying out new teaching methods, According to Meizlish et al. (2017), a new faculty program has a positive impact on teaching beliefs, teaching preparation, student evaluation, and engagement with the teaching center in new teachers' early careers rather than in more experienced cohorts. While researchers study the professional development of new teachers in various ways, the central focus of literature is on the transfer of teacher learning to improve students' learning.

Methods

This study employed a mixed-methods approach, including quantitative and qualitative data collection methods. The quantitative data was obtained through a survey, while the qualitative data was obtained from in-depth interviews.

Participants

The study included 99 teachers who completed the mandatory PD program for new faculty at a university between the 2016 and 2020 academic years. In order to obtain the necessary contact information with respect to the privacy of the faculty members, the author asked for permission to access the institutional database and only requested access to an e-mail address from the registration records.

The author approached the research participants by e-mail, explaining the research purpose, the data collection process, and the protection of their privacy and confidentiality. By clicking on the embedded link to the online questionnaire in the email, the prospective participants consent to participate in the survey. To contain the participants for the in-depth interview, there was a question asked for their consent to participate in the interview session. Only those participants who gave permission would have additional appointments to schedule the face-to-face or online interview. Finally, 32 teachers only consented to participating in the online survey, while 28 teachers consented to both the online survey and in-depth interviews. This resulted in response rates of 32% and 28% for each respective group. The author, guided by Malterud et al. (2015), was cautious to ensure that the small sample size included key informants who held relevant information in line with the study's aim.

Table 1
Demographics Characteristics of the Respondent Teachers

Age (years)	Number	Percent
< 30	1	3.12
30-39	18	56.25
≥ 40	13	40.63
Higher education teaching experience (years)		
< 2	5	15.6
3-5	9	28.1
> 5	18	56.3

Questionnaire

The questionnaire uses the Thai language and consists of two sections: demographic information, perceptions of PD, and preferences for PD types. The demographic information included age and number of years of teaching in higher education. To collect teachers' perceptions of PD, teachers were asked to rate their interest in PD to improve teaching skills, the need for PD to improve teaching skills, and the importance of PD in their teaching career using a 1–10 scale, where a higher score indicated a higher degree of their perception.

In order to understand teachers' preferences for different types of PD, the questionnaire asked teachers to rate the extent to which they preferred different PD types on a 1-3 scale, with one representing "not at all" and three representing "strongly." The development of seven items incorporated core features of effective PD, with the exception of duration. All items reflect varying degrees of characteristics that support professional learning, including collective

participation, coherence with the teacher's work, content focused on the required knowledge and skills, and an active learning experience (Boeskens et al., 2020; Darling-Hammond et al., 2017; Doyle et al., 2018). The questionnaire provided brief descriptions in Thai for each item.

Each single item of PD types was validated by using content validation to ensure that it accurately measured the targeted construct as defined in this study context (Halek et al., 2017). The author engaged three experts—two professional development experts and one professional development designer—in confirming the appropriateness of seven items of PD types or activities and the descriptions of each item that informed by related literature.

Semi-structured Interview

The interviews used open-ended questions to understand the respondents' view on the characteristics of effective PD for university teachers. Teachers were asked: What features of a teacher professional development program effectively motivate you to participate? The follow-up questions were guided by the concepts of teacher professional development (Darling-Hammond et al., 2017) to further explore the details of PD in case the teachers' answer touched on the PD attributes but left some rooms for the interviewer to delve into the how and the why of the prior answers.

Data Collection

This study collected data from a questionnaire through the online platform, while the interview was conducted face-to-face or via Zoom, with an average interview duration of 60 minutes. The collection period was four months, and reminder emails were sent two weeks and three weeks after the original approach.

In parallel with the data gathering, the author roughly analyzed the results and noted that teachers who completed different badges mentioned specific differences in their responses. When the answers' detail and richness repeatedly emerged, the author used data saturation to justify the number of interviewees. The study was approved by the Institutional Review Board of the university.

Data Analysis

For quantitative data, the author used descriptive statistics such as frequency, percentage, median, mean, and standard deviation. Each question on perceptions of PD was tabulated as a different item. The chi-square test was analyzed to find teachers' preferences for PD types across different teaching experiences, and the Mann-Whitney U test to find an association between teaching experience and perceptions of PD.

For qualitative data, individual teachers were the unit of analysis. The author examined the interview transcripts using the thematic content analysis method. To generate themes for the content, the author and research assistant noted patterns related to the characteristics of effective PD for university teachers. The data coding process applied the concepts of teacher professional development (Darling-Hammond et al., 2017) to explore the connections of meaning in the identified patterns. The coders demonstrated strong agreement (0.80-0.90) according to Cohen's kappa, and they addressed any discrepancies through clarification.

Results

Difference Between Teaching Experience and Preference for Professional Development Types

The median preferences were higher for workshops, doing a teaching and learning scholarship, and attending education conferences (Mdn = 3.00). On average, teachers' preferences for peer classroom observation (M = 2.06, SD = .759) and mentoring were quite low (M = 2.06, SD = .801).

In Table 2, a Mann-Whitney U test was performed to evaluate whether preferences for PD types differed by teaching experiences. The results indicated that teachers with more than five years of teaching experience had significantly higher preferences for participating in the education conference than those with fewer teaching experiences (U = 57.00, p = .04).

Table 2

Difference Between Teaching Experience and Preference for PD Types

PD Types	Teaching experience years	N	Median	Mean	SD	*Z*	*P*
Workshop	≤ 5	14	3.00	2.64	.497	-0.99	.319
	> 5	18	2.50	2.39	.698		
	Total	32	3.00	2.50	.622		
Mentoring	≤ 5	14	2.00	2.07	.829	-0.18	.854
	> 5	18	2.00	2.06	.802		
	Total	32	2.00	2.06	.801		
Peer observation	≤ 5	14	2.00	2.21	.699	-0.97	.329
	> 5	18	2.00	1.94	.802		
	Total	32	2.00	2.06	.759		
Class observation	≤ 5	14	2.00	2.21	.893	-1.22	.220
	> 5	18	3.00	2.56	.705		
	Total	32	2.00	2.41	.798		
Sharing forum	≤ 5	14	2.00	2.21	.579	-0.41	.675
	> 5	18	2.00	2.28	.752		
	Total	32	2.00	2.25	.672		
Education conference	≤ 5	14	2.00	2.14	.535	-2.91	.004*
	> 5	18	3.00	2.78	.647		
	Total	32	3.00	2.50	.672		
Scholarship of Teaching and Learning	≤ 5	14	2.20	2.29	.611	-1.69	.091
	> 5	18	3.00	2.67	.686		
	Total	32	3.00	2.50	.672		

*p < .05

Difference Between Teaching Experience and Perception of Professional Development

The median opinion of the three aspects was rated at a high level. While teachers rated their need for PD at a high level (M = 8.60, SD = 1.18) and reported high interest in professional development (M = 8.40, SD = 1.36), they were less likely to acknowledge its importance to their teaching career (M = 8.10, SD = 2.02). The standard deviation was high, indicating that teachers' opinions varied.

On average, teachers with more than five years of teaching experience reported higher interest (M = 8.72, SD = 1.23) and perceived need (M = 8.61, SD = 1.09) for PD than teachers with less teaching experience (M = 8.00, SD = 1.47 for interest; M = 8.57, SD = 1.34 for perceived need). However, respondents with less teaching experience reported a slightly higher perceived importance of PD to their teaching career (M = 8.14, SD = 1.83) than the others (M = 8.06, SD = 2.21). However, the Mann-Whitney U test as shown in Table 3 indicated teachers' perceptions were not statistically significant between teaching experiences, $U = 93.50$, $p = .203$ for interest in PD; $U = 118.50$, $p = .759$ for perceived need for PD; $U = 123.00$, $p = .905$ for importance to the teaching career.

Table 3

Difference Between Teaching Experience and Perception of PD

Perception of PD	Teaching experience Years	N	Median	Mean	SD	*Z*	*P*
Interest in PD	≤ 5	14	8.00	8.00	1.47	-1.274	.203
	> 5	18	9.00	8.72	1.23		
	Total	32	8.00	8.40	1.36		
Need for PD	≤ 5	14	8.50	8.57	1.34	-.306	.759
	> 5	18	8.00	8.61	1.09		
	Total	32	8.00	8.60	1.18		
Importance of PD	≤ 5	14	8.00	8.14	1.83	-.120	.905
	> 5	18	8.00	8.06	2.21		
	Total	32	8.00	8.10	2.02		

Characteristics of Effective Professional Development for University Teachers

Findings from in-depth interviews revealed the pattern of teachers' preferences for specific characteristics that would make up effective PD in university teaching—the paragraphs below present four major components that teachers embrace.

Pedagogical and Technological Knowledge Focused

As university teachers who generally lack a teaching background, PD should address the need for guidance on teaching-related techniques. They preferred clear examples of general techniques suitable for diverse class sizes over specific strategies for a particular subject area.

Introducing fundamental knowledge and basic skills of learning psychology helps prepare the participants for a teacher mindset that teachers might never know exists or do not consider before becoming teachers. Many teachers reported having difficulty understanding their students early in their teaching careers. Teachers would like to understand their students' individual differences through the lens of learning psychology. Some teachers expressed concerns about communicating with or advising students. In addition, PD should encompass teaching techniques that keep pace with evolving trends in education. This will equip teachers with the necessary skills to instruct effectively. PD should assist in informing teachers to be ready for the changing landscape of technology-enabled teaching as well as adult learners. As Teacher 13 exemplified, "online teaching techniques and teaching for working adults were necessary for changing contexts of higher education."

A quarter of the teachers interviewed (n = 7, 25%) expressed a need for the PD program to demonstrate and provide hands-on experience using teaching and learning support tools.

Some teachers are familiar with traditional lecture-based instruction and seek guidance on incorporating teaching and learning support tools into their practice. They expected the PD program to demonstrate how these tools could enhance lecture-based or active learning approaches. Teachers emphasized the role of technology and appropriate tools in enhancing student engagement. Utilizing diverse tools can facilitate student learning and communication between teachers and students.

Reflective Observation of Exemplary Teaching Practices

Teachers suggested incorporating classroom observation into the mentoring program to observe the teaching practices of highly qualified teachers. PD designers may also seek recommendations from educational professionals who have observed or worked with the teacher, or they may consult the faculty to approach any other relevant data demonstrating the quality of teaching experiences.

Observing qualified teachers' teaching can be more beneficial for some teachers than the traditional approach of having a mentor observe them. While individual experiences may influence teachers' perceptions and may not apply to all mentoring relationships, it is crucial to carefully implement observation-based professional development. Many teachers shared how they struggled to prepare and did not conduct their teaching in a natural classroom setting when their mentors came to observe the class. Teachers' perceptions of mentoring's judgment also influence their belief that their teaching aligns with the mentor's guidelines. Teacher 23, for example, expressed, “I feel pressured and afraid of doing something wrong, or I thought it was not wrong, but the mentor's eyes said it did not work. It felt like teaching in front of the committee.”

Teachers addressed diverse preferences for exposure to teaching strategies during their observations. Observing different classroom environments provided insights into various approaches to engaging students. Also, observing experienced teachers in related disciplines would be more likely to enhance the practicality gained in pedagogical approaches from the observation. For example, Teacher 14 described the benefits of classroom observation in related fields as the experience of “watching what teachers teach and how they teach.”

Teachers also expected for the integration of reflective practice and knowledge sharing among themselves. After observing experienced teachers, a forum should be held for participants to discuss and share their observations. Teachers could organize sharing as a small discussion group, where they exchange ideas, ask questions, analyze their teaching methods, and make adjustments to enhance student learning.

Job-Embedding

Teachers' work environments should recognize PD as on-the-job learning. Teachers defined job-embedded PD as continuous learning opportunities that encourage dialogue and discussions about pedagogical knowledge, with a focus on improving the quality of teaching. Rather than being a one-time event, formal and informal PD organizations can foster peer support. In this respect, individual teacher learning could evolve into a collaborative learning experience where teachers are more likely to engage in discussions with their peers. Teachers might start accepting that their teaching may have room for improvement. Similarly, opportunities for teachers to share experiences and exchange ideas prompted teachers to ask themselves what-if questions, such as, “What if I do not give a pure lecture but allow the

students to construct their knowledge?" (Teacher 17). Likewise, teachers learn from one another through discussions, which "help teachers, particularly those new to teaching, to evaluate their performance and know what needs improvement" (Teacher 13). Enabling dialogue between teachers also expands the likelihood of transferring learning to actual teaching.

Teachers also addressed collaborative teaching experience as an essential aspect of job-embedded PD. For instance, incorporating mentoring into the team-teaching course environment would increase the accessibility of mentors, enabling them to provide feedback for on-the-job learning. This approach would establish a connection between professional development and daily teaching practice. In this regard, teachers felt that PD experiences would be more applicable to their students and subject matter.

Relevance

Designing PD should relate the content and delivery to the needs of teachers and involve teachers since the design stage of the program. Teachers suggested surveying participants' needs prior to launching any professional development program. In addition to the survey, PD designers might conduct a short interview so that the prospective participants can address their needs and interests concerning the nature of teaching and their teaching situation. This approach was deemed necessary, particularly for those who possess prior teaching experience and specific problems or concerns.

Some teachers suggested that the PD program should not have a one-size-fits-all approach and should offer advanced content or alternative options for experienced teachers. This means that the design of the PD program should take into account the various issues that teachers may encounter at different stages of teaching. By analyzing the emergent issues, the program can be designed in a modular format, with some topics taught before the start of teaching to help teachers plan and design courses and others taught after several weeks of teaching to provide opportunities for teachers to observe, receive feedback from students, and apply new techniques. For example, topics related to outcome-based education, lesson planning, course syllabus design, and learning management systems can be taught before teaching. In contrast, more advanced topics such as classroom management, student engagement, consultation, and learning assessment can be taught after several weeks of teaching.

In cases where PD includes mentoring activities, another option is to explore the needs of teachers before pairing them with mentors. When the program incorporates the participants' opinions into the mentor selection process, mentoring becomes an integral part of the relationship between teachers and their mentors. Some respondents reflected on how they received mentoring beyond teaching observation feedback.

Discussion

Both the survey and the interview consistently revealed that the respondents had a strong interest in PD, which offers pedagogical knowledge. Teachers' preference for pedagogically focused PD is consistent with the effective characteristics of PD that many studies have previously proposed (e.g., Darling-Hammond et al., 2017; Doyle et al., 2018; Hubers et al., 2020). Comparing teachers' preferences by teaching experience indicated that teachers with fewer or higher experiences reported their preference in the PD types similarly. The

exception is found in higher preferences for participating in the education conference among teachers with more than five years of teaching experience. More experienced teachers may find education conferences a useful PD for improving the quality of teaching and learning, while others with less teaching experience may prioritize conferences within their field. Generally, teachers may frame the purpose of the conference as focusing on sharing and discussing the specialized topics within their discipline. Furthermore, university academics may expect to benefit from creating connections, building on their research, and enriching their career when engaging in a conference event. The finding that showed experienced teachers' interest in learning from academics and practitioners across educational fields through conferences may be further studied to understand teachers' learning intentions and the relevance of this PD type to their job focus.

Meanwhile, teachers with different teaching experiences expressed a similar interest in SoTL's teaching development. Teachers' preference in SoTL could relate to the characteristics of its systematic research-informed approach (Dunn et al., 2018; Stevens et al., 2023). In this study, different teaching experiences do not affect their interest in conducting inquiries to investigate their teaching practices with the aim of optimizing student learning and improving course experiences. The finding, however, is inconsistent with the study of Kálmán et al. (2019), which found that university teachers with more than two years of teaching experience were more likely to be open to research on teaching and were more likely to be experimenters in innovating higher education teaching. This study would argue that having fewer or more years of teaching experience should not determine teachers' engagement in teaching and learning research. Teachers, in the early or later years of their teaching career, may find a scholarly approach to reflect their teaching practice interesting. As Meijerman et al. (2024) noted, the motivation to start a SoTL project does not always originate from an experienced problem; it can also be an interest, a heartfelt mission, a frustration, or an insecurity. Viewing from the motivational aspect, teachers may view SoTL more engaging as undertaking PD that benefits student learning motivates teachers internally (Doyle et al., 2018). In addition, teachers' ideas that PD should be a job-embedded approach align with SoTL as a connection between professional development and daily teaching practice.

The results support other research indicating teachers have a less positive view of peer classroom observation and mentoring compared to other methods of PD (Hibbert & Semler, 2015). At least in this study, teachers with fewer or more teaching experiences reported lower interest in mentoring, observation, and sharing forums. To some extents, learning development through these PD types is socially constructed. Previous studies suggest integrating a collaborative approach to enhance teachers' learning experiences. However, engaging teachers in collaborative development requires a professional culture that supports these practices (Boeskens et al., 2020). Teachers may perceive conventional observation as evaluative and stressful, rather than receiving peer learning. In the Thai educational context, PD may come across normative practices that promote a social hierarchy in interactions between individuals of varying social statuses (Ungsuchaval et al., 2024). This societal factor, which influences feedback in the learning process, is consistent with the findings of Areemit et al. (2020), who found that the hierarchy and collectivism in Thai societal culture influence the learning culture and the unidirectional top-down feedback conversations between teachers and learners. In the situation of PD, following the more experienced teacher's lead could portray the younger teacher as humble and obedient, fostering a smooth and connected relationship but hindering teacher learning through social construction and collaboration.

This study also found that teaching experience had no affect on their perception of PD. Teachers, regardless of their experience level, exhibit a similar level of interest in PD, perceive a need for it, and place significant importance on it in their teaching careers. Many universities in Thailand, including the setting of this research, are currently striving to make their teaching and curriculum innovative for competency development. The implementation of professional development policies aims to engage faculty members in the acquisition of new educational and learning concepts. Teachers' perceived need and interest in enhancing their teaching skills may stem from their likelihood to adhere to the educational trends and established policies of the institution. Whether enforced by rules and regulations, the faculty members are, to a greater or lesser extent, required to redesign curriculum, teaching, and assessment practices. For university teachers who do not have an educational background in teaching, this may draw interest and instill a sense of obligation to adhere to the institution's professional development policy.

Although there is no significant difference, the results showed that the group with less than five years of teaching experience rates the importance of PD in their teaching career higher. It could be that the university under study requires new faculty members with less than two years of teaching services to complete an induction program, a requirement that impacts contract renewal and sets a time limit for advancement to a higher rank. Furthermore, the institution expects the group with less than five years of work experience to successfully complete the process of verifying teaching competence at a higher level. The institution's policy, currently in the process of developing and delegating career promotion standards for its teaching staff, aligns the verification of PSF with the attainment of higher academic ranks, despite not yet reinforcing the latter. Therefore, the group of teachers with less than 5 years of teaching experience, who are the primary target of PD that the university will enforce, sees PD as more important to their teaching career. However, the high interest and perceived need in PD, particularly among teachers with more than five years of teaching experience, may indicate that their longer experience in the education transformation process, compared to those with more than five years, leads this group of teachers to view PD as an interesting and necessary activity for their teaching career.

Conclusion

Teachers' preference for PD types addressed a need for pedagogical and technological knowledge guidance. Prioritizing workshops, conferences, and support for Scholarship of Teaching and Learning (SoTL) can help university faculty development meet the teachers' practical needs for up-to-date pedagogical and technological knowledge. Traditional practices like classroom observation and mentoring can be reframed to emphasize reflection and professional growth through a supportive and collaborative approach. Regardless of the years taught, teachers can be at different career stages, and the number of years in teaching does not determine how they think about PD. Teachers' views on pedagogical development, on the other hand, are more likely to concern various aspects of their academic roles, diversity in the professional field, and different job focus (e.g., research or teaching).

It is important to take into account the limitations of the current study. In the survey results, the sample size is relatively small and is not generalizable. The sample specificity of teachers who completed the mandatory PD program for new faculty at a university may limit the availability of the samples. In the meantime, the sample teachers are key informants who have the relevant experiences of teacher professional development provided at the university, their rich-textured information can elicit recall bias, which could influence the findings.

Another limitation of the study is that the participants' faculty affiliations are anonymous. Therefore, the study does not consider disciplinary differences, which could enhance understanding of the teaching context when interpreting the findings.

Conducting cross-sectional studies for future research to broaden the scope across multiple settings or populations could enhance the robustness of the findings. Further, the study may use methodological triangulation to gain more comprehensive and increased valid data while reducing research bias. Further research may explore how institutions can recognize and value PD in promotion and tenure processes. In an educational and learning landscape where innovative platforms for lifelong learning emerge (e.g., micro-credentials), how does PD for university teachers benefit from the new learning ecosystem?

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

During the preparation of this manuscript, I used Quillbot–AI-assistive technology-to improve language, readability, and proofreading.

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Distance Education During Times of War: Lebanese Students' Experiences Amid the Israel-Hezbollah Conflict

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Abstract

The Israel-Hezbollah conflict has severely disrupted education in Lebanon, leading to the destruction of educational infrastructure and the displacement of students. In response, educators have increasingly turned to distance learning solutions to maintain educational continuity and protect students from harm in conflict-affected areas. This qualitative, phenomenological study explored the experiences of 16 Lebanese students - 9 high school and 7 university students - who transitioned to distance learning during the conflict. Through interpretative phenomenological analysis, four key themes emerged: (1) students recognized the necessity of distance learning, appreciating its role in maintaining academic progress and avoiding delays in obtaining qualifications; (2) distance learning helped reduce exposure to physical harm, offering safety by limiting the need for students to leave their homes or shelters (e.g., bomb shelters); (3) the transition to distance learning was hindered by technological difficulties, including inadequate IT infrastructure and a lack of familiarity with digital tools; and (4) unreliable electricity and internet services, resulting from attacks on infrastructure, required flexibility from educators regarding deadlines and class attendance. The findings highlight both the resilience of Lebanese students and the potential of distance learning as an emergency educational intervention, while underscoring the critical need for enhanced technological infrastructure and comprehensive support systems in conflict-affected regions.

Keywords: distance learning, educational continuity, conflict-affected education, technological infrastructure, student resilience

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Introduction

Armed conflicts disrupt the education of millions of children and young people worldwide, with devastating consequences that extend far beyond the immediate crisis period. UNESCO estimates that conflict-affected countries account for over 35% of the world's out-of-school children, despite representing only 20% of the global school-age population (UNESCO, 2023). Over 75 million children and youth aged 3-18 require urgent educational support in crisis-affected areas (Education Cannot Wait, 2022). Traditional responses to educational disruption during warfare, including school closures, establishment of temporary learning spaces, or complete suspension of instruction, often result in prolonged learning gaps that persist long after hostilities end. Some students lose up to two years of schooling during these disruptions (Jundi, 2024). However, the growing availability of digital technologies and distance learning platforms offers new opportunities for maintaining educational continuity even when conventional schooling becomes impossible. The recent Israel-Hezbollah conflict provides a compelling context for examining how distance learning can serve as a critical tool for educational continuity amid armed conflict.

Literature Review

Distance Learning and Educational Continuity in Crisis Contexts

Research examining distance learning as a tool for educational continuity during armed conflicts remains critically underdeveloped. A systematic review by Burde et al. (2017) revealed that while emergency education research has grown substantially, studies focusing on technology-mediated educational interventions during active conflicts remain sparse and methodologically limited. The existing literature on distance education has predominantly emerged from stable educational environments where reliable infrastructure, adequate preparation time, and intact institutional support systems are assumed (Anderson & Dron, 2011; Moore & Kearsley, 2012; Thompson, 2023). While these studies provide valuable insights into online pedagogy and digital learning effectiveness, they offer limited guidance for understanding how remote education functions when implemented as an emergency response under crisis conditions characterized by infrastructure damage, student displacement, psychological trauma, and institutional instability (Chee, 2025).

The disconnect between distance learning research and emergency education practice represents a critical knowledge gap. Emergency education literature has traditionally emphasized physical safety and basic service provision over educational continuity and quality (Dickson-Deane et al., 2022). This approach operates within what Dryden-Peterson (2016) identifies as a “care and maintenance” paradigm that views education during crises as temporary rather than transformative. Conversely, distance learning research has focused on pedagogical optimization in stable environments (Bernard et al., 2014), developing within techno-pedagogical frameworks that assume consistent access to resources and support systems. This disciplinary separation has created a conceptual void where neither field adequately addresses how digital technologies can serve as effective tools for preserving meaningful educational engagement during humanitarian crises.

Studies examining education during conflicts have predominantly focused on documenting damage, analyzing post-conflict reconstruction, or exploring temporary arrangements rather than investigating how educational continuity might be maintained during active hostilities (Dickson-Deane et al., 2022; Zembylas et al., 2016). The theoretical framework for

emergency education, as outlined by the Inter-Agency Network for Education in Emergencies (2024), emphasizes preparedness and response but provides limited conceptual guidance on leveraging digital technologies for educational continuity during active conflicts. Recent meta-analyses of conflict-affected education interventions reveal a troubling absence of rigorous evaluation studies examining technology-mediated educational responses (Menashy & Zakharia, 2017).

The student perspective on conflict-affected distance learning remains particularly underexplored within educational research. While educational research increasingly recognizes the importance of student voice in understanding learning processes (Kayyali, 2024), crisis education research has traditionally privileged administrative and institutional perspectives over learner experiences (Dryden-Peterson, 2016; Komatsu, 2024). This represents a significant epistemological limitation. Phenomenological inquiry emphasizes that understanding educational phenomena requires careful attention to the lived experiences of those who encounter them directly (Komatsu, 2024). Students' subjective experiences constitute primary data about how emergency educational interventions actually function in practice, potentially revealing both intended outcomes and unintended consequences that remain invisible from institutional viewpoints.

Recent global events have demonstrated both the transformative potential and inherent limitations of large-scale distance learning implementation under crisis conditions. The COVID-19 pandemic provided an unprecedented experiment in emergency remote education, revealing that educational systems could transition rapidly to online learning when necessary, but also exposing profound digital divides and pedagogical challenges (Davey et al., 2023; Dhawan, 2020). However, pandemic-related educational shifts occurred within contexts of relative physical safety and maintained infrastructure in most developed countries (König et al., 2020). Armed conflict situations present fundamentally different and more severe challenges. In these contexts, students face immediate physical threats, educational institutions operate under extreme resource constraints, and basic services become unreliable or completely unavailable (Save the Children, 2013).

Lebanon's Educational Landscape During the Israel-Hezbollah Conflict

The recent Israel-Hezbollah conflict offers several characteristics that make it particularly relevant for examining conflict-affected distance learning. As a recent and well-documented conflict, this situation provides a contemporary case study for understanding how educational systems respond to warfare in the current technological era. This context allows for examination of emergency remote education implementation using current digital technologies and platforms representative of what educational institutions worldwide have access to today (Docherty, 2018; Wilmer, 2021). While Lebanon's telecommunications infrastructure faces ongoing challenges, basic internet and mobile connectivity remained available in many areas during the conflict, making distance learning a viable, if challenging, option for educational continuity (Docherty, 2018; Levitt, 2024; Wilmer, 2021).

Lebanon's educational system is characterized by its diversity and complexity, encompassing public, private, and semi-private institutions across primary, secondary, and tertiary levels. This multi-layered educational landscape provides varied contexts for examining how different institutional types and student populations experience the transition to remote learning during crisis. Lebanese universities, in particular, have varying degrees of technological readiness and international partnerships that influence their capacity to

implement emergency distance education measures (Abdul-Hamid, 2020; Al-Hroub & Jouni, 2023).

The temporal dynamics of the Israel-Hezbollah conflict created particularly compelling conditions for studying educational continuity. The conflict occurred during active academic periods, forcing immediate decisions about educational delivery rather than allowing for planned suspension during academic breaks. This timing created natural transition points that enable examination of how students and institutions navigate sudden shifts from traditional classroom-based learning to technology-mediated education under crisis conditions. Additionally, Lebanese students' limited prior exposure to formal distance learning modalities ensures that their experiences reflect genuine adaptation processes to emergency remote education rather than activation of pre-existing digital learning competencies (Levitt, 2024).

The Purpose of This Study

Given the significant gaps in understanding distance learning's role in maintaining educational continuity during armed conflicts and the limited attention paid to student experiences in emergency education contexts, there is a pressing need to examine these phenomena from the perspectives of those who lived through them. Lebanese students who experienced the transition to distance learning during the Israel-Hezbollah conflict represent a unique population whose voices can illuminate the complex realities of using remote education to maintain learning progress under extraordinary circumstances.

Understanding student experiences with conflict-affected distance learning contributes to advancing knowledge across multiple interconnected domains within educational research and humanitarian studies. This inquiry intersects with growing international discussions about education's role in humanitarian response and recovery (Inter-Agency Network for Education in Emergencies, 2024) while contributing to emerging theoretical frameworks around educational resilience and adaptive capacity during crises (Brock, 2017). The urgency of developing this knowledge base is underscored by the escalating frequency of conflicts worldwide and mounting evidence that educational disruption creates cascading effects on individual development, community stability, and long-term societal recovery (Chee, 2025).

This study seeks to address this critical knowledge gap by exploring the lived experiences of Lebanese students impacted by the Israel-Hezbollah conflict as they transitioned to distance learning. By examining their perspectives, this research aims to understand the meaning-making processes through which students experienced remote learning as a tool for educational continuity during crisis. The study focuses specifically on how students navigated the challenges and possibilities that emerged when distance learning served as the primary mechanism for preserving educational engagement while they simultaneously managed the psychological and practical demands of living in a conflict zone.

Research Question: How do Lebanese students experience and make meaning of their transition to distance learning during the Israel-Hezbollah conflict?

Method

Design

This study employed a qualitative phenomenological research design to explore the lived experiences of Lebanese students impacted by the Israel-Hezbollah conflict as they transitioned to distance learning. Interpretative Phenomenological Analysis (IPA) was utilized to capture the subjective meaning-making processes underlying educational disruption experiences (Love et al., 2020). IPA's dual hermeneutic approach was particularly appropriate for this cross-cultural context involving Arabic-English translation dynamics (Willig & Stainton Rogers, 2017).

Participants

Sixteen Lebanese students were purposively recruited to participate in this study (see Table 1 for sample characteristics). The sample comprised 9 high school and 7 university students, ensuring representation across educational levels most affected by crisis-induced disruption. Four inclusion criteria guided participant selection: (1) active enrollment in Lebanese educational institutions at conflict onset; (2) residence in conflict-affected regions; (3) direct experience with the transition from in-person to emergency distance learning; and (4) minimum age of 16 years to ensure sufficient cognitive maturity for phenomenological inquiry. Recruitment was conducted through educational institutions across multiple conflict-affected regions using informational flyers to solicit voluntary participation. This sampling approach ensured participants possessed rich, contextually relevant experiences while maintaining the demographic homogeneity required for rigorous interpretative phenomenological analysis.

Table 1
Sample Characteristics

Sample Characteristics	N	%	M	SD
Gender				
Male	6	37.5		
Female	10	62.5		
Age			18.14	4.16

Data Collection

Semi-structured interviews were conducted remotely via secure video conferencing platforms, with each session lasting 60-90 minutes and audio-recorded with participant consent. The interview protocol employed a funnel approach, progressing from broad descriptive questions (“Describe your experience when distance learning was announced”) to targeted probes exploring the emotional and psychological dimensions of the educational transition. Interviews were conducted in participants' preferred language (Arabic or English), with Arabic interviews professionally translated and verified through back-translation procedures. All recordings were transcribed verbatim to preserve authentic participant voices. Field notes captured contextual observations, non-verbal cues, and researcher reflections throughout the data collection process.

Data Analysis

Data analysis followed Willig's (2017) systematic IPA framework through six sequential stages: familiarization through repeated transcript reading, line-by-line analysis to identify meaning units, psychological theme development, theme organization into hierarchical structures, cross-case pattern analysis, and narrative integration with supporting quotations. Reflexivity was maintained throughout the analytical process through regular supervision and peer debriefing sessions.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board at the International Executive School, Strasbourg, France. All participants provided informed consent and were informed of their right to withdraw from the study at any time without consequence. Data protection protocols included participant pseudonymization, encrypted data storage, and systematic destruction of audio recordings following transcription completion.

Results

The interpretative phenomenological analysis identified four master themes from participants' experiences during their transition to distance learning amid the Israel-Hezbollah conflict (see Table 2 for summary of findings). These themes reveal how students understood and navigated this unprecedented educational disruption during an active conflict.

Table 2
Summary of Findings

Master Theme	Sub-Theme	Participant Distribution
Recognition of Distance Learning as Educational Necessity	Preserving academic continuity and future aspirations	16/16
	Appreciating institutional efforts and educational commitment	16/16
Distance Learning as Protection from Physical Harm	Avoiding dangerous travel and exposure to conflict zones	14/16
	Creating psychological safety within learning environments	15/16
Technological Barriers and Digital Unfamiliarity	Navigating unfamiliar digital platforms and tools	16/16
	Managing equipment limitations and technical failures	14/16
Infrastructure Vulnerabilities and Required Educational Flexibility	Coping with power outages and connectivity disruptions	15/16
	Experiencing educator adaptation and institutional understanding	16/16

Master Theme 1: Recognition of Distance Learning as Educational Necessity

Participants demonstrated a profound understanding of distance learning as an essential response to the conflict situation. They recognized its critical role in maintaining academic progress and preventing educational delays. For participants, distance learning represented more than an alternative educational modality. It emerged as a means of preserving their academic trajectories and future possibilities within a context that threatened to disrupt their educational plans. This recognition involved an active process through which students reframed their educational experience and constructed meaning around educational persistence.

Subtheme 1a: Preserving Academic Continuity and Future Aspirations

Participants consistently articulated their appreciation for the opportunity to continue their studies despite the challenging circumstances. They experienced the announcement of distance learning as a restoration of their ability to pursue their academic goals. Fatima's reflection illustrates this experience:

> When the bombing started getting closer to our area, I thought that was it for this semester. But when they announced we could continue online, I felt like someone had given me back my future. I knew it wouldn't be the same, but at least I wouldn't lose a whole year.

Her account reveals how the proximity of violence had initially disrupted her sense of educational continuity, and how distance learning functioned to restore her connection to her academic timeline.

The necessity of distance learning became particularly meaningful when participants considered the alternative of complete educational cessation. Khalil drew upon family experiences to understand his current situation:

> My older brother lost almost two years of university during the 2006 war. When I saw what was happening now, I was terrified the same thing would happen to me. Distance style, like e-learning classes meant I could still graduate on time and not fall behind my friends who live in safer areas.

This comparative perspective highlights how students drew upon collective memory of previous conflicts to understand the significance of maintaining educational continuity.

Subtheme 1b: Appreciating Institutional Efforts and Educational Commitment

Students recognized the considerable institutional efforts required to implement distance learning rapidly during the crisis. They interpreted these efforts as evidence of institutional care and commitment to their educational futures. Sara's reflection captures this appreciation:

> I realized how much work the professors and administration had to do to set everything up so quickly. They could have just cancelled everything, but they fought to keep our education going. It made me appreciate that someone was thinking about our future even when everything felt so uncertain.

For participants, this institutional response represented more than administrative efficiency. They experienced it as a form of support that validated their educational aspirations during a period of uncertainty. This recognition extended beyond personal benefit to encompass an understanding of education as something worth preserving even under the most challenging circumstances. Students interpreted the institutional commitment to maintain education as evidence that their learning mattered and that their futures remained important despite the conflict.

Master Theme 2: Distance Learning as Protection From Physical Harm

This theme captured participants' awareness of how distance learning functioned as a protective mechanism, reducing their exposure to physical danger by eliminating the need to travel to educational institutions. Participants experienced relief from the elimination of dangerous travel and found that staying home created both physical safety and psychological space for learning. This protection encompassed both immediate safety benefits and broader psychological relief from constant risk assessment.

Subtheme 2a: Avoiding Dangerous Travel and Exposure to Conflict Zones

Participants provided detailed accounts of how distance learning allowed them to avoid dangerous situations. They described the relief experienced by both themselves and their families when travel to school was no longer necessary. Omar's experience illustrates this relief:

> Our school is only fifteen minutes away, but to get there you have to pass through three areas that get bombed regularly. My mother was crying every morning worrying about me going to school. When they announced online classes, she was so relieved. She said it was like God had answered her prayers.

His account demonstrates how the threat of travel had created anxiety for entire families, and how distance learning resolved these safety concerns.

The protective aspect of distance learning became particularly significant for students experiencing displacement or living in emergency shelters. Layla described her situation:

> At that point, we were sleeping in a shelter for three weeks. Sometimes we have to move to my uncle's house when the bombing gets too close. With online classes, I can study wherever we are. My laptop and books come with me to every shelter. I don't have to choose between being safe and going to class.

Her account reveals how distance learning provided flexibility that enabled educational continuity despite frequent relocation for safety reasons.

Subtheme 2b: Creating Psychological Safety Within Learning Environments

Students described the psychological benefits of feeling protected while learning. They found that being in familiar, safe spaces enabled better concentration and educational engagement. Ahmad's experience demonstrates this connection:

> When I'm in class online, I can focus on my studies instead of listening for sirens or worrying about whether it's safe to walk home. At home, even if we hear explosions, I know I'm as safe as I can be while still learning.

His account suggests that traditional classroom attendance had required divided attention between learning and safety concerns, while distance learning allowed for more focused educational engagement.

The psychological dimension of safety extended beyond immediate physical protection to include the comfort of familiar environments. Students experienced their homes and shelters not merely as places of physical refuge but as spaces where they could maintain educational engagement. This transformation of domestic space into learning environments represented a significant shift in how participants understood and inhabited their educational experiences.

Master Theme 3: Technological Barriers and Digital Unfamiliarity

This theme encompassed the significant challenges participants faced due to inadequate technological infrastructure and their limited familiarity with digital learning tools. Students encountered digital learning as unfamiliar territory that required new skills and created unexpected obstacles to educational participation. The theme revealed a substantial gap between the necessity of distance learning and students' preparedness to engage effectively with technology-mediated education.

Subtheme 3a: Navigating Unfamiliar Digital Platforms and Tools

Participants consistently reported struggles with basic technological requirements for distance learning. They described confusion and frustration when encountering multiple platforms and digital tools. Mariam's initial experience illustrates these challenges:

> I had never used Zoom before, and suddenly all my classes were on different platforms. One professor used Google Meet, another used Zoom, and my language class was on some platform I'd never heard of. I spent more time figuring out how to join classes than actually learning in the first few weeks.

Her account reveals how the diversity of platforms created additional complexity that interfered with educational focus.

The learning curve for digital tools proved steep and sometimes distressing for participants. Yussef described his experience:

> My teacher would share her screen and ask us to work on a document together, but I didn't know how to do that. I felt so stupid because everyone else seemed to understand. I was afraid to ask questions because I thought they would think I'm not smart enough for technology.

His account demonstrates how technological unfamiliarity created anxiety about academic competence and social acceptance within the learning community.

Subtheme 3b: Managing Equipment Limitations and Technical Failures

Infrastructure limitations created additional barriers to effective educational engagement. Students described how equipment problems threatened their academic performance and created stress beyond the original learning content. Nour's experience during an examination illustrates these concerns:

> My laptop is old and crashes when I have too many applications open. During one exam, it crashed three times and I thought I was going to fail because I couldn't submit my answers. I had to borrow my cousin's phone to email my professor and explain what happened.

Her account demonstrates how technological limitations created academic vulnerability that extended beyond subject matter knowledge.

Students also struggled with the absence of technical support systems that would typically be available in traditional educational settings. Rana described this challenge:

> At school, if the computer doesn't work, you ask the IT person. At home, if something goes wrong with my internet or computer during class, I have no one to help me. My parents don't understand technology, so I have to figure everything out myself while trying not to miss important information.

Her experience highlights the isolation that accompanied technological difficulties and the additional burden of self-reliance in technical problem-solving.

Master Theme 4: Infrastructure Vulnerabilities and Required Educational Flexibility

This theme captured participants' experiences with unreliable electricity and internet services resulting from conflict-related attacks on infrastructure. Students described how these disruptions created constant uncertainty and required both personal adaptation and institutional flexibility. The theme revealed how the material conditions of conflict directly impacted educational processes and necessitated adaptive responses from both students and educators.

Subtheme 4a: Coping With Power Outages and Connectivity Disruptions

Power outages emerged as a persistent and unpredictable challenge that disrupted educational continuity. Students described these interruptions as creating cumulative learning gaps that were difficult to address. Zeinab's typical experience illustrates this challenge:

> I was in the middle of an important lecture when the electricity went out. It came back three hours later, but by then the class was over and I had missed all the examples the professor worked through. This happens at least twice a week, and I never know when it will happen.

Her account reveals how unpredictability became a constant feature of the educational experience.

Students developed various coping strategies to manage infrastructure limitations, often requiring creative problem-solving and family support. Dina described her adaptation:

> My father bought a generator so we could have electricity for a few hours each day. I had to plan my study schedule around when we run the generator. Sometimes I would wake up at 5 AM to attend a class if that's when we have power. My whole family adjusts their activities around my class schedule.

Her experience demonstrates how educational continuity required household-wide coordination and sacrifice, transforming distance learning into a family endeavor.

Subtheme 4b: Experiencing Educator Adaptation and Institutional Understanding

The unpredictability of infrastructure services required constant flexibility from both students and educators. Students appreciated the growing understanding that educators demonstrated regarding their circumstances. Hassan described this evolution:

> My teachers learned to record every class because they know some of us will miss it due to power cuts. They also extend deadlines automatically because they understand we might not have internet when assignments are due. At first, they were strict about attendance, but they realized it wasn't fair when we literally couldn't connect.

Participants experienced educator flexibility as a form of partnership in navigating unprecedented circumstances. Lina reflected on this collaborative adaptation:

> My professors had to learn to be flexible just like we had to learn to study in bomb shelters. They started asking at the beginning of each class if anyone had technical problems or missed parts due to power cuts. They would repeat important information and always provided multiple ways to submit assignments. It felt like we were all adapting together.

Her account suggests that the crisis created new forms of educational relationships based on mutual recognition of shared challenges and collaborative problem-solving.

Discussion

This study represents one of the first empirical investigations into student experiences of distance learning during armed conflict, addressing the critical knowledge gap between emergency education and distance learning research identified by Burde et al. (2017). Our findings reveal how Lebanese students constructed meaning around their educational transitions during the Israel-Hezbollah conflict through four interconnected processes that fundamentally challenge existing research assumptions.

The recognition of distance learning as educational necessity demonstrates students' active resistance to educational marginalization during crisis. Participants reframed distance learning not as a temporary substitute but as essential infrastructure for preserving academic identity and future aspirations. This finding directly contradicts Dryden-Peterson's (2016) "care and maintenance" paradigm, which positions learning as secondary to survival needs in emergency contexts. Students' explicit concerns about academic delays reveal that educational continuity serves dual functions of academic progress and psychological

protection, extending beyond the preparedness-focused framework outlined by the Inter-Agency Network for Education in Emergencies (2024). This suggests that current emergency education policies may fundamentally misunderstand the centrality of learning to student wellbeing during conflict.

The experience of protection through distance learning illuminates a previously undocumented paradox in conflict-affected education. Students transformed domestic spaces into secure learning environments, enabling focused academic engagement by eliminating the cognitive burden of safety monitoring required in traditional classroom settings. This challenges Save the Children's (2013) emphasis on physical access to educational institutions as the primary barrier to learning during conflict. However, this spatial transformation created new inequities based on household resources and stability, corroborating Menashy and Zakharia's (2017) concerns about how emergency interventions may reproduce existing disadvantages through different mechanisms.

Technological barriers revealed fundamental disconnects between distance learning theory and crisis implementation. The emotional distress students experienced when encountering unfamiliar digital platforms demonstrates how technological incompetence threatened their academic identities. This finding exposes limitations in distance learning research conducted in stable environments (Anderson & Dron, 2011; Moore & Kearsley, 2012), which assumes basic digital literacy and technical support availability. Students were compelled to simultaneously develop technological competencies while maintaining academic progress under extraordinary circumstances, creating a dual learning burden absent from existing distance education frameworks.

Infrastructure vulnerabilities emerged as defining features of conflict-affected distance learning, distinguishing it from other crisis education contexts, including pandemic responses. Unlike COVID-19 disruptions that occurred within maintained infrastructure systems, these students navigated chronic service interruptions that created cumulative learning gaps. The sophisticated adaptation strategies families developed demonstrate remarkable resilience but also reveal the substantial household resources required for educational continuity during infrastructure attacks. This finding challenges assumptions about distance learning accessibility during crisis and suggests that emergency education planning must account for infrastructure vulnerability as a primary barrier rather than a secondary consideration.

The collaborative pedagogical relationships that emerged represent a significant departure from both traditional classroom hierarchies and established distance learning models. Educators evolved from maintaining strict attendance policies to automatically accommodating infrastructure limitations, creating partnerships based on mutual recognition of shared challenges. This collaborative approach contradicts the assumptions underlying prior distance learning research (Bernard et al., 2014; Thompson, 2023), which presumes consistent resource access and institutional support. The pedagogical flexibility that emerged from necessity suggests that crisis conditions may catalyze more responsive educational practices than those observed in stable contexts.

These findings demonstrate that conflict-affected distance learning constitutes a distinct educational phenomenon requiring further empirical investigation. Students exhibited remarkable agency in constructing educational meaning under extreme conditions, actively negotiating the intersection of academic aspirations, technological limitations, and material

constraints. Their meaning-making processes encompassed identity preservation, future orientation, and psychological resilience alongside academic progress, revealing the multidimensional nature of educational continuity during crisis.

The implications for emergency education policy are substantial. Current approaches prioritizing basic access provision are insufficient for addressing the complex adaptive processes students engage in during educational transitions. Emergency interventions must recognize students as sophisticated meaning-makers capable of educational agency under extraordinary circumstances while providing comprehensive support addressing technological, infrastructural, and pedagogical challenges. Distance learning research must also reconsider foundational assumptions when examining technology-mediated education under extreme conditions, moving beyond research conducted in stable environments to account for the dynamic interplay between crisis conditions and educational processes.

Limitations and Future Research

This study's focus on Lebanese student experiences provides rich phenomenological insights but limits transferability across different conflict contexts. Future research should examine distance learning experiences across diverse conflict settings to distinguish universal challenges from context-specific adaptations. Comparative studies would enhance understanding of how infrastructure conditions, conflict characteristics, and educational policies influence emergency distance learning outcomes.

The exclusive focus on student perspectives leaves educator, family, and institutional experiences unexplored. Multi-stakeholder research would provide fuller understanding of crisis education implementation across different actors. Investigation of technical and pedagogical support systems enabling effective emergency distance learning would contribute practical knowledge for humanitarian education programming.

Conclusion

This research fundamentally advances understanding of distance learning as a tool for educational continuity during armed conflict by revealing the complex processes through which students navigate technology-mediated education under extreme circumstances. The findings demonstrate that effective crisis education requires comprehensive approaches addressing technological access, digital literacy support, infrastructure reliability, pedagogical flexibility, and recognition of student agency in constructing educational meaning during trauma. These insights provide essential evidence for developing sophisticated emergency education responses that move beyond basic service provision to support meaningful learning engagement during humanitarian crises, ultimately informing more resilient educational systems capable of maintaining quality education under the most challenging circumstances while honoring both the educational aspirations and lived realities of conflict-affected learners.

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Firms' Investments in Continuing Training: An Empirical Study of Bulgarian Enterprises

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Abstract

Continuing education and training (CET) is a priority issue for the EU educational policy. Bulgaria is one of the countries with the lowest involvement in continuing training and one of the reasons for that is the unwillingness of the private sector to invest in lifelong learning. In this regard, the present study focuses on the firm-provided training by discussing the results of a survey of 280 private companies carried out in 2024. It implies that the firm demographics determines to a great extend the training intensity. The prevalence of small businesses which do not have time, financial and human resources for implementing proper HRM practices explains the low involvement in CET. Therefore, the governments should take responsibility in supporting those companies in their efforts to invest in staff training.

Keywords: lifelong learning, continuing education and training, firm provided vocational training

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Introduction

Across the EU, Bulgaria is one of the countries with the lowest participation rate. One key reason is the limited investment in lifelong learning by the private sector. According to the recent Eurostat data, in 2020 the percentage of enterprises which have provided continuing training is 41.1% on average for Bulgaria compared to 67.4% for the EU-28. Tough the number has been gradually increasing since 2005 when it was only 28.7%, Bulgaria is still lagging behind most of the EU member states. With regard to that, the current study focuses on the training activity funded by the non-financial sector. It examines the determinants of the training intensity across Bulgarian enterprises which have provided continuing vocational training to their employees over the period 2022-2023. The results of the study would illuminate the factors and obstacles to investments in training which is expected to contribute to the educational policy at a national or local level.

Literature Review

In economic research, the participation of companies in continuing education and training of staff is explained through various paradigms. Human Capital Theory (Becker, 1964) emphasizes the economically rational reasons for lifelong learning, viewing it as an investment that enhances the productivity, efficiency, and competitiveness of a firm. Organizations are primarily motivated to invest in training for specific skills and competencies, as this reduces the likelihood of employees leaving the company after training. This way, the current employer can recoup the training costs (Mohrenweiser et al., 2019). Additionally, investing in specific skills makes workers more difficult to replace, thereby reducing turnover.

Conversely, firms also invest in general skills training if employees are willing to accept lower wages during the training period (Fleischhauer, 2007). Some studies suggest that such training can also be economically justified for employers (Pedrini, 2013). In situations of low labor demand, employees have fewer alternatives for changing jobs. In cases of information asymmetry, the current employer may offer higher wages to retain high-ability workers, while lower-skilled workers may leave (Brunello & Wruuck, 2020).

Institutionalism adds a social context to the motivation for lifelong learning. Training is seen as a response to regulations, norms, beliefs, cultural environments, and values at the national, sectoral, and organizational levels. It is influenced by factors such as the presence and strength of workers' associations (e.g., trade unions) (Waddoups, 2014), culture and ethics (cognitive aspect of the organizational institution), market structure or competition (normative aspect), and institutional changes (García-Cabrera et al., 2018; Wahda, 2017). By investing in training, modern organizations gain legitimacy and acceptance, especially at industry and regional levels.

According to Resource-Based Theory (Grant, 1996), a firm is a unique set of resources aimed at maximizing its value. An enterprise can achieve efficiency gains by coordinating the efforts of individuals with specific knowledge. The need for continuous knowledge acquisition is driven by dynamic market conditions resulting from technological progress, changing consumer needs, or competitive pressure. The main task of the manager is to coordinate this newly acquired knowledge.

A review of theoretical research on vocational education and training shows that the motivation for training human resources to reduce the mismatch between education and job requirements and to update workers' skills in a changing labor market can be explained by human capital theory and institutional theory. The main objective of the study presented in this paper is to investigate the attitudes of Bulgarian businesses towards the continuing training of human resources through research and analysis of factors derived from leading theoretical paradigms.

Methodology: Survey Methodology and Sample's Characteristics

The whole sample being surveyed includes 280 non-financial enterprises from four Bulgarian regions: northwestern, southeastern, southwestern (excluding Sofia), and the capital city of Sofia. Primary data was collected through direct standardized workplace interviews using a questionnaire of 43 questions developed particularly for this study. The questions were based on a systematic analysis of the relevant theoretical and empirical literature (Neycheva, 2024). The interviews were conducted in February and March 2024.

Sample's Demographics

The surveyed enterprises were predominantly micro and small businesses, reflecting the Bulgarian landscape and making the sample representative. About 30.7% of the companies have up to 9 employees, while another 30.4% employ between 10 and 49 people. The share of respondents with at least 250 employees is 13.6%. The respondents are evenly distributed among the four regions surveyed – 25% each. Predominantly, the staff has secondary education and is aged 30 to 49 years. Workers up to 29 years of age make up 14.4% on average. About 67.2% of the staff have general or specific secondary education, and 28.8% have at least a bachelor's degree. Nearly 60% of the companies serve the local or regional market.

About half of the companies define their performance as close to the industry average in terms of market leadership and innovations in products and services. About 20% perform better or worse than the average. The main strategies that the respondents apply for attracting customers and better positioning themselves compared to the competitors involve average price and quality (39%) or premium price with high-quality products/services (37%). The profit of 58% of the companies for the last financial year is close to the industry average. Only 4% of the participants earned a higher profit while 24% claim a lower profit level; 5% of the firms have not made any profit.

Staff Training Practices

53% of the surveyed organizations had at least one training session two years before the survey (February 2024). These companies are the subject of analysis in this study. A total of 631 internal (5 per enterprise on average) and 286 external trainings (3 per enterprise on average) were conducted. The ratio between training for managerial and non-managerial personnel is 18% to 82% for internal training and 42% to 58% for external one. A total of 8,800 employees participated in internal training (an average of 64 people per company), and 3,832 employees participated in external training (an average of 41 participants per company). The ratio between participants from managerial and non-managerial staff is 10% to 90% for internal and 32% to 68% for external training.

In 14% of companies, Human resource management (HRM) is handled by a person without proper qualification. These are mainly organisations with a small number of employees. For 45% of the companies, HRM is performed by a HR department or a HR expert. 10% use a specialised external provider while in 29% of the cases it is managed by the manager (owner) of the firm. A total of 62% have formalized HRM practices, including 37% with well-developed written strategies, plans, etc. Among companies with more than 250 employees, the total share of those applying HRM practices is higher than 90%. One-third of the companies, predominantly the smaller ones, do not apply specific HRM.

Table 1 summarizes the reasons for participating in training. Nearly 80% point out the importance of training for improving competitiveness or introducing innovations. This is most clearly expressed in the northwest as well as the southwest region. The existence of regulations on worker qualification is highlighted by 62% of the firms. It is selected by at least two-thirds of the firms in all regions but Sofia. Financial incentives from training investments and staff requests for training have the least weight. The output presented in Table 1 implies that the competitive landscape might explain the underlining motives for training. In region with a higher number of companies, such as the city of Sofia, training is viewed mainly as a tool for gaining a competitive advantage.

Table 1

Reasons for Training Participation

Reason	Total	Northwest	Southeast	Southwest	Sofia
To improve the competitiveness of the company	79.6%	90.3%	83.3%	90.6%	59.5%
Innovations requiring staff training	78.9%	93.5%	69.0%	90.6%	69.0%
Regulatory requirements	61.9%	93.5%	66.7%	68.8%	28.6%
To improve the image of the company	55.1%	90.3%	59.5%	62.5%	19.0%
Requests from employees	45.6%	90.3%	42.9%	56.3%	7.1%
Financial incentives (e.g. reduction of tax liabilities)	44.2%	87.1%	40.5%	59.4%	4.8%
Financial subsidies received (e.g. state, European, etc.)	40.8%	83.9%	23.8%	59.4%	11.9%

Some studies address the choice of training providers by focusing on the role of institutions in the higher education system (Aslam et al., 2022; Davis & Amirbekova, 2019). This question was also posed to the participants in the survey under discussion. According to the results, Bulgarian companies most frequently choose private training centers to provide employee training (see, Table 2). There is a notable disparity between companies based in Sofia and those in other regions. In the capital city, 95.7% of the companies opted for private training centers compared to just 45.5% in the southeastern region and 64.3% in the northwestern region.

Table 2
Distribution of Training Providers

	Total	By region			
		Northwest	Southeast	Southwest	The capital city of Sofia
University's training center	17.9%	17.9%	36.4%	9.1%	8.7%
NGO's training center	16.8%	14.3%	22.7%	31.8%	0.0%
Private training center	67.4%	64.3%	45.5%	63.6%	95.7%
Other	1.4%	4.3%	0.0%	0.0%	1.4%

This result appears paradoxical given the significant geographic imbalance in the distribution of higher education institutions (HEIs). The latter are heavily concentrated in the city of Sofia—home to 45% of all Bulgarian universities and university colleges. The preference for private training centers outside the capital may be due to a lack of viable alternatives. Possible explanations include the perceived inability or lack of trust in universities to meet specific vocational training needs, or the very nature of the training—particularly when it involves acquiring practical skills not typically covered by higher education (e.g., courses for blue collar workers).

The limited role of universities in continuing education aligns with findings of Mitreva (2019) for Macedonia as well as Neycheva and Baltov (2022) in a 2020 study on Bulgaria. In contrast, Fuchs et al. (2021) reported different results for Germany. In this study, university training centers were used by only 17.9% of respondents. They are most popular among the firms located in the southeastern region where 36.4% of the respondents claimed to use such educational units.

Results and Discussion: Factors Affecting Training Intensity

The following results are based on a correlation analysis aimed at identifying key determinants of company investment in continuing education. Training intensity is measured by the total number of internal and external training sessions conducted. The analysis includes only 137 companies that conducted at least one training session during the study period (2022–2023).

Training frequency is rated on a scale from 1 to 5. Outliers were identified using the z-score method; cases with a z-score greater than 3 (i.e., companies that conducted 25, 26, or 50 training sessions) were excluded from the descriptive statistics but included in the correlation analysis. Five intervals were created based on the average number of training sessions, using the mean ±½ standard deviation and mean ±¼ standard deviation.

Table 3 presents the correlation coefficients and significance levels for variables that were statistically significant at the 0.01, 0.05, and 0.10 levels. Consistent with findings in the literature, training frequency is positively correlated with enterprise size. This also explains the significant positive correlation with the number of managers, particularly senior managers, who are typically responsible for making decisions about training investments.

The ratio between the employee and managerial staff of the firm also plays a role: a higher ratio is associated with a greater frequency of training sessions, suggesting that more workers are being trained. This finding is supported by both the descriptive analysis and the observed

data. It may also help explain the limited role of university training centers as training providers (see, Table 2).

Companies with a higher proportion of young employees (under the age of 29) are more likely to conduct training, with the correlation (-0.22) being statistically significant at the 10% level. Labor shortages—both for skilled and unskilled workers—also influence training activity. A negative correlation indicates that companies facing hiring challenges are more proactive in offering training.

In compliance with the institutional paradigm, industry and market-related factors are also significant. Companies that perceive themselves as industry leaders, have a strong market position, or are innovation-driven tend to invest more in training. However, further analysis is needed to determine whether this relationship is causal or merely correlational.

Table 3
Factors for the Intensity of Staff Training

Factor	Result	Level of significance
Size of the enterprise	.322***	.000
Number of Senior Level Managers	.341***	.001
Number of mid-level managers	.293***	.005
Size of administration	.257**	.015
Employee-to-manager ratio	.257**	.015
Size of service personnel	.396***	.000
Proportion of staff under 29	.204**	.042
Share of staff with 9-19 years of experience in the company	-.172*	.093
Staff shortage	-.218**	.011
Scope of activities/market	.219**	.011
Industry Leader	-.262***	.003
Market share	-.201**	.023
Innovation Leader	-.250***	.005
Availability of HR Recruitment and Management Department/Specialist	-.180**	.035
Availability of formalized HRM practices	-.189**	.032
Communication of management with staff	-.214**	.012
Comparative level of last year's profit	-.169*	.064
Perception of learning as a normative requirement	.166*	.056
Perception of training as an obligation for the employee	.152*	.079
Perception of training as a choice for the employee	.174	0.046

***, **, * Significance level 0.01, 0.05, 0.10.

Organizational culture also matters. The structure of hiring and personnel management, including training, and the presence of formal HR practices is significant at the 5% level. Companies with dedicated HR departments or qualified specialists are more active in training. Interestingly, a negative correlation was found between ease of communication between managers and employees on the one hand and training frequency on the other hand,

suggesting that companies with communication challenges conduct more training. This seemingly paradoxical result may be explained by company size: larger organizations with more hierarchical layers often face greater communication barriers.

The learning culture within organizations was assessed using a composite index based on 21 dimensions at the organizational, team, and individual level, following the framework of Polo et al. (2018). While the overall index showed a positive (but statistically insignificant) correlation with training frequency, three specific components were significant for Bulgarian companies.

Training as a regulatory requirement is significant at the 10% level, consistent with findings in Table 1. From an individual's perspective, the understanding that training is a choice of the employee shows a positive statistically significant at the 5% level correlation with the number of trainings. It should be noted that this relationship retains its sign and significance even after controlling for the company's size. The statement that training is an employee obligation is significant at the 10% level. Though, this result might reflect a lack of contextual clarity.

Conclusion

Bulgaria remains among the EU countries with the lowest participation rate. One key reason is the limited investment by the private sector in lifelong learning. This study focuses on training activities funded by the non-financial sector during 2022–2023. The analysis shows that the company demographics—particularly size—is a major determinant of the training frequency. This aligns with Bishop (2020), who also highlights the role of company size. Smaller firms often lack the time, financial resources, and HR capacity to implement structured training programs, which explains their lower participation. Larger firms, by contrast, tend to have more managers, administrative staff, and formal HR practices, all of which support training initiatives.

In support to the relevant studies, regional disparities also matter here. Companies in more economically developed regions (measured by GDP per capita) invest more in training. This finding is consistent with Stacho et al. (2019) for Slovakia and Neycheva and Baltov (2022) for Bulgaria. Firms that view themselves as market or innovation leaders also conduct more training, in line with the postulates of institutionalism (Esteban-Lloret et al., 2018).

Regulatory requirements for employee qualifications are another driver of vocational training investments, as also recognised by Smith et al. (2019) and Wotschack (2020). From the employee perspective, training is more likely when it is perceived as both a personal choice and a professional obligation. Among workforce characteristics being examined, such as educational background, distribution by age and gender, only the proportion of employees under 29 years of age seems to matter. The higher share of employees from the other age groups show no significant impact.

Another key finding of the current study is the limited role of Bulgarian universities as training providers. This is largely due to the nature of the training, which is often targeted at lower-skilled workers and falls outside the scope of traditional higher education.

Overall, the output supports several tenets of institutional theory—particularly the idea that training is often a response to external norms and regulations. In Bulgaria, these are typically

national or sector-specific mandates. Internal organizational factors such as learning culture or union presence appear to be less influential. This highlights the need for public policy to create stronger incentives and a more supportive environment for continuing vocational education and training, especially for micro, small, and medium-sized enterprises.

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Incorporating Affect and Governmentality in Understanding Gender Inequalities in Chinese Higher Education

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Abstract

Equality, inclusivity, and the promotion of wider participation remain core objectives within the global higher education sector. Despite the apparent progress, exemplified by the increasing number of female students surpassing their male counterparts in many universities, gender inequality continues to persist and warrants sustained attention. Like many other Asian countries, there is little gender disparity during the nine-year compulsory education (primary and secondary education) in China, but gender disparities become starkly pronounced when it comes to higher education. Such inequality against women can be reflected in many folds, particularly in terms of more obstacles for female students to enter prestigious institutions and obtaining master's and doctoral degrees. The increasing access of female students to universities and degree-granting institutions in China indicates that it may not be the overt policies, laws, or sovereign barriers explicitly preventing women from pursuing higher education. It might be those subtle, non-coercive mechanisms through which gender inequalities continue to manifest in higher education and beyond that require more scrutiny. This paper will draw on the Foucauldian framework of governmentality to understand how power, knowledge, and discourse contribute to form the social norms according to which the constructions of the subject, like gender, are realized and normalized in Chinese higher education context. Through unravelling the link between affective governmentality as gendered apparatus and gender inequalities in education, this paper can help identify affective governance from both individual and social agencies and therefore inform educational practitioners to take actions.

Keywords: gender inequalities, governmentality, affect, higher education

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Introduction

To this day, even though female students in universities have outnumbered their male counterparts in various countries and regions (Al Masroori, 2022; Guo et al., 2010; Saadat et al., 2022), the issue of gender inequality persists. Such inequality against women can be reflected in many folds, including less female representation in STEM subjects (Guo et al., 2010), lower chances of entering prestigious institutions and obtaining master's and doctoral degrees (King, 2023). These unequal differences across the higher education sector have raised heightened global concerns (UNICEF, 2017) and China is particularly worth investigating. Like many other Asian countries, there is little gender disparity during the nine-year compulsory education (primary and secondary education) in China, but gender disparities become starkly pronounced when it comes to higher education (Olson-Strom & Rao, 2020). For instance, males are around 1.15 times more likely to pursue higher education than females (Liu, 2016), and the motivations of students for pursuing postgraduate courses are significantly influenced by gender (Liu & Morgan, 2018).

To understand how techniques of governing populations are implemented by power to normalize such gendered inequalities, this study draws on the Foucauldian concept of *governmentality*. Governmentality refers to governmental technologies that have the potential to result in a system of domination rather than the actual forms of domination (Foucault, 1982). Foucault (1975) argues that in modern institutions, power is often exercised most effectively through normalisation and surveillance, such as dominant norms and self-regulations. While this does not completely preclude the coexistence of coercive power such as overt institutional policies, it highlights that gender inequalities may persist through many subtle, non-coercive everyday practices. Governmentality theory suggests how power operates through discursive practices. However, it often overlooks the visceral, lived dimensions of how these norms are produced and sustained by individuals. Affect, which flows in bodies, can act as invisible channels of power, acting as a potential site of resistance and a tool for governance. Hence, this study aims to incorporate governmentality with affect theory to examine how discourses mobilise affect to reinforce power. *Affect* is defined as non-linguistic forces that operate beyond conscious emotion (Deleuze, 1988; Deleuze & Guattari, 1994), which in performing gender, experiences could be understood as a visceral internalization of external values and norms in families and societies. Conceptualizing affective governmentality to understand gender inequality, I pursue an analysis of cultural and societal factors. For example, in the East Asian context, Confucianism values are broadcast through discursive practices, the locus where the subject is personalised, defined, classified, hierarchised, normalised, surveilled, and prompted to self-surveillance (Foucault, 1975). Filial piety, requesting unconditional reverence and faithfulness towards one's parents (Gao, 2003; Ikels, 2004), has been regarded as the prime virtue for everyone in a society reigned by Confucianism (Zhou, 2006) and those who do not uphold such moralities are considered outlier and subjected to guilt and shame (Bedford & Hwang, 2003). This affective aspect of filial piety encourages individuals to act not solely from obligation but from affects of guilt and shame if they disobey, thereby strengthening a domestic hierarchy. Meanwhile, against the backdrop of China adapting neoliberal practices such as marketisation since the 1970s (So & Chu, 2012), female students are posed a dual expectation to be both accomplished in their future job market (marketable academically) and in their private life (marketable romantically) to be able to get married. In the Chinese context, women who are single and unmarried in their late 20s are labelled as "leftover women" (Ji, 2015). The potential failure to achieve socio-cultural benchmarks of success in both their vocational and private life triggers anxiety, fear and shame (Zheng et al., 2025). The affective pressure to

meet the “dual expectation” may steer female student away from doing a postgraduate degree or choosing subjects that align with traditional views of femininity or the image of the “care-giver” (e.g., education and nursing). In science/technology, representation is 57.5% male and 42.5% female, while engineering shows a wider gap (77.3% male vs. 22.7% female) (Guo et al., 2010). Through not mandating the unconditional obedience to parent and societal expectations, but shifting towards the affective response towards them instead, the system establishes a discursive domain wherein the utilisation of power is “rationalised” (Ball, 2012) for maintaining patriarchal hierarchies under the guise of familial relations.

The constant decline of birth rate in China (Li et al., 2024) has given rise to stronger societal penalties for more educated women as higher education correlates with lower fertility intentions among Chinese women (Lao, 2025). China’s two-child policy which was introduced in 2016 reduced female labour participation by 1.4%, and women with higher educational levels face the steepest penalties (Zhao et al., 2023). Employers openly discriminate against women of childbearing age to avoid maternity costs (Schneider et al., 2025), reinforcing domestic expectations on women and the message that higher education may not translate into career stability. Since the Chinese #Metoo movement in 2018, numerous Chinese women have utilised social media as a platform to express their critiques of patriarchal norms and their experiences as victims of gender-based discrimination (Chang & Jin, 2018). These platforms have become a vital space for articulating lived experiences of gender inequality, offering rich narratives that might otherwise remain undocumented. Research by Wolf (2000) also indicates that compared with men, women tend to include additional dimensions to online emotional expressions, encompassing solidarity and mutual support. Given this tendency, social media not only captures a wider range of affective responses but also serves as an ideal site for examining gendered experiences and collective resistance.

Given China’s rapidly declining birth rate (Li et al., 2024), the relationship between higher education and gender equality has become critically intertwined with social development. This study will offer timely insights for policymakers and educational practitioners seeking to align educational access with broader societal goals. As one of the most populous countries globally, the discussion on gender inequalities in Chinese higher education will provide meaning implications for future educational trajectories as equality, inclusivity and widening participation are the mutual goals of the global higher education sector.

Aims

The goal of this essay is to use Foucauldian theories to explore how a nexus of predominant cultural and societal discursive practices, which are rules and norms that produce and maintain knowledge of power (Foucault, 1972) subject women to gendered expectations. Examining discursive practices will reveal how they navigate, resist or internalise gender inequalities, helping to understand their lived realities. I will explore how affects of fear, anxiety, shame and guilt circulate through Chinese societal and cultural discourses to uphold power and in which ways these affects are pervasively embodied and articulated.

Literature Review

Theoretical Framework

The overarching theoretical framework of this proposed research draws on Foucauldian (Foucault, 1991) lens of power – governmentality and dispositif - and the Deleuzian (Deleuze, 1988; Massumi, 2002) conceptualisation of affect. Governmentality is defined by Foucault as the "conduct of conduct" (Foucault, 1991, p. 102), which is a form of power exercised through discourses and knowledge regimes that construct "truth" and normalise social behaviour (Foucault, 2007). Central to this process are discursive practices, which establish the conditions for how knowledge is formed and legitimized (Foucault, 1972). Foucault (1972) defines discursive practices as the rules, norms, and institutional frameworks that govern the production, maintenance, and legitimisation of knowledge within a specific society (pp. 45-47). While discourse refers to the broader systems of meaning, discursive practices are the actions that determine what can be stated, who is permitted to speak, and what is recognized as truth within a specific historical and social context. They produce social norms, including gendered subjectivities, by classifying, hierarchizing, and surveilling individuals (Foucault, 1991, 1994).

Foucault (1980) also introduced the idea of Apparatus/Dispositif, which is a heterogeneous ensemble of practices, institutions, laws, regulations, and discourses that organise and regulate social behavior. Foucault (1975) suggests that it is through apparatuses that power and knowledge are enmeshed together, and certain behaviours are normalised and regulated. In addition, Foucault (1980) contends that Apparatus/Dispositif is beyond institutional scope as it is "…in short, the said as much as the unsaid" (p. 194). Apart from explicit discourses, apparatus also entails implicit norms and practices such as bodily disciplines and cultural expectations. Scholars like Ahmed (2004) expanded on the idea of extra-institutional apparatus, stating that through extra-institutional repetition, families and media can use affective tactics as apparatus to place subjects into gendered and/or racialised hierarchies. Hence, focusing on extra-institutional factors helps to explain why gender inequalities still persist in Chinese society (Shen, 2022; Zeng et al., 2014) that claim to have ensured equalities from institutional entities.

While Foucault (1975) introduces the concept of disciplinary power, Deleuze (1992) draws upon Foucault by arguing that late capitalism shifted from disciplinary societies to societies of control where power operates through modulation, which is a fluid, ever-changing deforming system. While he agrees with Foucault's preposition that power shapes subjectivity, he further argues that in the society of control, power is intensified by internalising discipline through modulation (Deleuze, 1992), one representation being the modulation of affect. *Affect* is elaborated by Deleuze (1988) in his writings on Spinoza as the ability to affect and be affected. He further elaborates on it as taking on the dynamic and kinetic features, in that affects are "no longer feelings or affections; they go beyond the strength of those who undergo them" (Deleuze & Guattari, 1994, p. 164). To put it succinctly, affect transcends mere feeling or emotion; it constitutes a force or energy that impacts a body's modes of existence (Zembylas, 2006). Massumi (1995) argues that "affect", as an automatic intensive response which is regarded as unbound by meaning and signification, differs from "emotion", which is a subjective qualified intensity that involves narrative and interpretative understanding. Affects, which involves automative, bodily response, are nonsignifying and noncategorical, while emotions, which entail social and linguistic interpretations, occur subsequent to these automatic affects.

Incorporating discourse and power with affective studies provides the necessary instruments for conducting dynamic, nuanced study on embodied social action and the complex processes that shape social existence (Wetherell, 2013), such as gender inequalities. As Wetherell adds:

> …. How are practices clumped, who gets to do what when, and what relations does an affective practice make, enact, disrupt and reinforce? Who is emotionally privileged, who is emotionally disadvantaged and what does this privilege and disadvantage look like? …remains to be explored. (Wetherell, 2012, p. 20)

Gender (In)equalities in Modern-Day China

Gender is institutionalised through social and cultural structures that reproduce bias and inequality. UNICEF (2017) defines gender equality as the equal valuing by society of the similarities and differences between men and women, ensuring rights and opportunities are not determined by whether they are born male or female. In China, these inequalities intersect with a stark urban-rural divide: despite national progress in education, rural women face disproportionate exclusion due to poverty, patriarchal norms, and male-dominated household hierarchies (Liu & Wang, 2009; Mu, 2021). When resources are limited, families often prioritize sons' education over daughters' (Gromkowska-Melosik & Boron, 2023), reinforcing systemic disparities.

In recent years, the development of the Internet Era has given rise to a new discursive space on social media, providing a platform for "the powerless" to challenge entrenched cultural norms (Lu & Chu, 2012). Within this context, Chinese women, who continue to face systemic gender inequalities, have increasingly turned to social media as a means of self-expression, articulating their empowerment in ways that are subtle yet assertive (Chang et al., 2018). However, while social media offers opportunities for resistance, it also reinforces existing gender disparities. Deep-seated patriarchal structures persist even within digital spaces, as evidenced by women's continued adherence to traditional gender roles, particularly in domains such as family and career (Liu, 2023). Thus, women's voices of resistance are amplified yet still remain embedded in the very power structures that reproduce gender inequality.

Confucianism

Confucianism, rooted in the teachings of Confucius and his followers (Zufferey & Oldstone-Moore, 2023), has profoundly shaped gender hierarchies in China. Though some scholars contend that Confucianism has been misunderstood as one of the root causes of sexism in China (Koh, 2008; Rosenlee, 2006), many still believe culturally it is responsible for positioning women as subservient to male-dominated hierarchies and prescribed gender roles. Despite the fact that the term "gender" is non-existent in Chinese language, a highly complex and rigorously enforced gender system based on the concept of different gender role still existed in premodern China (Chan & Oldstone-Moore, 2023). Such differentiation is mainly represented with the inner-outer (*nei-wai*) dichotomy (Chan & Oldstone-Moore, 2023) and filial piety.

Nei-wai

The didactic *nei-wai* binary on gender stipulated that men occupy the wider domain of *wai*, which is the expansive field of the outer, whilst women are confined to the limited realm of

nei, which is the inner part (Rosenlee, 2006). This binary renders women only functional and complementary in terms of inter-gender roles as the *nei* is for serving the *wai*. The education of Confucianism for women connotates humbleness, inferiority and a lower family status. Principles to be learned include serving one's mother-in-law, honoring one's husband, bringing glory to one's name and humble chastity (Zhou, 2006). In other words, women's intellectual capacities are agencies to serve for others in the family, not themselves. Rosenlee (2006) argues that this gender difference denies women an entitlement to full humanity because it is only in the *wai* that a person is not only filial and respectable, but also completely educated and cultured.

Filial Piety

Filial piety, requesting unconditional reverence and faithfulness towards one's parents (Gao, 2003; Ikels, 2004), has been regarded as the prime virtue for everyone in a society reigned by Confucianism (Zhou, 2006). It is considered a severe accusation if one does not manifest filial piety, the most serious disconformity being not bearing a son. From a practical side, sons are expected to take care of their parents when they get older, thus leading to a preference on sons over daughters. Since the Northern Song Dynasty (960-1127) when people became zealous about official posts like civil servants, a son's educational achievement has been identified as one way of providing care for parents. This might have shifted some domestic filial duties to daughters and daughters-in-law (Zhang, 2020) and laid the foundation for the long-serving inner-outer gender roles.

Market Discipline

Even though Chinese society has not been fully aligned with Western neoliberalism (Nonini, 2008), it has introduced a unique hybrid model called "state neoliberalism" (So & Chu, 2012), which displays many neoliberal tendencies such as market-oriented policies. Although such market-driven society seemingly creates a fair arena for individual competition, it obscures how structural barriers such as pre-existing inequalities and predetermines individual's success. Foucault (2008) contends that neoliberalism constitutes a principle of rearranging the society by establishing a particular type of governmentality and a new regime of truth for the governance of individuals. Neoliberal governance reframes higher education as a private investment through reducing education to an individualistic market transaction (Lakes & Carter, 2011), aligning institutional practices and student behaviors with market-driven logics. Individuals are expected to practice "self-care and self-optimization" (Foucault, 2008, p. 226), and the focus shifts from state control to the promotion of individual autonomy and self-management. This transition entrenches inequalities by naturalizing disparities as matters of personal responsibility rather than systemic injustice. The background of neoliberalism reproduces and legitimizes inequalities through normalizing discourses such as self-optimization and self-care.

Synergies of Confucian-Neoliberal Affective Governmentality

Production of Shame and Guilt

Confucian scholars have argued that both shame and guilt are considered essential moral affects, even though interpretations of their nature diverge. Traditional thoughts position guilt as an internal affect tied to autonomy and individual accountability (Bellah, 1970; Kohlberg, 1987), while shame is framed as an external reaction to social judgment which is often linked

to “losing face” (Scheinin, 1998). However, contemporary scholars like Berkson (2021) challenge this dichotomy, arguing that shame is instead inner-directed (related to one’s character) and guilt outer-directed (focused on actions and consequences). This tension reflects broader cultural differences: Bedford and Hwang’s (2003) ethnographic work highlights how Confucian Rationalism grounds shame and guilt in obligations to others whereas Western Individualism roots them in the autonomous self. Thus, in Chinese contexts, these affects emerge not from individual introspection but from interconnected social obligations.

Such affects are embodied in cultural apparatuses for gendered governance. The tradition’s filial imperative demands lifelong reciprocity from children, with rigid *nei/wai* roles: sons fulfill duty through public achievement, daughters through domestic service (Rosenlee, 2006). Women who transgress by pursuing higher education or delaying marriage face affective punishment: they are branded “leftover” (Ji, 2015), deemed unfilial (Tsai & Choo, 2025), and stigmatized as social “disrupters” (Gu, 2021). For men, filial piety prompts educational ambition; for women, it generates shame for “selfish” aspirations and guilt for neglecting household duties. This affective discipline exemplifies Foucault’s governmentality where power operates not through coercion, but through the internalization of affective responses.

Mobilisation of Anxiety and Fear

Extending on Foucault’s (2008) idea of neoliberal governmentality, scholars have argued that the anchorage point of power is affects of fear and anxiety. Wrenn (2014) suggests the neoliberal focus on self-optimization and comparison of worth with others stirs the fear of inadequacy and anxiety of uncertainties. Krce-Ivančić (2018) claims that widespread prevalence of anxiety is what facilitates the entrenchment of neoliberalism in modern subjectivity. For women, especially, the societal expectation of their participation in the workforce whilst still maintaining their domestic roles amidst a transforming neoliberal labour market, exacerbates the pressure on them to fulfill multiple responsibilities and to “have it all” (Zhou, 2020). Previous research has shown that the impact of anxiety is most severe when women are considering postgraduate studies, as it is challenging to balance their studies with other domestic responsibilities (Bosch, 2013).

Even though a plethora of previous studies have drawn on governmentality studies and discourses of power to explain representations of gender inequalities such as the disciplining women through discourses (Balbus, 1985), unequal gendered labor (Oksala, 2013) and biopolitical control through gender (Repo, 2016), most have neglected the role of affect in naturalising inequality. Those that have incorporated affect with governmentality examined how care constitute subjectivities in education (Pereira, 2019) and the use of affective governance to maintain gratitude among school graduates (Shoshana, 2021). However, affective governmentality has not been explored to examine gender inequalities while considering certain cultural and societal contexts.

Conclusion

Chinese female students are exposed to both cultural (e.g. Confucius values) and societal (e.g. neoliberal market principles) apparatus with discourses that discourage them from pursuing higher education or lucrative fields (e.g. STEM). These include discursive practices from family and kin groups that portray women pursuing higher education as impractical and

obstructive to finishing the filial duty of getting married, traditional discourses permeating in modern day society that reinforce females' domestic duties, educational resource prioritisation of sons over daughters; gendered societal discourses on social media that stigmatize unmarried, highly educated women and market-oriented narratives prescribing that women should "have it all" before a certain age. These apparatuses are embodied through discourses of affect such as shame, fear and anxiety which take part in the governing of the subjects.

In terms of pedagogical praxis, educational practitioners may expose how traditional and neoliberal discourses co-construct gendered expectations and remind students how to identify and resist this affective governance, as has been mentioned, affect can act as a site of resistance. As for the institutions, current initiatives are not sufficient to address the discursive roots of gender inequalities. Educational policies have to consider the cultural and societal narratives that might devalue women's higher education trajectories. Meanwhile, against the backdrop of the modern era and young women being its mainstream users, the impact of social media platforms can also be mobilised to for reproducing and perpetuating anti-stigmatising discourses. For example, the state can intervene and regulate stigmatizing narratives such as "leftover women" through algorithm.

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

The author declares that Deepseek, 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 Deepseek, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, analyses, and discussion are originally written and derived from careful and systematic conduct of the work.

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Enhancing Narrative Generation in ESL: Tailored Prompting for Proficiency-Specific Learning

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Abstract

Narratives can be powerful tools for teaching English as a Second Language (ESL), but they must be carefully tailored to specific proficiency levels to be effective. This paper evaluates the capability of large language models (LLMs) to generate level-specific narratives and introduces a novel prompting method designed to enhance narrative generation for distinct educational levels. The method leverages English profiling frameworks, such as the Commoerbs, nouns) based on target levels. Usinn European Framework of Reference (CEFR), by introducing and restricting word forms (e.g., vg the Flesch-Kincaid and Dale-Chall readability frameworks, the study adopts a quantitative approach to assess efficacy. Narratives were generated for two proficiency levels: 7th grade (elementary) and 10th grade (intermediate). To evaluate the efficiency of the proposed method, it was compared to the widely used Instruction and Role-based Zero-Shot Prompting approach. Additionally, the study examined its performance when integrated with complementary techniques, such as the Tree of Thought method. Results demonstrate that the novel method improves narrative performance by 63% for elementary levels and 20% for intermediate levels. While the Tree of Thought method did not enhance efficiency, it contributed to a better balance of difficult word usage.

Keywords: narrative generation, ESL, LLM, educational technology, language education, prompting technique, GPT

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Introduction

To achieve fluency in English, one must master four key aspects: reading, speaking, writing, and listening (Ali, 2022). In order to master these skills, students must actively practice their English. However, effective practice depends on access to appropriate learning materials. Stories are an excellent learning resource because they engage all four aspects of language acquisition (Simmons, 2007) and are particularly effective in capturing the reader's interest (Wang & Lee, 2007). Stories also provide valuable context for the reader and are especially effective in sticking in people's memories. In fact, even adults can still recall stories told to them when they were young, highlighting the lasting impact of storytelling.

Large Language Models (LLM) are a disruptive technology that has gained popularity, particularly in education, due to their potential. GPT is the most popular LLM and has proven to be an effective tool in the educational world. While GPT cannot fully replace the role of a teacher, it serves as a valuable tool in language education (Chan & Tsi, 2023), and GPT can be used to create learning material. The generated learning materials have been shown to match or even surpass those found in school databases (Namilae & Leddo, 2024) while adding other advantages such as personalized learning (Hatmanto & Sari, 2023). Because of its ability to generate unlimited personalized content, GPT can be leveraged to create tailored stories for language learners. But in order to ensure contextually appropriate output, effective prompting techniques are essential.

Designing a narrative suitable for a specific audience level is challenging and requires a properly trained educator (Melzi et al., 2023). Furthermore, the narrative is created for ESL students, which means they have limited proficiency in the English language. Giving ESL students material that is difficult to read may overwhelm learners and discourage them because their English proficiency may still be at an elementary or middle school level, requiring carefully tailored resources.

Several frameworks exist to grade English proficiency, such as the Common European Framework of Reference (CEFR). This framework has been proven effective in text classification (Gaillat et al., 2022) and verb classification (Milton & Alexiou, 2020), which leads to determining learners' abilities. These profiling methods will play a critical role in boosting LLM potential and providing more context for better segmentation targeting. The knowledge from the CEFR will be used as the context and knowledge for narrative generation. The readability of the generated stories will be assessed using established metrics, such as the Flesch-Kincaid and Dale-Chall formulas.

This study will also examine the adaptability of prompting methods in conjunction with other prompting techniques. Specifically, it will compare the effectiveness of the Tree of Thought method with CEFR-based profiling in narrative generation. Tree of Thought is selected because it enhances creativity by allowing models to explore multiple options (Yao et al., 2023), making it a suitable approach for refining narrative content.

ChatGPT in Education

ChatGPT is a large language model (LLM) that utilizes natural language processing (NLP) technologies to engage in real-time interactions and provide personalized responses (OpenAI, 2022). Recent studies have explored ChatGPT’s applications in education, particularly in second-language learning, where it has shown promising results through unique approaches.

For instance, ChatGPT is used as a conversation partner (Young & Shishido, 2023) and as a teaching assistant specifically to prepare materials for learning (Mikeladze, 2023). Furthermore, GPT-personalized material is very good and has been proven to be usable in the education world (Pataranutaporn et al., 2021).

However, despite these advancements, research indicates that optimizing prompt design remains a significant challenge. One study suggests that while GPT-4o exhibits strong conversational capabilities, its impact on real-life communication still requires further investigation, particularly in assessing grammar and vocabulary accuracy (Lo et al., 2024). These findings highlight the need for structured prompting techniques to improve ChatGPT's effectiveness in language education, ensuring that its outputs align with specific learning objectives.

Narrative Generation

Studies have explored how models like GPT can create coherent and engaging narratives, particularly in interactive storytelling and game development. For instance, Wang and Gordon (2023) leveraged GPT to generate dynamic storylines for a simple Story Creation Game by using GPT-3.5. This study shows that the stories generated by GPT incorporated all elements of the story and were particularly easy to read. Similarly, studies by Tian et al. (2024) attempted to compare human-generated plots by dividing them into various plot points, and this study showed that GPT has poor pacing issues and is focused on positive endings. Despite that, both studies demonstrated the potential of narrative generation using GPT.

While much of the existing research focuses on plot coherence and structure, its application in language education, particularly for ESL learners, remains underexplored. Additionally, prior studies indicate that while GPT is a powerful storytelling tool, its outputs can be diverse and unpredictable (Lo et al., 2024). These challenges highlight the need for novel prompting techniques to ensure that AI-generated narratives align with specific educational objectives, making them more effective for structured learning environments.

Prompt Engineering

Prompt engineering is a technique used to refine AI-generated outputs by providing structured input that guides the model's responses (Schmidt et al., 2024). It plays a crucial role in optimizing language models, ensuring that they generate contextually appropriate and high-quality results (Giray, 2023). While some research suggests that role-based prompting is less relevant for creative writing, it has been shown to improve performance compared to zero-shot prompting (Kong et al., 2024).

Despite these findings, the potential of role-based prompting in language learning remains underexplored, particularly when targeting specific proficiency levels. Additionally, Tree-of-Thought (ToT) prompting, which enhances model reasoning by exploring multiple possibilities, has demonstrated improvements in AI-generated outputs (Yao et al., 2023). Our previous research indicates that while prompting techniques significantly influence narrative generation, their effectiveness in adapting AI-generated content to specific educational levels has been limited. This limitation underscores the need for new prompting frameworks that align with structured learning objectives, ensuring that AI-generated narratives effectively

support language acquisition. To address this gap, we will evaluate the compatibility of various prompting techniques for educational applications.

To further refine prompt design, this research will incorporate meta-prompting, a technique that autonomously generates prompts by leveraging the LLM itself (Tamenaoul et al., 2024). Meta-prompting has proven effective as it enables the model to act as both a conductor and an expert, facilitating a more structured and adaptive approach to prompt optimization (Suzgun & Kalai, 2024).

Keyword Targeting

Focusing on specific keywords is an effective method for enhancing learning, particularly when introducing new concepts. Various techniques have explored the use of keywords as a means of structuring learning experiences. For example, research utilizing the Zone of Proximal Development (ZPD) has demonstrated the importance of targeting new vocabulary within the learner's developmental range (Zaretsky, 2021). Similarly, the Spaced Repetition System (SRS) has been employed to reinforce key vocabulary through frequent review, ensuring retention over time (M & G, 2024). Additionally, vocabulary grading frameworks, such as those based on the Common European Framework of Reference for Languages (CEFR), offer structured approaches to categorizing words according to learner proficiency levels.

Methodology

The goal of this study is to introduce a prompting technique that targets a specific level of learning and to evaluate its impact on text readability while testing its adaptability with another prompting technique. Tree of Thought prompting technique will be used and mainly focused to enhance the story. To measure readability, this research employs two established formulas: Flesch-Kincaid Ease (FKEF) and Dale-Chall Formula (DCF). FKEF primarily considers syllable count (Flesch, 1948), where a lower FKEF score indicates a more difficult-to-read text. In contrast, DCF focuses on word difficulty (Dale & Chall, 1948), where a higher DCF score signifies increased complexity. Both formulas are used to ensure a comprehensive readability assessment, as syllable count alone does not always correlate with difficulty.

Prior research indicates that GPT's default output aligns mostly with college-level readability based on FKEF and DCF. Thus, this study focuses on targeting 7th-grade (early level) and 10th-grade (intermediate level) texts.

The data collection will follow these methods:

1. *Title Generation:* 100 story titles will be generated randomly using GPT-4o.
2. *Vocabulary Assignment:* Each title will be paired with a grade-appropriate keyword that must be introduced to the reader selected from a list of keywords from CEFR collected from CEFR-J list.
3. *Keyword Restriction:* List of Verb, Adverb, Adjective will be listed for restriction to ensure GPT fully maximizes CEFR Keyword. Suitability will be determined using CEFR levels (A1 for early level, B2 for intermediate level).
4. *Text Generation:* GPT-4o was chosen for its ability to generate structured and coherent text, making it well-suited for evaluating readability across different educational levels. Each story will be generated three times using distinct approaches:

(1) Zero-Shot prompting, (2) the new prompting method (PCEFR), and (3) PCEFR combined with Tree of Thought (PCToT).

5. *Readability Evaluation:* The generated narratives will be analyzed using Flesch-Kincaid Ease (FKEF) and Dale-Chall Formula (DCF). The results will be compared against a baseline (e.g., GPT-4o default output) to assess the impact of the proposed prompting technique. And to measure its performance, every readability pass will be calculated and represented in percentage.

To illustrate the process of title generation and keyword assignment, Figure 1 presents an example. Each title is assigned verbs at two levels to apply ZPD.

Figure 1
Example of the Data

Title: A girl discovers a hidden talent for dance that surprises everyone.
Early level verb: dance, find, enjoy
Intermediate level verb: surprise, demonstrate, express

Then based on the information on Figure 1 prompting will be designed according to their approach:

1. *Zero Shot:* A role-play based prompting and instruction. The instruction is focused on creating a narrative and introducing verbs based on Figure 1 to teach new verbs for students.
2. *PCEFR:* PCEFR using the same approach with Zero Shot. The difference is every CEFR keylist (A1 for beginner and A1-B1 for intermediate) is listed by using prompt and adding constraint to the instruction to not include any words that are not included in the CEFR keylist.
3. *PCToT:* PCToT using the same approach with PCEFR. Because this one focused on checking PCEFR adaptability with other prompting methods, the instruction is using the Tree of Thought approach for the 3 main parts of the story (Introduction, Key points, Ending).

Limitation

This research presents several notable limitations that must be considered:

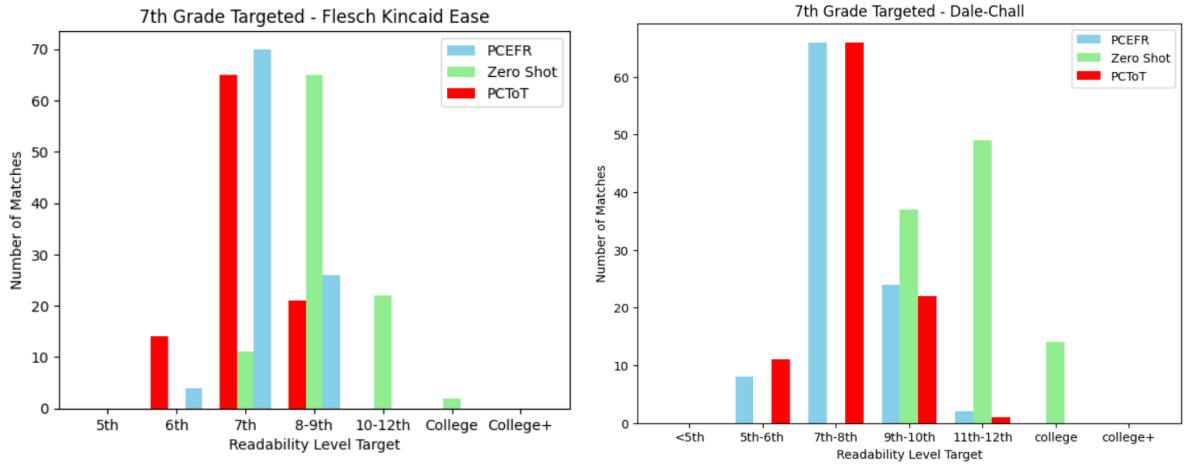
1. *User Interest Not Measured:* The research does not account for variations in user interest, which could influence the effectiveness of the GPT-level targeting.
2. *Limitation to GPT-4o Mini:* The study focuses exclusively on GPT-4o, which may not fully represent the potential outputs or limitations of other language models.
3. *CEFR Level Restrictions:* The study specifically targets CEFR A1 (7th grade) and B1 (10th grade) language levels, which may limit the applicability of the findings to higher or lower proficiency levels.

Discussion

7th Grade

Figure 2

7th Grade Focused Prompt Results



A significant improvement is observed in both readability metrics when targeting the 7th grade specifically. As shown in Figure 2, Zero-Shot only generates a small number of 7th-grade-level texts based on FKEF and none based on DCF. Without any specific context, GPT tends to rely on syllable count as the primary factor for difficulty, which results in most content being classified at 11th-12th grade level in DCF, with some even reaching college-level difficulty. In contrast, the PCEFR results in a wider spread of 7th-grade-level content, demonstrating its effectiveness in targeting the desired readability level. PCToT also has similar performance and has almost no significant differences in data distribution even though it was focused on the plot writing. It indicates that PCToT is suitable to target beginner narratives.

Table 1

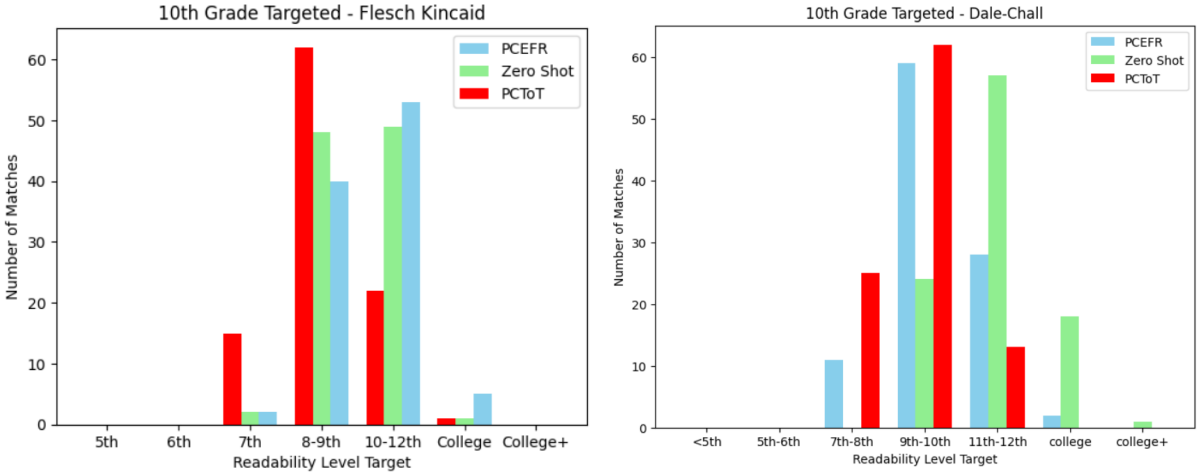
7th Grade Performance Table

Method	FKEF 7th Grade	DCF 7th Grade	Performance Value
Zero Shot	11	0	5.5%
PCEFR	70	66	67.5%
PCToT	65	66	65.5%

Additionally, Table 1 presents the performance of the prompting technique. PCEFR achieves an accuracy of 67.5%, making it the best-performing method for 7th-grade targeting. Zero-Shot, by comparison, performs poorly, with only 5.5% of its outputs at the 7th-grade level. Adding PCToT leads to similar results, with an accuracy of 65.5%.

10th Grade

Figure 3
10th Grade Focused Prompt Results



Unlike the 7th grade, Zero-Shot is able to generate a substantial amount of 10th-grade-level material. This result is expected, as previous research suggests that GPT performs better when generating content for higher education levels. However, similar to the 7th grade, GPT tends to disregard word familiarity, which results in a low DCF score. As shown in the DCF results, most content is generated at the 11th-grade level or higher, with some even reaching college-level difficulty.

PCEFR, however, results in a more balanced distribution of readability scores, with similar spreads in both FKEF and DCF. It indicates that PCEFR did enhance narratives for the intermediate level for the word familiarity. The word complexity has a similar performance with Zero Shot with no significant difference in distribution. As for PCToT, it increases the DCF precision but lowers the FKEF precision. This suggests that PCToT enhances word familiarity more than the word complexity.

Table 2
10th Grade Performance Table

Method	FKEF 10th Grade	DCF 10th Grade	Performance Value
Zero Shot	49	24	36%
PCEFR	53	59	56%
PCToT	22	62	42%

As seen in Table 2, the PCToT achieves the highest performance, with an accuracy of 56%. Zero shot has 36% performance because of the word complexity and PCToT has 42% performance. It shows that PCEFR is performing better than other prompting techniques but PCToT is underperforming on word complexity. PCToT somehow creates much easier word complexity narratives instead.

Conclusion

Using the proposed technique shows a good result if compared with a simple Zero-shot prompt. In this research we find that GPT if we use simple prompting the GPT will disregard word familiarity. Using CEFR as the knowledge and context will help GPT to determine and to target specific levels of learning better achieving higher than 50%. It increased word complexity and word familiarity precision for specific grades. Furthermore in this research we find our prompting method is adaptable with Tree of Thought although it has issues on intermediate level Flesch Kincaid Ease specifically. However the research disregards the plot therefore further research needed in that area.

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

This paper acknowledges the use of generative AI technologies during the writing process. OpenAI's GPT-4o mini model was employed solely to enhance the readability and clarity of the Introduction and Related Work sections. The AI was not used to generate original research content or ideas. All AI-assisted outputs were carefully reviewed, edited, and validated by the author to ensure academic integrity and alignment with the paper’s research contributions.

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Assessing Students' Mastery of the Key Phenomena of Child Development

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Abstract

For over half a century, psychology was a science confined to a narrow circle of specialists. Today, it is an elective subject in most American educational institutions and one of the required core disciplines in many pedagogical programs. However, as experience shows, this humanitarian science is not among the easiest to comprehend. From this perspective, improving the methodology for assessing the assimilation of psychological knowledge appears to be a relevant and promising research task. Sixty graduate students participated in our study. We examined their understanding of key phenomena in child development, such as J. Piaget's concept of object permanence, L. Vygotsky's cognitive-emotional-volitional triad, and A. Bandura's theory of learning through observation and imitation. The stimulus material was A.P. Chekhov's short story Grisha, whose main character, a boy aged 2 years and 8 months, demonstrates all of the above qualities. The students were tasked with determining whether the story's protagonist had fully developed these traits. According to the results, the participants were relatively successful in identifying text fragments that illustrated the psychological phenomena under study. However, many of them encountered significant difficulties when interpreting the content of these fragments. It was found that the primary reason for these challenges was a lack of skills in systematic and organized analytical activity. These findings suggest directions for improving the methodology of teaching psychology to non-specialists. Teaching complex psychological concepts to students while simultaneously training them in analytical thinking skills appears to be the most productive approach.

Keywords: J. Piaget, object permanence, L. Vygotsky, perceptual triad, A. Bandura, social learning, A. Chekhov, psychological prose, training for schoolteachers

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Introduction

Improving the methods of teaching psychology is one of the most important tasks of modern humanistic education. In a society where psychology has ceased to be a narrow discipline, and where the demand among non-psychologists for a deeper understanding of psychological knowledge has significantly increased, there is a growing need for well-designed instructional approaches. They will prevent the superficial comprehension of this science by a broader audience. Psychology is the scientific study of the principles and processes underlying human mental functions, behavior, interpersonal communication, and purposeful activity. The quality of its instruction in educational institutions will undoubtedly influence how deeply we understand the human being—his/her needs and transformation in our rapidly changing world. As scientist state, without deep understanding of humans, we may lose both technology and culture.

This work is devoted to exploring of how psychological knowledge—some key phenomena of child development—is acquired by graduate students, who are current and prospective schoolteachers. In this study, fiction literature was used which illustrated these key phenomena: social learning originated by Albert Bandura (1925-2021), object permanence discovered by Jean Piaget (1896-1980), and perceptual triad described by Vygotsky (1896-1934).

Literature as a Method of Teaching Psychology

The use of literature for educational purposes is a very old and fruitful tradition. It arose more than two millennia before the birth of psychology as an independent science.[1] For ancient Greek and Roman philosophers, literature served as a means of educating children and youth, developing their personality, morality, erudition, and communication skills. Socratic dialogues in the works of Plato were educational literature that formed the mental and moral qualities of the reader (Plato, 380 B.C.E.; Reid, 1998). In ancient Rome, all forms of education were associated with reading, copying, memorizing, and analyzing the great examples of classical literature of the time (Johnson, 2010).

Ancient pedagogical theories were repeated in key trends of following historical epochs. Educators of the Renaissance based their teaching on classical works and emphasized the importance of both ancient and modern literature for human development. Like philosophers of the past, the most brilliant thinkers of the Enlightenment viewed literature as a universal tool that provides readers with an understanding of the world necessary for their social, ethical, and civic maturation (Locke, 1830). So, valuable ideas of the past regarding the importance of literature for education did not disappear but were transformed and “woven into the fabric” of world humanistic pedagogy. Psychology has borrowed and applied this method in accordance with its mission and goals.

Literature as a method of teaching psychology was widely used by representatives of the psychoanalytic school. Sigmund Freud (1856–1939) and his followers turned to the outstanding works of the ancients—Greek myths, drama, and fairy tales—to explain the functioning of deep mental processes (Bettelheim, 2010; Freud, 1997; Jung, 1971). In their practice, literature became an instrument of treatment of mild to moderate mental health

[1] As an independent science, psychology appeared in Germany in 1879 when Wilhelm Wundt founded the first experimental laboratory at the University of Leipzig and started systematic studies of human mental processes.

issues. In the mid-50s, Eric Berne (1910–1970), an American psychotherapist and the founder of transactional analysis, employed the best-known fairy tales to illustrate his new theory (Berne, 1972). Over time, popular fairy tales, as well as other literary genres, became widely used in the mental health industry for treating and preventing traumas and mild neurotic disorders, and fostering patients' self-awareness and education. This therapeutic approach became formally known as bibliotherapy (also referred to as literary or reading therapy) (Canty, 2017; Correll et al., 2024; Dovey, 2015; Lindberg, 2024).

The development of literature itself, the emergence of such a genre as psychological prose, expanded the boundaries of its application. It turned out to be excellent illustrative material for explaining psychological ideas, concepts and theories. Indeed, in addition to the well-conscious reality, verbal narration reflects the unconscious patterns of human mental activity and behavior. Literary plots, characters, and their relationships are a kind of repository of knowledge about the inner world of people. Thus, the method of teaching psychology using literary works has entered the academic environment (Boyatzis, 1992; Pitts, 1978; Psychology in Literature, 2015; Toom, 2013a, 2013b; 2015).

Methodology of the Study

Goal, Tasks, and Hypotheses

The study aimed to implement the method of literary illustrations for assessing the mastery of psychological knowledge by students-educators studying psychology as a core discipline in their educational program.

The study was based on the following hypotheses:

1. Psychological prose describing the human inner world and behavior is an adequate representation of reality and a suitable stimulus material for the study of students' understanding and comprehension of psychological phenomena.
2. The computerized format of the study allows for more accurate and detailed recording of students' reasoning and analysis of their answers.

The study tasks were:

1. To analyze students' mastery of such psychological developmental phenomena as perceptual triad, object permanence, and social learning.
2. To find possible causes of students' insufficient comprehension of these phenomena illustrated in psychological prose.

Instrumentation and Stimulus Material

One of the practical assignments of the course was selected for the study. The course was conducted in an asynchronous online format, so the study can be categorized as a computerized survey. The data received were analyzed with the use of simplified content analysis. The study participants' assimilation of psychological knowledge was explored through Anton Chekhov's short story *Grisha*[2] (201 stories by Anton Chekhov, n.d.).[3] This literary work is a classic example of psychological prose. The story describes a day in the life of a two-year-eight-months old boy. After a long and cold winter, he is taken out for a walk

[2] Grisha is a Russian name, short for Grigoriy, the Russian version of the English name Gregory.

[3] Anton Pavlovich Chekhov (1860–1904) is a prominent Russian writer known as the greatest master of world psychological prose.

for the first time. He walks along the boulevard with his nanny and gets to know the world beyond his nursery room. The story contains vivid and detailed descriptions of how a child perceives the new objects and people outside of his home, how he copes with unusual experiences, and how he thinks, speaks, forms concepts, and comprehends knowledge essential for his further understanding of reality.

Study Participants

Sixty students from the Graduate School of Education participated in this study in Fall 2024 and Spring 2025. All of them were current and prospective schoolteachers and attended the author's online course of *Child Development and Learning in the Cultural Context* at Touro University. A group of participants included 41 women and 19 men. Regarding their ethnicity, 65% individuals were Caucasians, 20% were Latin Americans, 11% were African Americans, and 4% were Asian Americans. English was a native language for fifty-five individuals, and remaining five people positioned themselves as bilingual.

Procedure

In completing their course assignment, students read Chekhov's short story and then answered three questions related to the three phenomena of child development being studied:

1. In which story's fragments is Grisha's perceptual triad (PT) illustrated?
2. Has Grisha developed J. Piaget's object permanence (OP)?
3. How would A. Bandura explain Grisha's communication delay (SL)?

An important condition for completing this practical assignment was the justification of the opinions. When answering questions, the study participants had to cite/describe excerpts from the text as evidence.

Data Analysis

Question 1

The study participants were asked to find in which story's fragments presented in the №3 column of Table 1 a perceptual triad is illustrated. They made choices and wrote down the answers "Yes"/ "No" in the № 4 column of the table. To support their opinion, they highlighted in the text of the selected fragments the key components of the perceptual triad: words that denote sensation, emotion, and motor action. In Table 1, a typical answer to this question is shown. The components of the perceptual triad identified by a student are highlighted in colors: sensations in orange, emotions in blue, and motor actions in green.

Table 1

A Typical Student's Answer Including the Text's Analysis and the Professor's Comments

1. № fr.	2. A student's comments	3. Search for fragments illustrating the perceptual (S-E-M) triad	4. A student's answer: yes/no	5. Professor's comments
1.		There stands Grisha's chair on high legs, and on the wall hangs a clock which exists to swing its pendulum and chime. From the dining-room, one can go into a room where there are red armchairs. Here, there is a dark patch on the carpet, concerning which fingers are still shaken at Grisha.	No	Correct
2.	Sensation Emotion Motor action	He **hears** a fearful tramping. A crowd of soldiers, with red faces and bath brooms under their arms, move in step along the boulevard straight upon him. Grisha **turns cold with terror** and looks inquiringly at nanny to know whether it is dangerous. But she neither weeps nor runs away, so there is no danger. Grisha looks after the soldiers and begins to **move his feet in step** with them himself.	Yes	Correct You found a perceptional triad: sensation, emotion, and action
3.		The brightness of the sun, the noise of the carriages, the horses, the bright buttons are all so impressively new and not dreadful that Grisha's soul is filled with a feeling of enjoyment and he begins to laugh.	No	Incorrect
4.	Sensation Emotion	Here there is a great deal of smoke, there is a smell of roast meat […]. The cook and the nurse kiss each other and sit down on the bench together with the man and begin talking in a low voice. Grisha, wrapped up as he is, feels insufferably hot and stifled.	Yes	Incorrect. These are sensations, not emotions. There is no perceptual triad here.

The principle of categorizing the answers was as follows. If no mistakes were made in the analysis of all four fragments, then the student's answer to the first question was considered correct. If mistakes were made in all four fragments, then the student's answer to this question was considered incorrect. In all other cases, the student's answer was categorized as incomplete.

Question 2

The study participants were asked whether Grisha had already developed his OP. They should make their conclusions and support their opinions by finding two text fragments that contain evidence of existing/not existing the OP.

The following rules were adopted to categorize the answers: 1. The combination of a correctly identified fragment with a correct conclusion and a correct justification presented the correct answer. 2. An incorrectly identified fragment was considered the wrong answer. 3. All other types of answers formed the category of incomplete answers.

In Table 2, in a typical answer to this question, key phrases representing the conclusion and rationale are highlighted in bold. This answer has the status of incomplete because, although the student found the correct fragment, he made the incorrect conclusion and justification.

Table 2

A Typical Answer to Question 2 With the Professor's Feedback

Student's answer	Professor's comments
Definition: According to Piaget, "Object permanence is the understanding that even if something is out of sight, it still exists" (Bogartz, Shinskey, & Schilling, 2000). Example: "Where does she disappear to?" Grisha has more than once looked under the bed, behind the trunk, and under the sofa, but she was not there." (Chekhov, n.d.). When she is not next to him, he thinks that she must be hiding within his room, and, since he does not find her, **he believes that she does not exist at all.** **Grisha's object permanence is not yet formed.**	This definition alone is insufficient for making a solid conclusion. The correct example is found but it is wrongly interpreted. Wrong conclusion. Mental representation of the object (the aunt's image in the child's memory) proves that the boy's OP formation is rather in progress.

Question 3

The study participants were asked how Albert Bandura, the author of social learning theory, would explain Grisha's communicative delay. They were expected to give their answer supporting it by the two text fragments, which contained evidence. It was expected from them that they would come true to the ideas of Bandura, supplementing them with in-text-citations and supporting their statement by at least two examples from the story's text. Based on these conditions, the criteria for evaluating answers were formulated. The answer was considered correct if the statement made was adequate to Bandura's ideas. The answer was considered wrong if the statement was inadequate, even if the rest of the conditions were followed. An answer was considered incomplete if at least one supporting example from the story was omitted.

In Table 3, a typical answer to this question is shown. This answer is categorized as the correct one because it follows all requirements. As confirmation of Bandura's ideas, correct examples of the adult characters' treatment of the child were found.

Table 3

A Typical Answer to Question 3 With the Professor's Feedback

A student's answer (fragment)	Professor's comments
Grisha's father is **neglectful.** His mother and nanny are **improper models** for him to develop speech and communication skills. For example, when Grisha decided to run after cats, his nanny **harshly grabbed his shoulder**: "Stop! Where are you off to? Haven't you been told not to be naughty?" Instead of educating the kid through good language the nanny **yells and harms** him for his actions.	**Good** observations of adult behavior towards Grisha An **excellent example** of the nanny's harsh style of communicating with the child.

Results

Data analysis allowed us to identify the following:

1. The overwhelming majority of responses to each of the three questions fell into the category of "incomplete."
2. Incomplete answers are the most diverse category—the justification for the answers demonstrates different kinds of errors—they could be unclear, contradictory (wrong and right examples are represented as proof at the same time), unfounded (examples were not presented), and even fictitious (examples did not belong to the text).
3. The correct selection of examples does not ensure a full and deep understanding of the examples' content. The choice of examples provided might be correct, but their interpretation is not always adequate.
4. Errors in the interpretation of such psychological phenomena as Vygotsky's PT, Piaget's OP and Bandura's SL illustrated in the narrative are caused by the insufficiency of some aspects of thinking skills associated with understanding literary texts.

The numerical results of the study are presented in Figure 1.

Discussion

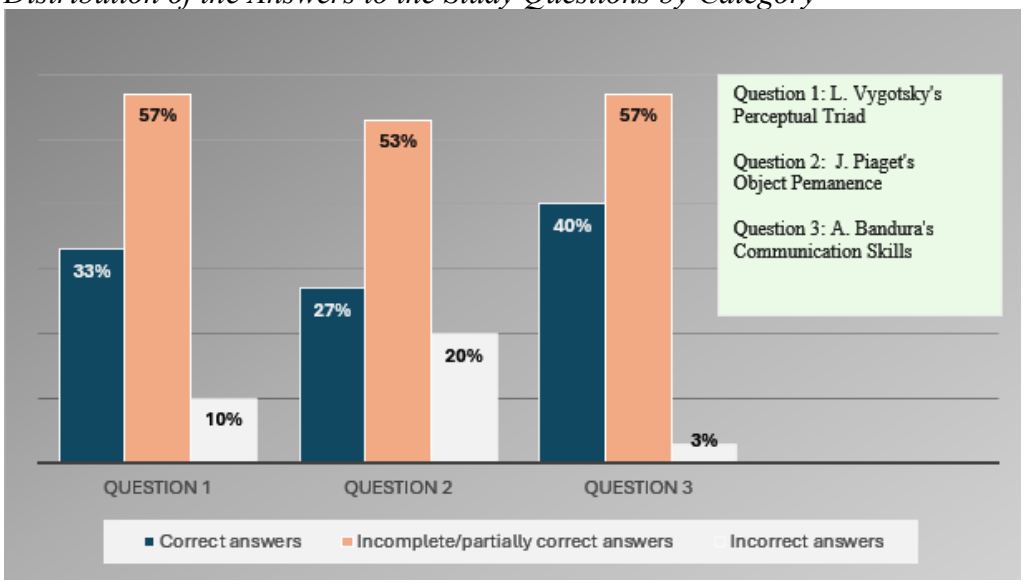
An analysis of the errors made by the study participants when answering questions suggested possible causes of an insufficient comprehension of phenomena under the study within the investigated population.

Finding Vygotsky's Perceptual Triad

In his work "Early Childhood," L. Vygotsky wrote that perception is the leading mental function of a child from one to three years of age, and it is characterized by two important features. Firstly, it is emotionally colored, and secondly, it is directly connected with motor functions, i.e., with action (1984). Everything that the child feels with his senses is accompanied by his emotional experiences. Each thing is charged with an emotionally attractive or repulsive force, and it stimulates him to act. Everything that he sees makes him excited and motivates him to touch it: "His finger is in every pie." This unity of sensation, emotion, and motor reaction—let's call it a perceptual triad—is very figuratively illustrated in Chekhov's story using the example of the toddler Grisha.

Figure 1

Distribution of the Answers to the Study Questions by Category



The most striking and convincing example of the perceptual triad is the fragment of the text where Grisha looked at horses for the first time in his life. In Table 1, it is presented in fragment # 2. The student correctly pointed to all three components, i.e., “hears” referred to an auditory sensation, “turns cold with terror” was an emotion, and “moves his feet in step” was a motor action.

However, the presence of a PT in fragment #3 was not obvious for this student, although all three components were present. The bright sun and buttons, as well as the noise of the carriages, brought new sensations to Grisha. They were joyful and stimulated positive emotions in the child. His sensations and emotions were accompanied by an immediate motor action: laughing.

On the contrary, in fragment # 4, the student saw a PT where it is not present. He correctly categorized the word “smell” as a sensation but incorrectly attributed the sensations of “heat” and “stuffiness” to the category of emotion and forgot about motor action altogether.

Errors in detecting components of PT can be explained as follows. Mental phenomena have their representations both in scientific language and in the language of everyday life. Fiction abounds in everyday concepts. To understand and analyze literary texts from a scientific point of view means finding scientific equivalents for everyday concepts. This is facilitated by extensive experience in handling texts and good reading skills. Apparently, many study participants did not have sufficient reading skills, had a small vocabulary, and experienced difficulties in moving from the system of everyday concepts to the system of scientific ones.

It is known that younger generations, carried away by computer games and immersed in the digital world, lose the need to read books and therefore do not acquire the skills to analyze literary texts. Confirming facts were found by the author of this work as well as other researchers and representatives of various cultures (Chtenie v epokhu tsifry, 2024; Karpov & Voronova, 2022; Klopotova & Smirnova, 2024; Schwartz, 2024; Teaching in UK, n.d.; Toom, 2015; Toom & Inshakova, 2019; Twenge, 2018).

Recognizing Piaget's Object Permanence

OP is one of the most intriguing phenomena of human development. It is this very concept that causes the great bewilderment of the young protagonist in Chekhov's story. Unsurprisingly, the study participants found this question—whether Grisha had developed OP—to be the most challenging.

By definition, OP is a child's understanding that an object does not cease to exist even if it disappears from sight (Cherry, 2023; McLeod, 2025). This concept's development is closely linked to memory, and memory trace is the neurophysiological basis of OP. Additionally, OP is associated with the simultaneous evolution of other concepts, such as spatial awareness, temporal understanding, and cause-and-effect relationships. If the child does not master them, their concept of OP suffers. Thus, the shaped concept of OP means the recognition that the object persists across different contexts, settings, and moments in time. Usually, OP is formed around age two.

Table 2 shows a typical answer to the question of whether Grisha has formed OP. The student found a fragment in the story that describes the boy's memories of his aunt. The choice of the fragment is correct. However, further reasoning led the student to the false conclusion about the absence of OP: "Since he does not find her, he believes that she does not exist at all." Many students were similarly confused by Grisha's decision to look for his aunt "under the bed, behind the trunk, and under the sofa." Only a few study participants recognized that the boy's behavior was completely consistent with the entire logic of his life—he was searching for his aunt where he usually saw her, in his room. After all, he was not yet familiar with the world outside his home. He simply couldn't imagine her anywhere else.

Grisha is two years and eight months old. He remembers not only that his aunt sometimes visits and once gifted him the drum but also the events of the current day. He is biologically quite mature for having the OP. In the case of his aunt, who is not a central figure in his life, Grisha's OP concept is just in the process of formation. The idea that the concept of OP is not developed towards the aunt is wrong.

His family is a completely different matter. Mama, Papa, and the cat are central figures in his world. He remembers them even after leaving home; he knows that they continue to exist and knows where they can be. He dreams about having them with him on the boulevard on that clear and sunny April day. "He wants to say that it would be just as well to take with them Papa, Mama, and the cat, but his tongue does not say what he wants to" (201 stories, n.d.). He transfers them in his imagination from the house to the boulevard and manipulates their images. The formed permanence of objects is evident here.

The main reason for errors in answering the question about Grisha's OP was the lack of contextual thinking. Many students did not understand that determining the presence of OP cannot be built based on one short definition or an isolated fragment. As it is impossible to make a diagnosis based on a single symptom, it is also impossible to draw conclusions on the development of a complex psychological phenomenon based on a single indicator. The entire narrative must be involved in the search for an answer. All indicators must be found in the text and analyzed in their relationship with each other—the child's age, his ability to remember, familiarity with the outside world, and, in particular, with the object in relation to which the presence of permanence is determined.

Contextual thinking develops in the course of neurophysiological and social maturation. It is one of the most important aspects of logical thinking that appears at the last stage of cognitive development, according to Piaget. None of our students have ever been specially taught this, and those of them who applied this thinking strategy when analyzing the text did so rather spontaneously and intuitively. Since this has proven productive, teaching this thinking strategy should become the subject of special training accompanying the study of psychology (Kalashnikov, 2019).

Identifying Bandura's Social Learning

The third question was perhaps the easiest of all because the correct answer was already contained in its formulation. According to the content of the story, the boy Grisha really demonstrates communication delay: for his age, he speaks poorly, preferring the language of facial expressions and gestures to the language of words. In support of this fact, the students carefully stated the provisions of social learning theory and cited sources (Bandura, 1977). However, many of them ignored the need to substantiate their statements: they did not provide any supporting examples from the text. Unsubstantiated answers accounted for more than a third of all incomplete answers.

Such an unfocused manner of presentation is characteristic of non-rigorous thinking. Many study participants demonstrated a lack of skills in systematic and organized text analysis; it is their responses that were often incomplete or inaccurate.

The category of correct answers was replenished by participants who analyzed the story thoroughly, first dividing the text into fragments to facilitate step-by-step, chronological examination. These participants were able to identify the causes of Grisha's delayed communicative development and illustrate key ideas from A. Bandura's theory. This strategy has proven its effectiveness and given a reason to assume that teaching the skills of systematic and organized intellectual activity in the process of analyzing fiction can be carried out using P. Galperin's method of "step-by-step formation of mental actions" (Galperin, 1969).

Being generalized, the results of these study participants' analysis of the text looks like this. During the entire day described in the story, no one talks to Grisha, and no one explains anything to him to satisfy his childish curiosity. The parents are busy with themselves; the nanny, with whom Grisha spends most of her time, is ignorant, rude, and verbally abusive. That day, only a stranger "with shiny button" treated the boy kindly, and the only person who once gave him a toy was his aunt. (Maybe that's why he is constantly looking for her?) There are no suitable models for observation and imitation around this child. He is deprived of the social environment necessary for the timely and successful development of his communication skills.

Conclusions

The acquisition of knowledge of psychological phenomena depended on the ability of students to analyze, with sufficient depth and accuracy, the text of a literary work containing descriptions of these phenomena. Four factors responsible for errors in text analysis were identified:

- Loss of interest in reading among today's students, which results in a limited vocabulary and difficulty in applying scientific concepts when interpreting psychological phenomena.
- Lack of experience in organizing and structuring information during intellectual activity.
- Weak analytical skills manifested in a comparative analysis of theoretical models of these phenomena with their textual illustrations.
- Lack of contextual thinking necessary for comprehending literary texts.

The teaching of psychology in the third millennium—in the digital era—requires not only an informative but also a competency-based approach, which involves students having formal operational thinking skills, as well as the ability to interpret behaviors. These skills are especially significant for teachers. Thus, traditional lecture forms of learning should be supplemented with methods of analyzing concrete real-life situations, working with literary texts, and using information technologies.

The use of fiction literature to assess the acquisition of psychological knowledge, although a fruitful research method, must be carried out with consideration of the specific cognitive characteristic of today's students. Already belonging to the digital world, young generations have been losing the need to read and the ability to analyze texts. This may place certain limitations on research based on reading fiction.

Teaching complex psychological concepts to students while simultaneously training them to develop skills for structured intellectual activity and higher forms of thinking appears to be the most productive approach. Perhaps P. Galperin's method of "step-by-step formation of mental actions," adapted to the format of specific verbal problems-solving tasks, can be especially useful. With the gradual assimilation of strategies for performing mental actions, the necessary thinking skills will be internalized and automated.

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

The author declares that Quill Bot and ChatGPT40, 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 mentioned instruments, 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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Teaching Python in the Bachelor: Experiences and Recommendations

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Abstract

This paper presents practical insights and pedagogical innovations from teaching Python in the Bachelor of Science in the Business Information Technology (BIT) program at the FHNW University of Applied Sciences and Arts Northwestern Switzerland. Addressing the unique challenges of introducing programming for undergraduate students in a curriculum that merges business and IT, we critically evaluate traditional instructional approaches and propose a shift toward a more modern, student-centered methodology by actively promoting modern technologies. Key obstacles identified include cognitive overload, the abstract nature of programming, and a mismatch between academic content and industry needs. In response, the paper explores the integration of emerging tools such as Large Language Models (LLMs) and the Vibe Coding paradigm to enhance learning engagement, accessibility, and outcomes. LLMs act as code co-pilots and explainers, supporting both students and instructors, while Vibe Coding promotes a design-first, iterative approach to problem-solving through natural language interfaces. Building on these trends, the paper proposes a gamified, AI-supported teaching concept currently under development using Python's pygame library. Features include a modular "Python Islands" learning journey, point-based rewards, daily coding prompts, and collaborative contests. The overarching goal is to foster deeper understanding, active learning, and adaptive thinking in programming education. Initial implementation and feedback are anticipated in 2026.

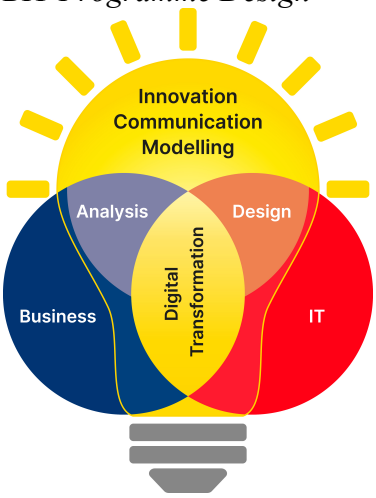
Keywords: Python, teaching programming, LLM, Vibe Coding

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Introduction

The Business Information Technology (BIT) Bachelor programme at FHNW blends computer science and management topics to prepare students for roles at the intersection of business and IT. Typical job profiles for students finishing this Bachelor programme comprise IT Project Manager, Business Analyst, Application Manager and Consultant for managing and building IT systems.

Figure 1
BIT Programme Design



Source: www.fhnw.ch

The design of the BIT programme is depicted in Figure 1. The two circles "Business" and "IT" in Figure 1 represent the pillars business administration and computer science. Business administration comprises selected modules from management science like supply chain management, accounting, finance, marketing etc. which are of particular interest for BIT students because of the rising importance of IT. Computer science is an analogy on the IT side with modules like programming, databases, internet technologies etc.

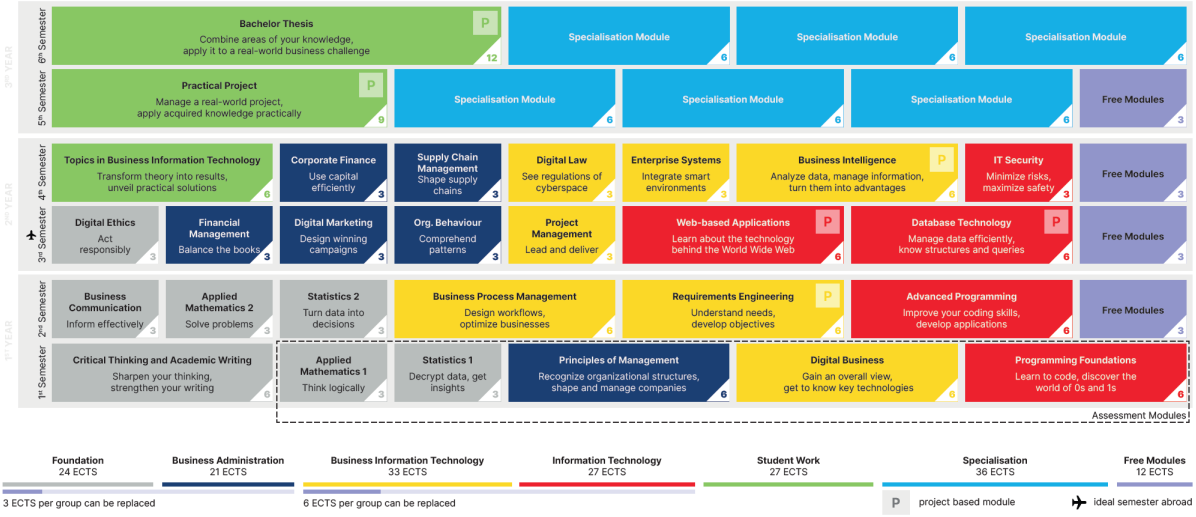
The intersection in the figure "Digitalization" can be considered as the core part of BIT. In courses like Business Process Management, Digital Business, Business Intelligence etc. students learn how IT can be used to bring the business forward. On top of the diagram innovation, communication and modelling highlight areas where BIT seeks to put a particular focus also with regards to competing universities in Switzerland. IT is rapidly evolving, the trade-off to keep the programme stable and nevertheless to offer the latest insights is mastered by offering free / elective modules like Internet of Things, Mobile Computing etc.

Figure 2 shows the organization of the BIT programme into different module groups. The module groups are:

- Foundations: give insight into the necessary basics like mathematics, business communication etc.
- Business Administration: basics of management science relevant for a BIT student
- Business Information Technology (BIT): areas where the interplay between business administration and IT is vital
- Information Technology: give insight into the core IT areas

- Specialization: allows to put the focus on a specific area of interest in the last two terms of the study (offered are Data Science, Digital Business Management and Digital Trust)
- Free modules (electives): takes into account the rapid development of IT and related fields

Figure 2
BIT Module Overview



Source: www.fhnw.ch

Challenges in Teaching Programming

Python is the core programming language in BIT and introduced in two modules. The first module "Programming foundations" is dedicated to the core principles of programming with code organization, variables, controls structures and data types. The second module "Advanced programming" contains advanced content like object-orientation, graphical user interfaces and persistence of data. The specializations build upon the Python basics by introducing advanced libraries like NumPy, Pandas, TensorFlow etc.

As outlined before, BIT is not a "pure hard core" IT programme, therefore teaching programming – widely considered as the "king" discipline in IT – poses a tricky challenge in balancing necessary skills on the one side and not overwhelming undergraduate students (Caspersen et al., 2008; Or-Bach & Lavy, 2004). Based on interviews with our students and teachers in 2021 the following main challenges have been identified (Telesko et al., 2023):

- The starting point of programming is the development of an algorithm, which demands strong analytical skills. It is widely acknowledged among researchers that the ability to abstract is essential for learning to program. However, these skills such as grasping sorting algorithms or organizing concepts into a hierarchy are often lacking at the outset and differ significantly from the kind of thinking students are used to in subjects like mathematics (e.g. solving equations or understanding assignment operations).
- In introductory programming courses, instructors often face the choice of whether to adopt an "OO-first" (object-oriented first) approach as the primary teaching model. Introducing OO concepts from the beginning enables students to develop this mindset early through extensive examples, but it also confronts them with unfamiliar and potentially confusing ideas like inheritance, late binding, overloading, and overriding

in the initial weeks. Conversely, beginning with procedural programming – focusing on data types, control structures, etc. – makes the initial learning curve gentler. However, when OO is introduced later, students frequently question which paradigm to follow and may shy away from OO entirely due to uncertainty. Interviews with students revealed that despite the promise of an "OO-first" curriculum, the understanding of OO principles remained weak by the end of the first term.

- Programming entails juggling multiple tasks at once, such as developing ideas, learning syntax, writing or modifying code, and navigating an IDE. This multitasking often leads to cognitive overload and stress, as students quickly realize time constraints. Moreover, early programming efforts usually yield limited visible results (e.g. basic console output), which can further reduce their motivation.
- Creating software is inherently cross-disciplinary, drawing from areas like infrastructure and project management, requirements analysis, databases, and more. Yet, university curricula are often divided into separate modules, neglecting the interconnected nature of these topics. As a result, programming tends to focus on abstract or simplified "toy" problems, which stands in contrast to the practical and integrated objectives of a Business-IT program.
- Syntax frequently becomes a stumbling block, prompting students to ask "why" certain elements are required. For instance, comparing a basic print command in Python with Java, students often find the boilerplate code in Java difficult to justify or comprehend. Industry practices generally don't align well with academic programming education. While university teaching often emphasizes syntax and algorithmic depth, industry places greater importance on efficient division of labor (such as frontend versus backend) and productivity tools (e.g. DevOps). Additionally, academic staples like recursion are often viewed critically in professional settings. In general, "programming in the large" – relevant to real-world projects and involving multi-layer systems, object-relational mapping, and legacy integration – differs markedly from the "programming in the small" typically taught in beginner-level courses, which usually center on simple desktop apps or basic web frontends.

Important Trends

Large Language Models (LLM)

Large Language Models (LLMs), such as GitHub Copilot OpenAI GPT-4, Anthropic's Claude, Mistral AI, Google Gemini etc., are revolutionizing how programming is taught and practiced. These models can generate code, explain syntax, offer documentation-style answers, and even perform debugging based on natural language prompts. Their impact on teaching software development is profound, with growing academic interest in their integration into curricula. Discussions about the impact of using LLMs on productivity in the professional software industry are ongoing with almost equal positive and negative statements.

From an educational standpoint, LLMs reduce the entry barrier for beginners. Studies by Ahmad et al. (2023) and Finnie-Ansley et al. (2022) highlight that students using LLMs in programming assignments gain confidence and learn faster by receiving immediate, context-aware feedback. However, these benefits come with caveats – overreliance may lead to shallow learning and misconceptions if not scaffolded properly by instructors. In professional settings, Chen et al. (2023) categorize LLM usage into "co-pilot" and "agent" roles, where the former assists the developer while the latter generates complete solutions. A third role –

the "explainer" – may be added which can be regarded as coach to explain the focused code snippets and the underlying theory. This is a task which also helps to support teachers in classes with a big number of students.

While useful for rapid prototyping, concerns persist about code security, maintainability, and explainability. This has led to emerging best practices such as "human-in-the-loop review", LLM code linters, and ethical AI use guidelines (Sridhar et al., 2023).

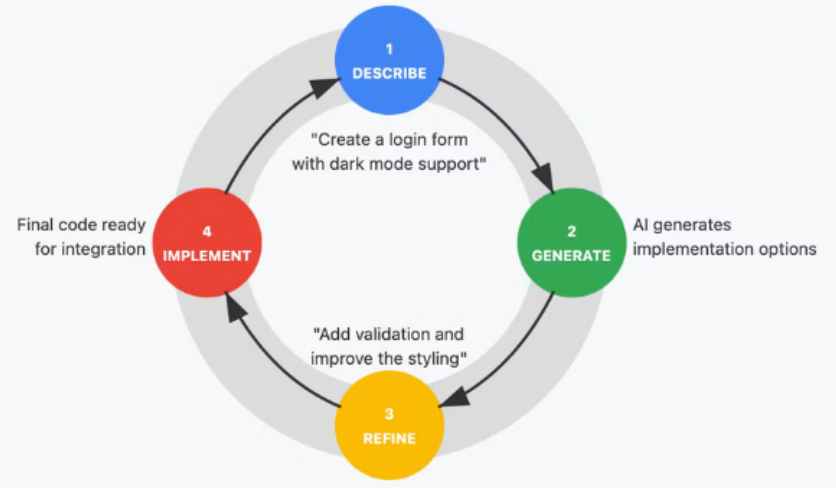
Vibe Coding

Vibe Coding is an innovative pedagogical and professional programming approach that integrates natural-language guidance and AI assistance into the coding process. Introduced by Andrej Karpathy – a software engineer working for Tesla and OpenAI – Vibe Coding encourages intuitive, design-first coding using LLMs. Key advantages include accessibility, rapid prototyping, and enhanced creativity. Karpathy coined the term "Vibe Coding" to express the state of "flow" by guiding AI models (such as LLMs) to generate functional code while focusing on conceptualization, design, and iterative testing.

The Vibe Coding workflow as shown in Figure 3 explains the paradigm of the four step approach (Gehlot, 2025).

- Describe: Here the programming task is described in plain language, akin to explaining concepts to a colleague. This can be regarded as a user requirements specification.
- Generate: AI creates an initial solution which in most cases does not meet the users' expectations.
- Refine: Via prompts the user seeks to push the tool to optimize the existing solution ("try and error").
- Implement: AI-generated code can be difficult to debug due to its dynamic, iterative way of creation and lack of clear architectural structure. Vibe Coding allows testers to leverage AI to generate and execute test cases using natural language thus realizing the next stage called "Vibe Testing".

Figure 3
Vibe Coding Workflow



Source: https://ssojet.com/blog/mastering-vibe-coding-essential-skills/

Vibe Coding can therefore be regarded as an approach where the software engineer acts as "conductor", by letting generate all relevant software engineering artefacts, i.e. code, test cases, comments etc. via natural language prompts.

From a scientific perspective, studies demonstrate Vibe Coding's utility in education and accessibility. Chow and Ng (2025) report improved inclusivity and engagement in clinical teaching through AI-assisted application development. Sapkota et al. (2025) distinguish Vibe Coding from the more rigorous "agentic coding", emphasizing its benefits in early-stage design and conceptual modeling. Chen et al. (2025) show that visually impaired programmers benefit from AI-supported coding workflows, provided interface challenges are addressed. These findings support the use of Vibe Coding in project-based learning, bootcamps, and first-year university programming courses.

However, some experts caution against relying solely on Vibe Coding in professional settings due to potential quality and security concerns (Willison, 2025). This underscores the importance of combining Vibe Coding with foundational knowledge in algorithms, system design, and code review for long-term skill development. It seems to be best suited for rapid, disposable projects rather than work for production-ready environments. This is also emphasized by the fact that recently more and more posts on software engineering platforms ask for troubleshooting or refactoring Vibe Coding solutions.

Enhanced Learning Concept for Python

Based on the results from the exam gradings, interviews with students and teachers and incorporating the paradigm change how programming will likely be done in future we aim to promote a shift from the existing traditional approach to a modern style of teaching programming.

Traditional Approach to Teaching

The traditional method involves teaching via slides, textbooks, and code snippets. While highly structured and predictable (e.g. by the number of slides shown in a unit), it lacks engagement, practical relevance, and fails to stimulate curiosity. Mostly, students are passive and have difficulties moving to an active style because of the complexity of tasks they have to accomplish within a short period of time. These tasks comprise setting up an integrated development environment like Eclipse, IntelliJ or PyCharm and continuously managing the infrastructure (e.g. working with Git and GitHub), finding a suitable algorithm for the problem and finally coding it using the correct syntax. Due to the high effort, we can observe in most lectures that lecturers skip the highly necessary task of writing test cases and performing unit tests.

Summarizing, the classical approach follows the process steps: explaining theory with slides/textbook → showing code examples → coding exercises, where the last step in most cases does not really work as intended. Usually, the lecturers tend to overestimate the velocity of students' coding capabilities. The author observed that the velocity planned – in terms of slides or coding examples – normally is around one third more than what is realized.

The Modern Approach of Teaching

The modern approach now aims at emphasizing actively AI integration and problem-solving via prompt engineering to stimulate the participation of students and to lower mental barriers. The main idea is to reward not only writing but also reading code by taking into account that future software engineers act like "dispatchers" when implementing new features. For the assessment the decisive point is that students can explain code – whoever the author is – down to every single source code line. Discussions about gaining productivity using LLM's are obsolete in our context because coding at universities is done for mere problem solving and not measured by predefined key performance indicators.

Summarizing, the aimed pedagogical shift reflects a new problem-solving process expressed by the following steps: Prompt → LLM Output → Test/Iterate → Final solution.

Realizing the Concept

The new teaching concept will integrate gamification- and AI tools and is currently being implemented in a Bachelor thesis by using the Python "pygame" library.

The new concept is based on the following principles:

- "Showing code, no slides": Students will be encouraged within the guided self-study to get acquainted with the Python "theory." The new curriculum C25+ will reserve more time for this task.
- Active use of AI tools for problem solving, explanation and reflection.

The Bachelor thesis will implement selected gamification features:

- "Python Islands" model: each island covers a well-defined topic (e.g. Strings, Lists, Dictionaries etc.) with quests and paths.
- Reward systems: Points, badges, and themed challenges will stimulate interest and strengthen the competition character among students.
- Daily reminders: Reminders will enable to keep the students active and not to postpone programming tasks for a longer period.
- Coding contests: Good results have been achieved in the past years by introducing coding contests. Usually, a team of 2-3 persons solve a predefined, bigger problem which encompasses the topics covered in the lecture. For this feature, normally the usage of LLMs is forbidden to strengthen the cognitive capabilities.

Conclusion

Teaching programming at the undergraduate level must change. Over the past years, interviews with students / teachers, analysis of module grades and UQM (University Quality Management) results – a survey where students assess a module from their viewpoint – have shown that programming modules need a thorough redesign. The main pain points are excessive demands regarding content and velocity, not suitable learning material and style like mainly using books and slides and not taking into account new technologies like LLMs which drastically will change job profiles in the IT.

Based on these pain points, a Python prototype supporting gamification is currently being implemented. This prototype will be extended in the future using student projects. The prototype will encompass a navigation concept ("Python islands") for structuring learning

topics, a reward system for answering questions and mastering programming challenges, a daily reminder to keep the students active and interested and a coding contest to simulate the "Hackathon" feeling. It is expected to have the first feedback ready by students at the end of the autumn term, i.e. February 2026.

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A Survey of Digital Literacy Among Counselling Psychology Teachers in Southwestern Nigeria Universities

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Abstract

Digital literacy of counselling psychology teachers in southwestern Nigerian universities was examined in this study. Two hundred and twelve counselling psychology teachers were drawn. Their ages ranged from 20 to 60 years, with a mean age of 30 years. Son et al. (2011) questionnaire was the outcome measure. Results show that 42.9% of the respondents have 1–5 years' experience using computers in the classroom despite 11 to 15 years teaching experience. Ownership of notebook PCs was highest (86.0%), followed by Tablets (58.5%). The majority of the respondents learnt computer skills using informal approaches. Most of the respondents considered their computer literacy, internet literacy and typing speed good. Majority (97.2%) indicated they used the internet all the time. Most respondents judged themselves to be intermediate for a range of applications. Overall, the use of digital tools to augment teaching was low. Only 42, representing 22.2% of the respondents used digital tools in their classroom. Lack of computer skills and limited access to the internet were two impediments to the use of digital tools in the classroom. Majority of the teachers have positive perceptions concerning the use of instruction. Addressing the identified skill gaps through targeted professional development, embedded digital literacy modules, and institutional support were recommended.

Keywords: teacher digital literacy, counselling psychology teachers in Nigeria, computer in teaching

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Introduction

In the 21st century, technology has become embedded in nearly every aspect of counselling practice, from appointment scheduling and case documentation to client communication and service delivery. In Nigeria, studies have identified a significant deficit in digital literacy among various professional groups, including counselling psychology teachers (Asemewalen, 2025; Ayodeji, 2025). This corroborates De Simone and Manolio (2024) who reported that only 9 percent of Nigerians surveyed in their study used a computer in the last three months, with men using it twice as much as women. Similarly, National Information Technology Development Agency (NITDA) director disclosed that the Nigeria digital literacy rate stands at 50 percent as at 2024. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), digital skills are the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital technologies for employment, decent jobs, and entrepreneurship (UNESCO Institute for Statistics, 2018). In the context of guidance and counselling, digital literacy involves the integration of technology into professional practice (Carretero et al., 2017; Ofole & Ohakwe, 2021).

Digital skills play a pivotal role in the modern world, shaping both individual opportunities and societal progress. Proficiency in digital skills is increasingly recognized as a fundamental requirement for active participation in various aspects of life, including education, employment, and social interaction. Arifin et al. (2025) emphasised that addressing digital literacy gaps is critical to enhancing the professional performance of counselling educators and enabling their effective participation in the digital age. Evidence indicates that technology can provide flexible and tailored mental health support, reduce barriers to accessing care, and generate valuable insights into mental health trends at both individual and population levels (Löchner et al., 2025; Torous et al., 2025). Digital literacy is therefore essential for counsellors and psychotherapists to navigate digital environments, deliver evidence-based and accessible services, and uphold client safety and privacy—particularly for Generation Z and Millennial clients, whose ICT experiences and skills differ significantly from those of previous generations. Research consistently emphasises the need for guidance and counselling educators to possess strong computer skills to equip future counsellors with the competencies required for effective technology integration in practice, as teachers' digital competence directly influences student learning outcomes (Tran et al., 2024).

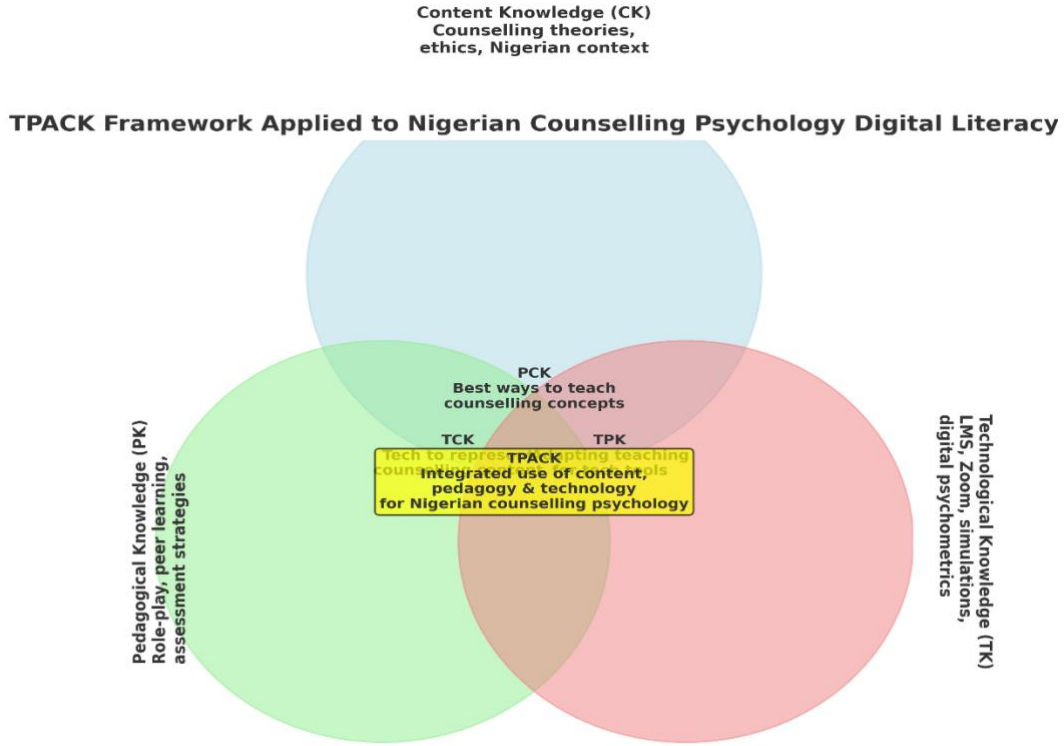
A systematic review of the literature reveals the existence of multiple frameworks for defining and assessing digital literacy. While they share certain similarities, each has distinct features, strengths, and limitations. Some models focus primarily on technical competencies, such as computer and ICT skills (Martin, 2006), whereas others incorporate social and cultural dimensions (Chen, 2015; Ng, 2012). Eshet-Alkalai and Amichai-Hamburger (2004) conceptualise digital literacy as a broad set of cognitive, motor, sociological, and emotional skills needed to function effectively in digital environments, extending beyond the mere operation of software and devices. Martin (2006) proposed three progressive levels—digital competence, digital usage, and digital transformation—representing a shift from basic proficiency to advanced, creative applications. Bawden's (2008) framework identifies four components: underpinnings (traditional and ICT literacy), background knowledge of information resources, central competences (knowledge assembly), attitudes and perspectives (independent learning, moral/social literacy). Ng's (2012) model emphasises three dimensions, including socio-emotional factors, while Spires et al. (2019), adapting Spires and Bartlett (2012), classify digital literacy into searching and using, creating, and

communicating with digital tools. Gruszczynska et al. (2013) describe it from two perspectives: access, skills, and practices, and the contexts in which they occur. Chen's (2015) "9 Cs" framework encompasses communication, collaboration, critical thinking, creativity, citizenship, character, curation, copyright, and connectedness. The European Commission's Digital Competence Framework (DigComp) identifies five competence areas and 21 specific skills across eight proficiency levels, providing a basis for teacher development and guiding the integration of technology into education (Carretero et al., 2017). The National Digital Literacy Framework (NDLF), developed by the National Information Technology Development Agency (NITDA), provides a structured roadmap for advancing digital literacy in Nigeria. It emphasises six core competency areas, namely device and software operations, information and data literacy, communication and collaboration, digital content creation, cybersecurity and online safety, as well as digital problem solving.

This study is grounded in the Technological Pedagogical Content Knowledge (TPACK) framework (Carretero et al., 2017), which posits that effective teaching with technology requires the integration of specific technological tools—such as hardware, software, applications, and information literacy practices—to prepare both pre-service and in-service teachers to guide students toward a deeper understanding of subject matter. The framework combines three core domains of knowledge: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK), which can be integrated in various ways. Within this study, three combinations are particularly relevant: (i) Technological Content Knowledge (TCK), which refers to knowing which technologies best represent and enhance counselling psychology content (e.g., using simulation software for role-play in counselling sessions); (ii) Technological Pedagogical Knowledge (TPK), which involves understanding how counselling teaching methods can be adapted through technology (e.g., implementing a flipped classroom model with pre-recorded lectures on therapy techniques); and (iii) Pedagogical Content Knowledge (PCK), which relates to knowing the most effective teaching methods for counselling psychology concepts without necessarily involving technology. The relationship between this framework and counselling psychology teachers' digital literacy is illustrated in Figure 1.

Figure 1

Technological Pedagogical Content Knowledge (Tpack) Model for Counselling Psychology Teachers' Digital Literacy



Purpose of the Study

The broad purpose of the study is to assess the digital literacy of Counselling Psychology teachers in universities in Southwestern Nigeria. Specifically, the study was designed:

i. To assess counselling psychology teachers' experience with using computers to teach counselling courses;
ii. To explore the types of computers the counselling psychology teachers owned;
iii. To explore how counselling psychology teachers acquired their computer and digital competencies;
iv. To identify counselling psychology teachers' self-assessment of computer and internet usage;
v. To investigate counselling teachers' assessment of usage of computer application;
vi. To analyze counselling psychology self-assessment of experience with popular software application;
vii. To identify extent counselling psychology teachers, integrate computers into teaching;
viii. To analyse factors influencing the use of computers in teaching counselling courses;
ix. To explore counselling psychology teachers' perceptions of computers and the use of technology for teaching.

Materials and Methods

Design

The design adopted for this study is a descriptive survey. It systematically described the issues of digital literacy of counselling psychology teachers.

Participants

The study sample comprised 212 counselling psychology teachers, of whom 118 (55.7%) were female and 94 (44.3%) males, with a mean age of 30 years. Age distribution showed 32.5% aged 34–40 years, 25.5% aged 41–47 years, and 5.2% aged 20–26 years. Most participants were married (79.2%), while 16.5% were single and 4.3% widowed. Teaching experience varied, with 42.9% having 11–15 years, 26.9% having 6–10 years, and 14.6% having less than 5 years. In terms of qualifications, 83.0% held a PhD and 17.0% a Master's degree in Counselling Psychology. Institutional affiliation indicated 68.4% teaches in public universities and 31.6% in private institutions.

Measure

A 52-item digital literacy questionnaire, adapted from Son et al. (2011), was employed to evaluate participants' computer access, competence, and usage in both personal and professional settings. The tool addressed six key areas: socio-demographic information, attitudes toward technology, participation in technology-based learning, engagement with technology, perceptions of technology use, and attitudes toward barriers to integration. Items were revised to align with counselling-related activities and updated to incorporate emerging practices such as cloud computing and file-sharing services. The instrument showed strong reliability, with an overall reliability coefficient of $r = 0.80$ and Cronbach's alpha values ranging from 0.75 to 0.83 across its subscales.

Data Collection and Analysis

Between December 2024 and January 2025, data were collected from counselling psychology teachers who met the inclusion criteria of holding g at least a Master's degree, teaching GCE 101–103, owning a personal computer, and providing consent. Trained research assistants distributed questionnaires in participating institutions, with completed forms retrieved after one week. Data from the digital literacy questionnaire were analysed using descriptive statistics, summarised in frequencies and percentages, and presented in tables and charts.

Results

In line with the study's purpose and the volume of data collected, all questionnaire responses are presented as follows:

Experience Using Computers in the Classroom

Table 1 presents the findings on counselling psychology teachers' experience with using computers to teach counselling courses. The results indicate that, although a significant proportion of the teachers (42.9%) had extensive teaching experience (11–15 years), only 14.1 out of the 42.9% reported to have integrated computers into their classroom instruction. This suggests that long years of teaching experience do not necessarily translate into technological proficiency, and highlights a potential gap in the adoption of digital tools for teaching counselling courses.

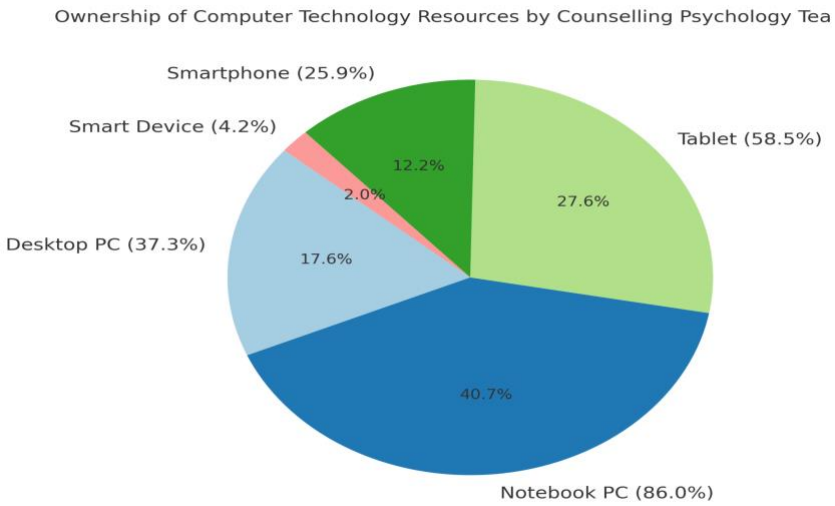
Table 1
Teachers' Experience Using Computers in Teaching Counselling Courses

Year of Teaching Experience	Frequency	Percent (%)
1-5 years	91	42.9
6 - 10 years	57	26.9
11 - 15 years	30	14.1
15-20 years	28	13.2
21 years and above	06	2.8
Total	212	100

Types of Computer Ownership

When asked to indicate the computer technology resources they possessed, the results revealed that most teachers owned various types of digital devices. A large majority (86.0%) had a notebook PC, while more than half (58.5%) owned a tablet. Fewer than half reported having a desktop PC (37.3%) or a smartphone (25.9%), and only nine respondents (4.2%) possessed a smart device. These findings are presented in Figure 1.

Figure 1
Digital Device Ownership

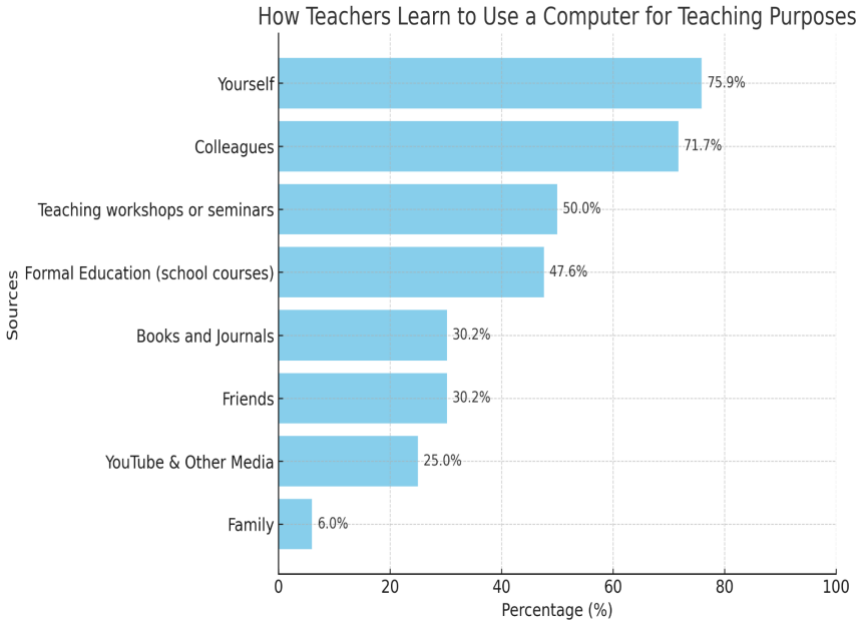


Acquisition of Digital Skills

The responses obtained revealed that teachers acquired their computer skills through a variety of sources, with informal learning methods emerging as the most common. A significant majority (75.9%) reported being self-taught, while nearly as many as 71.7% learnt from their colleagues. Half of the teachers indicated receiving training through workshops or seminars,

and almost half (47.6%) developed skills as part of their counsellor training coursework. Less common were skills acquired through YouTube tutorials (25.0%) or from family members (6.0%). These patterns suggest that teachers often rely heavily on personal initiative and peer support to build their digital competencies.

Figure 2
How Counselling Psychology Teachers for Teaching Purposes



Counselling Psychology Teachers' Self-Assessment of Computer and Internet Usage

When asked to rate their digital skills on a four-point scale, the result presented in Table 2 shows that most respondent described their abilities as "good." Just over half (50.5%) considered their computer literacy to be good, and an equal number (50.0%) rated their internet literacy at the same level. Typing speed received slightly lower ratings, with 40.6% describing it as good. Excellence was far less common across all categories, with only 11.8% rating their computer literacy as excellent, 22.6% for internet literacy, and 23.6% for typing speed.

Table 2
Counselling Psychology's Self-Assessment of Digital

S/N	Digital skills	Poor	Adequate	Good	Excellent
1	Computer literacy	9(4.2%)	71(33.5%)	107(50.5%)	25(11.8%)
2	Internet literacy	5(2.4%)	53(25.0%)	106(50.0%)	48(22.6%)
3	Typing speed	5(2.4%)	71(33.5%)	86(40.6%)	50(23.6%)

Counselling Teachers' Assessment of Usage of Computer Application

When asked about their usage of popular software applications, majority (97.2%) indicated used internet concordance software, followed by e-mail (91.0%), word processing (74.5%), and computer games (72.6%) on a daily basis. Other applications with high levels of daily or near-daily engagement (three to four times per week) included cloud computing tools (84.4%), counselling software (80.6%), video conferencing platforms (69.4%), multimedia applications (61.4%), and blogging tools (60.4%). In contrast, some software types were used far less often. Over half of the respondents indicated that they rarely or never used— or were unfamiliar with—graphics applications (72.6%), text chat platforms (60.8%), online forums, and wikis. This result is presented in Table 3.

Table 3

Counselling Teachers' Assessment of Usage of Computer Application

Programme	Almost everyday	3-4 times per week	1-2 times per week	1-2 times per month	Rarely	Never/I don't know
Word processing	151(71.2%)	23(10.5%)	31(14.6%)	7(3.3%)	0(0.0%)	0(0.0%)
E-mail	158(74.5%)	35(16.5%)	19(9.0%)	0(0.0%)	0(0.0%)	0(0.0%)
Internet	206(97.2%)	6(2.8%)	0(0.0%)	0 (0.0%)	0(0.0%)	0(0.0%)
Database	32(15.1%)	13(6.1%)	46(21.7%)	50(23.6%)	56(26.4%)	15(7.1%)
Spreadsheet	15(7.1%)	13(6.1%)	30(14.2%)	116 (54.7%)	38(17.9%)	0(0.0%)
Graphics	6(2.8%)	3(1.4%)	32(15.1%)	17(8.0%)	145(68.4%)	9(4.2%)
Website design	205(96.7%)	7(3.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
Multimedia	97(45.8%)	33(15.6%)	43(20.3%)	39(18.4%)	0(0.0%)	0(0.0%)
Social networking	5(2.4%)	23(10.8%)	119(56.1%)	4(1.9%)	3(1.4%)	58(27.4%)
Counselling software	30(14.1%)	141(66.5%)	16(7.5%)	5(2.4%)	3(1.4%)	17(8.0%)
Concordance software	193(91.0%)	5(2.4%)	5(2.4%)	3(1.4%)	6(2.8%)	0(0.0%)
Blogging	37(17.5%)	91(42.9%)	48(22.6%)	18(8.5%)	9(4.2%)	9(4.2%)
Wiki	6 (2.8%)	88(41.5%)	59(27.8%)	17(8.0%)	15(7.1%)	27(12.7%)
Online discussions of forums	5(2.4%)	108(50.9%)	5(2.4%)	77(36.3%)	10(4.7%)	7(3.3%)
Text chatting	0(0.0%)	25(11.8%)	33(15.6%)	25(11.8%)	23(10.8%)	106(50.0%)
Video conferencing	5(2.4%)	142(67.0%)	28(13.2%)	22(10.4%)	10(4.7%)	5(2.4%)
Computer games	154(72.6%)	38(17.9%)	20(9.4%)	0(0.0%)	0(0.0%)	0(0.0%)
Cloud computing	64(30.2%)	115(54.2%)	11 (5.2%)	3(1.4%)	8(3.8%)	11(5.2%)

Self-Assessment of Experience With Popular Software Application

When asked about their experience with popular software applications, the results displayed n Table 4 shows that most respondents reported frequent use of certain tools. A large majority (97.2%) used internet concordance software, followed by e-mail (91.0%), word processing (74.5%), and computer games (72.6%) on a daily basis. Other applications with high levels of daily or near-daily engagement (three to four times per week) included cloud computing tools (84.4%), counselling software (80.6%), video conferencing platforms (69.4%), multimedia applications (61.4%), and blogging tools (60.4%).

In contrast, some software types were used far less often. Over half of the respondents indicated that they rarely or never used—or were unfamiliar with—graphics applications (72.6%), text chat platforms (60.8%), online forums, and wikis. These patterns suggest that while teachers are highly engaged with general productivity and communication tools, their interaction with more specialized or collaborative applications is comparatively limited. When asked to self-assess their digital skills, many counselling psychology teachers rated themselves as having intermediate proficiency across a range of applications, with advanced proficiency being the next most common rating (Table 5). Lower ratings were reported for multimedia applications, online video conferencing, online discussions, and spreadsheet use.

Table 4
Self-Assessment of Digital Skills

How would you rate your computer skills on the following	None (1)	Basic (2)	Intermediate (3)	Advanced (4)
E-mail	0(0.0%)	20(9.4%)	135(63.7%)	57(26.9%)
Internet	0(0.0%)	24(11.3%)	154(72.6%)	34(16.0%)
Word processing	0(0.0%)	67(31.6%)	118(55.7%)	27(12.7%)
E-mail (mobile)	13(6.1%)	26(12.3%)	67(31.6%)	106(50.0%)
Presentation software	11(5.2%)	3215.1%)	147(69.3%)	22(10.4%)
Web search engine	15(7.1%)	23(10.8%)	146(68.9%)	28(13.2%)
Downloading and installing programs	14(6.6%)	63(29.7%)	122(57.5%)	13(6.1%)
Social networking	22(10.4%)	46(21.7%)	94(44.3%)	50(23.6%)
Communications applications	23(10.8%)	71(33.5%)	68(32.1%)	50(23.6%)
Online chart	23(10.8%)	76(35.8%)	9142.9%)	22(10.4%)
Internet security	21(9.9%)	77(36.3%)	93(43.9%)	21(9.9%)
Multimedia applications	23(10.8%)	53(25.0%)	114(53.8%)	22(10.4%)
Online video conferencing	22(10.4%)	59(27.8%)	110(51.9%)	21(9.9%)
Online discussions	22(10.4%)	6229.2%)	89 (42.0%)	39(18.4%)
Spreadsheet	30(14.2%)	81(38.2%)	78(36.8%)	23(10.8%)
Wiki	30(14.2%)	83(39.2%)	76(35.8%)	23(10.8%)
Database	28(13.2%)	113(53.3%)	55(25.9%)	16(7.5%)
Blog applications	57(26.9%)	68(32.1%)	65(30.7%)	22(10.4%)
Cloud computing	85(40.1%)	62(29.2%)	37(17.5%)	28 (13.2%)
Website design	154(72.6%)	39 (18.4%)	19(9.0%)	0(0.0%)
Computer games	109(51.4%)	57(26.9%)	30(14.2%)	16(7.5%)

Table 5
Computer-Related Access and Usage

S/N	Questions	Yes (%)	No (%)
1.	Do you have a computer connected to the internet?	58(27.4)	154(72.6)
2.	Do you have an email account outside your smartphone or university account?	25(11.7)	24(187)
3.	Do you use a website?	102(48.)	110(51.9)
4.	Do you have a personal homepage?	15 (7.0)	197(92.9)
5.	Do you understand the basic functions of computer hardware components (e.g CPU and hard disk)?	29 (13.6)	183(86.3)
6.	Do you use keyboard shortcuts?	62 (29.2)	150(70.8)
7.	Do you use a computer connected to the internet at university?	29 (13.7)	183(86.3)
8.	Do you use a computer for teaching purposes?	47(22.2)	165(77.8)
9.	Do you find it easy to learn something by reading it from a computer screen?	62(29.2)	150(70.8)
10.	Do you use CD-ROMs to supplement your teaching?	16 (7.5)	196(92.5)
11.	Do you use websites to supplement your teaching?	42(19.8)	170(80.1)

Integration of Computers Into Teaching of Counselling Courses

Integration of computers into teaching requires a broad spectrum of skills, ranging from basic literacy to advanced technical expertise. As shown in Table 6, the responses from counselling psychology teachers indicate that many lack certain skills essential for the effective use of computers, related equipment, and software in both personal and professional contexts. Most respondents reported being able to carry out only fundamental tasks such as properly turning on and shutting down a computer (95.8%), starting and exiting a program (87.3%), printing documents using a printer (75.5%), creating a basic Microsoft Word document (56.6%), sending and receiving email attachments (94.3%), and searching for information using a web search engine (67.9%). However, a majority indicated they could not perform more advanced tasks, such as transferring files from a hard drive to a USB drive, downloading and saving files from the web, using online video conferencing tools, recording and editing audio, or creating simple databases using Microsoft Access or Excel.

Table 6
Integration of Technology Into Teaching Counselling Courses

Questions	Yes (%)	No (%)
Can you properly turn on and shutdown a computer?	201(95.8)	11(5.1)
Can you start and exit a computer program?	185 (87.3)	27 (12.7)
Can you print a document using a printer?	160(75.5)	52(24.5)
Can you create a basic Microsoft Word document?	120(56.6)	92(43.4)
Can you send and receive attachments through email messages?	200(94.3)	12(5.7)
Can you search for information using a web search engine?	144(67.9)	68(32.1)
Can you move a file from a hard drive to a USB drive?	82(38.7)	130 (61.3)
Can you download and save files from the web?	116(54.7)	96(45.2)
Can you change the font style and size in a document?	67(31.6)	145(68.4)
Can you change monitor brightness and contrast?	62(29.2)	150(70.8)
Can you minimize, maximize and move windows on the desktop?	88(41.5)	124(58.5)

Can you perform file management including deleting and renaming files?	77(36.3)	135(63.7)
Can you copy, cut and paste inside a document?	87(41.0)	125 (58.9)
Can you create a simple presentation using Power Point?	67(31.6)	147(68.4)
Can you install a software program?	34(16.0)	178 (83.9)
Can you write files onto a CD?	43(20.3)	169(79.7)
Can you resize a photograph?	24(11.3)	188(88.6)
Can you create a basic Excel spread sheet?	58(27.4)	154(72)
Can you scan a disc or file for viruses?	87(41.0)	125(58.9)
Can you use a video conferencing tool on the web?	56(26.4)	156(73.6)
Can you record and edit sounds?	17(8.0)	195(91.9)
Can you create a simple database using Access or Excel	42(19.8)	170(80.1)
Can you create a simple web page?	12(5.6)	200(94.3)

Factors Influencing the Use of Computers in Teaching Counselling Courses

Several factors influence computer use, including user attitudes, prior experience, access to technology, and perceptions of its usefulness. Respondents cited lack of teachers' computer skills and limited access to computers. This finding, presented in Table 7.

Table 7
Factors Influencing the Use of Computers in Teaching Counselling Courses

S/N	Factors	Frequency	(%)
1	Limited time	28	13.2
2	Limited access to the internet	39	18.4
3	Lack of teachers' computer skill	43	20.3
4	Lack of interest of teachers	8	3.8
5	Lack of university support	15	7.1
6	Curricular restrictions	0	0
7	Limited facilities	12	5.6
8	Limited knowledge of computer	37	17.5
9	Lack of computer skills of students	13	6.1
10	Lack of students' interest	9	4.2
11	Lack of computer-based materials	5	2.4
12	Inflexible teaching methods	3	1.4
13	Others (please specify)	0	0

Teacher's Perceptions of Computers and the Use of Technology for Teaching

As presented in Table 8, overall, teachers demonstrated very positive attitudes toward integrating technology into their classrooms. Most (91.1%) reported enjoying the use of computers, 91.0% felt comfortable using them, and an equal proportion (91.1%) expressed willingness to learn more. Similarly, the majority (88.6%) agreed that it was important to learn how to use computers, while 76.9% believed that incorporating computers could enhance their teaching. Additionally, 72.2% felt that computers could make teaching and learning more engaging.

Table 8
Teacher's Perceptions of Computers and the Use of Technology for Teaching

S/N	Answer Options	Strongly Agree (1)	Agree (2)	Uncertain (3)	Disagree (4)	Strongly Disagree (5)
1.	I enjoy using computer	79(37.3%)	114(53.8%)	13(6.1%)	3(1.4%)	3(1.4%)
2.	I feel comfortable using computers	81(38.2%)	112(52.8%)	13(6.1%)	3(1.4%)	3(1.4%)
3.	I'm willing to learn more about computers	79(37.3%)	114(53.8%)	13(6.1%)	3(1.4%)	3(1.4%)
4.	I think computers are difficult to use	2(0.9%)	5(2.4%)	15(7.1%)	114(53.8%)	76(35.8%)
5.	I feel threatened when others talk about computers	5(2.4%)	10(4.7%)	16(7.5 %)	110(51.9%)	71(33.5%)
6.	I believe that it is important for me to learn how to use computers	80(37.7%)	108(50.9%)	15(7.1%)	5(2.4%)	4(1.9%)
7.	I would like to use computers in the classroom	65(30.7%)	56(26.4%)	78(36.8%)	7(3.3%)	6(2.8%)
8.	I feel that my teaching could be improved by using computers	65(30.7%)	98(46.2%)	49(23.1)	0(0.0%)	0(0.0%)
9.	I think that computers can make learning	65(30.7%)	88(41.5%)	32(15.1)	8(3.8%)	19(9.0%)
10.	I believe that training in computer-assisted counselling be included in counsellor education	85(40.1%)	93(43.9%)	34(16.0)	0(0.0%)	0(0.0%)

Discussion

Experience Using Computers in the Classroom

This study assessed the digital literacy of counselling psychology teachers in universities across Southwestern Nigeria. Findings revealed that, irrespective of gender, age, educational status, type of university, or years of teaching experience, fewer than half of the respondents reported substantial experience using computers in the classroom for counselling courses. This indicates a significant gap in the practical skills required for effective technology integration in teaching. These results align with previous research (Atomatofa, 2025; Nwuke & Yellowe, 2025) which identified limited computer literacy as major barriers to technology adoption in higher education. The findings highlight the urgent need for targeted professional development, improved and deliberate strategies to build teachers' competence in using digital tools to enhance the delivery of counselling psychology instruction.

Types of Computers Owned by the Counselling Psychology Teachers

The result showed that large majority had a notebook PC, while more than half owned a tablet. Fewer than half reported having a desktop PC. The types of digital devices owned by teachers have important implications for teaching counselling psychology courses. High ownership of notebook PCs and tablets suggests that teachers have access to portable and flexible tools that can support classroom instruction, preparation of teaching materials, and online engagement. However, the relatively low ownership of desktop PCs, smartphones, and smart devices may limit opportunities for certain activities such as mobile learning, app-based instruction, or multimedia production. Limited access to advanced or versatile devices could also affect the ability of teachers to deliver interactive, collaborative, and technology-enhanced lessons, particularly in hybrid or remote learning environments. This result corroborates previous studies, such as Dele-Ajayi et al. (2021) and Tondeur et al. (2018) which reported similarly that educators in higher education often have access to personal digital devices.

How Counselling Psychology Teachers Acquired Their Digital Competencies

The outcomes suggest that majority of teachers relied heavily on personal initiative and peer support to build their digital competencies—an approach that may contribute to uneven skill development across the profession. This finding corroborates studies (Adegoke et al., 2019; Ning & Danso, 2025) which reported that educators frequently acquire computer skills through self-learning and informal networks, with formal professional development playing a comparatively smaller role. There is a risk of uneven skill levels. Some teachers may advance quickly, while others may struggle without structured guidance. Need for enhanced formal training:

Counselling Psychology Teachers' Self-Assessment of Computer and Internet Usage

The finding from this study collaborates earlier researches (Abbiati et al., 2025; Afari et al., 2023) which reported that though computers are available for educators they hardly adopt the technology for educational purpose. The outcome shows that majority of the counselling psychology teachers rated themselves as having intermediate proficiency across a range of applications, The implications of this pattern are twofold. First, it reflects a strong orientation toward digital tools that support basic communication, content creation, and administrative tasks, rather than those designed for advanced collaboration, creative production, or subject-specific instructional innovation. Second, the limited use of specialized applications may indicate gaps in training, exposure, or perceived relevance to counselling psychology teaching.

Counselling Psychology' Competence With Specific Technical Skills and Hardware Use

Another notable finding from this study is that many teachers handling counselling psychology courses may lack the skills needed to effectively integrate these collaborative and interactive tools into their teaching. The importance of wikis, forums, and blogs in the context of counselling education cannot be overstated: wikis facilitate collaborative content creation and knowledge organization; forums enable structured discussions and peer support; while blogs provide a platform for personal reflection, sharing professional insights, and fostering community engagement. This pattern corroborates with the work of Malakul and Sangkawetai, (2024) who found that though educators are proficient in basic productivity and

communication tools, they often demonstrate limited competence or confidence in using more specialized online platforms that promote collaborative learning and professional interaction.

Counselling Psychology Teacher's Integration of Technology Into Teaching and Learning

The study found that most counselling psychology teachers rarely use digital tools in their teaching. Limited skills in applications such as video conferencing, file sharing, and data management constrain opportunities for interactive, technology-enhanced learning and may leave graduates underprepared for the digital demands of modern counselling practice. Similar studies attribute this gap to insufficient training, low confidence, and inadequate institutional support (Abbiati et al., 2025; Afari et al., 2023).

Factors Influencing the Use of Computers in Teaching Counselling Courses

The study found that computer use in teaching is shaped by factors such as attitudes, prior experience, access, and perceived usefulness, with computer anxiety and low confidence emerging as key barriers. The most common obstacles cited were inadequate skills and limited knowledge of computers, echoing earlier research linking low competence and confidence to poor technology integration (Gómez-Fernández & Mediavilla, 2022; Ivanishchenko et al., 2024). Targeted training and mentorship could address these gaps and enhance technology use in counselling education.

Counselling Psychology Teachers' Perceptions of Computers and the Use of Technology for Teaching

Teachers' overwhelmingly positive attitudes toward technology—marked by enjoyment, comfort, and willingness to learn—suggest a strong basis for advancing digital integration in counselling education. Recognising the benefits of technology for engagement and effectiveness, they are likely to embrace training initiatives. This aligns with Ocak and Karafil (2021) that teacher attitudes strongly influence technology adoption. Harnessing this readiness through targeted development and institutional support can better prepare students for digitally driven counselling practice.

Conclusion

The study concluded that while counselling psychology teachers generally possess basic computer skills, many lack advanced competencies needed for technology-enhanced learning, telecounselling, and digital resource management. Limited skills and knowledge, alongside competence-related and attitudinal barriers, hinder effective integration. However, their positive attitudes toward technology present an opportunity. Targeted digital literacy, training, mentorship, and institutional support could bridge these gaps, fostering innovative teaching, equitable access, and better preparation for technology-driven practice.

Recommendations

The following recommendations emerged from the study:

i. There is need for the university staff development departments to conduct continuous professional development (CPD)to bridge the gap between basic literacy and advanced application skills tailored to counselling psychology.
ii. The government should implement comprehensive digital Literacy policies and mandate institutions to support digital tool integration.
iii. The universities should establish clear guidelines for digital resource usage and staff accountability.
iv. The universities should expand internet coverage and improve bandwidth reliability across all departments.
v. Schools should encourage knowledge sharing among teachers on technology integration strategies.
vi. Counselling educational curricula need to be updated to include comprehensive digital skills modules which will equip future counsellors with the competencies they need to function effectively in the digital era.

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Counseling for International Students: Applicable Strategies for Non-anglophone Universities

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Abstract

A literature review highlights challenges in providing effective counseling for international students. Key issues include limited language proficiency, cultural mismatches between students and counselors, stigmatization of mental health, and institutional gaps in addressing the unique psychological and social needs of international students. Additionally, the lack of multilingual resources and cultural competency training for counselors exacerbates these difficulties, leaving many students unsupported in their academic and personal journeys. Drawing on lessons from worldwide literature, this study proposes practical strategies to enhance counseling services in non-Anglophone university contexts. These include culturally responsive counseling programs, integrating tailored training in cultural humility and region-specific mental health practices for counselors; peer support systems, fostering connections among international students to reduce isolation and build community; multilingual and culturally adapted resources, such as translated self-help materials and culturally relevant case studies; integrated campus-wide support networks, combining academic, administrative, and counseling services to create a holistic support system; and hybrid digital counseling platforms, leveraging technology to provide multilingual, flexible, and accessible mental health support. These strategies aim to address the structural and interpersonal barriers faced by international students, enhancing their well-being and integration. This study offers actionable recommendations for policymakers, educators, and counselors to foster inclusive, supportive, and culturally competent environments for international students in the context of non-Anglophone universities.

Keywords: cultural competency, international student counseling, multilingual mental health support, non-anglophone universities, peer support systems

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Introduction

International student mobility has significantly increased in recent decades, contributing to the cultural and academic diversity of higher education institutions worldwide (UNESCO, 2023). While international students enrich host institutions with their perspectives, they also face unique challenges, particularly in non-Anglophone university contexts, where language, culture, and systemic barriers often hinder their academic success and well-being. Counseling services are critical in addressing these challenges, yet gaps in institutional readiness and support mechanisms persist.

Despite the extensive body of research on international student mobility, existing literature has largely focused on broad trends without adequately distinguishing between the unique challenges and advantages of Anglophone and non-Anglophone universities in attracting and supporting international students. While studies have examined factors influencing student choice, such as language, tuition, and institutional reputation (Altbach, 2013; Wit, 2010), there remains a gap in comparative analyses that systematically contrast the experiences, policies, and support structures in these two contexts. There is a trend of growing adoption of English-taught programs in non-Anglophone countries (Wächter & Maiworm, 2014), but research on how these programs compare in effectiveness and appeal to those in Anglophone universities remains scarce. Similarly, studies on cultural adaptation and student well-being (Hyun et al., 2007; Smith & Khawaja, 2011) have primarily focused on English-speaking environments, leaving a gap in understanding how international students navigate challenges in non-Anglophone settings. The absence of such research limits the ability of non-Anglophone institutions to adopt best practices from their Anglophone counterparts while tailoring solutions to their distinct linguistic and cultural landscapes.

Previously, we examined the factors that pull international students to Japan (Tran & Jin, 2022b), the challenges they face (Tran & Jin, 2022a), the connection between the support services provided to international students and the factors that influence their choice of a particular university in Japan (Tran et al., 2022a). Additionally, we demonstrated that online stress seminars could be a potential tool for increasing the resilience of international students during the pandemic (Tran et al., 2022b).

This paper aims to bridge the literature gap by providing a structured analysis of the differences between Anglophone and non-Anglophone universities, identifying applicable practices, and proposing strategies to enhance international student experiences across diverse higher education settings, especially to the Japanese context. It will contribute to recommendations to enhance the inclusivity and effectiveness of counseling services in these academic environments.

Method

This study employed a literature review approach using Google search engine and Google Scholar to identify articles, websites, reports, documents published between 2000 and the present. The search focused on counseling practices for international students in both Anglophone and non-Anglophone university contexts, using keywords such as “international student counseling,” “mental health support,” “cultural competency,” and “non-Anglophone universities.” Articles were screened for relevance based on their focus on challenges, best practices, and lessons learned in counseling international students. A comparative analysis was conducted to identify distinctions and commonalities in counseling practices between

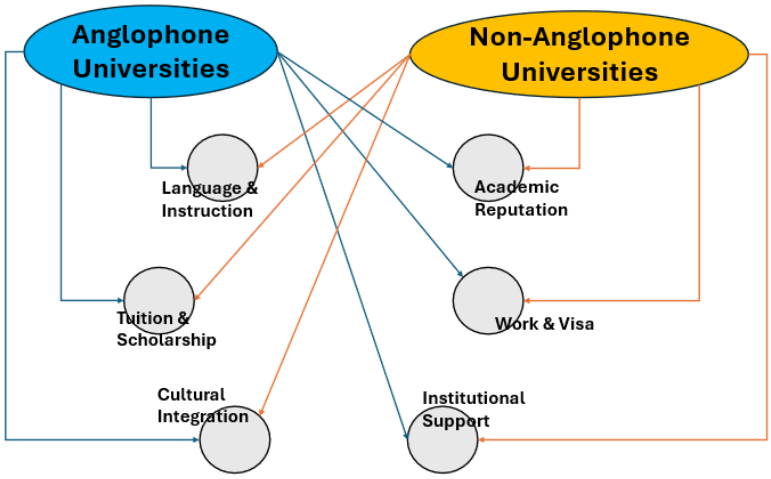
Anglophone and non-Anglophone universities. This analysis aimed to extract lessons learned from Anglophone institutions that could be adapted to non-Anglophone settings, considering the unique linguistic and cultural contexts of the latter.

Conceptual Framework

In this study, Anglophone universities refer to higher education institutions located in countries where English is the native language, such as the United States, the United Kingdom, Canada, Australia, New Zealand, and Ireland. These universities operate entirely in English, both in academic instruction and administrative processes, making them highly accessible to international students from diverse linguistic backgrounds (Altbach, 2013; Wächter & Maiworm, 2014). We refer to non-Anglophone universities as institutions located in countries where English is not the native language. This category includes universities in Europe (e.g., Germany, France, the Netherlands), Asia (e.g., Japan, China, South Korea), the Middle East (e.g., Saudi Arabia, UAE, Egypt), Africa (e.g., Morocco, Senegal, Ethiopia), and South America (e.g., Brazil, Argentina). While many of these institutions offer programs in English—particularly at the graduate level—the primary language of instruction, research, and administration often remains the national or regional language (Kuroda et al., 2018; Ota, 2018).

International students are a growing demographic in global higher education, but the ability to attract and support them varies significantly between Anglophone and non-Anglophone universities. These differences stem from factors such as language, academic reputation, cultural adaptation, and institutional support structures (Figure 1).

Figure 1
Anglophone Versus Non-anglophone Universities (by the authors)



Regarding language and medium of instruction, in Anglophone universities, English as the primary medium of instruction is a major pull factor. Many students from non-English-speaking countries see studying in the U.S., U.K., Canada, and Australia as an opportunity to improve their English proficiency while earning a degree. Meanwhile, in non-Anglophone universities, while some programs are offered in English, a significant portion of courses remains in the local language, creating a barrier for international students (Wächter & Maiworm, 2014). To counter this, universities in countries like Germany, Japan, and China have been expanding English-taught programs (Kuroda et al., 2018).

Regarding academic reputation and global rankings, many universities in the U.S., U.K., and Australia consistently rank high in global university rankings (QS, THE), which increases their attractiveness to international students seeking prestige (Altbach, 2013). However, non-Anglophone universities in Europe and Asia are improving in rankings, but their recognition is often region-specific. Countries like Germany and the Netherlands attract students through tuition-free or low-cost education (Wit, 2010).

In terms of tuition fees and scholarships, Anglophone universities charge higher tuition fees as a common deterrent. For instance, international students in the U.S. often pay three times the tuition of domestic students (ICEF Monitor, 2023). Scholarships exist, but they are highly competitive. Meanwhile, many European and Asian institutions offer lower tuition fees, sometimes even free education (e.g., Germany, Norway). Government-backed scholarships, such as China's CSC Scholarship and Japan's MEXT Scholarship, help offset costs (Kuroda et al., 2018).

Regarding work opportunities and post-study visas, Anglophone countries like Canada and Australia offer favorable post-study work visas, which are a major attraction. The U.K. recently reintroduced a two-year post-study work visa (Bell et al., 2024). Non-Anglophone universities in Japan and Germany also provide work opportunities for international graduates, but language barriers can limit job prospects outside academia (Kuroda et al., 2018; MyGermanUniversity, 2025).

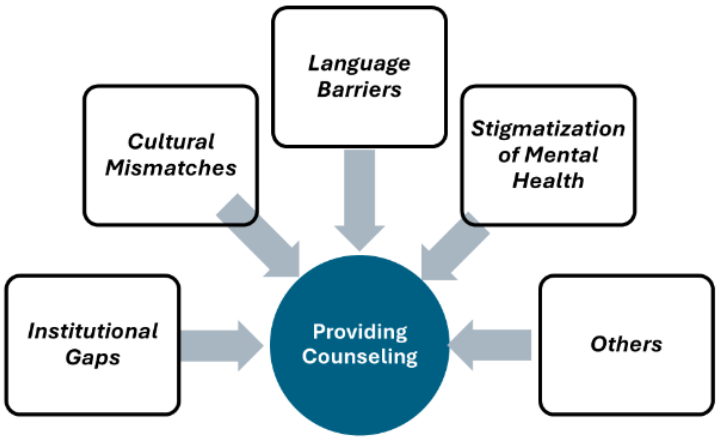
In the aspect of cultural and social integration, Anglophone universities generally have more diverse student bodies and established multicultural support services. Peer mentoring, international student associations, and mental health services are well-developed (Hyun et al., 2007). At non-Anglophone universities, international students often struggle with cultural and linguistic adaptation, and mental health support is less accessible due to stigma and resource limitations (Smith & Khawaja, 2011).

Regarding institutional support and counseling services, Anglophone universities seems to have more experience in handling international students has led to well-developed student support services, including multilingual counseling and academic support (Glass & Westmont, 2014). On the contrary, non-Anglophone universities often lack sufficient multilingual counselors and culturally responsive support structures (Sawir et al., 2007). However, initiatives like hybrid digital counseling (Elkhodr et al., 2024) are helping bridge this gap.

Key Challenges in Counseling for International Students

Figure 2 illustrates the key challenges faced by international students in counseling services, highlighting four primary obstacles: language barriers, cultural mismatches, mental health stigma, and institutional gaps. These are factors that we found to be major from literature, among other challenges, that collectively hinder students' access to effective mental health support and adaptation to university environments.

Figure 2
Challenges in Providing Counseling (by the authors)



Language Barriers

Language is a significant obstacle for international students (Kambouropoulos, 2015), impacting their ability to seek and receive counseling support (Williams et al., 2018). A lack of proficiency in the host country's language often deters students from accessing available mental health resources due to concerns about miscommunication, stigma, and misunderstanding of culturally specific expressions of distress (Sawir et al., 2007). Research indicates that international students who experience difficulty articulating their emotional and psychological struggles in a second language may be less likely to seek professional counseling (Smith & Khawaja, 2011). Non-Anglophone universities often lack sufficient multilingual counseling services, limiting accessibility for students with limited proficiency in both the local language and English (Hyun et al., 2007). While some institutions provide interpreters or bilingual counselors, these resources are often inadequate, leading to frustration and reduced engagement with mental health services (Arthur, 1997). Additionally, differences in linguistic structures and cultural communication styles can affect how mental health symptoms are conveyed and understood, further complicating the counseling process (Nam & Kim, 2025). Studies have also highlighted that in many Asian and European non-Anglophone universities, international students rely more on informal peer support rather than institutional counseling services due to language barriers (Glass & Westmont, 2014).

To address these challenges, institutions must implement proactive language-inclusive strategies, such as offering multilingual digital counseling platforms, training counselors in cross-cultural communication, and providing translated self-help materials tailored to international students' linguistic backgrounds (Liu et al., 2024). Without such measures, language barriers will continue to hinder the effectiveness of counseling services and the overall well-being of international students in non-Anglophone settings.

Japan has experienced a steady increase in international student enrollment, with government initiatives such as the *Global 30 Project* and the *Top Global University Project* (MEXT, 2021) aiming to attract more foreign students (Tran & Jin, 2022b). However, language remains a major barrier to effective counseling services for these students, as the majority of university mental health support is offered primarily in Japanese (Miller et al., 2019). While some universities provide English-speaking counselors, the availability of multilingual mental health professionals is limited, making it difficult for non-Japanese-speaking students to seek help (Kanehara et al., 2015). Research suggests that international students in Japan

often experience psychological distress due to academic pressure, cultural adaptation, and social isolation, yet hesitate to seek professional help due to linguistic and cultural barriers (An, 2022). Many students report struggling to express their emotional concerns effectively in Japanese, leading to frustration and disengagement from available mental health resources. A systematic review highlighted that communication difficulties in Japanese adversely affect mental health, creating stress in daily life and challenges in describing symptoms within medical settings (Miller et al., 2019). Similarly, a study found that foreign nationals residing in Japan are less likely to seek appropriate mental health services, with the lack of medical interpreters exacerbating their mental health conditions (Takubo et al., 2020). These findings underscore the critical need for enhanced language support and culturally sensitive counseling services to improve mental health access for international students in Japan. Furthermore, the Japanese tends to emphasize indirect communication and non-verbal cues, which may not align with the expectations of students from different cultural backgrounds, resulting in misunderstandings between students and counselors (Nadiger et al., 2024).

To address these challenges, some Japanese universities have begun implementing multilingual support systems, including AI-driven chatbots, online mental health platforms, and peer-led counseling services in English and other languages. For instance, the development of AI chatbots, such as “emol,” demonstrates the potential of digital solutions in providing mental health support (Fujita et al., 2025). Additionally, efforts to train university counselors in cross-cultural psychology and improve collaboration with international student offices have been suggested as crucial steps in bridging the counseling gap (Kanehara et al., 2015). However, there is still a significant need for systemic improvements to ensure that international students in Japan have equitable access to effective and culturally competent mental health services.

Cultural Mismatches

Cultural differences between counselors and international students can lead to misunderstandings and ineffective support (Smith & Khawaja, 2011). Many counseling models used in higher education institutions, particularly in Western countries, are rooted in individualistic frameworks that emphasize personal autonomy, self-expression, and open discussion of emotions (Arthur, 1997). In contrast, students from collectivist cultures—such as those from many Asian, African, and Middle Eastern societies—may be more accustomed to prioritizing family expectations, social harmony, and indirect communication in their problem-solving approaches (Triandis, 2001; Yeh & Inose, 2003). This misalignment can cause discomfort for international students when engaging in counseling, as they may feel that expressing personal struggles openly contradicts their cultural norms regarding privacy and emotional restraint (B. S. K. Kim et al., 2001).

A study found that Asian international students in the United States were significantly less likely to seek counseling services compared to domestic students (Mori, 2000), partly due to concerns about cultural mismatches and a perceived lack of understanding from Western-trained counselors. Many international students studying in Australia expressed dissatisfaction with counseling approaches that lacked cultural sensitivity, leading to reduced engagement with mental health services (Sawir et al., 2007). Additionally, cultural differences in the perception of mental health itself may prevent some students from seeking support. In many Asian and African cultures, mental distress is often associated with social or spiritual issues rather than psychological conditions, making Western-style counseling less relevant or even stigmatizing (Hyun et al., 2007; Wong & Hyde, 2024).

To bridge this cultural gap, universities must invest in training counselors in cultural competence, equipping them with the skills to navigate diverse value systems, communication styles, and help-seeking behaviors (Sue et al., 1998). Research suggests that the use of culturally adapted counseling frameworks—such as integrating family-based interventions or incorporating collectivist perspectives into therapy—can improve the effectiveness of mental health support for international students (Nam & Kim, 2025). Furthermore, universities can enhance peer support networks, recruit bilingual and culturally diverse counselors, and provide psychoeducational workshops that address mental health from a culturally inclusive perspective (Glass & Westmont, 2014). Without such efforts, the risk remains that cultural mismatches will continue to deter international students from seeking essential psychological support, exacerbating issues related to academic performance and personal well-being.

Stigmatization of Mental Health

Stigma surrounding mental health is prevalent in many cultures, discouraging international students from seeking help. A study found that approximately 44% of international graduate students reported experiencing an emotional or stress-related problem that significantly affected their well-being or academic performance within the past year, yet many did not seek counseling services (Hyun et al., 2007). This reluctance is often rooted in cultural beliefs that perceive seeking psychological help as a sign of weakness or failure, leading to self-stigmatization and fear of disclosure. Additionally, a lack of awareness about available counseling services exacerbates this issue. Research indicates that international students who are unaware of counseling services experience higher levels of academic stress and poorer psychological adaptation compared to those who are informed about such resources (Nina, 2009; Zeng et al., 2023). These findings highlight the critical need for universities to promote mental health awareness and destigmatize help-seeking behaviors among international student populations. These campaigns can provide accurate information about mental health conditions and available support services, fostering a more supportive environment (Withers et al., 2022). Establishing peer support networks can encourage students to share experiences and seek help without fear of judgment. Offering culturally sensitive counseling services that respect diverse backgrounds can encourage international students to utilize mental health resources. Training counselors in multicultural competencies ensures they are equipped to address the unique challenges faced by these students (N. Kim et al., 2019). Implementing regular mental health screenings and promoting self-management strategies can help in early identification and intervention of mental health issues. Providing tools and resources for self-care empowers students to take proactive steps toward their well-being (Withers et al., 2022). Moreover, online platforms that offer mental health information and virtual counseling can provide anonymity and flexibility, making it easier for students to seek help.

Institutional Gaps

Many universities lack the infrastructure and resources to adequately support international students, leading to significant institutional gaps. These deficiencies include insufficiently trained counselors, inadequate outreach programs, and the absence of culturally relevant resources (Sawir et al., 2007). A study highlighted that despite repeated calls to action, counselors often feel unprepared to support international students in the US. This lack of preparation can be attributed to limited training in multicultural competencies within counseling programs, leading to inadequate cultural competence when working with diverse student populations (Anandavalli et al., 2020). Furthermore, a recent study emphasized the

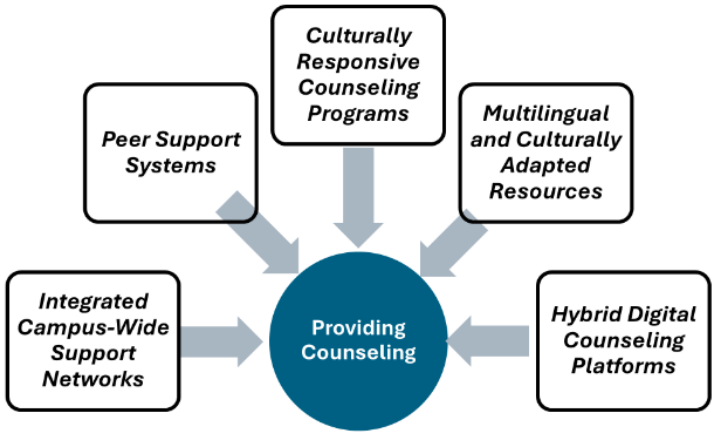
importance of mental health professionals' multicultural self-awareness and the need for diverse and culturally competent staff as key components of inclusive mental health services for international students. The findings suggest that universities should prioritize training for professionals, incorporate diverse approaches, ensure confidentiality, encourage active faculty participation, and provide suitable physical environments to enhance the quality of mental health support for international student populations (Sakız & Jencius, 2024). Research indicates that international students often remain unaware of available counseling services due to ineffective outreach efforts (Hyun et al., 2007). The lack of culturally tailored counseling services poses a barrier to effective mental health support for international students. Cultural differences in beliefs about mental health and unfamiliarity with counseling concepts can hinder international students from utilizing available services (Mori, 2000), suggesting that universities should develop resources that resonate with the diverse cultural backgrounds of their student populations (Kambouropoulos, 2015).

Strategies for Non-anglophone Universities

Non-Anglophone universities face distinct challenges due to resources and linguistic diversity. Best practices from Anglophone institutions, such as integrating digital counseling platforms and peer mentorship programs, can be adapted to address these gaps (Figure 3). Additionally, non-Anglophone universities, including universities in Japan must prioritize developing culturally relevant resources and training programs tailored to their specific contexts.

Figure 3

Proposed Strategies (by the authors)



Culturally Responsive Counseling Programs

Implementing culturally responsive counseling programs is aiming to effectively support their diverse student populations (Sue et al., 1998). Training counselors in cultural humility and region-specific mental health practices enhances their ability to address the unique challenges faced by international students. Cultural competence training effectively shifts attitudes, increases knowledge, and develops the skills of mental health providers, thereby improving service delivery to culturally diverse clients (Chu et al., 2022). Japanese universities are increasingly recognizing the importance of culturally responsive counseling to support their international student communities. E.g. Rikkyo University offers various support services tailored for international students, including English-speaking resident supporters and a buddy system to assist with academic and daily life (Rikkyo University, 2024). However, challenges persist in fully integrating culturally responsive counseling

practices across all institutions. Universities should prioritize training for professionals, incorporate diverse counseling methods, ensure confidentiality, encourage active faculty participation, and provide suitable physical environments to enhance the quality of mental health support for international student populations.

Peer Support Systems

Implementing peer mentorship programs can enhance the well-being and integration of international students. These programs offer guidance, foster a sense of belonging, and mitigate feelings of isolation, thereby improving mental health outcomes (Glass & Westmont, 2014). Peer mentorship programs help alleviate feelings of loneliness and alienation among international students by connecting them with experienced peers who provide support and understanding during their transition to a new academic and cultural environment (Grew, 2024). Mentors assist international students in navigating academic challenges, including understanding course requirements, developing effective study strategies, and managing time efficiently, which can lead to improved academic performance. E.g., the University of North Dakota's International Peer Mentor program is designed to assist incoming international students in adapting to a new environment and academic system (UND, 2024). Engaging in peer mentorship fosters cross-cultural communication skills and intercultural understanding, benefiting both mentors and mentees by broadening their perspectives and enhancing their ability to interact effectively in diverse environments (Grew, 2024).

Multilingual and Culturally Adapted Resources

Providing multilingual and culturally adapted resources is essential for ensuring that international students can access and relate to mental health support services effectively. Translated self-help materials and culturally relevant case studies enhance accessibility and relatability, thereby improving mental health outcomes for these students. Offering mental health resources in multiple languages ensures that international students can comprehend and utilize the information effectively, reducing language barriers that might otherwise prevent them from seeking help. Incorporating culturally relevant case studies and examples makes mental health materials more relatable to international students, fostering a deeper understanding and connection to the content. Culturally adapted mental health interventions are associated with significant improvements in depression and anxiety symptoms among young people. This suggests that tailoring resources to align with students' cultural contexts can lead to more effective mental health support (Mishu et al., 2023).

Non-Anglophone universities should prioritize the development and dissemination of multilingual and culturally adapted mental health resources. This includes translating into the languages commonly spoken by their international student population and incorporating cultural nuances into case studies. By doing so, universities can create a more inclusive and supportive environment that acknowledges and respects the diverse backgrounds of their students, enhancing their well-being and academic success.

Integrated Campus-Wide Support Networks

Establishing integrated campus-wide support networks is crucial to effectively support international students (Sakız & Jencius, 2024). Collaboration among academic, administrative, and counseling services fosters a holistic support system that enables the proactive identification and assistance of at-risk students (Arthur, 1997). Regular interaction

among faculty, administrative staff, and counseling services ensures that concerns regarding a student's well-being are promptly addressed. This integrated approach facilitates timely interventions and support. By uniting various campus services, universities can offer a seamless support experience that addresses academic challenges, mental health concerns, and social integration issues concurrently. An integrated network allows for the monitoring of student performance and behavior across different settings, enabling the early detection of students who may be struggling and the provision of necessary support (Martirosyan et al., 2019).

Japanese universities are increasingly acknowledging the importance of integrated support systems for international students. E.g. the University of Tokyo has implemented initiatives to support international students, such as providing information on daily life, academic support, and counseling services. These efforts aim to create an inclusive environment that addresses the diverse needs of international students.

Hybrid Digital Counseling Platforms

Leveraging technology through hybrid digital counseling platforms, including multilingual digital platforms and AI-driven tools, offers accessible and flexible mental health support for international students. These tools address barriers such as time constraints and stigma associated with seeking traditional in-person counseling services (Liu et al., 2024). Digital platforms enable students to access mental health resources at their convenience, accommodating varying schedules and time zones. This flexibility is particularly beneficial for international students who may face challenges in accessing on-campus services. E.g. Joy Mental Fitness offers online counseling services specifically designed to meet the diverse needs of international students, providing a flexible and accessible means of addressing their mental health concerns (Joy, 2024). AI-driven tools can provide anonymous support, allowing students to seek help without fear of judgment. This anonymity can encourage individuals who might otherwise be reluctant to engage with mental health services. Platforms like Wysa, an AI-powered personal coach, offer support for managing stress, improving sleep, and working through tough situations, thereby addressing mental health needs while mitigating stigma (Wysa, 2024). AI-driven platforms can monitor user interactions to identify signs of distress and provide timely interventions. E.g. the ChatPal chatbot offers psychoeducational content and exercises such as mindfulness and breathing, mood logging, gratitude, and thought diaries, supporting users in managing their mental health proactively (Wysa, 2024).

Non-Anglophone universities can integrate hybrid digital counseling platforms to enhance mental health support for international students. By adopting AI-driven mental health companions like Earkick, which uses real-time biomarker analysis and a multi-modal large language model companion for mental health support, universities can provide personalized and culturally sensitive support to their diverse student populations (Earkick, 2024).

Conclusion

International students face unique challenges in non-Anglophone universities that require tailored counseling approaches. This paper highlights key issues and presents evidence-based strategies to enhance counseling services. By adopting culturally responsive, technologically innovative, and integrated support systems, universities can foster inclusive environments that promote the well-being and success of international students.

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Nurturing Life Skills Among Children

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Abstract

The early years of a human life serve as a foundation for the whole life. The role of adults is pivotal in shaping not only their child's academic success but also in instilling essential life skills. The early nurturing process becomes a key factor for children to acquire crucial skills that will aid them in navigating the complexities of life. The study aim to evaluate life skills development of 6 to 8 year old children in Nagarjuna Municipality Ward No. 2. Among the total population of children aged 6 to 8 years, 73 children were selected for the study through the purposive sampling method. The assessment questionnaire has been prepared with reference to The Life Skills Education for Children and Adolescents in Schools, Geneva. The validity score of the questionnaire is 0.8367. The assessment focused on enhancement of psycho-social competence, which includes the four major areas: Decision-making and Problem solving, Creative thinking and Critical thinking, Communication and Interpersonal Relation, Coping with Emotion and Stressors. Among the total study population 76% of children have the ability to solve age appropriate problems. Similarly, only 41% of children are able to create new ideas, 47% of children could analyze the different situations in the classroom, 74% of children easily participate in different activities, and 86% of children express their emotions. Life skill training from the early years supports to development of interpersonal relations, coping with emotions, decision-making and problem solving skill was key finding of the study.

Keywords: life skill, independent, development, creative thinking, communication and Interpersonal relation, psycho-social competence

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Introduction

Early years of a human life serves as a foundation for the whole life. Life skills are fundamental for finding the direction to adjust in complexity of various situation of life. Life skill help children to maintain social connection, problem solving skill, creativity (Rout et al, 2024). Life skill development characterized by the practical, social, emotional and mental health development in children (Devis, 2023). Life Skill includes critical thinking, intrapersonal and interpersonal qualities necessary for children and adolescents to live productive and satisfying life (Olsson, 2024). These skills are essential support to fill the gap between real life experience and academic education. According to United Nation Children's Fund UNICEF (2019), life skill is a psychological and interpersonal skills that generally considered as essential for a human life (UNICEF, 2019). In this regard, World Health Organization (WHO) has different definition of life skill development. According to WHO, it is a skill to be flexible with positive behavior to enable to deal with the different challenges of everyday life (Ash, 2023). Developing life skills among the children help them to live independently, build leadership, and adjust in society (Sharma, 2021). According to Dr. Roma Kumar, a Clinical Psychologist, "Life skill training develop a sense of responsibilities as good citizen, who protect their surroundings. It assists children to build self-confidence and effectively coping with major life transitions and problems such as bullying and prejudice" (Sharma, 2021). UNESCO, UNICEF and WHO identified some essential life skills such as self-awareness, empathy, critical-thinking, creative-thinking, decision-making, problem solving, effective-communication, interpersonal relationship, coping with stress and coping with emotion (Ash, 2023). In this fast-paced life, it is critical to practice life skill activities beyond standard academic learning. Role of adult is pivotal in shaping not only their academic success but also in instilling essential life skills. The early nurturing process becomes a key factor for children to acquire crucial skills that will aid them in navigating the complexities of life (Wahi, 2022). During these years, life skills education has been found to be essential in school education. Including life skills education in day-to-day activities may help them work with the challenges of life. Teaching children to communicate in groups may develop their leadership personalities (Kirchhoff & Keller, 2021). Day-to-day theoretical and practical activities can enhance in development of life skill of children. Parents, teachers and care giver can plan different activities for the development of life skill among children. 21st century education system has been identified as a process of life skill development among children (Torkos & Bernadett, 2020). Involving children in different household activities may support them to develop life skills. During cooking meal, children can help in washing vegetables, mix ingredient and cooking with supervision. Similarly, children could be involved in gardening and other household chores, through which the children can learn life skills (Rodriguez, 2016). The life skill development has based on psycho-social competence, which includes the four major areas: Decision-making and Problem solving, Creative thinking and Critical thinking, Communication and Interpersonal relation, Coping with emotion and Stressors (WHO 1997). Decision making and problem solving relate to the ability to select various possibility with understanding the problems of situation. Critical thinking refers to the ability to think analytically and logically about anything and any situations. Similarly, creative thinking is to innovate new ideas and produce primary aspects. Interpersonal relation is the quality of building relationship (Ash, 2023). Psycho-social competence is ability of individuals to cope with the obstacle of daily life (Manjunatha & Saddichha, 2011). However, recent studies have focused on life skill development but very few studies have focused on psycho social competence in Nepal. Life skill practices are very essential for human development but in this digital era life skill practices are overlooked and

avoided due to the extreme dependence on technology, reduced social relation and interactions, and limited practices on experiential learning.

Research Questions

The study was concentrate to identify the life skill development of children of age 6 years to 8 years. Thus to fulfill the inquiry it focus on some questions.

1. How do the children demonstrate decision making and problem solving skill in class room setting?
2. How do children participate and interact during group activities in the classroom?
3. How role do the parents and teachers play in the development of life skills among children?

Objectives

The study aim to assess the life skills development among the children with aged 6 to 8 years.

- To examine the ability of decision making and problem solving skill in class room setting.
- To assess the level of children's participation in interaction during group activities.
- To identify the role of parents and teachers in the development of life skill among children.

Literature Review

Life skills are important in the formation of personality development because they influence a person's ability to effectively navigate personal, social and professional domains. It is essential in personality development because it empower individuals with the resources they need to handle various elements of life efficiently. The review has been done to identify the recent studies and their outcomes on importance of life skill development in childhood and early adolescents. It has concentrated on different domains of the previous studies.

The Magic Box India Foundation introduce a program on life skill with the objective to enhance to develop complete secondary education, secure job, and build bright future. This program is also called Childhood to Livelihood. The main purpose of the program is to develop life skill among the children with age 11 to 15 years. In 2019, a study was conducted in Indonesia with the goal of developing life skill curriculum model. The objective of the model was to support facilitators intervene in activities for children of early childhood period. The result of the study found that the method of teaching life skill should be play-way method. Therefore the model was based on creative learning and work based activities (Nurani & Pratiwi, 2019).

Preschool Life Skill Program is a program based on Trauma Informed Frame-work, which is focused on the children who are significant trauma history. The researcher believed that the life skill program can support the children having trauma history. The purpose of the study is to analyse specific preschool life skill curriculum for two boys, who had experienced significant trauma and to illustrate how the preschool life skill program may be provided within the trauma informed frame-work. The evaluation was conducted in a one-on-one setting in a UK-clinic and also in home by parents. The result of the study was identified that both boys learnt skills, however the development was occasionally erratic. The result indicated that both boys enjoyed the activities but less in overall advantages of the program.

The study found that the parents were satisfied with the program, that they found improvement in household activities (Rees et al., 2024).

An analytical study on effect of the program among the children identify that the consistence practices significantly develop participants' school attendance, ambition and socio-emotional skills. This program improves educational and socio-emotional outcomes among the early adolescents (Tagat et al., 2025). Socio-emotional development is essential during adolescents. Identifying the necessity of the situation, World Health Organization (WHO) and United Nation Children's Fund (UNICEF) initiate a program Helping Adolescents Thrives (HAT) to emphasis on developing adolescent's socio-emotional life skill. The major objective of this program is to reduce suicide rate of adolescents. In collaboration of UNICEF, WHO, Save the Children and Mental Health Psychosocial Support develop a training program "I Support My Friends" for children and adolescents to teach how to support a friend in stress with encouragement and supervision of trusted adults (WHO & UNICEF, 2021).

There are number of studies conducted life skill development but very few studies have concentrated on domains of psycho-social competence. There is lack of researches on life skill in Nepal. Regarding this, there is significant need of study on life skill development.

Methodology

The current study intend to collect data on developmental status of children of 6 years old to 8 years old, using four primary areas of psycho-social competence with reference of The Life Skills Education for Children and Adolescents in Schools, Geneva, WHO (WHO, 1997). Thus the study based on four domain model; Decision making and Problem solving, Creative thinking and Critical thinking, Communication and Interpersonal relation, Coping with emotion and Stressors. The assessment was conducted using 5 point rating scale.

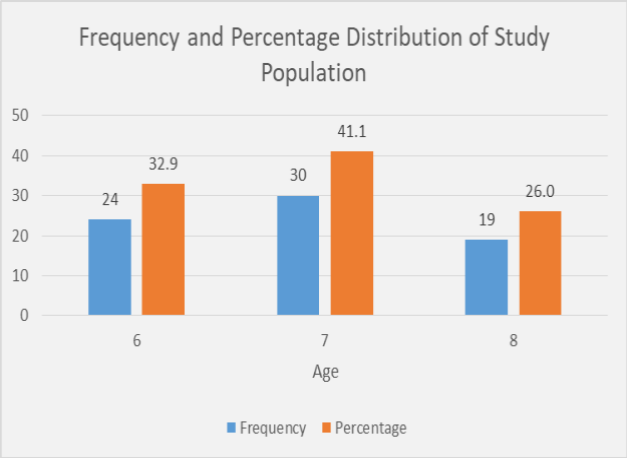
Study Design

A descriptive and cross-sectional study design was adopted for the investigation. A qualitative method was employed to identify the key findings of the study. A case study was analyzed to find the deeper insight of the study. The case study included the child's history and current practices.

Study Area

The Nagarjun Municipality ward no. 2 from Kathmandu valley was chosen as a study area. Nagarjuna Municipality located at the center of Kathmandu Valley, which has undergone diverse urbanization from different part of Nepal. Three schools from this municipality are selected to find the study population. Among the three schools, two schools are pre-school and one school is elementary school. These three schools are located in same ward. The data has been analyzed through the statistical analysis on SPSS software and a case study. The sample size was determined using purposive sampling method with 73 children from three different schools. The study population consist of aged 7 (N = 30; 41%), 6 years (N = 24; 33%), and 8 years (N = 19; 26%).

Figure 1
Study Population



The assessment was done through 21 questions based on four domains of psycho-social competences of life skill. The validation of the questionnaire was done through conducting pilot testing among 25 children of age 6 years. The validation score was 0.873 and calculated through Cronbach's Alpha. Simultaneously the validation was approved by Central Department of Home Science Tribhuvan University.

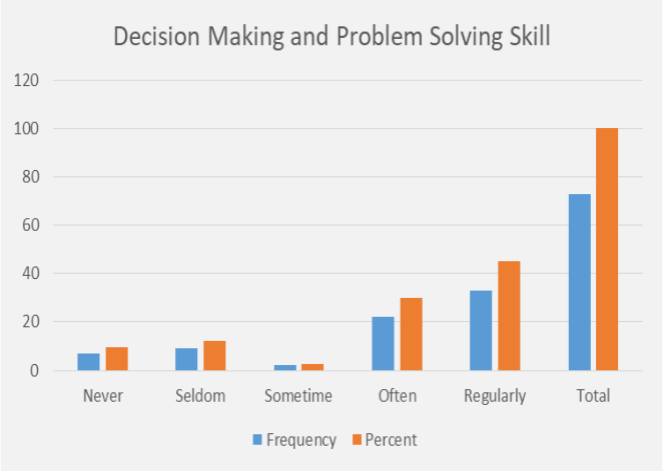
Result

The result of the study has demonstrated the importance of life skills during the early stage. Regarding the result the data was analyzed on the four domains of psycho-social competence of life skill.

Decision-Making and Problem Solving

The result of the assessment on problem solving and decision making, 30% of children often shows ability to make decision and solve problems during the classroom activities and 45% of children regularly have ability to solve the age appropriate problems from total population (N = 73).

Figure 2
Decision Making and Problem Solving Skill



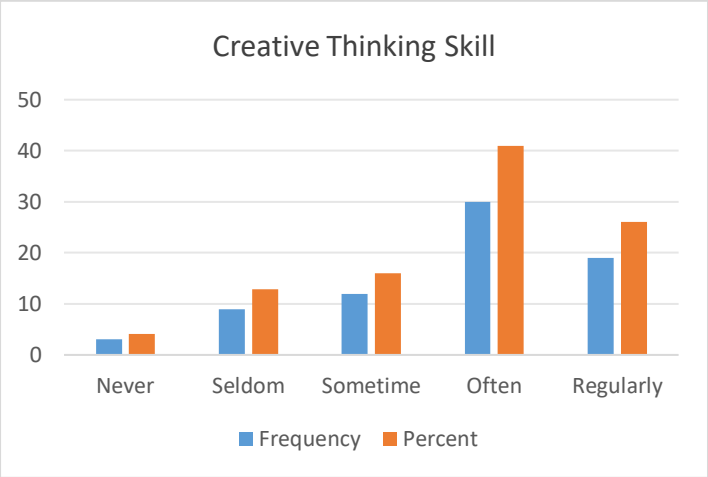
In the cumulative calculation 76% of children have ability to solve the problems as well as participate in decision making activities.

Creative Thinking and Critical Thinking

The creative thinking and critical thinking assessment have done in two different aspects including different assessment questions. It has been focused on their creative skills such as decorating pictures with different colour, create new structures with blocks and loose part materials. The result of the assessment has been presented in Figure 3 below.

Figure 3

Distribution of Creative Thinking Skill

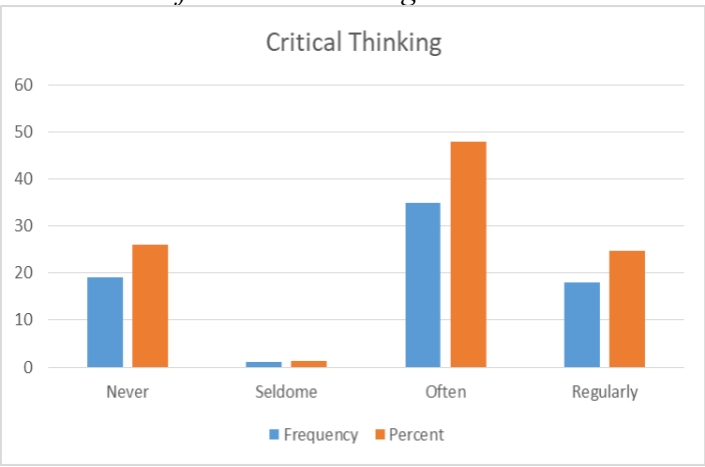


The result has presented that 41% of children frequently demonstrate their creative skills. However, some children occasionally participate in creative activities, the result has been presented the rate of higher percentage.

Simultaneously, the assessment has done on the critical thinking skills. Among the entire population (N = 73), 47% of children often completed the critical thinking activities. The set of activities include regular activities such as tie up shoe lace, age appropriate critical word puzzles.

Figure 4

Distribution of Critical Thinking Skill

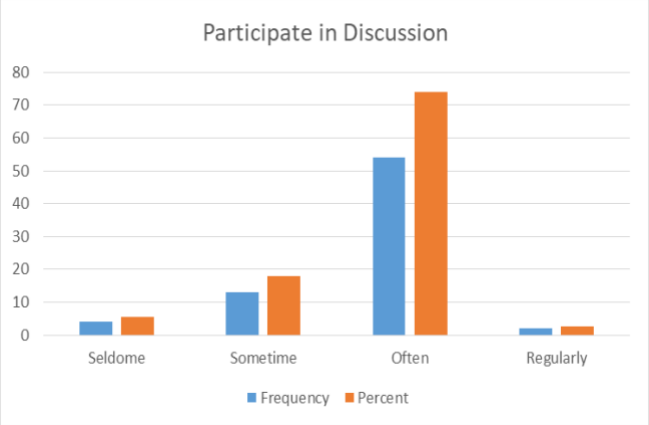


Communication and Interpersonal Relation

Development of communication skill is essential for early stage. Thus the assessment has been conducted on communication and interpersonal relation area.

Figure 5

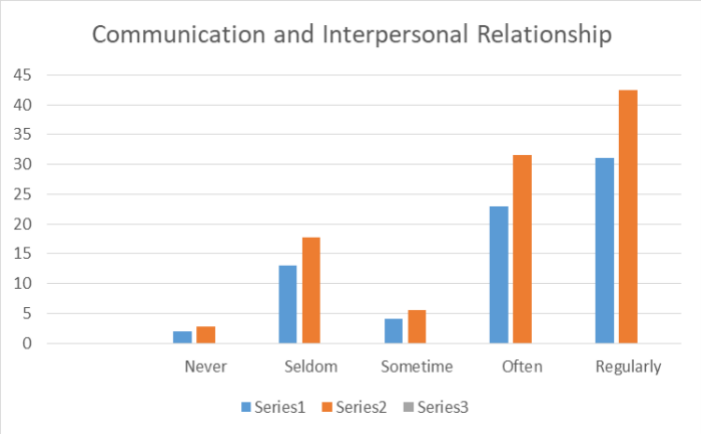
Rate of Frequency and Percentage of Children Participate in Discussion



The result has identified that the 74% of children often participate in group discussion.

Figure 6

Communication and Interpersonal Relationship

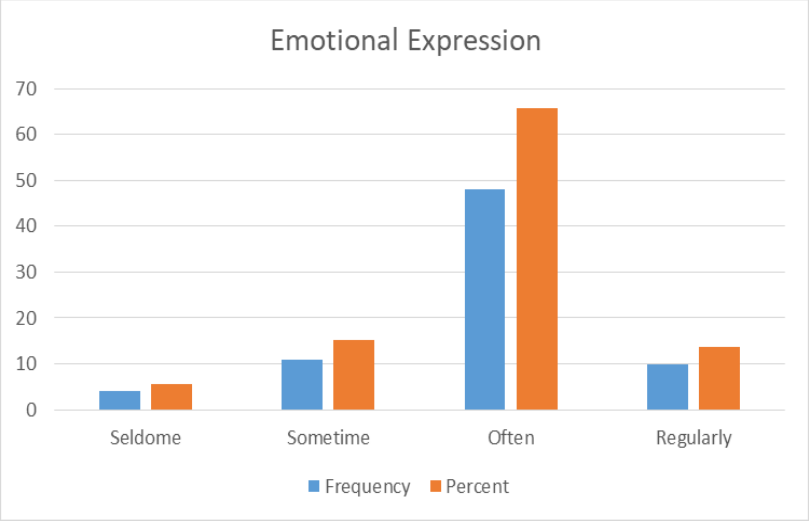


The figure above depicts the findings of the communication and interpersonal relationship assessment. These findings demonstrate that the higher percent (42%) of children express their feelings toward their teachers.

Coping With Emotions and Stressors

Emotional development is essential in the early stages. The children should be able to cope with their emotional age appropriately. Regarding this the present study try to identify the ability of coping emotional during the class room activities.

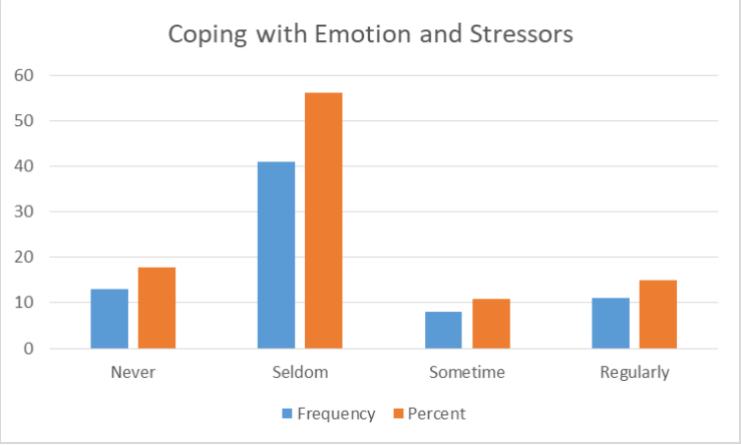
Figure 7
Level of Emotional Expression



The result of the study identified that the greater percentage of children often express their emotion during the different situation in the classroom.

Simultaneously, the current study attempted to determine the level of coping with emotion and stress. It has been assessed by the observing behavior during the classroom activities and gathering input from teachers. Since the emotional behavior cannot be measured in descriptive analysis the researcher obtained the information from teachers and conducted the observational assessment.

Figure 8
Coping With Emotion and Stressors



The result of the study found that the higher rate of study population are unable to cope with stress and emotional behavior.

Case Study

The case study was emerged when the researcher noticed that a child was unable to complete an age-appropriate task of life skill competence. The researcher investigates through the teacher's interview to analyse the case history.

Rima (her name has changed) is 6 years old and in grade UKG. During the assessment, she was unable to tie her shoelaces or button her shirt. In each task she seeks for the teacher's assistance. She hardly complete a few tasks. Her teacher indicated during the interview about her case that her progress in this area is slow owing to a lack of practices both at home and at school. She is gradually developing after the discussing with her parents and regular practices at home and at school in day to day activities.

This case study demonstrate that the regular practice can support the development of life skill of a child. Similarly, in collaboration of household activities and school activities plays major role in holistic development of a child.

Conclusion

The study conclude that the life skill development is essential during early years. This enable to navigate the complexity of different situation of life. It supports to be independent, emotionally strong. It is the foundation of personal and social development. Nurturing life skill during the early years is significantly essential for all children. The four domains of psycho-social competence can be a major factors of life skill development.

The result of the study identified that the child who regularly involved in life skill activities are significantly developed, whereas the child who has not got the opportunity to participate in life skill activities are unable to complete the task.

The involvement of teachers and parents is critical in involving children in day to day life skill activities. The collaboration between school teachers and parent to support children, can have a impact on their development.

Recommendation

The present study recommend that there should be more research on life skill development during early years. The caregivers and parents should plan to involve child in day to day life skill activities. Parents and teachers should encourage their children to practice life skill activities. 21st century skill based curriculum should be applied in each educational institute.

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Development and Evaluation of Teaching Materials for University Students on Biodiversity Conservation: A Case Study

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Abstract

Biodiversity, the foundation on which we live, is threatened by the negative impact of human activities on nature. It has been pointed out that in order to improve the current situation, each of us needs to change our way of thinking and behavior. We have therefore developed a curriculum for this purpose. This case study aimed to achieve two main objectives: (1) to develop and evaluate a curriculum (aimed at university students aspiring to become childcare and primary school teachers in Japan) to promote knowledge acquisition and behaviour change in biodiversity conservation; and (2) to examine its international versatility by implementing and evaluating the curriculum for Turkish and Indonesian to implement and evaluate the curriculum with university students. The sample for this study consisted of (1) 126 university students from four Japanese universities, (2) 22 university students from one Turkish university and 20 university students from one Indonesian university. The results of the evaluation by the Japanese class participants revealed that the curriculum stimulated interest and understanding of biodiversity conservation and triggered behavioural change. Evaluations in Turkey and Indonesia showed similar results, with Turkey revealing that it provided an opportunity to deepen awareness of the nature of science. This curriculum could be made internationally useful by adapting it to take account of local realities.

Keywords: biodiversity conservation, university students, curriculum development

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Introduction

Biodiversity, the foundation on which we live, is in crisis due to the negative impacts of human activities on nature. However, none of the 20 individual targets in the Aichi Biodiversity Targets 2011-2020 has been fully achieved, and the successor Kunming-Montreal Biodiversity Framework has reiterated targets to reduce threats to biodiversity in order to realise a world in harmony with nature (UNEP, 2022). Species and gene conservation and measures against invasive alien species are examples, but the values and behaviours of society have been identified as the underlying causes of these problems (IPBES,2019). In other words, changing our thoughts and behaviours is essential to improve the current situation. Education and awareness-raising is one of strategies, and pre-school and primary school education is no exception. If teachers have the right knowledge and mindset and take action towards conservation, they will have an impact on children, directly and indirectly. The development of educational programmes for students who will be responsible for this practice in the future has been cumulative, and our attempt is a continuation of this.

The study developed a curriculum based on the results of a survey on biodiversity conservation among Japanese students who wanted to become nursery and primary school teachers (Doi et al., 2022) and evaluated whether the curriculum provided class participants with the opportunity to acquire knowledge and change their behaviour regarding biodiversity conservation.

Our research has 2 objectives. The first is to develop and evaluate a curriculum (aimed at university students who want to become nursery and primary school teachers in Japan) to promote knowledge acquisition and behaviour change in relation to biodiversity conservation. And secondly, to implement and evaluate the curriculum with university students in Turkey and Indonesia to test its international generalisability.

Method

The curriculum was developed based on the findings of Doi et al. (2022) and the benefits of treating the science-related content and its social impact as a series of interlocking narratives as noted by Levinson (2009). It is in an interactive lecture format with slide material developed in PowerPoint. The slides were based on the importance of “future thinking” and its elements (picturing, predicting and planning) (Ardh & Fujii, 2022) and the theoretical ladenness of observation (Hanson, 1958) in order to become “shapers of a sustainable society”, The following content and sequence was used. (1) What is biodiversity? (2) Four crises that threaten it, (3) What are alien species? (4) Examples of alien species causing unexpected situations (Mongoose in Japan), (5) Merits and Demerits of Agriculture, (6) Examples of insecticides causing unexpected situations (Lake Shinji, Japan), (7) Impacts on biodiversity from “deforestation of tropical rainforests”, “burden from livestock farming” and “burden from cultivation of single crops”, (8) Collapse of the ecosystem pyramid due to the increase in human presence, (9) the question: can we abandon our convenient and comfortable lifestyles?

Curriculum evaluation was carried out by analysing class participants' responses (Japan 126, Turkey 22, Indonesia 20) to the questionnaire. Choice responses were asked for using the five-choice method. Open-ended responses were analysed and evaluated using after-coding. It was conducted and reviewed by the first and fourth authors to establish reliability.

Results

The choice answer questions were as follows; (i) I felt the importance of thinking critically (ii) I felt the importance of predicting the future, (iii) I felt the importance of thinking about connections, expansion, and relationships with other regions, including foreign countries, (iv) I felt the importance of not losing "bio-diversity", (iv-1) I felt the importance of not losing "genetic diversity", (iv-2) I felt the importance of not losing "species diversity", (iv-3) I felt the importance of not losing "ecosystem diversity", (v) I realized that agriculture has a big impact on the environment, (vi) I felt that there is a big connection between preserving biodiversity, our economic activities, and human society, (vii) There were connections between living things that I didn't know about until I took the class, and (viii) I felt an aspect of science (e.g., pesticides deprive organisms other than specific species of habitat) that I didn't know about until I took the class. Responses were requested using the five-case method (5– Extremely Likely; 4– Likely; 3– Neutral; 2– Unlikely; 1-Extremely Unlikely). The open-ended questions were (A) what you, as a citizen, can do on a daily basis to conserve biodiversity, (B) impressions, questions and things you would like to know more about after taking this class. The results of responses to the choice questions are presented Table 1.

Table 1

The Results of Responses to the Choice Questions (percentage of 5s and 4s)

	JPN	TUR	IDN
(i) thinking critically	93.6	100	85
(ii) predicting the future	100	90.9	80
(iii) relationships with other regions	100	86.3	90
(iv) not losing "bio-diversity"	98.4		95
(iv-1) not losing "genetic diversity"		81.8	
(iv-2) not losing "species diversity"		90.9	
(iv-3) not losing "ecosystem diversity"		100	
(v) agriculture has a big impact	96	90.9	90
(vi) our economic activities and society	97.6	100	95
(vii) connections between living things	94.5	77.3	60
(viii) aspect of science	92.1	72.7	65

Source: Original research results

More than 95% of respondents in all countries selected "the main relevance of environmental issues to our society and economy", and more than 90% in all countries selected "the importance of not losing biodiversity" and "the main impact of agriculture on the environment".

The results of the free text responses are as follows. The results of the after-coding of students' responses to comments, questions and what students would like to know more are presented in Table 2.

Table 2

The Results of the After-Coding of Students' Responses to Comments, Questions and What Students Would Like to Know More

JAPAN		TURKEY		INDONESIA	
Transformation of consciousnes Deepening of awareness	44	The relationship between science and society	14	environmental problem	14
Interesting learning experiences	38	Personal Growth	8	biodiversity	12
Importance of biodiversity / ecosystems	36	environmental awareness	8	awareness-raising activities	7
introduced (non-native) species	27	Changing perspectives	6	Role of the individual	3
Human impact	18	biodiversity	5	plastic waste	2

Source: Original research results

There were differences between countries in terms of comments, questions and what they wanted to know more about. Japanese students were significantly more likely to comment on non-native species (There were scattered comments on this among Turkish students, but none among Indonesian students.). Turkish students were significantly more likely to comment on the nature of science, such as the relationship between science, technology and society. Indonesian responses were mostly questions (often about environmental issues, especially those related to plastics). On the other hand, a commonality was found in the Japanese and Turkish responses. It was the joy of gaining new knowledge and previously unthought-of new perspectives, and an awareness of the deepening of one's own awareness, described by a large number of students.

The results of the after-coding of students' responses on what could be done in daily life are shown in Table 3.

Table 3

The Results of the After-Coding of Students' Responses on What Could Be Done in Daily Life

JAPAN		TURKEY		INDONESIA	
Avoiding environmental impact in daily life	57	Raising awareness and updating knowledge	19	Avoiding environmental impact in daily life	17
Raising awareness and updating knowledge	32	Avoiding environmental impact in daily life	11	Take action	2
keep and cultivate living things until the end of their lives	17	Take action	10	Do not kill a living things unnecessarily	1
Do not kill a living things unnecessarily	15	Social reforms	7		
Take action	5	Focus on education	3		

Source: Original research results

"Avoiding environmental impacts in daily life" and "Take action" were common categories across the three countries (with some differences in description). The more common responses from Japan and Turkey were "Raising awareness and updating knowledge". The most common statements in Japan alone were "keep and cultivate living things until the end

of their lives" and "do not kill living things unnecessarily". The latter was also mentioned once in Indonesia. The most common statements in Turkey alone were "Social reform" and "Focus on education".

Discussion

The analysis of the optional responses from three countries (Japan, Turkey, and Indonesia) shows that the lessons raised students' awareness of the interconnectedness of environmental issues, human society and the economy, as well as the significant impact of agriculture on the environment. More than 90% of the responses were positive, highlighting their awareness of agriculture's environmental impact and their commitment to reducing biodiversity loss. On the other hand, "the importance of thinking critically and predicting the future" item was answered positively by more than 90% of the respondents in Japan and Turkey, while the figure was slightly lower in Indonesia. In addition, the percentage of positive from Indonesia for question vii (There were connections between living things that I didn't know about until I took the class) and viii (I felt an aspect of science that I didn't know about until I took the class) are significantly low. This fact suggests that the contents of this material was a mismatch for Indonesian students.

The analysis of the open-ended responses is described below.

Analysis of "Thoughts, questions and things you would like to know more about" item shows that this lesson was very interesting for both Japanese and Turkish students as they were pleased to have gained new knowledge and perspectives. However, these students' perceptions were not the same. Many of the Japanese students focus on their own behaviour, saying "I thought that small daily actions lead to biodiversity conservation", "I wanted to know more deeply about the advantages and disadvantages of agriculture" and "I thought that perhaps we need to consider whether insects should be easily killed". On the other hand, Turkish students' statements were based on the "nature of science", such as "I realised how comprehensive science is" and "In the future I will pay more attention to the relationship between science and society and give it more importance". On the other hand, the Indonesian students' questions (e.g., about deforestation and plastic waste) do match with the country's specific socio-scientific context. Questions such as "How can we protect nature at a time when many industries are clearing forests for business?", "Can we completely eliminate plastic waste from Indonesia?" indicate the need of change to adapt materials and develop localized curriculum like suggested by Oludipe (2011) and Caballero-Serrano et al. (2017).

There were also some country-specific characteristics in terms of what could be done in daily life. Japanese respondents focus on keeping and cultivating due to the unique Japanese culture in which it is extremely common to see breeding cases lined up in the back of primary school classrooms for the continuous rearing and observation of insects and small fish, and people of all ages enjoy rearing insects from larva to adult. This aligned with previous studies, such as Schachat (2015), "positive perceptions of insects in East Asia have influenced Japanese artworks", and Doi and Ardh (2024), "the unique Japanese view of nature that reveres animals, insects, birds and plants has influenced culture and customs". In Turkey, comments referring to social change were prominent, such as "as a nation we can improve our recycling practices", "we will help enact laws to protect biodiversity" and "wrong land use must definitely be corrected". These perspectives aligned with research results from Gules-Bal and Karakas (2018) that suggested that Turkish students perceived biodiversity within social and political context. Indonesian students asked a notably high

number of “questions”. Their free-response comments reflect the complexities of a variety of factors, such as the social conditions and views of nature in the country. These questions reflected the environmental issues in Indonesia including plastic pollution (Phelan et al., 2020). As discussed above, the programme was shown to have some versatility in terms of inducing behavior change in participants. On the one hand, the responses reflect the social and contextual situation in each country, indicating the need to adapt the materials accordingly.

Conclusion

The lesson using this material stimulated interest and understanding of biodiversity conservation. The lessons using this material also promoted understanding of the risks of biodiversity loss, and the importance of predicting the future, thinking critically, and considering links with other regions, as well as the significant links between environmental issues and human society and the economy. The effectiveness of dealing with familiar topics was apparent. Lessons using this material have the potential for international generalizability. However, it needs to be evaluated in many more countries and, in doing so, the content needs to be arranged according to the contextual issues in those countries.

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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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Raciolinguistics: A Literature Review & Future Research Directions on the Manifestations of Racist Ideologies in the Classroom in the U.S. Educational System

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Abstract

This systematic literature review explores the questions: *What is raciolinguistics?* And *how does it manifest itself in the classroom?* Raciolinguistics examines the intersection of language and race, highlighting how linguistic hierarchies reflect and reinforce racial ideologies. In the U.S. educational system, raciolinguistic ideologies manifest through language policies, some bilingual programs, and curricular practices that privilege white linguistic norms while marginalizing racialized students. The review highlights three key findings: 1) English-only policies position multilingualism as a barrier, leading to the exclusion of bilingual learners. 2) Subtractive bilingual programs, rather than fostering true linguistic inclusion, reinforce assimilation by prioritizing English over students' home languages. 3) The emphasis on standard English in curricula delegitimizes linguistic diversity and embeds bias in teaching practices. These manifestations of raciolinguistic ideologies shape student experiences, fostering self-doubt and disengagement among marginalized students. By analyzing these dynamics, this review underscores the urgent need for equity-driven reforms that embrace multilingualism as an asset and promote inclusive pedagogical approaches that affirm students' linguistic and cultural identities in the U.S.

Keywords: raciolinguistics, language policies, bilingual education, standard language ideology, linguistic marginalization

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Introduction

Language and race are deeply intertwined, shaping how individuals navigate educational spaces and broader society. Raciolinguistics critically examines this relationship, showing how linguistic hierarchies reflect and reinforce racial ideologies. In the U.S. educational system, these ideologies manifest in policies, curricula, and pedagogies that privilege white linguistic norms while marginalizing racialized language practices—such as African American Vernacular English (AAVE), Spanglish, and Indigenous languages—which are often stigmatized or erased (Flores, 2020; Flores & Rosa, 2015a; Sung, 2018; Zentella, 2014). These ideologies are embedded in institutional structures, influencing language policy, bilingual education, and the dominant framing of standard English as the only legitimate form (Flores & Rosa, 2015b; García et al., 2021).

In classrooms shaped by diverse linguistic and cultural identities, raciolinguistic ideologies remain influential. Teachers and students alike bring with them assumptions, expectations, and biases shaped by a broader system that privileges white language norms. As Flores and Rosa (2015b) argue, examining not only the "eyes" but also the "mouth" and "ears" of whiteness reveals how these ideologies shape classroom interactions. This literature review critiques how English-only policies, transitional bilingual programs, curricular standards, and biased assessments perpetuate linguistic injustice, calling for critical reflection and systemic change in language education. English-only policies like Arizona's Proposition 203 enforce assimilation and devalue multilingualism (Gandara & Hopkins, 2010). Some bilingual programs, despite their intentions, often prioritize English over home language maintenance, structuring bilingualism as a transitional phase and relying on assessments that favor English dominance (Chávez-Moreno, 2022). Curricular norms further perpetuate deficit views of non-standard varieties, reinforcing linguistic inequality (Austin, 2022; Pino, 2022).

Methodology

This literature review examined the questions "What is raciolinguistics and how does it manifest itself in the classroom?" I conducted a systematic search of research in peer-reviewed journals and books using the online databases of ERIC, JSTOR, Academic Search Premier, Education Full Text (H.W. Wilson), Criminal Justice Abstracts, Sociological Abstracts, and the Google Scholar search engine. I searched for education policies on the National Clearinghouse for English Language Acquisition (NCELA) and for physical books at Northern Illinois University, Founders Library. I limited searches to research connected to discipline in schools, published in English. Search terms included "bilingualism," "raciolinguistics," "linguicism," "history of racism," "racist ideologies in education," and "case studies on race-based discrimination in the classrooms." These were crossed with outcomes such as "ideology," "teaching practices," "language profiling," "dropout," and "language policies in education." My inclusion criteria looked for publications on a) theoretical analysis and practical application of raciolinguistics as a field and Critical Race Theory (CRT), b) specifically the applicability to the educational setting in the United States, and c) focused on policies and manifestations of raciolinguistics and their short- or long-term outcomes, such as academic engagement, achievement, climate, or self-perceptions. I excluded publications written in other languages rather than in English and not connected to the educational system of the United States.

Survey of the Field of Raciolinguistics

On Human Categorization

Early human societies already categorized individuals based on physical differences to establish collective identity and security. Ancient Mesopotamia and Egypt demonstrated social stratification where conquered peoples were often enslaved and seen as inferior, reflecting power dynamics rather than racial ideology (Fredrickson, 2002; Snowden, 1983). Greek and Roman societies emphasized cultural superiority over physical traits, enslaving those deemed *barbaric* (Isaac, 2004). Beyond the Mediterranean, ancient Indian and Chinese societies developed hierarchies like the caste system, which stratified society based on hereditary roles and, later, skin tone (Thapar, 2003). While not explicitly racial, these systems echoed exclusion and control based on perceived differences; for example, ancient African societies' diversity was later distorted by colonial narratives branding them as homogeneous or uncivilized (Banton, 1987; Bartlett, 2001; Keita, 1993b) ignoring the reality that ancient African societies were diverse—culturally, linguistically, politically.

In the mid-15th century, the portuguese prince Henry the Navigator sponsored voyages to West Africa, initiating a new kind of slavery that began targeting Africans specifically (Kendi, 2019). While earlier Islamic and European slavery was not racially based, these Portuguese expeditions marked a shift toward racialized slavery, as they began to enslave Africans exclusively. Gomes de Zurara, Prince Henry's biographer, played a key role in shaping early racist ideology. In his 1453 *Chronicle of the Discovery and Conquest of Guinea*, he described enslaved Africans in terms of skin color and physical features, yet grouped them into a single category deserving of enslavement, regardless of their diversity. This marked one of the earliest instances of turning Blackness into a unified, inferior identity, laying the groundwork for the idea of race as a social hierarchy. Although the term "race" was not formally used at that time, Zurara's writing effectively invented the first racist idea: the notion that all African people could be treated as a single, inferior group. Race-making, then, became a tool to justify enslavement and maintain power.

During the 17th and 18th centuries, the Enlightenment paradoxically celebrated equality while fostering scientific racism. Thinkers like Carl Linnaeus and Johann Friedrich Blumenbach classified humanity into distinct *races*, attributing moral and intellectual characteristics to these groups (Keita, 1993a; Kendi, 2019). Blumenbach's taxonomy idealized Caucasians, reinforcing Eurocentric biases and justifying colonial expansion (Bartlett, 2001; Gould, 1981; Hannaford, 1996; Stepan, 1982). Philosophers like Kant and Hume embedded racial distinctions in their discussions of morality and reason, asserting natural hierarchies of races (Eze, 1997; Kidd, 2006). Pseudoscientific practices like phrenology and physiognomy further entrenched racial stereotypes, influencing colonial policies and shaping public perceptions of racial inferiority (Gould, 1981; Stocking, 1987). The Industrial Revolution amplified these ideas, legitimizing the exploitation of non-European populations and embedding systemic racism into economic and political systems (Hannaford, 1996).

Colonialism formalized racial ideologies into structured systems that profoundly influenced global societies. European empires developed legal and social frameworks to sustain racial hierarchies. The Doctrine of Discovery legitimized the dispossession and extermination of Indigenous peoples, branding them as "savage" and incapable of self-governance (Dunbar-Ortiz, 2014; Newcomb, 1992). The transatlantic slave trade institutionalized racial ideologies, commodifying African identity and embedding race as a primary axis of inequality (Baptist,

2014; Davis, 2006). In Africa, colonial powers imposed artificial borders and hierarchies, privileging certain groups to maintain control and sowing seeds of ethnic conflict and systemic racism (Mamdani, 1996; Nzongola-Ntalaja, 2002). Colonial education systems and cultural policies reinforced racial hierarchies by promoting Eurocentric values and erasing indigenous knowledge (Fanon, 1961; Ngũgĩ, 1986).

Understanding this history is crucial to dismantling the enduring frameworks of colonial racism and addressing its global impact (Blommaert, 2010; Fanon, 1961). Colonialism also wielded language as a tool of control, systematically erasing indigenous languages and imposing the colonizer's language to enforce cultural and ideological dominance (Flores & Rosa, 2015a; Sung, 2018). By stigmatizing and marginalizing indigenous languages, colonial powers relegated their speakers to the lowest rungs of the social hierarchy, further reinforcing racialized systems of oppression (Ngũgĩ, 1986). The enduring perception that certain languages are superior to others has permeated modern societies, perpetuating linguistic discrimination and the marginalization of minoritized communities (Fanon, 1961). These dynamics illustrate how linguistic hierarchies continue to shape power relations and social stratification worldwide.

Raciolinguistics as a Field

Raciolinguistics is an interdisciplinary field that critically examines the intersections of race, language, and power, rooted in colonial structures that position the language of the dominant race as the norm. As Alim et al. (2016) explain, it moves beyond analyzing linguistic forms to critique how language constructs and reflects systems of racial inequality and dominance. The field aims to expose how language perpetuates social, political, and economic oppression while also considering how marginalized communities resist linguistic oppression through transformative efforts in policy, pedagogy, and practice (Alim, 2010; Alim et al., 2016; Paris & Alim, 2017). This focus on critique and resistance marks raciolinguistics as a critical, progressive approach that seeks to dismantle linguistic discrimination.

Race ideology is rooted in a belief that some physical features are inherently superior to others, reinforcing power dynamics that favor those perceived as belonging to the "superior" race. This perspective has its origins in colonial history, shaping how societies categorize and value people (Rosa & Flores, 2017). Similarly, language ideology operates under the assumption that there is a single "proper" or "correct" way to use language—typically modeled after the language practices of the dominant, so-called superior race. These two ideologies intertwine, creating a raciolinguistic ideology characterized by three interconnected concepts: the white listening subject, the idealized speaking subject, and the racialized body (Flores & Rosa, 2015b).

According to Rosa and Flores (2017), the *white listening subject* "is not a biographical individual but an ideological position and a mode of perception that shapes our racialized society" (p. 151); hence, it refers to those who expect others to adhere to "correct" language standards. This expectation can be upheld by individuals, professional groups, or institutions like the education system. In response to these expectations, the *idealized speaking subject* emerges—a monolingual speaker who flawlessly masters the standard or "appropriate" language, becoming the measure against which others are judged. Meanwhile, the *racialized body* includes anyone who speaks a non-standard variety, uses the language as a second or third language, or speaks in a dialect marked as different. These individuals are often expected to strive toward becoming the idealized speaking subject, a goal that is ultimately

unattainable. It is in this inherent impossibility that the raciolinguistic problem arises. The idea that those marked as racially different can never fully meet the standards set by the white listening subject becomes a tool to control, categorize, and undermine entire cultures. Language, then, becomes a mechanism not just of communication, but of power and oppression over, for example, varieties like AAVE and Spanglish (Rosa, 2019).

Language practices are not neutral; they are shaped by racial ideologies that reinforce power structures, influencing educational settings, media representations, and everyday interactions. Lippi-Green (2004) and Baugh (2000) expose how linguistic profiling perpetuates systemic racism in education and employment, as "people use false assumptions about language to justify judgments that have more to do with race, national origin, regional affiliation, ethnicity, and religion than with human language and communication" (Lippi-Green, 2004, p. 292). Similarly, the concept of a "standard language," critiqued by Cameron (2007) and Lippi-Green (2004), reinforces white linguistic hegemony by positioning white, middle-class language norms as ideal while stigmatizing others.

Intersectionality in raciolinguistics reveals that language, race, and power are mutually constitutive elements that shape social realities (Crenshaw, 1991). Linguistic features like accents or hybrid languages (Spanglish, Mock Spanish) become markers of racial identity, often leading to discrimination. For example, AAVE has been racialized as inferior despite its intricate linguistic structure (Alim & Smitherman, 2020), while accents influence perceptions of intelligence and professionalism (Baugh, 2000; Cameron, 2007). Zentella (1997) highlights how Spanglish, though a marker of Latinx identity, is stigmatized because ideas of "Standard English" are racialized constructs rather than objective linguistic categories (Flores & Rosa, 2015b).

The Manifestation of Raciolinguistic Ideologies in the Classroom

Raciolinguistic and Institutional Policies

Educational policies often reinforce systemic racism by upholding norms rooted in raciolinguistic ideologies that privilege whiteness. Though often seen as neutral, these policies shape access and outcomes for marginalized students (Nieto & Bode, 2018). English-only policies, driven by movements like U.S. English and English First since the 1980s, reflect such ideologies (Lawton, 2008). Even before English was officially declared the U.S. language in 2025, many states had already legislated English-only education. These policies, such as California's Proposition 227, devalued bilingualism by restricting instruction in students' home languages, limiting opportunities for English learners and eroding their linguistic heritage (Gandara & Hopkins, 2010).

In Arizona, Proposition 203[1], known as the "English for the Children" initiative, was a ballot measure English proficiency that mandated that all public-school instruction for English learners (ELs) be conducted in English, effectively replacing bilingual education programs with a structured English immersion (SEI) model (Arizona Secretary of State, 2000). Proponents argued that a) immersion in English would help students learn the language faster

[1] Proposition 203 remains in effect. However, there is ongoing debate regarding its implementation and potential amendments. The Arizona School Boards Association (ASBA) has expressed interest in revising the law to better serve ELLs, citing concerns that the current approach may not effectively support students' language acquisition and academic success.

and achieve academic success; b) English fluency was essential for integrating into society and accessing better job opportunities; and c) bilingual education programs were ineffective and kept students segregated from mainstream education. Additionally, Senate Bill 1014 (SB 1014)[2], enacted in Arizona in 2019, reformed the state's approach to educating English Language Learners (ELLs). Previously, Arizona mandated that ELL students participate in a four-hour daily block of structured English Immersion (SEI) instruction, which often segregated them from their peers and limited access to comprehensive academic content. This bill states that a) reducing SEI hours enabled ELL students to spend more time in mainstream classrooms, promoting better integration with English-speaking peers and access to a broader curriculum; b) increased exposure to diverse academic content and interactions would lead to higher overall academic achievement for ELL students; c) granting school districts the autonomy to adopt instructional methods tailored to their specific student populations, fostering innovative and effective teaching strategies; and d) that the previous four-hour SEI block was not supported by research as the most effective method for language acquisition and that more flexible, research-based approaches could yield better results.

The Arkansas the Code titled "Basic Language of Instruction," was originally enacted in 1919. The statute mandates that "the basic language of instruction in the public-school branches in all the public schools of the state shall be the English language only" (Arkansas Code, 2024). Over the years, it has undergone amendments to address the evolving educational landscape and the needs of a diverse student population. In 2021, the Arkansas General Assembly passed Act 663, which amended § 6-16-104 to allow educators to communicate with students in their native languages to facilitate English proficiency. This amendment acknowledged the practical needs of non-English-speaking students and provided flexibility for bilingual or dual-immersion programs approved by the Division of Elementary and Secondary Education. As of January 2025, the Arkansas Code § 6-16-104 remains in effect, with the provisions from the 2021 amendment incorporated. The statute continues to mandate English as the basic language of instruction while allowing certain exceptions to support English language learners.

In West Virginia, the Code §18-2-7 pertains to the state's educational system, specifically focusing on the courses of study and the language of instruction within schools (West Virginia Code, 2024). The statute designates English as the primary language of instruction in West Virginia schools. However, it also recognizes American Sign Language (ASL) as a credited foreign language course. West Virginia Code §18-2-7 remains in effect, upholding the provisions regarding the establishment of course standards and the recognition of ASL as a foreign language. The statute continues to guide the State Board of Education in approving curricula and ensuring that English serves as the primary medium of instruction, with accommodations for ASL as part of foreign language education.

Raciolinguistic Bilingualism

Bilingual programs aim to help students become proficient in two or more languages, often serving as a bridge between cultural and linguistic identities. However, beneath the surface of these well-meaning educational policies lies the influence of raciolinguistic ideologies, which shape how language is taught, valued, and regulated in schools. These programs, rather than fostering true bilingualism, often function as mechanisms for linguistic assimilation,

[2] The 2019 version of SB 1014 is in effect, implementing the changes to the SEI program. The 2025 version is still in the pre-filed stage and has not yet been enacted into law.

reinforcing racial hierarchies that privilege English over other languages (Román et al., 2019; Rosa & Flores, 2017). The distinction between subtractive and additive bilingual programs highlights this disparity.

Subtractive bilingual programs prioritize English acquisition at the expense of students' home languages, reinforcing linguistic hierarchies that devalue non-English languages. Examples include Early Exit Transitional Bilingual Programs and ESL Pull-Out, Push-In, and Sheltered/Structured English Immersion (SEI) Programs, which are not bilingual programs but they exist in the context of language education (García, 2009). Additive bilingual programs, such as Dual-Language Immersion and Late Exit Transitional Bilingual Education, aim to develop proficiency in both languages, which is the goal of bilingualism.

Early Exit Transitional Bilingual Programs are designed to facilitate the shift from a student's native language to English, with the goal of mainstreaming students into English-dominant classrooms as quickly as possible (Baker & Wright, 2021; García, 2009). While these programs provide initial instruction in students' home languages, the gradual reduction of non-English instruction reflects an underlying belief that English is the ultimate linguistic goal. This approach aligns with raciolinguistic ideologies that position English as the language of academic and professional success while treating students' native languages as temporary crutches rather than legitimate linguistic systems. The assumption that students must eventually abandon their home languages to achieve academic success reinforces a deficit perspective, framing bilingualism as a barrier rather than an asset—particularly when the bilingual speaker is racialized. This ideology is evident in policies that measure program success primarily by English proficiency test scores, rather than by students' ability to maintain and develop bilingual skills.

ESL (English as a Second Language) programs vary in structure but generally function within a raciolinguistic framework that constructs non-English speakers as linguistically deficient. While these programs claim to support multilingual learners, they ultimately reinforce the dominance of English and fail to value students' home languages as legitimate modes of learning and communication (Flores & Baetens Beardsmore, 2015; Flores et al., 2015).

In Pull-Out ESL programs, students are removed from their mainstream classrooms for a portion of the day to receive separate English instruction. This model isolates students from their peers, positioning English as the only valuable language for academic success while reinforcing the notion that their home languages are insufficient. By segregating students based on language ability, these programs contribute to racial and linguistic stratification, further marginalizing bilingual learners (Ovando & Combs, 2017). This reinforces a hierarchy where English is seen as the legitimate academic language, while students' home languages are positioned as obstacles to learning.

Dove and Honigsfeld (2018) mention that Push-In ESL programs are, to some extent, better than Pull-Out programs. However, although ESL teachers enter mainstream classrooms to provide support, the primary expectation remains that students conform to standard English norms. Rather than promoting a truly bilingual learning environment, this approach subtly pressures students to abandon their home languages in favor of English. Likewise, although scholars such as Faltis in in the 90s defend sheltered/structured instruction immersion programs' positivity of segregation for someone who is not proficient in the target language, the truth is that segregation may produce social isolation and self-perceptions of inferiority

for students (Baker & Wright, 2021; Constantino, 1993). These programs aim to teach academic content using simplified English, assuming that students will naturally acquire English proficiency through immersion. However, by disregarding students' home languages as valuable resources for learning, these programs contribute to linguistic erasure. The focus on English-only instruction mirrors broader assimilationist policies that seek to suppress linguistic diversity, reinforcing the belief that dominant languages are the norm while minoritized languages are obstacles to success.

Flores and Rosa (2015a) argue that students classified as English learners are often racialized as lacking linguistic legitimacy, regardless of their actual language abilities. The racialized nature of ESL classifications means that Black, Indigenous, and Latinx students are disproportionately placed in these programs, despite demonstrating proficiency in English. The emphasis on English acquisition over bilingual development implicitly devalues students' home languages, reinforcing the message that English is superior and necessary for full participation in academic and professional spaces.

Raciolinguistic Curriculum and Teaching Practices

The emphasis on standard English in education undermines other languages and varieties, privileging Eurocentric norms and marginalizing racially and linguistically diverse students. Curricula often promote "a homogeneous, idealized form of spoken and written language... enforced by hegemonic institutions, such as governmental bodies and schools" (Licata et al., 2023, p. 125), also referred to as standard or academic language (Flores, 2020). This ideology positions English as the only legitimate medium for conveying knowledge, disregarding the value of other linguistic and cultural practices. As García et al. (2021) note, English language arts teachers face the "absurdity of trying to teach only in English" using a Eurocentric curriculum, even though bilingual students often demonstrate greater linguistic and intellectual depth (p. 207). Pino (2022) illustrates this with his experience of being sent to speech therapy for nonstandard pronunciation, despite being an English speaker, showing how language racialization devalues students' abilities and fosters feelings of inadequacy. This process—known as *languagelessness* (Rosa, 2019)—frames nonstandard varieties as inferior, reinforcing the idea that students must conform to white linguistic norms to succeed (Cameron, 2007; Fallas-Escobar, 2024; Flores & Rosa, 2015a; Licata, 2021; Lippi-Green, 2004; McWhorter, 2017). As Pino (2022) powerfully states, students' language—and even their existence—can be perceived as deficient, threatening "the invisibility and normalcy of whiteness" (p. 5).

Furthermore, teaching practices shaped by raciolinguistic ideologies devalue the linguistic and cultural practices of racialized students, limiting their academic opportunities and reinforcing systemic inequities. Implicit biases, deficit framing in pedagogy, and cultural mismatches in the classroom all contribute to the marginalization of racialized students. Teaching practices, for example, in many educational settings often reflect implicit biases. Chávez-Moreno (2022) argues that teachers' "explanations of the persistent disparities they perceive in their classrooms influence their practices and what they view as needed interventions" (p. 555). Some scholars contend that ESL teachers, for example, should prioritize fostering critical consciousness to ensure educational equity, a perspective supported by longstanding research emphasizing the role of educators in developing students' critical awareness (Chávez-Moreno, 2022; Palmer et al., 2019). However, teachers may unconsciously interpret linguistic features like African American English (AAE), Spanglish, or other varieties as signs of academic weakness in need of speech therapy (García, 2008;

Pino, 2022) rather than evidence of linguistic dexterity. For instance, a Black student who uses AAE features, such as "He be running," might be unfairly labeled as needing remediation, even though such expressions reflect complex grammatical rules within AAE. This bias overlooks the student's linguistic competence and reinforces the raciolinguistic ideology about "standard" English being the only valid form of communication.

Additionally, by structuring the curriculum around a narrow linguistic standard, educational institutions not only limit access to diverse linguistic traditions but also reinforce a hierarchy where white, monolingual English remains the default and all other linguistic expressions are either erased or positioned as exceptions. As García et al. (2021) note, "even when racialized and/or bilingual writers have attained recognition by having their work included in the school curriculum, the language practices of the authors are tagged as exceptional and unique" (p. 209), which means that their works are often framed as deviations from an assumed linguistic norm rather than valued on their own terms. This marginalization is further reinforced by the ways in which academic language itself is defined. As García et al. (2021) explain, "attempts to identify detectable linguistic characteristics of academic language tend to stem from idealized representations of texts produced mostly by white monolingual English-users occupying a socially dominant position" (p. 209). Because the dominant standard is rooted in the linguistic practices of white monolingual speakers or the *White listening subject*, any divergence from this norm is marked as an exception rather than as a legitimate and integral part of academic discourse. This exclusionary framework is not incidental but systemic, as normative approaches to language in education actively erase non-dominant voices. García et al. (2021) describe this erasure, stating that "it is in this abyssal light that normative approaches to language and education continue to generate absences and failures" (p. 216). Additionally, the persistent scarcity of representation from linguistically marginalized authors further perpetuates white linguistic dominance. As Austin (2022) points out, the "scarcity of representation from speakers of languages outside of white mainstream English (WME), coupled with a language eradication approach in English Language Arts spaces, contributes to white linguistic hegemony" (p. 246).

Implicit biases often lead teachers to hold lower expectations for students of color, assuming they are less capable of academic success. These biases can manifest in grading, classroom dynamics, and recommendations for advanced programs, ultimately limiting opportunities for racialized students to access higher-level academic pathways (Pino, 2022). Additionally, teachers from predominantly white, middle-class backgrounds may experience a cultural mismatch when working with students from diverse communities (Chávez-Moreno, 2022). This mismatch can lead to misunderstandings of students' behavior or communication styles, alienating students and preventing the use of culturally relevant pedagogies that affirm their identities. The pervasive deficit-framing of racialized students and their communities further exacerbates educational inequities. Rather than addressing systemic barriers, this perspective places the burden of change on students and their families, framing them as lacking the skills, values, or resources needed for success. Such narratives ignore the systemic inequities that contribute to educational disparities and perpetuate the myth that failure is rooted in individual or cultural deficiencies.

Findings

The analysis reveals that raciolinguistic ideologies embedded in educational policies and practices continue to marginalize students from racially and linguistically diverse

backgrounds. These ideologies manifest in various ways, shaping students' educational experiences and reinforcing systemic inequities.

a) English-only policies treat students' home languages as deficits rather than assets, fostering feelings of inadequacy and disengagement among bilingual and multilingual learners.
b) Some bilingual programs, though framed as inclusive, subtly promote English dominance by downplaying the value of students' native languages, leading students to see their linguistic diversity as irrelevant.
c) The emphasis on standard English delegitimizes non-standard varieties and other languages, embedding bias into instruction and assessment and undermining students' cultural and linguistic identities.

Discussion

This literature review draws on raciolinguistics to examine how language and race intersect in U.S. classrooms, where institutional policies and teaching practices often reinforce white linguistic dominance and marginalize racialized students. English-only mandates, such as Arizona's Proposition 203 and Arkansas's Code §6-16-104, exemplify policies that devalue multilingualism and treat students' home languages as obstacles rather than assets (Arizona Secretary of State, 2000; Arkansas Code, 2024; Flores & Rosa, 2015a; Gandara & Hopkins, 2010). These policies uphold white linguistic hegemony by positioning non-English speakers as deficient, limiting access to academic and economic opportunities.

Even some bilingual programs contribute to linguistic assimilation by treating English proficiency as the ultimate goal. Transitional models, in particular, frame students' native languages as temporary tools, rather than integral to identity and learning (Chávez-Moreno, 2022). This dynamic reflects broader societal patterns in which bilingualism is celebrated when associated with white, middle-class speakers, but seen as a deficit when tied to racialized communities (Flores & Rosa, 2015b).

Curricula and pedagogy further reinforce these inequities by privileging standardized English and marginalizing other linguistic forms. Academic language is often defined around white monolingual norms (García & Li, 2014; García et al., 2021), while non-standard varieties and non-white authors are framed as deviations. Textbooks lack representation of linguistically diverse voices, and implicit biases in teaching and assessment often position racialized students as linguistically deficient (Austin, 2022; Pino, 2022). For example, Pino (2022) recounts being sent to speech therapy despite speaking English as a first language, highlighting how systemic bias pathologizes linguistic difference.

While raciolinguistics has been applied to education policy and theory, a significant gap remains in understanding how raciolinguistic ideologies manifest in everyday classroom interactions. As Flores and Rosa (2015a) argue, we must examine the "mouth" and "ears" of whiteness, recognizing that the white listening subject may also be students racializing the language practices of teachers. Studies like Flores et al. (2020) and Flores et al. (2018) on dual-language students in Chicago illustrate how raciolinguistic frameworks can uncover hidden biases in classroom discourse and guide more equitable pedagogy.

Addressing raciolinguistic inequities requires systemic reform across educational policy, curriculum, teacher preparation, and community engagement. Equitable funding, revised tracking systems, and the elimination of punitive discipline policies are essential to

supporting marginalized students. Anti-racist curricula must highlight contributions from racialized communities and validate students' linguistic identities, while teacher training must address implicit bias and promote culturally sustaining pedagogy. Research should also examine the ideological limitations within anti-racist movements themselves—some of which, as McWhorter (2021) critiques, risk reinforcing racial divides through performative actions rather than structural change. Nonetheless, the frameworks advanced by DiAngelo (2018) and Kendi (2019) continue to influence education discourse and merit critical engagement.

Conclusion

Raciolinguistics offers a critical lens to examine how language reinforces racial inequities in education. While much research addresses policy-level issues, future studies must investigate real-time classroom interactions to uncover how raciolinguistic ideologies are enacted daily. This shift allows for the identification of both harmful practices and moments of resistance, revealing opportunities for more equitable teaching. Transformative change requires moving beyond symbolic reforms to implement raciolinguistically informed curricula, teacher training, and policies. Centering the lived experiences and linguistic practices of racialized students is essential for creating inclusive educational spaces that validate diverse identities and challenge the dominance of standardized English norms.

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Adaptive Tactical Decision Making in Ice Hockey: Integrating Multi-agent Reinforcement Learning Framework With Advanced Computer Vision Techniques

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Abstract

This study proposes an integrated framework that combines with Multi Agent Reinforcement Learning (MARL) with advanced computer vision techniques, including pose recognition via MMaction2, object detection with Yolov11, and multi-object tracking using ByteTrack. The McGill Hockey Player Tracking Dataset (MHPTD) is used to analysis the ice hockey team sport. In building the framework with MARL, each player is modeled as an autonomous agent whose observation space encompasses self-position, puck state, and the spatial locations of teammates and opponents. By incorporating inputs from the MHPTD dataset, the framework dynamically adapts strategic behaviors, like defending, attacking. When simulating realistic ice hockey scenarios, the framework can be used for strategy optimization using the group object detection, play behavior modeling by pose recognition and positional data tracking, advanced AI opponents' strategic analysis in future games. Reward function is setup to encourage agents to move towards the puck and getting rewards when shooting to the opponents' door. Multi-agent setup can simulate full team sport. The framework can enhance the simulation of complex player interactions, bridge the gap between MARL simulation and real-world fix-field team sports, provide insight in coaching and sport education.

Keywords: multi agent reinforcement learning, object detection, pose detection

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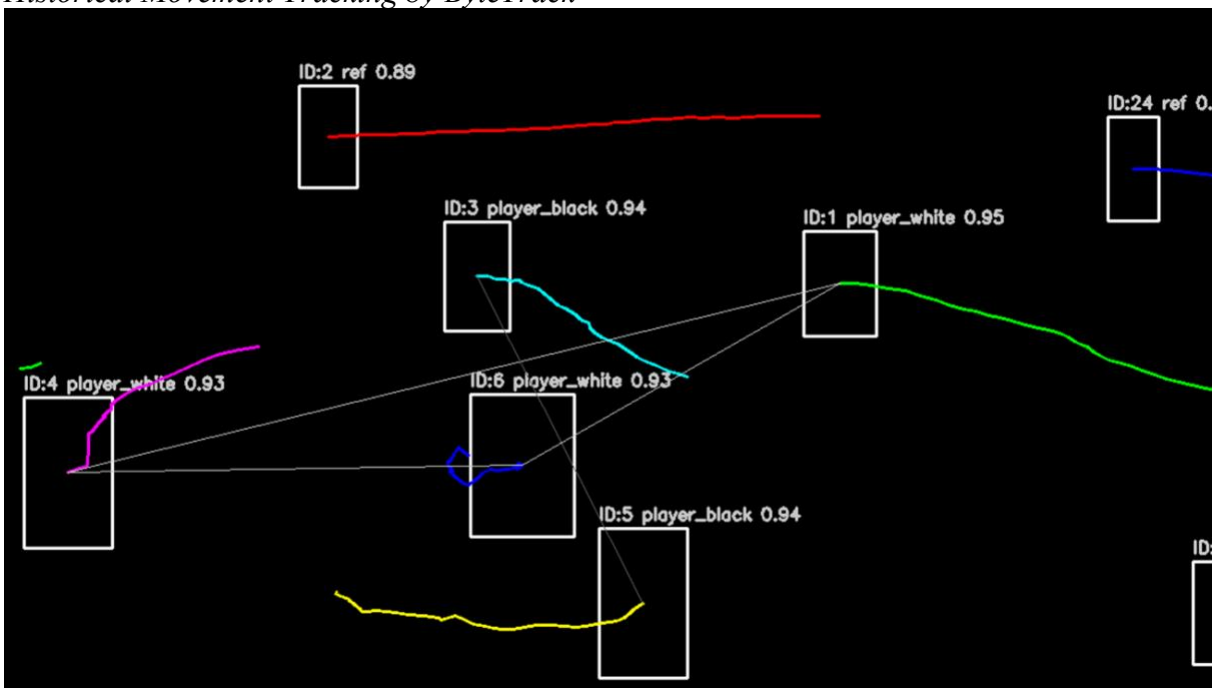
Introduction

With the development of science and technology, the application of artificial intelligence and machine learning in sport analytics have opened new opportunities for optimizing team dynamics, tactical strategies and individual player evaluation in sport education (Weber et al., 2022; B. Zhang, 2024). This research presents an integrated framework that utilizes Multi Agent Reinforcement Learning (MARL) with computer vision techniques including Yolov11 for object detection, MMAction2 for pose recognition, and ByteTrack for multi-object tracking. The framework applied to the McGill Hockey Player Tracking Dataset (MHPTD) in order to create an environment for simulation and testing the MARL.

The center of this research lies in agent-based modeling of players; each individual player can be conceptualized as a learning agent who is able to perceive and interact with other agents (Albrecht et al., 2024). Each agent is equipped with a space which represents the coordinate's locations, also the distance to the other players including teams and opponents, the puck. Therefore, by employing a Multi Agent Reinforcement Learning (MARL), agents learn to optimize the individual rewards, at the same time coordinate with team structures, reflect hocky strategies, such as power-play setups, transition plays.

Figure 1

Historical Movement Tracking by ByteTrack



In order to build the integrated framework, Yolov11 is utilized for object detection (Jocher & Qiu, 2024) to identify players from the same team and opponent team, the puck (ball), and the referee in each frame. ByteTrack links these frames across time to produce the historical movement tracking, continuous identifying the movement of objects (Y. Zhang et al., 2022). In the next step, MMaction2 is used to perform pose-based action recognition which is designed by MMaction2 Contributors (2020), to identify each individual player's movement including skating, passing, shooting positions. After the vision-based techniques, it enables reinforcement learning agents to perceive status information of the players' location, movement, and behavior.

Theoretical Background

Compare to traditional reinforcement learning, the concept of Multi Agent Reinforcement Learning (MARL) was introduced by Markov games, a generalization of Markov Decision Processes to multi agent settings (Littman, 1994), building upon this foundation, a structured theoretical overview of MARL by categorizing algorithms across Markov and extensive-form game frameworks, and analyzing task structure (cooperative, competitive, mixed) was introduced (K. Zhang et al., 2021) with decentralized learning over networks, mean-field approximations, convergence behavior of policy-gradient methods, and the influence of game structure on theoretical guarantees and algorithm design. Moreover, modern MARL theories has built connections with methodologies by covering theoretical models (e.g., Markov games, coordination graphs), learning paradigms (independent, centralized, decentralized, and partially observable settings), algorithmic developments (value-based, policy-gradient, actor-critic, and communication-based methods), and practical applications ranging from robotics and autonomous systems to complex multi-agent simulations (Albrecht et al., 2024). Practically, the usage of MARL supports full team simulations and facilities automated strategy optimization and opponent behavior analysis.

In MARL, the Multi Agent Deep Deterministic Policy Gradient (MADDPG) can address the non-stationarity problem, it adopts a centralized training with decentralized execution framework. Each agent i maintains an actor $\mu_i(s_i|\theta_i)$ that maps local observations to actions, and a critic $Q_i(s, a_1, ..., a_1|\varphi_i)$ that uses the global state and joint actions during training (Lowe et al., 2017). Transitions (s, a, r, s′) are stored in a shared replay buffer. The critic is updated by minimizing the loss:

$$L(\varphi_i) = E[(r_i + \gamma\, Q_i'(s', \mu_1'(s_1'), ..., \mu_n'(s_n')) - Q_i(s, a))^2] \quad (1)$$

and the actor is updated using the policy gradient:

$$\nabla\theta_i J = E[\nabla\theta_i \mu_i(s_i)\, \nabla_{ai}\, Q_i(s, a) \mid a_i = \mu_i(s_i)] \quad (2)$$

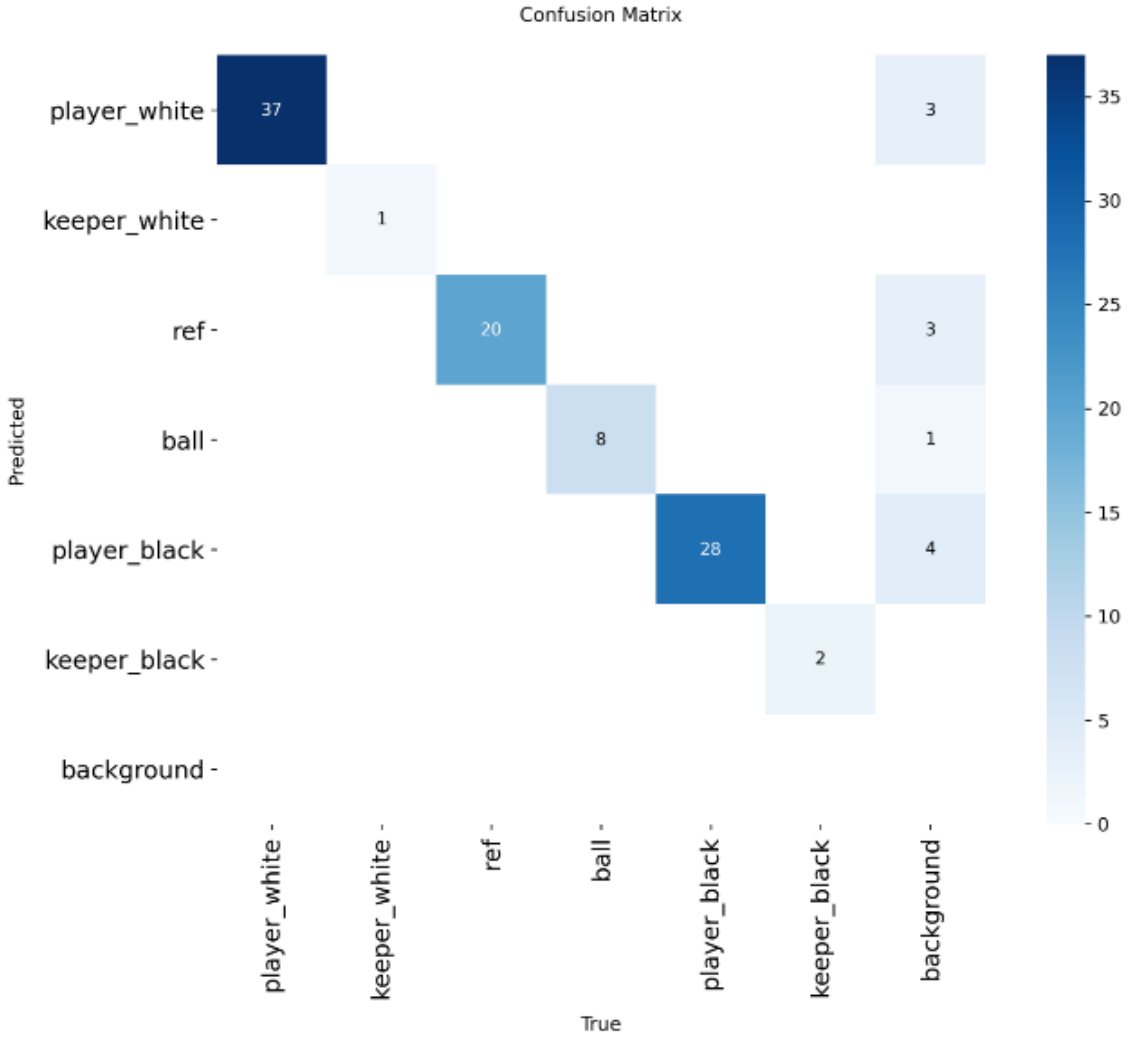
(Lowe et al., 2017)

To simulate ice hockey with MARL, we can design the model with 8-agents where each player (4 per team: 3 players + 1 goalie) observes local state information like position (by ByteTrack), puck location (by Yolov11), and nearby players. Because of reinforcement learning, the reward function combines sparse rewards for goals with dense rewards for puck possession, positioning, score, and team coordination. On the other hand, the punishment can be loss of puck possession, loss of score.

Methodology

In this chapter, the research methodology utilized for vision techniques and MARL simulation are presented in detail. First, the McGill Hockey Player Tracking dataset (MHPTD) is selected to make the analysis (Zhao et al., 2020). The dataset contains video clips of NHL gameplay, six classes are designed to perform the object detection in yolo format with player_color1, goalie_color1, player_color2, goalie_color2, referee, and puck. In the traditional ice hockey game, there are 12 players, because of the camera field of view limitations, each frame contains partial view of the rink. With simplified and focused environment, we plan to design the 4 vs 4 game play to reduce complexity and accelerate training time in the reinforcement learning.

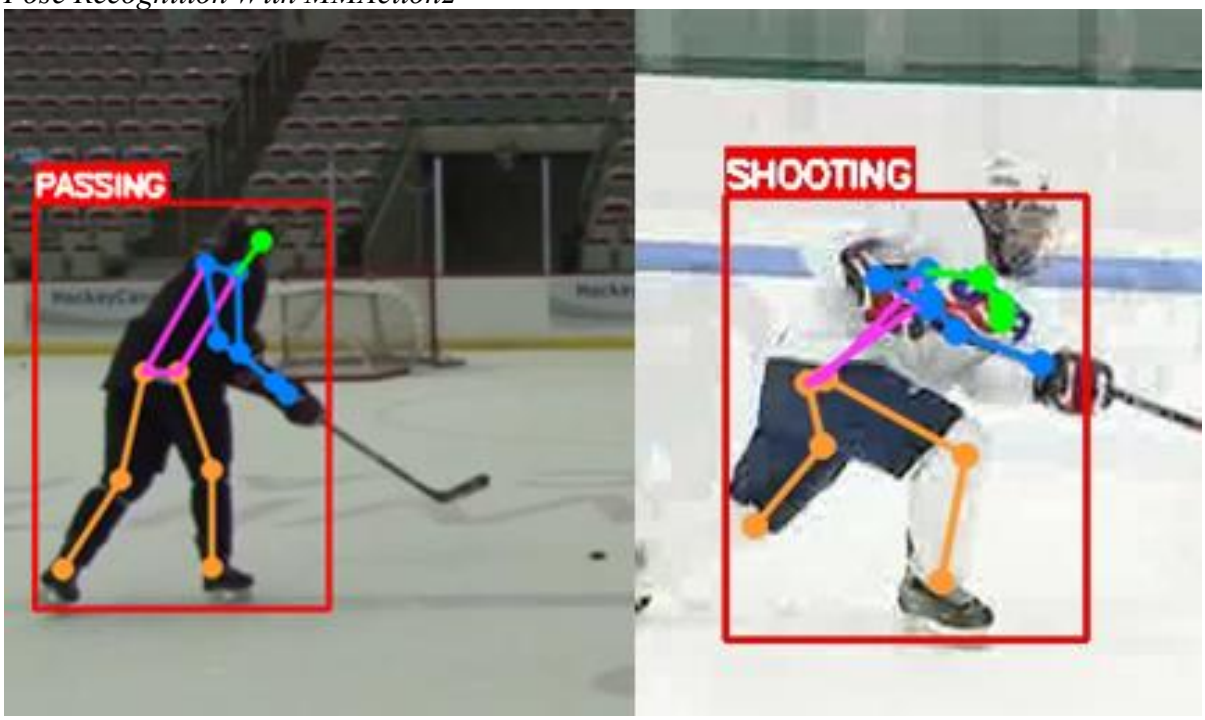
Figure 2
Yolov11 Confusion Matrix in Training



In the Yolov11 training, data was partitioned into training (80%), validation (10%), and testing (10%) sets to enable model generalization assessment. The evaluation was conducted using metrics including mean Average Precision (mAP) and class-wise confusion matrix analysis. From Figure 2, the confusion matrix of ice hockey class training revealed strong classification performance on dominant classes like player_white and player_black. This pipeline demonstrates YOLOv11's capability for real-time multi-object detection in dynamic ice hockey environments.

After object detection by Yolov11, Byte Track is utilized to track players across frames. ByteTrack links those detections across time, by following each player as they move around the rink. Even when players overlap, change directions quickly, or partially disappear, ByteTrack can keep tracking of players, by matching their position, and confidence scores. As a typical example in Figure 1, the historical movement tracking shows the changing locations of each object.

Figure 3
Pose Recognition With MMAction2



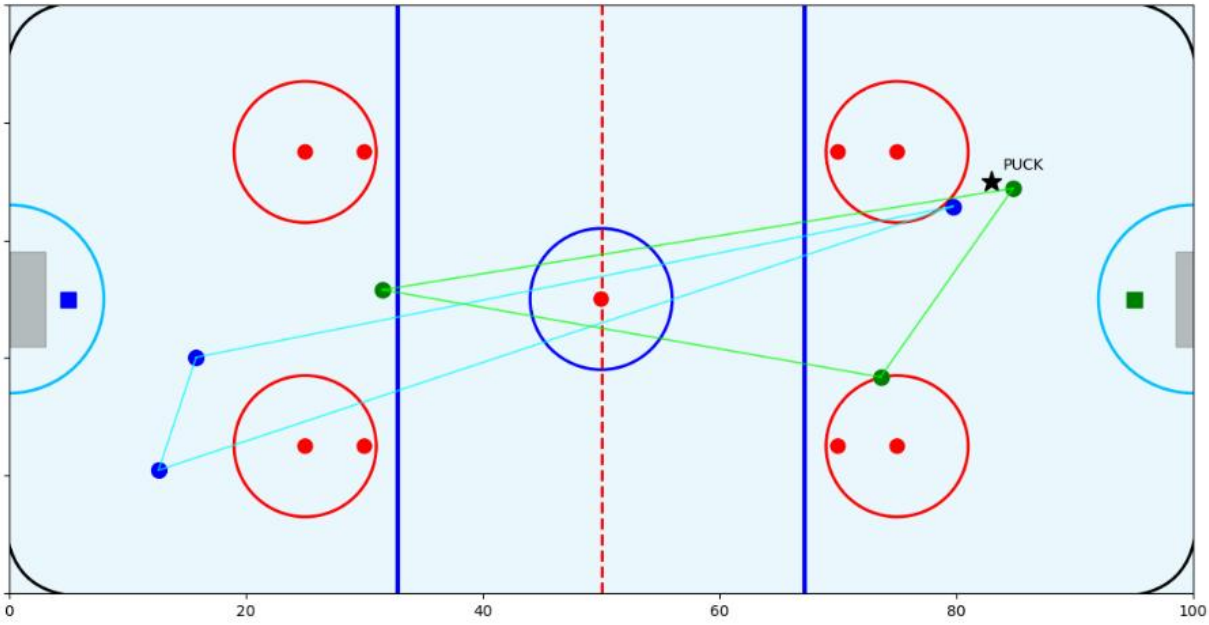
In the next step, we use MMAction 2 to recognize player actions like passing, shooting, and skating. In each frame, pose estimation is conducted to analyze body movements of hockey players, such as in Figure 3, when a player raises their stick to shoot or stretches out to make a pass. This is especially useful in ice hockey, where actions happen quickly. With MMAction2, we can automatically detect key plays like shots on goal, successful passes, or even defensive actions. This makes it possible to break down the game into meaningful collection of movements, which can then be used for strategy review, performance statistically analytics, or even highlights for market values.

After the pose recognition, the next step is to simulate ice hockey game using Multi Agent Reinforcement Learning. In the simulation, each agent (player or goalie) acts independently based on the detected positions from the Yolov11. In the detection of Yolov11, it provides the position of objects in a frame by bounding boxes and class probabilities. Therefore, the center of the objects is defined as the (x_i, y_i) coordinates of the midpoint of the bounding box which represents the estimated self-location. In the perspective of ice hockey game, there are agents of TeamA, TeamB, and the puck location. Based on the results of MMAction2, the agent actions are defined for each frame, like skating, passing, shooting; or the moving direction which can be detected by ByteTrack. It provides the velocity vector of each agent as (V_x, V_y) for direction or movements. In designing the reinforcement learning, the reward function is programmed to incentivized agents (not puck) behaviors through action-based feedback. Agents receive a reward of +0.5 for successfully passing the puck to a teammate, and +1.0 for executing a shot, encouraging cooperative play and offensive engagement. When a team scores a goal, all players on that team receive +5.0, while players on the opposing team are penalized –2.0, reinforcing coordinated strategy and defensive responsibility. After the above preparation, we can begin to train MADDPG agents in vision grounded hockey simulation.

Findings and Discussions

In the MARL simulation, it demonstrates that reward and penalty structure affect agent behavior. There is a rise in meaning team dynamics. The puck is moving passively in the simulation, agents learn to pursue the puck, coordinate basic passing, and shoot toward the goal when in procession. The team-level rewards for scoring and penalties for conceding promotes cooperative strategies within each team, as evidenced by frequent passing attempts and spatial clustering around the puck. In MADDPG training, the combined vision inputs (Yolov11, ByteTrack, and MMActions2) serve as the input status to individual agent's policy network which presents the selected actions based on the observation, such as the agent's position, puck position, teammates position, opponents position. It enables training of MADDPG agents to learn in dynamic environments.

Figure 4
MARL Simulation



In Figure 4, the green dots represent TeamA, blue dots are TeamB; the black star is the puck. In the reinforcement learning, they act as agents, each agent's policy network receives a vector of local observations as input. For agent i, the observation vector T_i includes of the agent's own position at time T, the position of the puck, and the positions of teammates and opponents. For example:

$$T_i = [x_i, y_i, x_puck, y_puck, x_teammate1, y_teammate1, ...] \quad (3)$$

The actor network takes this observation vector and outputs the next timestamp T_i action vector that represents a direction to move at the current timestamp.

$$T_{i_next} = [\Delta x, \Delta y] \in \mathbb{R}^2 \quad (4)$$

In the above formular, Δx and Δy indicate the movement direction in the horizontal and vertical axes. This output can be directly applied to update the agent's position within the environment for the next T timestamp. After calculating the movement direction, it is time to train the centralized critic network of MADDPG that intakes all actions of all agents, and

puck to evaluate how good each joint action is. Past experiences are stored in the replay buffer which can help agents to learn from the training. During Training, each agent acts according to their own observation which shows what we discussed before about the centralized training with decentralized execution framework (Lowe et al., 2017), make it possible for agents to study the team strategies in ice hockey.

Conclusion and Limitations

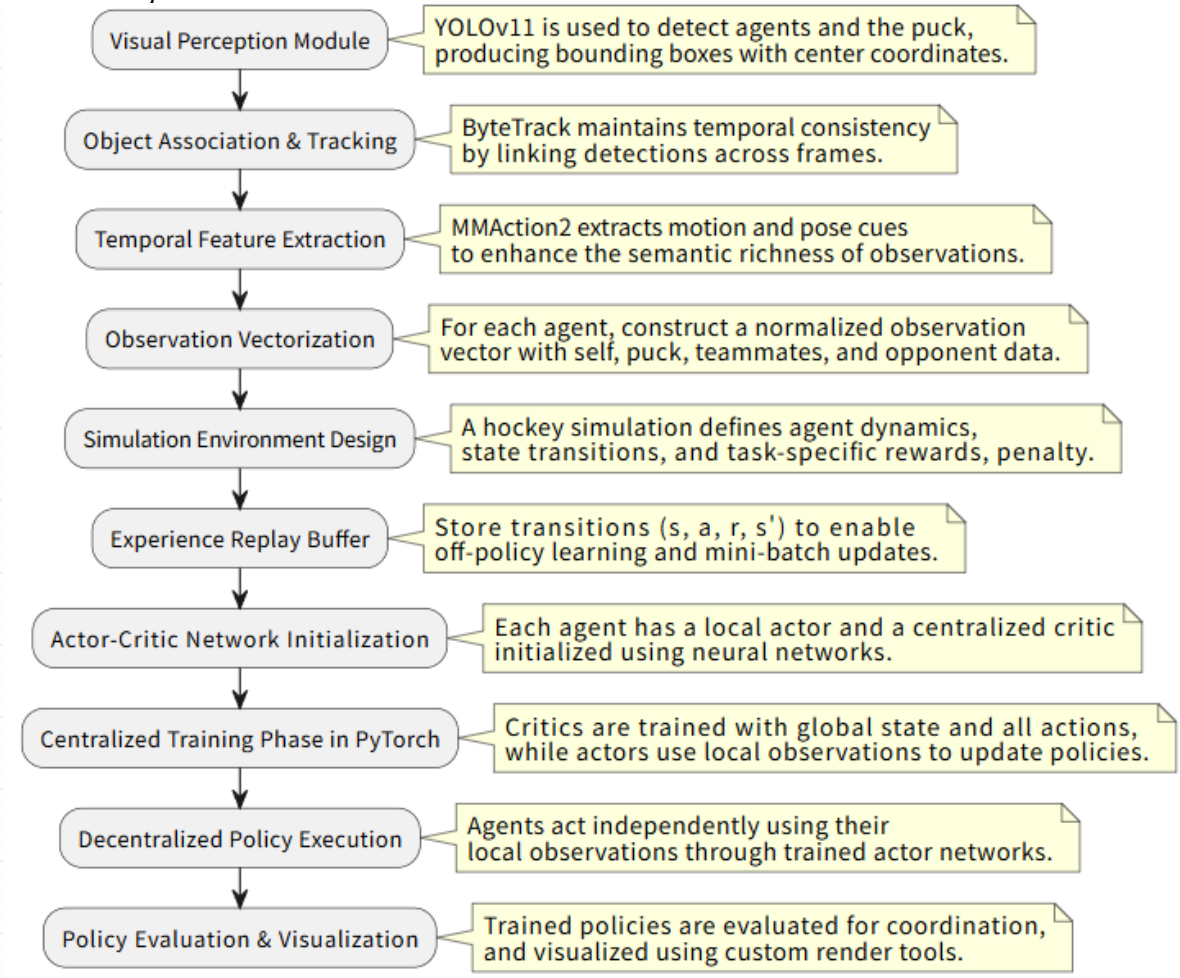
This research developed how to integrate computer vision techniques with MARL which could enable trained agents to simulate in complex and dynamic fix-field multiplayers sport field. As illustrated in Figure 5, the research pipeline begins with applying Yolov11 for object detection to identify players in different teams and the puck, followed by using ByteTrack to track movement of players and the puck. MMAction2 method is used to extract pose of the players. All above factors are vectorized into structured vectors, and feed into reinforcement learning simulations with reward and penalty. Transitions are stored in a replay buffer, which is used to enable off-policy learning. In the simulation of ice hockey, we designed 4 vs 4 agent game. As in MADDPG algorithm, each agent is equipped with an actor critic pair, where centralized critics are trained. This centralized training with decentralized execution framework is implemented in PyTorch, and the learned policies are evaluated through coordinated behavior and visual analytics.

Through the MADDPG training, each agent learns the decision making strategies in two ways, one is the collocation within team members, such as the connection between ball-holder who are going to attack, with other attackers and defenders at the same team; or the connection between defenders with goalie. Each agent can access the others' status including location, historical movement and pose; to make joint strategies within the team, it is easy for coaches to develop the teammate collocation patterns, for example, how to design successful attack strategies. At the same time, issues can be noticed, such as overcrowding and breakdowns. Another is the connection with opponents, agents can learn competitive responses based on the opponents' behavior. Opponents are modeled as part of the system; each agent's critic considers the actions and positions of opponents. It helps agents to understand and interpret tactical countermeasures, such as exploring weak zones, planning successful passing.

In the simulation environment, it helps coaches and educators to replicate realistic game environments and how team response under different strategies. Coaches can test the influence of tactical changes and observe the actions from agents of opponents. In the pedagogical perspective, the simulation provides detailed visualized feedback from historical realistic gameplay. It offers coaches to test different strategies based on the simulation, and observe the responses from the agents.

Figure 5

Research Pipeline



There is one significant limitation of the McGill Hockey Player Tracking Dataset (MHPTD) in this research, it is the restricted field of view from the moving camera. The camera is always tracking the movement of the puck and game; it cannot provide the full-size rink view which can offer view on the entire ice hockey field. As a result, there are observation bias, making it difficult to locate the exact location of objects, in using Yolov11 for object detection, which is the relative location, not the exact location of detection. Moreover, in training of the MADDPG, the relative locations of agent exert negative influence on the accuracy of result. The moving camera also provides challenges on Re-Identification (Re-ID) of objects, especially in the situation where the camera follows the puck or zooms in. Individual objects, such as the players might temporarily disappear from the camera, it can cause ID switching or loss of tracking.

The ideal situation for future research could be utilized using a full-size camera, this kind of camera is able to catch the entire rink view. At the same time, each player can be photographed to offer more details visual information, such as body orientation, pose dynamics, and team number, which can enhance the process of Re-ID. For example, we can train the photographs of Teemu Selänne to develop the personalized player recognition module, enable ByteTrack to track him with body features and pose. When it applies to all players, it will enhance accuracy of object detection and tracking of players.

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Exploring Future Teachers' Acceptance of Wearable Technologies for Anxiety and Stress Management: A TAM-Based Study

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Abstract

This study employs Davis's (1989) Technology Acceptance Model (TAM) to investigate future teachers' perceptions of wearable technologies for anxiety management. Wearable devices capturing physiological data are increasingly prominent in educational and psychological literature. Wearables can be worn on the wrists and hands for non-invasive, real-time monitoring of signals such as heart rate and electrodermal activity. Modern-day pressures create unique stressors for future educators, including balancing training and assessment demands, administrative burdens, and uncertainty regarding future positions. Accordingly, such devices offer innovative solutions by monitoring early physiological indices and prompting awareness. Understanding the technological adoption factors is essential for initiating their use in educational settings. The sample consists of student teachers enrolled at the University of Palermo, responding to a questionnaire based on TAM constructs: perceived usefulness, perceived ease of use, attitudes towards and intention to use. Items examine pre-service teachers' perceptions of wearable technologies for managing anxiety related to being a student teacher. The research design uses multiple regression techniques to explore factors predicting intentions to use wearable technologies. Results can offer insights into the practical implications for developing targeted teacher training programs that address concerns surrounding the usefulness and usability of wearables. Thus, informing strategies to enhance usability, like designing intuitive interfaces, alongside awareness initiatives such as interactive workshops to promote understanding and engagement.

Keywords: wearable technology, teacher wellbeing, technology acceptance model, pre-service teachers, stress management

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Introduction

The teaching profession is increasingly related to high levels of anxiety and stress. Pre-service teachers, often navigating new professional environments as well as the demands of their training courses, experience unique stressors and a vulnerable period of uncertainty and new challenges. As a result of this, attention has turned to seeking new methods of promoting emotional well-being amongst future educators.

Wearable technologies offer innovative methods of managing psychological stress through real-time monitoring and biofeedback of physiological states and markers of stress. Devices with specialised biosensors provide users with physiological data that can be used to manage these states through self-regulation techniques. When integrated successfully, these tools could enable pre-service teachers to manage their stress proactively, thus supporting self-regulation and self-management of anxieties at a time when wider, institutional support may not always be readily available.

Despite the growing body of research surrounding such wearable devices within the contexts of education and mental healthcare, there are limited implementations of these devices within teacher and, specifically, teacher training contexts. An important foundation of any integration of new technologies in new contexts is an understanding of the perceptions of the future users, in order to understand factors that may motivate adoption. This study explores pre-service teachers' acceptance of wearable technologies using the Technology Acceptance Model ([TAM], Davis, 1989), offering new insights into the perceptions of future educators of wearable technologies for anxiety and stress management.

Background

The role of the teacher has evolved significantly in recent years; teachers now have responsibilities beyond solely delivering subject content and regular teaching activities, including emotional support for students and the efficient use of ever-changing and new technologies (*UNESCO*, 2024). These changes have not only impacted teacher stress levels due to intensified workloads, but also due to the new emotional demands that come with being a teacher in the present climate. It has been reported that burnout is increasing (Turner & Garvis, 2023), and such burnout contributes to teachers leaving the profession, with attrition levels also on the rise. The teaching profession today requires teachers to provide a significant amount of emotional labour, where educators are now having to not only focus on their already demanding teaching duties, but also look to regulate and coregulate emotions with students in order to provide safe emotional environments, especially in the context of inclusive classrooms. In a systematic review, Kariou et al. (2021) found a significant association between emotional labour and teacher burnout, which has also been linked to reduced teaching efficacy and early departure from the profession. Furthermore, teacher emotions impact not only the teacher's own well-being but also the entire classroom environment. Teacher emotions have been found to influence student outcomes (Pi et al., 2022), academic achievement (Madigan & Kim, 2021) and teaching efficacy (Aldrup et al., 2024). Moreover, associations have been revealed within student-teacher interactions and student wellbeing (Braun et al., 2020; Frenzel et al., 2021), further highlighting how positive emotional interactions support co-regulation and thus self-regulation development processes for students. Sáez-Delgado et al. (2022) demonstrate that emotionally regulated teachers create emotionally safer learning environments, supporting students' social-emotional growth. In turn, this could foster improved student behaviour, engagement, and outcomes.

Whilst there exists a body of research for anxiety and stress within in-service teachers, research regarding anxiety in pre-service teachers remains limited, despite this being a known time of increased vulnerability (Gorospe, 2022) in which pre-service teachers face additional pressures, including feelings of unpreparedness, anxiety over future careers, and performance in new placement positions. These factors all contribute to heightened anxiety levels before they even begin their professional, in-service careers, and whilst they are still developing their professional identities, meaning that these early experiences can have potentially long-lasting effects on their confidence in classrooms and professional environments. Given the aforementioned importance of emotional regulation within the teaching career, teacher education programs signify an important period for the development of healthy anxiety and stress management skills. Early intervention could therefore help prevent burnout and improve teacher resilience and retention, and for this reason, the present study focuses on pre-service teachers.

In order to address pre-service teacher anxiety and stress, it is first important to be able to successfully measure it. Emotion is a complex concept to accurately measure, and self-report data, when used alone, comes with the risk of bias. Data triangulation includes the use of multiple sources or methods to enhance the credibility and validity of findings (Noble & Heale, 2019; Sciberras & Dingli, 2023). Within the digital era, new technologies offer opportunities to improve and support the well-being of teachers throughout their careers. Technologies such as wearable devices can measure physiological markers of anxiety, including electrodermal activity (EDA), heart rate, and heart rate variability (HRV), offering objective measurements and insights into stress (Meijer et al., 2023). While these tools are at present mainly used within student samples (Betancourt et al., 2017), for concepts such as behaviour prediction or attention monitoring, there is a potential for applying these to teacher contexts, especially for pre-service teachers who may benefit from such insights. Combining subjective self-reports with objective physiological measures from wearables could provide a more accurate comprehension of teacher emotions and stress.

From a critical disability studies perspective, technologies should be developed with intentionality and inclusivity. Researchers have raised attention to the need to critically inquire into the field of assistive technologies, arguing for the design of technologies with the users, ensuring that diverse needs and contexts are addressed through conscious and coproduction approaches (Mankoff et al., 2010; Williams & Gilbert, 2020). For pre-service teachers, involving their perceptions for guiding the design of wearable-supported stress management tools and integrations into curriculums could increase usability, acceptance, and relevance. Therefore, collecting the perceptions of pre-service teachers and understanding what would guide their adoption of such technologies is a crucial foundational step. The Technology Acceptance Model ([TAM], Davis, 1989), an adaptation of the Theory of Reasoned Action, has been used within educational contexts (Antonietti et al., 2022; Dele-Ajayi et al., 2019; Scherer et al., 2018) and stands as a valid tool for understanding the factors that impact technology adoption.

Teacher burnout is a growing global issue, the shift to teaching in a digital era has brought new possibilities for supporting teacher well-being through technologies such as wearable devices capable of monitoring physiological stress markers. When combined with data triangulation and inclusive design principles, such technologies could enhance both the measurement and management of pre-service teacher anxiety. However, it is important to understand how pre-service teachers perceive and would potentially adopt these tools. This gap underscores the rationale for the present study, which examines pre-service teachers'

acceptance of wearable technologies for anxiety and stress management using the constructs of the Technology Acceptance Model (Davis, 1989).

Research Questions

- How do future teachers perceive wearable technologies for anxiety management?
- What factors predict future teachers' intentions to use such technologies?
- Using the constructs of the Technology Acceptance Model (Davis, 1989), how do perceived usefulness, ease of use, and attitudes towards use influence participants' behavioural intentions to use wearables in the context of anxiety and stress management in teacher training?

Methodology

Research Design

A quantitative, cross-sectional survey design was employed to assess participants' acceptance of wearable technologies through TAM constructs. Participants were introduced to the concept of wearable devices for measuring physiological markers of anxiety and stress, and thus their potential use for wellbeing management, by a brief talk from the researcher. Participants were also briefed about different types of applications of wearable technologies that they may be familiar with already. Participants were then invited to complete an online questionnaire based on the validated TAM items.

Sample

The study utilised a non-probabilistic, convenience sampling method to gather participants, targeting students enrolled in the Primary Sciences Education program at the University of Palermo. It was made clear that participation was completely voluntary, and consent was gained in order to collect responses and process results. After data cleaning, the sample consisted of 596 pre-service teachers, 96.2% of the sample identified as female, whilst 3.1% identified as male, and 0.7% preferred not to disclose. Regarding the age of the participants, 86.2% were in the 18-24 age range, 10.2% in the 25-34 age range, 2.6% in the 35-44 age range, whilst the remaining were aged 45 or above.

Measures

The study employed the Technology Acceptance Model (Davis, 1989) to assess participants' perceptions of wearable technologies for anxiety and stress management in the context of teacher training. The TAM is a widely used theoretical framework for understanding how users accept and use technology, it suggests that perceived usefulness and perceived ease of use of the specific technology influence individuals' attitude towards use, which in turn affects their behavioural intentions to use said technology. Thus, these factors are purported to impact the likelihood that the technology would be adopted for actual use. Perceived usefulness focuses on how much the individual believes that the technology, in this context- wearable technologies, will improve their performance or results. Perceived ease of use refers to how much effort the person believes using the technology would be, whether it would be easy or difficult to use and learn to use. In the present study, the TAM framework was adapted to the specific context of wearables for anxiety and stress management. Responses were collected using a 7-point Likert scale ranging from strongly disagree to strongly agree. The questionnaire was split into the

TAM subsections. Perceived Usefulness (PU) included items such as "using a wearable device would help me manage my anxiety." Perceived Ease of Use (PEOU) included items such as "I think wearable devices like Fitbits or Apple Watches would be easy to use." Attitudes Towards Use (ATU) included items such as "I think using a wearable device to monitor stress would be a positive experience." Behavioural Intentions (BI) included items such as "If available, I would use a wearable device to monitor my stress throughout my teaching career." The questionnaire was structured in this way to ensure that the items reflected the theoretical constructs and structure of the TAM while being relevant to the specific context of wearable devices and technologies for stress and anxiety management in the teacher training context. The questionnaire was designed and results analysed in English but translated into Italian by a native Italian speaker in order to disseminate the questionnaire to the Italian participants.

Data Analysis

Statistical analysis was managed using Jamovi 2.2.5, utilising multiple regression to assess the predictive values of PU, PEOU, and ATU on BI to use wearable technologies for anxiety management in a teacher training context. PU, PEOU and ATU were input as the independent variables, with BI as the dependent variable. This approach enabled the study to assess the extent to which the participants' perceptions of usefulness and ease of use impacted their attitudes, and thus behavioural intention, towards the use of wearables for anxiety management. After data collection, the raw data were prepared and cleaned, including screening for and handling of missing values. Then, before conducting the regression analysis, various assumption checks were carried out in order to affirm the reliability of the results.

Results

A multiple regression analysis was conducted to examine the extent to which the independent variables: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Attitude Toward Use (ATU) predict the dependent variable, Behavioural Intentions (BI) to adopt wearable devices for anxiety and stress management. Before interpreting the regression results, the necessary assumption checks were carried out. The plots of standardised residuals against predicted values showed no discernible or funnel patterns, supporting the assumption of homoscedasticity. Normality of residuals was examined through a Q-Q plot showing the standardised residuals against theoretical quantities; there were no substantial or sharp deviations from the line, thus confirming that residuals were normally distributed. Multicollinearity among the predictors was evaluated using the Variance Inflation Factor (VIF) and Tolerance statistics. All VIF values were below 3, and all Tolerance values were above 0.3, indicating no multicollinearity concerns. The Durbin-Watson statistic (DW = 1.96) also suggested no significant autocorrelation. As well as the assumption checks, initial relationships between variables were also examined through visual inspection of scatterplots. The scatterplots indicated that the relationships between BI and predictors ATU and PU were linear, satisfying the assumption of linearity. However, the scatterplot inspection for PEOU and BI was not showing a clear linear pattern, suggesting a potentially weak or non-linear relationship.

Regarding the regression results, the overall model was strongly significant, [$F(3, 592) = 764.00$, $p < .001$], accounting for 79.5% of the variance in BI ($R^2 = .795$, adjusted $R^2 = .794$) (full output in Table 1). The large effect size demonstrates that the TAM predictor variables

together provide a strong explanation of individuals' intentions to use wearable technologies for anxiety and stress management.

Table 1
Model Fit Measures

				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.891	0.795	0.794	764	3	592	< . 001

Note. Models estimated using sample size of $N = 596$

Specific inspection of the individual predictors (Table 2) revealed that Attitude Toward Use (ATU) was the strongest predictor of BI ($\beta = 0.70$, $p < .001$), suggesting that more positive attitudes toward wearables were strongly associated with greater behavioural intention to use them. Perceived Usefulness (PU) was also a significant predictor ($\beta = 0.29$, $p < .001$), meaning that users who perceived the wearables as helpful and beneficial were more likely to have the intention to use them. However, reflecting the non-linear relationship revealed by the scatterplots, Perceived Ease of Use (PEOU) did not significantly predict BI when controlling for ATU and PU ($\beta = 0.05$, $p = .093$), suggesting that ease of use may not directly influence behavioural intention.

Table 2
Model Coefficients - BI

			95% Confidence Interval			
Predictor	Estimate	SE	Lower	Upper	t	p
Intercept	-0.4023	0.1508	-0.69846	-0.1061	-2.67	0.008
ATU	0.7008	0.0334	0.63511	0.7665	20.95	< .001
PEOU	0.0454	0.0269	-0.00751	0.0982	1.68	0.093
PU	0.2854	0.0352	0.21622	0.3546	8.10	< .001

However, PEOU may affect BI to use wearables indirectly through attitudes; therefore, a separate regression using ATU as the dependent variable and PEOU as the independent predictor variable was conducted. It was found that PEOU was a significant predictor of ATU ($\beta = 0.19$, $p < .001$), thus supporting the concept that PEOU is a factor to be considered for promoting positive attitudes towards the use of wearables. This was also the case when PEOU was the independent, predictor variable and PU was the dependent variable ($\beta = 0.34$, $p < .001$). These results show that while ease of use may not directly predict behavioural intention in this context, it could have indirect effects, through influencing attitudes and perceived usefulness.

Discussion

The present study sought to examine future teachers' perceptions on the use of wearable technologies for anxiety and stress management in the context of teacher training. Overall, the findings support the predictive value of the independent variables within the TAM in the context of wearable technologies. The strong model fit (R^2 = .795) indicates that TAM variables together account for a significant proportion of variance in behavioural intention to use wearable technologies for anxiety management among pre-service teachers. The findings suggest that future teachers are more likely to adopt wearable devices if they are aware of and recognise their potential benefits, holding more positive attitudes toward their use.

Attitudes Towards Use emerged as the strongest predictor of behavioural intentions to use, with a β value of 0.70. This finding highlights the central role of the evaluative judgments in promoting technology adoption decisions as proposed by Davis (1989). Looking towards the specific anxiety management context of the present study, this suggests that fostering positive attitudes towards wearables for this use, such as through workshops or demonstrations of efficacy within wellbeing management strategies, could be an important part of the curriculum for increasing adoption among teachers in training.

Perceived Usefulness was also a significant predictor of behavioural intentions to use, with a β value of 0.29, demonstrating that future teachers' beliefs about the technology's usefulness in supporting anxiety management influence their adoption intentions. The educational context may especially amplify the importance of usefulness, as teachers-in-training may perceive wearables as tools that can support their professional well-being, thus enhancing their teaching effectiveness (Burić et al., 2020).

On the other hand, Perceived Ease of Use did not directly predict behavioural intentions to use wearables, with an insignificant (p = .093) β value of 0.05, when controlling for PU and ATU. However, following analyses demonstrated significant indirect effects of PEOU on BI through its associations with ATU and PU. This indirect influence aligns with previous research that suggests that PEOU often influences behavioural intention indirectly by shaping users' attitudes (Lazim & Ismail, 2021). In the specific case of wearables for anxiety management, this implies that while ease of use alone may not directly influence behavioural intentions, workshops for future teachers that demonstrate how to use such wearable devices could enhance perceived benefits and positive attitudes, thereby indirectly encouraging adoption. The weaker direct influence of PEOU may also be related to the demographic and contextual factors. Given that the sample of pre-service teachers was generally a younger sample, it is likely that a large part of the sample was more familiar with mobile and wearable technologies already, thus the ease of use may be less considered in comparison to the technology's usefulness and their attitudes toward it. Age was also raised by Rauschnabel and Ro (2016) as an influencing factor, confirming that the age of participants is something that should be considered in more in-depth analyses of the present data when looking at factors influencing behavioural intentions to use. For the younger sample who may be more digitally confident individuals, usability may matter less than effectiveness.

In the present study's context, future educators appear to value the effectiveness and how well wearables could help manage their stress, over ease of use. These findings have several practical implications. Teacher education programs seeking to integrate wearable technologies for anxiety and stress management should not only focus on enhancing technological readiness but also work to prioritise interventions that clearly communicate the

benefits and efficacy of these devices. Demonstrating usefulness through hands-on workshops and explanations of real-world applications of wearable technologies for mental health monitoring, in order to facilitate positive user attitudes, could foster greater adoption intentions. Such positive attitudes towards use were shown to be the most important factor; thus, positive framings of such technologies are crucial for integration. Furthermore, successful integration could include providing information about how physiological data relates to emotional states and, thus, mental health well-being strategies. Curriculums could include a combined approach that also looks towards promoting positive wellbeing, offering information to the students about the value of physiological signals, and the strategies that come with being aware of these, such as breathing techniques and mindfulness.

Overall, the findings align with TAM theory, which suggests that usefulness and ease of use shape intention both directly and indirectly through influencing attitudes towards use. The dominance of attitude as the key predictor emphasises the importance of users' overall positive feelings toward wearable devices in encouraging adoption, while perceived usefulness also plays a substantial, independent role. In summary, the regression analysis supports the TAM framework by demonstrating that attitudes and perceived usefulness are significant, meaningful predictors of behavioural intention to use wearable anxiety and stress management technologies. The model's robustness was ensured through thorough assumption checks, which allow for these conclusions to provide a strong basis for future research and practical applications in technology adoption.

Limitations and Future Recommendations

The study has several limitations which should be acknowledged. Firstly, the demographic of the sample, consisting of mostly young pre-service teachers at a single Italian university, limits the generalizability of the findings. Though the results are useful for the specific context of Italian future teachers, future research should include more diverse populations across different educational and cultural settings to validate these results. Also, as mentioned in the discussion, the sample being younger could have also impacted the results, in that PEOU has been suggested to be less of a concern for more digitally competent, younger groups. Future research should consider the impact of age as well as the relationship between the level of previous experience with wearable technologies, as this may affect perceptions. Lastly, future research should thematically analyse perceptions that future teachers have regarding wearable technologies in order to capture and address any concerns and consider suggestions future teachers have regarding features and necessary training for effective implementation, thereby using a coproduction approach. Future research could also materialise the aforementioned hands-on workshops with future teachers in order to allow the students to trial the wearables.

Conclusion

The present study reinforces the applicability of Davis' (1989) Technology Acceptance Model in understanding pre-service teachers' acceptance of wearable technologies for anxiety management. Attitudes and perceived usefulness play crucial roles in shaping behavioural intentions, with perceived ease of use influencing intention indirectly. These insights contribute to a growing body of research on perceptions of the users of innovative technologies in educational contexts. The strong predictive power of both perceived usefulness and attitudes towards use suggests that if wearable technologies are shown to be beneficial for teacher wellbeing, they may be more widely accepted as useful tools.

Integrating wearable technology into teacher education programmes offers pathways to more emotionally resilient and equipped educators. As burnout and stress continue to challenge the profession, it is important to look towards strategies and personal tools for novice teachers.

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Advantages and Disadvantages of Non-native Mandarin Chinese Instructors: Student Perceptions at the University of Botswana

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Abstract

The teaching of Mandarin Chinese at the University of Botswana has been ongoing for over a decade. Initially, it was predominantly taught by native Mandarin Chinese instructors, but in recent years, local Mandarin Chinese instructors have also taken on this role. Despite this shift, limited research exists on student perceptions of both native and non-native Mandarin Chinese instructors. This qualitative study investigates these perceptions, focusing on the advantages and disadvantages of learning Mandarin Chinese from each type of instructor. Data were gathered through questionnaires administered to sixteen students enrolled in Mandarin Chinese courses at the University of Botswana. Using content analysis, key themes were identified and categorised. The findings highlight several perceived advantages of local Mandarin Chinese instructors, including their ability to use students' first languge to explain complex concepts, adapt teaching styles to suit students' learning needs, offer clear explanations with relatable examples and understand students' challenges due to shared cultural or linguistic backgrounds. Conversely, native Mandarin Chinese instructors are perceived as advantageous in their ability to provide accurate pronunciation and tonal instruction, and impart deep cultural knowledge and authentic language usage. However, the disadvantages of one group often align with the advantages of the other. The study has significant implications for classroom practices and teacher professional development, suggesting that a balanced approach incorporating strengths from both native and non-native Mandarin Chinese instructors may optimise the learning experience.

Keywords: Mandarin Chinese, University of Botswana, native, non-native, instructors

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Introduction

The teaching of Mandarin Chinese as a foreign language has gained significant momentum globally, including in many African countries, as part of broader efforts to strengthen diplomatic, economic, and cultural ties with China (King, 2013; Nel, 2016). The expansion is closely linked to China's soft power strategy, particularly through the establishment of Confucius Institutes (CIs), which have become central to promoting Chinese language and culture abroad (Gil, 2017; Ng, 2023). In Africa, the proliferation of CIs has facilitated the institutionalisation of Mandarin instruction in higher education, often accompanied by scholarships, cultural exchanges, and academic collaborations (Bodomo et al., 2024).

At the University of Botswana, Mandarin Chinese has been taught for over a decade, primarily under the auspices of partnerships with Chinese institutions such as the Confucius Institute. These partnerships have historically relied on native-speaking instructors, who are often perceived as ideal language models due to their cultural authenticity and linguistic intuitions (Medgyes, 1994; Walkinshaw & Duong, 2014). Native speakers are also seen as custodians of cultural knowledge, capable of providing immersive and context-rich instruction (Sung & Poole, 2016).

In recent years, however, the instructional profile has gradually diversified to include locally trained non-native instructors. These instructors, often graduates of Chinese language programmes and trained through formal academic pathways, bring a unique pedagogical approach informed by their shared cultural and linguistic background with their students. Research suggests that non-native language teachers can serve as effective role models because they have personally navigated the challenges of acquiring the target language, making their strategies relatable and inspiring to learners (Calafato, 2019; Llurda & Calvet-Terre, 2024). Moreover, their presence contributes to the sustainability and localisation of Chinese language education in African contexts (Raletsatsi, 2025).

Despite the increasing presence of both native and non-native Mandarin Chinese instructors in higher education institutions across Africa, there is a noticeable gap in the literature concerning student perceptions of these two instructor types, particularly in the Southern African context. Student perceptions are a key component in evaluating instructional effectiveness, as they influence motivation, engagement, and overall learning outcomes (Cudney et al., 2025). Studies have shown that learners often associate native speakers with linguistic accuracy and cultural depth, while valuing non-native instructors for their empathy, clarity, and shared learning experiences (Benke & Medgyes, 2005; Sung & Poole, 2016).

At the University of Botswana, where the Chinese Studies programme continues to grow, understanding how students perceive native versus non-native instructors is both timely and essential. This study aims to explore students' perceptions of the advantages and disadvantages of non-native Chinese instructors at the University of Botswana. Specifically, it investigates how learners compare the teaching effectiveness, cultural insight, linguistic accuracy, and overall classroom engagement offered by native versus non-native instructors. The research seeks to contribute to the broader discourse on teacher identity in foreign language education and inform future staffing and training policies within the Chinese Studies programme by foregrounding the student voice.

Literature Review

Over the past three decades, scholarly interest in non-native speaker teachers (NNSTs) has expanded significantly, particularly in the field of English language education (Selvi et al., 2024; Wang & Mason, 2023). According to Calafato (2025), this body of research has explored both the pedagogical strengths and the challenges faced by NNSTs in comparison to native speaker teachers (NSTs). While early perspectives tended to idealise native speakers as the ultimate language models (Medgyes, 1992; Phillipson, 1992), more recent research has taken a more balanced view, recognising that NNSTs bring unique advantages to the classroom (Selvi et al., 2024).

One of the most influential frameworks in this area is Medgyes' (1992) Native/Non-Native Teacher Model, which posits that NSTs and NNSTs differ systematically in their language proficiency, teaching styles, and attitudes toward learning, but that these differences are complementary rather than hierarchical. According to the model, NSTs typically excel in providing authentic linguistic input, cultural depth, and idiomatic usage, whereas NNSTs often have heightened metalinguistic awareness, can anticipate learner difficulties, and are adept at using the learners' first language (L1) to scaffold understanding. This theoretical perspective underscores the value of viewing both groups as equally important contributors to language education, depending on the context and learning goals.

Numerous empirical studies support Medgyes' propositions, showing that NNSTs often possess a heightened metalinguistic awareness, which enables them to explain grammatical rules clearly and anticipate learner difficulties (Kamhi-Stein, 2009; Llurda, 2005). NNSTs' own experiences as language learners make them particularly empathetic toward students' struggles, allowing them to offer tailored strategies that address common pitfalls (Braine, 2005; Thompson & Fioramonte, 2012). Moreover, NNSTs can use students' L1s to clarify complex concepts, thus enhancing both comprehension and engagement, particularly in multilingual classrooms (Calafato, 2019; Carless, 2006). These capabilities are especially relevant in contexts where teachers and students share similar linguistic and cultural backgrounds, enabling culturally responsive pedagogy (Mahboob, 2010).

Despite these strengths, NNSTs have historically faced negative perceptions regarding their linguistic competence, particularly in pronunciation, fluency, and depth of cultural knowledge. These perceptions are linked to the ideology of "native-speakerism," a bias that positions native speakers as the ideal teachers (Holliday, 2006; Moussu & Llurda, 2008). Such attitudes can undermine the professional credibility of NNSTs, affecting hiring, recognition, and student perceptions (Park, 2012; Revesz & Medgyes, 1994). Institutional policies or market preferences often reinforce these biases, even where evidence of teaching effectiveness points in the opposite direction.

According to Wang and Mason (2023), while most research on NNSTs has focused on English language education, much less attention has been given to their role in teaching other global languages such as Mandarin Chinese. Mandarin is increasingly taught worldwide, including in African nations such as Botswana, yet little is known about how NNSTs are perceived in these contexts (Gu et al., 2021; Llurda & Calvet-Terre, 2024). Existing studies tend to focus on the personal trajectories of NNSTs, emphasising the effort required to achieve near-native proficiency and the transformative nature of their learning journey (Liu & Wang, 2018; Zhang & Zhang, 2018), but seldom examine student perceptions or comparative classroom effectiveness.

In Botswana, Mandarin is emerging as a strategic language due to growing Sino-African relations (Masule & Raletsatsi, 2020). The Chinese Studies Programme at the University of Botswana employs both native instructors from China and local non-native instructors. Native instructors are praised for providing authentic linguistic input and cultural insights (Walkinshaw & Duong, 2014), yet cultural distance and limited knowledge of students' L1 can sometimes reduce teaching effectiveness (Lorenz et al., 2021). Conversely, local NNSTs, often Batswana who learned Mandarin as a second or foreign language, share cultural and linguistic backgrounds with their students and may be better equipped to mediate between Setswana, English, and Mandarin (Raletsatsi, 2025). This cross-linguistic mediation, combined with personal experience of learning Mandarin, positions them well to scaffold beginners through tonal challenges and the complexities of the writing system.

Despite these potential advantages, there is a scarcity of empirical studies examining the pedagogical effectiveness and student perceptions of NNSTs in Mandarin instruction within the African context. Raletsatsi (2025) explored the perceptions of local Mandarin instructors, the challenges they face, and how their teaching compares to that of native speakers.

Grounded in Medgyes' (1992) theoretical framework, this research contributes to broader debates on teacher identity, equity in language education, and the localisation of language teaching in higher education. As Mandarin spreads globally through Confucius Institutes and university partnerships, understanding how to train, support, and integrate local NNSTs will be essential for ensuring both sustainability and cultural relevance in language programmes.

Methodology

This study adopted a qualitative research approach to examine students' perceptions of both native and non-native Mandarin Chinese instructors at the University of Botswana. The participants consisted of sixteen Chinese Studies Programme students. To capture their perspectives, open-ended questionnaires were administered, allowing for detailed and reflective responses.

The open-ended questions explored students' perceptions of the strengths of both local and native Mandarin Chinese instructors, as well as their comparative views on the instructional approaches used by each group and they are as follows:

1. How do students perceive the specific strengths that local (non-native) Mandarin Chinese instructors bring to the classroom?
2. What advantages do students associate with native Mandarin Chinese instructors?
3. How do students compare the teaching approaches of native and non-native instructors?

The data collected were analysed using qualitative content analysis, which involved systematically coding the responses to identify recurring patterns, categories, and themes. This method was chosen to facilitate an in-depth understanding of how students interpret and evaluate their learning experiences with instructors of different linguistic and cultural backgrounds.

Findings

Several themes emerged from the content analysis of the questionnaires, which are outlined below.

Perceived Advantages of Local Instructors

Use of Students' First Language (L1) to Explain Complex Concepts

Students consistently reported that local instructors' ability to incorporate students' native language Setswana significantly facilitated comprehension of challenging Mandarin grammar and abstract ideas. One participant noted, "I found it easier to understand difficult grammar points when they were explained in Setswana because it helped me relate new concepts to what I already knew." Others expressed that the explanations reduced confusion and created a less intimidating learning environment, encouraging them to ask questions more freely.

Adaptation of Teaching Styles to Suit Students' Learning Needs

Participants appreciated the flexibility local instructors demonstrated in modifying teaching approaches based on student progress and needs. One student remarked, "Our lecturer often changes the way lessons are delivered depending on how well we are following." Another one said, "I appreciate that the lecturer doesn't rely only on one teaching method." The use of varied instructional methods such as games and role-plays was seen as beneficial in addressing diverse learning preferences.

Clear Explanations With Relatable Examples

Local instructors were praised for their use of culturally relevant and relatable examples, which helped students grasp and retain new vocabulary and concepts better. One participant said, "The lecturer always gives examples that relate to our daily lives, which makes it easier to understand and remember new vocabulary." Students also indicated that drawing parallels between Mandarin language elements and familiar aspects of daily life in Botswana made learning more meaningful. One student explained, "I learn better when the lecturer links Mandarin phrases to things we experience here, like local customs or Setswana sayings." Other students observed that, examples grounded in common social contexts, such as family roles and school routines, enhanced understanding.

Understanding Students' Challenges Through Shared Cultural and Linguistic Backgrounds

The shared cultural and linguistic background between local instructors and students fostered empathy and patience, which students found encouraging. One student responded, "Our lecturer understands the difficulties we face because they have experienced similar language barriers themselves." Several participants also highlighted that local instructors' personal experiences with similar language barriers enabled them to anticipate and address common difficulties effectively. As one student observed, "It helps that the lecturer can relate to our struggles because they speak Setswana too, so they explain things in a way that makes sense to us." The participants further emphasised that this cultural affinity contributed to a supportive and relatable learning atmosphere.

Perceived Advantages of Native Instructors

Ability to Provide Accurate Pronunciation and Tonal Instruction

Students consistently highlighted the clarity and naturalness of native instructors' pronunciation as a key benefit to their language acquisition. One participant remarked, "The native instructor's pronunciation is very clear and natural, which helps me learn the correct tones and sounds from the start." Others emphasised that hearing accurate tones and intonation from a native speaker made it easier to imitate and develop authentic Mandarin speech. For instance, one student said, "I find it easier to imitate the tones when the lecturer speaks, it makes my Mandarin sound more authentic." Additionally, students highlighted that they valued the immediate corrective feedback native instructors provided on difficult tones, which significantly enhanced their speaking skills.

Imparting Deep Cultural Knowledge

The contribution of native instructors in conveying rich cultural insights was highly regarded by students. Many noted that learning about Chinese festivals, traditions, and social customs added meaningful context to their language studies. As one student explained, "I appreciate how the teacher explains the cultural background behind idioms and expressions, helping me understand their real-life usage." Students further expressed that native instructors brought authentic cultural perspectives that extended beyond textbook knowledge, enriching their overall learning experience.

Authentic Language Usage

Students valued the exposure to everyday Mandarin language and contemporary slang provided by native instructors. They stated that this exposure helped them grasp how Mandarin is used in real-life situations across China. One participant shared, "The native lecturer uses everyday language and sometimes even slang that helps me understand how Mandarin is really spoken in China." Students further acknowledged that the inclusion of real-life conversations and current expressions made lessons more practical and engaging, preparing students to communicate more confidently outside the classroom setting.

Comparative Disadvantages

Students' responses revealed that the disadvantages of one group of instructors often reflect the advantages of the other, emphasising a complementary dynamic rather than a hierarchical one.

Limited Use of Students' First Language by Native Instructors

Several students indicated that native Mandarin Chinese instructors faced challenges in explaining complex concepts due to their limited proficiency in students' first language which is mainly Setswana. They stated that this sometimes resulted in confusion or reduced engagement. One student noted, "Sometimes the native lecturer explains things only in Mandarin, and I get lost because I don't fully understand the grammar yet." Another shared, "It would be easier if they could also explain in Setswana, especially when introducing something new, and considering that some of them do not speak good English."

Lack of Native-Like Pronunciation From Local Instructors

While local instructors were appreciated for their clarity and accessibility, some students expressed concern about their pronunciation and tonal delivery. One student remarked, "Our local teacher is very good at explaining, but their pronunciation is not always like what I hear from native speakers." This suggests that while local instructors excel in comprehension and support, they may fall short in modelling native-level speech, which is critical for oral fluency.

Reduced Cultural and Linguistic Authenticity in Non-native Instruction

Students also pointed out that local instructors, despite their pedagogical strengths, sometimes lacked the depth of cultural insight and real-life language use that native instructors offer. As one student explained, "I sometimes wish we could hear how things are really said in China, especially with tones and slang." This was seen as a limitation for students seeking immersion in Mandarin as it is used in native-speaking contexts.

Less Flexible Teaching Approaches Among Native Instructors

Some students observed that native instructors tended to rely more on direct instruction and less on adaptive or student-centred methods. This sometimes led to a mismatch with students' learning styles. One participant stated, "The native instructor is good with pronunciation, but the way they teach doesn't always match how we learn." This reflects a perceived rigidity in instructional delivery, especially when compared to the more adaptable approaches of local instructors.

Discussion

This study set out to explore student perceptions of native and non-native Mandarin Chinese instructors at the University of Botswana. The findings reveal that students recognise distinct and complementary strengths in both groups, highlighting how each instructor type contributes uniquely to the Mandarin language learning experience.

Consistent with earlier research on the benefits of L1 use in second language acquisition (Cook, 2001; Turnbull & Dailey-O'Cain, 2009), students appreciated local instructors' ability to use Setswana to explain complex concepts. This use of the students' linguistic repertoire enabled more accessible instruction, reduced anxiety, and promoted deeper understanding, particularly at the beginner level. Local instructors were also valued for their adaptability in teaching styles, and their cultural and linguistic empathy, which allowed them to anticipate learner difficulties and respond with relatable examples. These findings support the growing recognition that non-native instructors often provide pedagogical advantages through shared sociolinguistic experiences with their learners (Medgyes, 1992).

On the other hand, students perceived native instructors as invaluable sources of linguistic and cultural authenticity, echoing Llurda's (2005) argument that native speakers serve as important models for pronunciation, tone, and idiomatic usage. The ability to model accurate pronunciation and correct tonal errors in real time was seen as a key asset of native instructors, particularly as tonal accuracy is a persistent challenge for Mandarin learners. In addition, students valued exposure to authentic language use and deep cultural insights,

which enhanced their understanding of Mandarin in real-world contexts and supported their intercultural competence.

However, the comparative disadvantages reported highlight the limits of relying exclusively on either instructor type. Native instructors' limited command of students' L1 sometimes hindered their ability to explain abstract or difficult content, while non-native instructors, despite their clarity and accessibility, lacked native-level pronunciation and deep cultural immersion. This mirrors the findings of Benke and Medgyes (2005), who argue that native and non-native instructors differ in their instructional strengths but are not inherently superior or inferior to one another.

Importantly, student feedback points toward the potential benefits of a blended or team-teaching approach, where the strengths of both instructor types are integrated. Such an approach would allow students to benefit from the linguistic accuracy and cultural depth of native speakers, while also drawing on the pedagogical flexibility and cultural relatability of local instructors. This model aligns with calls for inclusive language teaching practices that respect and strategically use both native and non-native speaker resources in the classroom (Selvi et al., 2024).

Overall, these findings contribute to the broader discussion of language teacher identity and effectiveness. They underscore the importance of not viewing native and non-native instructors in binary terms but rather recognising their complementary roles in the language learning process.

Limitations

Despite offering meaningful insights, this study has several limitations. The small sample size of sixteen students may not fully capture the diversity of experiences within the wider student body. Relying solely on self-reported questionnaire data also limits the depth and objectivity of the findings, as responses may be influenced by personal bias. Additionally, the study was conducted at a single institution, which restricts the generalisability of the results. Lastly, the focus on perceptions rather than actual language proficiency limits the ability to draw conclusions about instructional effectiveness.

Future research should consider involving a larger and more diverse sample across multiple institutions to improve generalisability. A mixed-methods approach that includes interviews, classroom observations, and performance assessments could offer a deeper understanding of the impact of instructor type on student learning outcomes. It would also be valuable to investigate how the integration of students' first languages affects long-term retention and communicative competence in Mandarin Chinese. Finally, comparative studies examining teacher training models for both native and non-native instructors could inform more effective pedagogical strategies.

Recommendations

Based on the insights drawn from student perceptions, the following recommendations are proposed to enhance Mandarin language teaching and learning at the University of Botswana.

1. Implement team-teaching or co-teaching approaches to combine the linguistic authenticity and cultural knowledge of native instructors with the pedagogical clarity and cultural relatability of local instructors.
2. Encourage local instructors to use Setswana strategically, especially for grammar instruction and abstract language explanations, to aid comprehension and reduce cognitive overload.
3. Offer continuous training for both native and non-native instructors. Native instructors, in particular, could benefit from cross-cultural communication training, learner-centred strategies, and use of multilingual resources.
4. Create teaching resources that blend Mandarin content with Setswana or Botswana cultural elements to enhance engagement and relevance.
5. Organise exchange programmes, virtual immersion sessions, and cultural talks or workshops by native speakers to deepen students' exposure to authentic language and culture.
6. Establish a system for regular feedback to monitor instructional effectiveness and respond to evolving student needs.

Conclusion

This study explored student perceptions of native and non-native Mandarin Chinese instructors at the University of Botswana, focusing on the perceived advantages and disadvantages of each group. Non-native instructors were valued for their ability to use students' first language to clarify complex concepts, adapt teaching styles, and provide culturally relevant explanations. Native instructors were recognised for their accurate pronunciation, tonal guidance, deep cultural knowledge, and idiomatic language use.

However, the study also revealed that each group's strengths often reflected the other's limitations. These findings point to the value of an integrated instructional model that draws on the strengths of both native and non-native instructors. Such a model could provide both linguistic authenticity and pedagogical clarity, leading to a richer and more balanced language learning experience.

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

The author acknowledges the use of Grammarly, an AI-assisted writing tool, for proofreading the manuscript. Its application was limited to correcting grammar and spelling, as well as rephrasing sentences to enhance accuracy and clarity.

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Greater Ambition, Broader Horizons: Building an AI Agents Platform for Teaching and Learning for Chinese Enhancement Courses, HKU

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Abstract

The integration of artificial intelligence (AI) in e-learning within the education sector reveals its transformative potential for enhancing teaching methodologies for both students and educators. To align with our university's AI-ready policy, our programme has adopted various ICT tools and strategies to improve accessibility and teaching efficiency, while also preparing both teachers and students for a technology-driven future. In this paper, we will discuss and share the experiences of leveraging AI tools to personalize teaching and learning pathways that facilitate immediate feedback and tailored content to address individual teaching and learning needs for both teachers and students. We introduced a six-tier pyramid of AI applications, ranging from basic chatbots for FAQs to advanced language models that adapt to the evolving educational landscape while equipping teachers with innovative tools. Evidence from implemented e-learning initiatives, such as virtual reality (VR) and artificial intelligence (AI), highlights the changing of pedagogical principles, and the challenges teachers and students encountered and are being solved. Through these adoptions, we can observe how teaching and learning are evolving to meet the demands of a technology-driven educational landscape.

Keywords: artificial intelligence, e-learning, teaching methodologies, personalized learning

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Introduction: Critical Pedagogical Shifts Under GenAI

The deep impact of Generative Artificial Intelligence (GenAI) on higher education is that it has fundamentally changed the teaching and learning practices in recent years. (Ahmad et al., 2021; Teaching and Learning Research Center, n.d.). It has become the key factor of classroom reform in the era of information 2.0 (Liu & Wang, 2020). Nowadays, GenAI is not merely a tool in helping students indulge in a novel learning experience itself, but also as a force reshaping the teacher's role (Gentile et al., 2023). As "teachers find themselves at the forefront of a revolution that demands not only a reimagining of pedagogical approaches but also a continuous commitment to professional development" (Cukurova et al., 2024, p. 4).

The recent advances in GenAI, particularly those conversational AI agents that enabling natural language understanding and generation, have created a new learning environment where machines communicate on human terms and support learning in novel ways (Li et al., 2024), thus allows students to gain greater potential in learning autonomy (Sari, 2023) and personalized learning opportunities through pseudo-life scenarios, whether on computer-based applications or in a virtual reality environment like Meta's Quest, Microsoft's HoloLens, or Apple's Vision Pro. Under this change, the role of the teacher is evolving from a sole knowledge transmitter to a collaborator (Kamalov et al., 2023), a mentor (Ghamrawi et al., 2024), and a coach (George, 2023). Beyond facilitating student-centered learning, teachers became designers and maintainers in a sustainable AI-assisted learning environment. This requires teachers to engage with AI as allies in providing AI tools that can enhance students' critical thinking, creativity, and lifelong learning.

Table 1
Critical Pedagogical Shifts

Traditional Role	**AI-Driven Role**
Knowledge transmitter	Adaptive learning pathway designer
Uniform assessment enforcer	Diagnostic feedback interpreter
Task execution supervisor	Cross-disciplinary task architect
Isolated skill evaluator	Holistic competence assessor

From Knowledge Transmitter to GenAI Agent Developer

As the University of Hong Kong aims to be AI-ready by September 2025, it is crucial to align with the university's AI policies by integrating Generative AI (GenAI) into the Chinese language courses offered by the Chinese Language Enhancement Programme (CLEP) under the School of Chinese.

Since 2023, CLEP has developed a number of AI tools to enhance teaching and learning activities by Dr. C.M. Chan and his team. These tools range from content creation, graphic design, communication skill development, brainstorming and strategy formation, modern and ancient language learning, to oral and video presentation support.

Figure 1

An AI Essay Feedback System for Students to Evaluate Their Writing Assignments



Note. Teachers can also utilize it to give periodic feedback on students' assignments.

Figure 2

An AI Poster System Is Designed to Help Students Create Their Poster Assignments

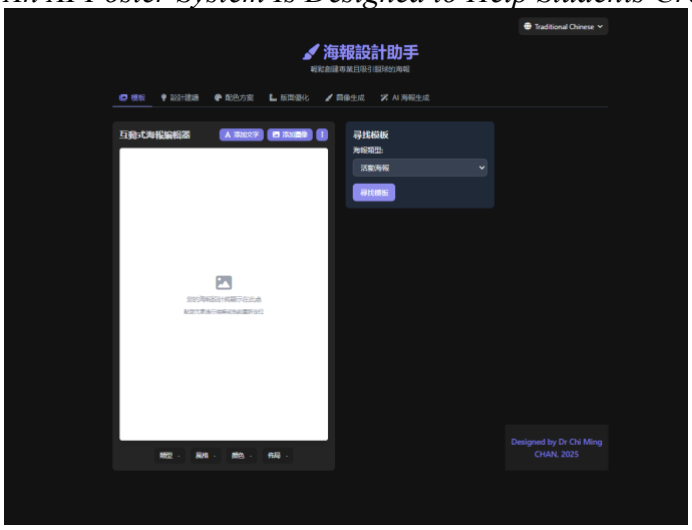
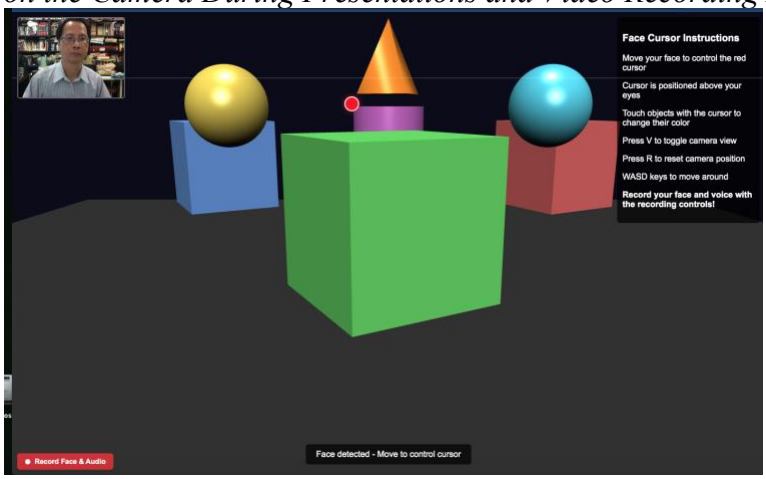


Figure 3

An AI-Powered Face-Checking System Is Designed for Training Students to Maintain Focus on the Camera During Presentations and Video Recording Assignments



Note. Student can control the red dot by moving his/her head in alignment with the device's camera to train the proper eye contact. This system also has a record function for students to review and improve their performance at a later time.

These AI tools broaden access to resources and break the constraints of interaction in a conventional classroom, thus promoting autonomy in the language learning process.

From RECTI to RECTI-AI Approach

Some of our CLEP courses, like CBBA9003 (Business Chinese) and CSSC9001 (Practical Chinese for Social Sciences Students) in CLEP, have adopted a comprehensive teaching model of RECTI (Revitalize, Enhance, Create, Transfer, and Integrate) in recent years to design the learning activities. The RECTI model provides a systematic training framework for enhancing students' proficiency in written, visual, and oral communication by consolidating, enriching, transferring, and integrating language knowledge into their disciplines. Teaching and learning activities are divided into five phases:

1. **Revitalize**: to identify and revitalize foundation knowledge and communication skills through exercises.
2. **Enhance**: to deepen students' understanding by providing specific resources to complete problem-solving tasks in simulated scenarios.
3. **Create**: to conduct interdisciplinary projects to integrate the usage of the Chinese language in various academic subjects.
4. **Transfer**: to apply language and communication skills in other professional contexts or other novel situations.
5. **Integrate**: to enable students to express complex concepts across their subject disciplines.

Since AI-assisted learning is mainstream in education in the future, it is necessary for the RECTI model to incorporate AI. The new Recti-AI model enhances language learning with innovative AI tools like chatbots, customized AI agents, and AI avatars to create specific learning content for various subjects. It changes the role of teachers, making them guides who help students adapt their learning practices. It addresses the growing need for effective communication skills that bridge technical and non-technical subjects (Olkhovaya et al., 2016).

The integration of AI technologies into RECTI improves learning materials and methods, encourages creative language use, facilitates knowledge transfer between different contexts, and incorporates language proficiency into complex disciplinary tasks. This integration not only enriches students' learning experience but also prepares them to excel in the world of AI-mediated communication and knowledge work, which is becoming more common. As a result, teachers transition from transmitters of knowledge to facilitators and designers in the AI-enhanced learning environment.

A Centralized Generative AI Platform for Language Enhancement: The VCLLCBOT Platform

To effectively implement AI strategy in CLEP, we also launched a project aimed at creating a comprehensive GenAI platform, VCLLCBOT, designed for widespread adoption across the university to help students enhance their Chinese language proficiency. This initiative focuses on providing a secure, flexible, and accessible environment for teachers and students to gain competence in AI, enhancing teaching, learning, and administrative processes (Remarks: VCLLC stands for Virtual Chinese Language Learning Centre).

Figure 4
VCLLCBOT: AI Agent Creation Platform

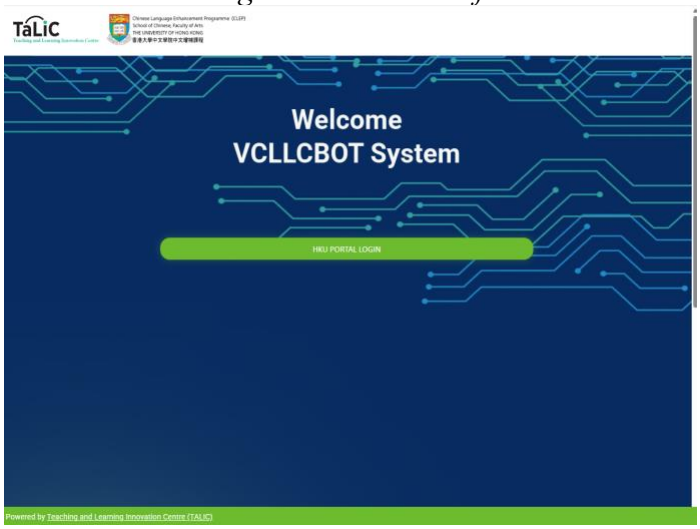


Figure 5
VCLLCBOT: AI Agent Creation Platform

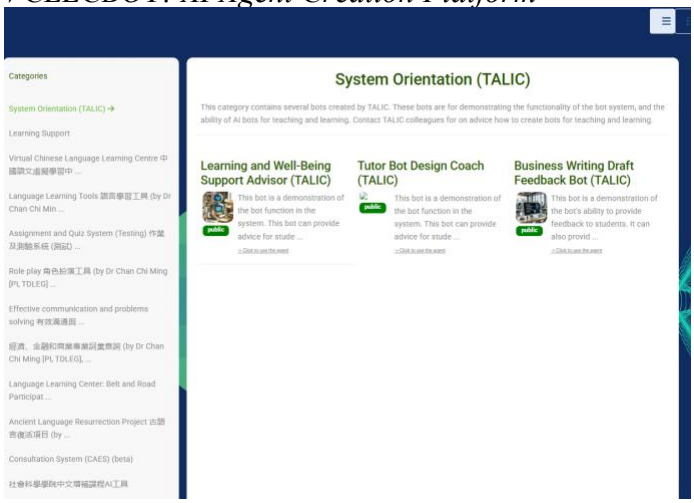


Figure 6
VCLLCBOT: AI Agent Creation Platform

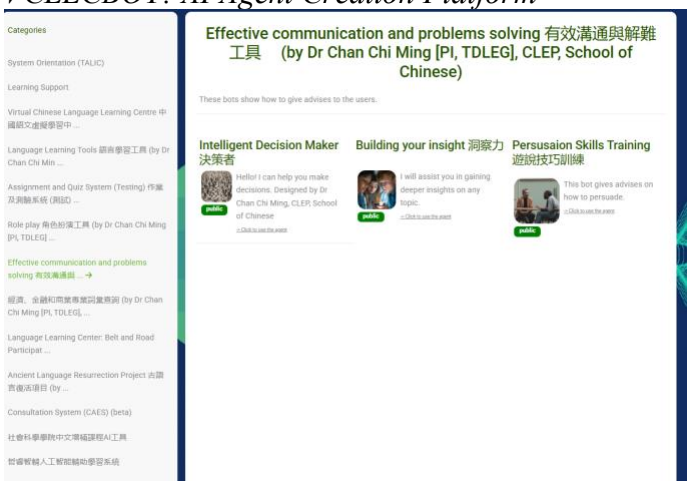


Figure 7
VCLLCBOT: AI Agent Creation Platform

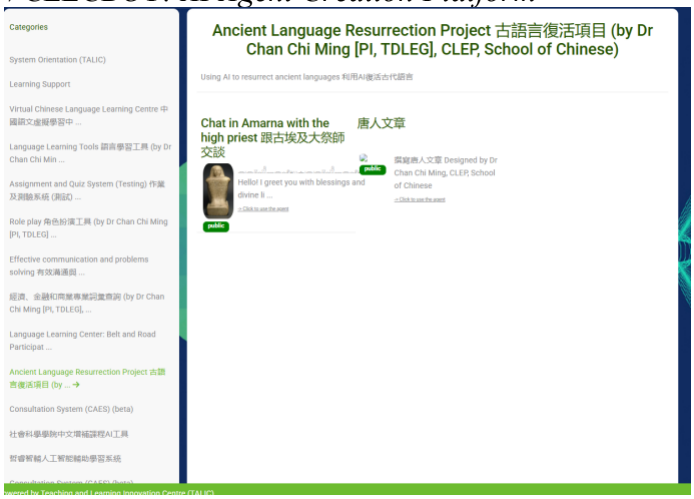


Figure 8
VCLLCBOT: AI Agent Creation Platform



The VCLLCBOT is an initiative in AI-enhanced pedagogy, developed through strategic collaboration between CLEP and the Teaching and Learning Innovation Centre (TALIC),

funded by the Teaching Development and Language Enhancement Grant (TDLEG). This project establishes a POE-like GenAI platform for teaching and learning in the Chinese language through AI agents. Its architecture addresses four core features, each yielding distinct pedagogical benefits.

1. Centralized Repository for AI Agents created by teachers and students
   This is the foundational feature which provides teaching staff and students with a dedicated hub to deploy discipline-specific AI agents. The centralized repository enables teachers to align AI tools directly with the course learning purpose while facilitating cross-departmental collaboration through shared development standards. It also ensures the university's governance over data privacy protocols.

2. Dual-Pathway Agent Architecture
   The VCLLCBOT Platform uses a dual-pathway design to support both specialized knowledge and broad skill development:
   - Discipline-specific agents function as specialized tutors, trained in specific program areas. For instance, a linguistics-focused agent for economics and finance students provides tailored writing frameworks that generic tools cannot offer. This helps students master discipline-related writing conventions and nuanced expressions.
   - General-purpose agents, on the other hand, support foundational literacies across Chinese language enhancement courses. They standardize assistance for rhetorical refinement, presentation structuring, and Chinese language knowledge.

3. Cognitive Apprenticeship via HOTS Agents
   Higher order thinking skill (HOTS) agents go beyond simple tasks to act like expert mentors. They are decided by teachers and use the Socratic scaffolding method by asking a series of questions to break down complex tasks. They guide students to brainstorming, analyzing targets, conducting decision-making, and building strategies to complete the tasks assigned by teachers through questions. This turns AI from just an information provision tool into a partner that helps students develop strategic thinking and problem-solving skills.

4. Diachronic-Synchronic Language Expansion
   The platform extends linguistic support across temporal and contextual dimensions:
   - Modern Language Modules enable comparative syntactical analysis across living languages (e.g., pragmatic contrasts in Mandarin-Cantonese discourse) using a multilingual translator.
   - The historical languages sub-platform facilitates philological reconstruction through corpus-based morphological analysis of Classical Chinese. These capabilities enable temporal literacy by simulating historical communicative contexts, allowing students to engage with language as a dynamic historical artifact.

The VCLLCBOT Platform allows teachers and students to create and utilize AI agents for teaching and learning, with 120 AI agents developed to date, including 110 currently active and 10 inactive. The platform integrates into 13 courses and involves 1,168 students (over two-thirds of CLEP students), provides direct access through course Moodle pages, enabling students to enhance their Chinese language and communication skills through interactive learning. By April 2025, it has facilitated 7,296 message exchanges and 2,025 topic

discussions, demonstrating its effectiveness in promoting engaging and dynamic learning experiences.

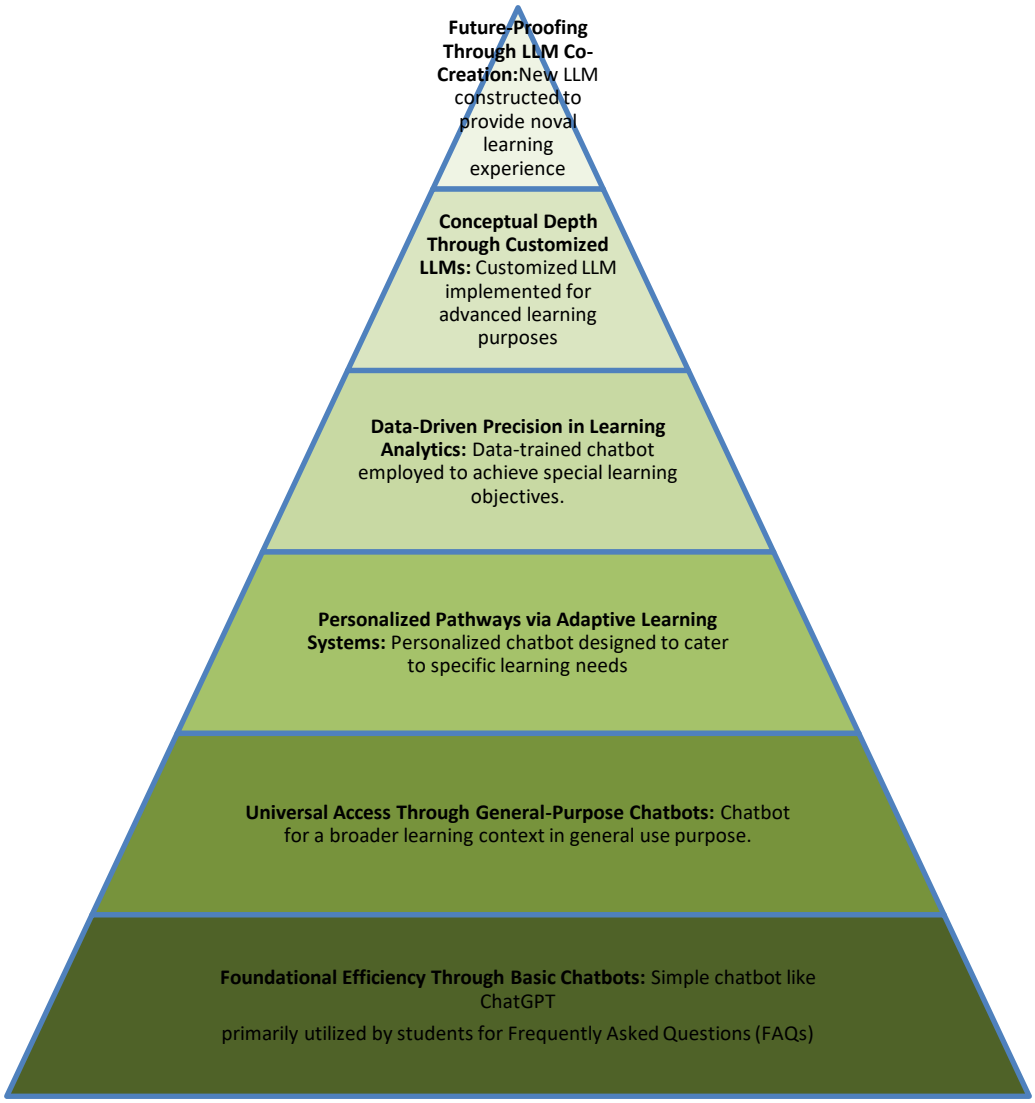
Six-Tier Pyramid (STP) for AI-Enhanced Language Teaching and Learning

The philosophy behind the adoption of AI in CLEP's teaching and learning method comes from the Six-Tier Pyramid (STP) for AI usage initiated by Dr. C.M. Chan of CLEP, which emphasizes that AI should not be used as a tool to generate immediate knowledge for use only. AI in learning is rather a significant advancement of the processing of knowledge through digestion, extraction, organization, and presentation (DEOP). We believe that mastering and practicing the DEOP sequence is essential for every student. What AI integration contributes to the DEOP sequence is that it streamlines the traditional time-consuming DEOP process, delivering results in seconds which would otherwise require significant effort and time. It should not be a replacement tool for the process itself.

For example, students in CSSC9001 will collaborate in groups to discuss discipline-related case studies with the AI tools offered by the class teachers during the lesson. They then compared and critiqued the AI-generated works, evaluating the effectiveness of AI in strategy formation and completion of the writings. During the lesson, they will learn how to craft effective prompts for best tasks through group discussion. This comprehensive approach aims to develop students into proficient users of AI, enabling them to leverage it as a powerful tool for brainstorming, strategizing communication, generating content, and critically assessing their outputs for better results.

The STP structure aims to maximize the functionality and benefits of deploying AI in language teaching and learning for teachers and students by redefining its role in language learning, showing how AI tools can evolve from a basic automation tool to an advanced cognitive partnership.

Figure 9
Six-Tier Pyramid (STP) for AI-Enhanced Language Teaching and Learning



Tier 1: Foundational Efficiency Through Basic Chatbots:
This foundation tier contains basic chatbots designed to automate replies to repetitive tasks like general information enquiries, answering basic grammatical rules of the Chinese language, assignment submission deadlines, etc. Students can immediately access answers during self-directed study via these chatbots.

Tier 2: Universal Access Through General-Purpose Chatbots:
The second tier includes general-purpose chatbots that offer cross-disciplinary information, bridging the gap in language learning and subject-specific knowledge. This will ensure equitable access to foundational knowledge provided by LLMs while preserving the educator's role as a contextual guide through background prompts writing. Tools in this tier enable teachers to curate enriched lesson materials. Students also benefit from the preset chatbots to deepen their understanding of concepts.

Tier 3: Personalized Pathways via Adaptive Learning Systems:
The third tier uses AI agents to identify and analyze the strengths and weaknesses of students through data analytics. These agents enable teachers to tailor instructions and

recommendations to students on subject-related assignments. For example, a student struggling with sentence structure might receive targeted exercises to recognize his/her weakness.

Tier 4: Data-Driven Precision in Learning Analytics:
The fourth tier includes data-trained chatbots to provide precise insights into language and communication issues. One example is recognizing a class-wide weakness in Chinese idioms usage and creating agents for strengthening it accordingly. Students benefit from precise, evidence-based feedback and exercises.

Tier 5: Conceptual Depth Through Customized LLMs:
At the fifth tier, teachers will customize LLMs to handle complex linguistic concepts through recontextualization to explain specialized ideas or skills. For instance, LLM trained on classic Chinese resources could clarify syntactic differences relative to Standard Chinese.

Tier 6: Futureproofing Through LLM Creation:
The sixth tier focuses on developing specific LLMs to conduct tailored niche linguistic domains. This process not only ensures technical proficiency but also cultivates AI literacy, enabling teachers and students to critically evaluate AI tools' outputs.

From Tool Usage to Future-Ready Competencies: An Eight-Dimension AI Literacy Framework

The VCLLCBOT Platform highlights the powerful use of AI in cross-disciplinary language learning under the idea of the Six-Tier Pyramid. It creates a learning partnership between teachers and students to develop their future-ready AI skills and AI literacy through the AI agents. We also developed the "Eight-Dimension AI Literacy Framework" to measure the competency of AI literacy.

The principles of the Eight-Dimension AI Literacy Framework are the outcome of our teaching and learning practices, as well as the formative approaches and guidelines developed by other institutions, such as the five foundational dimensions of AI literacy (Digital Education Council, 2026), insights from the Drexel University guide, and UNESCO's AI and education reports. The "Eight-Dimension AI Literacy Framework" integrates a broader, more nuanced perspective, bridging educational innovation with the competencies needed for an AI-driven future. (Digital Education Council, 2026) This framework combined technical competence, critical evaluation and ethical application:

Table 2
Eight-Dimension AI Literacy Framework

Dimension	Core Focus	Key Competencies
1. Foundational Awareness	Basic AI concepts	-Distinguishing AI tools from traditional software -Recognize AI systems in daily life -Identify common AI applications (e.g., chatbots, recommendation engines)
2. Technical Interaction	Operational proficiency	- Navigate AI interfaces (e.g., ChatGPT) - Input effective prompts - Retrieve and refine outputs - optimizing queries for research
3. System Mechanics	Understanding AI workflows	- Grasp data training processes - Identify algorithmic limitations - Troubleshoot basic errors
4. Critical Evaluation	Output assessment	- Analyze the relevance, accuracy, and utility of AI outputs - Select appropriate context strategies - Verify alignment with task requirements
5. Ethical Integration	Responsible deployment	- Address privacy/security risks - Mitigate bias in AI applications - Ensure transparency in AI-assisted work
6. Adaptive Innovation	Creative problem-solving	- Repurpose AI tools for novel scenarios - Combine AI with human ingenuity - Develop hybrid solutions
7. Social Responsibility	Macro-level impact	- Evaluate AI's societal implications - Advocate for equitable policies - Lead ethical AI adoption in communities
8. Global AI Leadership and Innovation	Future-oriented innovation	Design AI for global challenges (climate, equity)

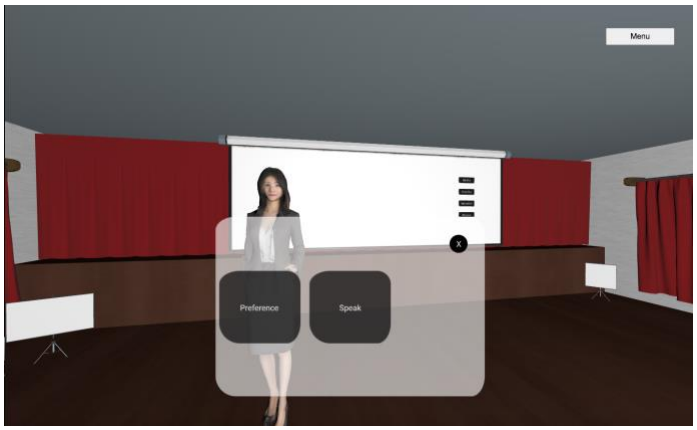
This Eight-Dimension AI Literacy Framework emphasizes the importance of basic technical competence as well as critical evaluation, ethical application, human-centric creative and innovation, and understanding AI's ethical and societal implications. It also helps students to leverage AI as a powerful learning partner for ethical, interdisciplinary, and problem-solving in the increasingly complex global environments.

Conclusion: Next Development

The integration of AI in language learning requires tailored GenAI models, AI agents and tools which meet individual learners' needs for real-time insights and feedback into students' progress, strengths, and areas for improvement. To serve this purpose, we have developed an avatar-led learning environment and will be implementing it in the coming semester in 2025.

Figure 10

An AI Avatar in WebXR Classroom



Note: The AI Avatar acts as a teacher or consultant to directly engage in conversations with students and provides a pseudo-life environment in WebXR and virtual reality for language learning.

To succeed in an AI-driven future, students and teachers must adopt a mindful and forward-thinking mindset. AI should not be a mere instrument for task completion, but as a tool for intellectual stimulation and deeper exploration. Treating AI as a tool for sparking curiosity, creativity, and critical thinking, teachers and students can unlock the full potential of AI to enhance problem-solving skills, promote innovation, and encourage lifelong learning. This shift in perspective will turn AI into a dynamic partner toward meaningful growth and success, rather than just for efficiency in task completion.

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Smart Factories, Skilled Workforce: The Role of Digital Twins in Industry 4.0 Education

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Abstract

The rapid digital transformation, driven by technologies like AI, IoT, and AR, is reshaping industrial production, with Digital Twin technology emerging as a key enabler of Industry 4.0. The IndustriSphere project leverages this technology to create real-time digital replicas of physical systems, optimizing production processes, reducing costs, and improving sustainability. By integrating advanced tools such as 3D scanning and machine learning, IndustriSphere enables real-time performance monitoring, and resource optimization. A unique focus of the project is its emphasis on workforce education and training. Through AR-based virtual platforms, employees can engage in immersive training without disrupting production, reducing errors and enhancing skill development. This approach not only improves operational efficiency but also prepares the workforce for the demands of modern industrial environments. Despite challenges such as high initial costs and data management complexities, digital twins are transforming factories into intelligent, sustainable ecosystems. IndustriSphere demonstrates how this technology can drive industrial innovation while fostering a skilled, adaptable workforce. By bridging the gap between technological advancement and human expertise, digital twins are paving the way for a smarter, more sustainable future in Industry 4.0.

Keywords: digital twins, Industry 4.0, workforce training, smart factories, augmented reality

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Introduction

The rapid digital transformation and advancements in technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), and Augmented Reality (AR) are revolutionizing the industrial sector, driving the development of smart factories and flexible production models. Within this context, Digital Twin technology has emerged as a cornerstone of Industry 4.0, enabling precise simulation and management of production processes. The IndustriSphere Digital Twins project will aim to adopt and implement this technology, enhancing industrial efficiency, innovation, and sustainability. By integrating cutting-edge technologies, the project provides realistic digital representations of physical facilities, machinery, and processes, contributing to production optimization, operational cost reduction, and overall performance improvement.

Digital Twins are dynamic, intelligent representations of physical systems synchronized in real-time with their physical counterparts through sensors, data, and machine learning algorithms. This enables real-time monitoring, simulation, and performance prediction. IndustriSphere leverages 3D scanning, AR, Big Data analytics, and AI to create detailed models of industrial facilities and machinery, enable predictive maintenance, optimize production processes in real-time, and provide virtual training platforms for personnel. These capabilities improve skills, reduce errors, and enhance process familiarity, ultimately driving operational excellence.

The application of Digital Twins through IndustriSphere brings significant benefits to industrial production and business operations. Enhanced efficiency and cost reduction are achieved through IoT sensors and data analytics, which provide continuous insights into machine performance, production conditions, and energy needs. This allows businesses to prevent issues, minimize downtime, and optimize operations. Predictive maintenance further reduces unexpected downtime, lowers costs, and extends machinery lifespan by anticipating equipment failures. Additionally, the integration of sustainability is facilitated through Life Cycle Analysis (LCA), enabling energy and resource optimization aligned with sustainable development principles.

Interactive training platforms powered by AR allow employees to learn in virtual environments without disrupting production, reducing training costs and errors. Such immersive training capabilities have been explored in recent studies that combine Digital Twin technology with Virtual Reality environments to enhance operator preparedness and task accuracy (Martínez-Gutiérrez et al., 2023). Data-driven decision-making is also enhanced through Big Data analytics and machine learning algorithms, which provide actionable insights for improving production forecasts, performance analysis, and strategic planning. Beyond operational monitoring, Digital Twins have also been leveraged to assess and develop engineering competencies across the full spectrum of enterprise operations (Masaev et al., 2024) These features collectively empower businesses to adapt to the demands of the modern industrial market.

Despite its proven value, Digital Twin technology faces challenges, including high initial investment costs, the need for effective real-time data management, and ensuring data security and privacy. However, as IoT, AI, and AR technologies evolve, Digital Twins are expected to become more deeply integrated into industrial ecosystems, transforming factories into intelligent, automated, and efficient systems.

Literature Review

The transition to smart factories has intensified the demand for a workforce capable of operating and optimising digitally connected production systems. Traditional industrial training models, often based on classroom instruction or supervised on-the-job practice, are increasingly misaligned with the pace and complexity of Industry 4.0 technologies. Scholars have argued for immersive, data-driven training environments that replicate real-world operational contexts without the risks and costs of live production (Perno et al., 2025).

Digital Twin technology has gained attention in workforce development literature as a means of closing the skills gap in high-tech manufacturing. By providing a synchronised, interactive replica of a production environment, Digital Twins enable experiential learning where operators can explore complex systems, simulate process variations, and troubleshoot scenarios in real time. This approach promotes procedural knowledge acquisition, improves safety awareness, and fosters systems thinking (Zhang et al., 2024).

Recent studies extend the concept to include sustainability education, where DTs integrated with Life Cycle Sustainability Assessment (LCSA) offer insights into the environmental impact of operational choices (Petri, 2025). Such integration helps embed sustainability principles directly into workforce training, supporting dual objectives of operational efficiency and environmental stewardship.

Within this scholarly discourse, the IndustriSphere Digital Twins project distinguishes itself by placing workforce training at the core of its Digital Twin architecture, rather than treating it as a by-product of process digitalisation. While many industrial Digital Twin implementations are conceived primarily as operational monitoring and optimisation tools, where training benefits emerge indirectly through incidental exposure to system data, IndustriSphere was designed from the outset as a dual-purpose platform. Its architecture intentionally integrates training-oriented functionalities, such as AR-enabled procedural guidance, interactive troubleshooting simulations, and embedded sustainability metrics, into the same digital environment used for live operational decision-making. This ensures that every layer of the Digital Twin, from data acquisition and AI analytics to 3D modelling and visualisation, serves not only to improve machine performance but also to develop operator competence, support cross-disciplinary upskilling, and accelerate knowledge transfer across the workforce. In doing so, the platform redefines the Digital Twin from a passive digital replica into an active educational ecosystem that evolves alongside the physical factory, aligning human capital development with the continuous improvement cycles of Industry 4.0 (Longo et al., 2017).

Methodology

The methodological framework of IndustriSphere project is structured to address two intertwined goals, namely; (a) enabling high-fidelity simulation of industrial processes for operational decision-making, and (b) creating an adaptable platform for multi-level workforce training in a smart factory environment. To achieve these objectives, the project follows a sequential yet iterative development process in which each technical component of the Digital Twin is aligned with both operational and training requirements. Rather than building a purely engineering-focused model and later adapting it for educational purposes, the design process ensures that training needs are embedded from the outset. This approach ensures that every stage, from data capture to interface development, is evaluated not only for

its ability to support accurate, real-time simulation, but also for its capacity to create immersive, user-friendly learning experiences for operators, engineers, and maintenance staff.

The methodology that is followed within the framework of the IndustriSphere project is based on six key building blocks, as follows:

I. Digital environment creation: The process begins with high-precision 3D laser scanning of the partner facility (B&T Composites), producing a detailed geometric model of the production layout, including machinery, workstations, and material flows. This model serves as the visual and spatial foundation for the Digital Twin. The AR-based modules of IndustriSphere draw from the concept of "learning factories" where immersive, scenario-driven training environments have been shown to effectively prepare manufacturing operators for complex tasks (Afy-Shararah et al., 2024).
II. Real-time data synchronisation: A network of IoT sensors is deployed to collect live data on operational parameters (e.g., machine speeds, energy consumption, environmental conditions, and equipment health metrics). This ensures that the Digital Twin reflects current, rather than static, plant conditions during training exercises.
III. AI-based predictive modules: Machine learning algorithms are integrated to process historical and real-time data for anomaly detection, failure prediction, and process optimisation. In the training context, these modules allow operators to practise interpreting predictive alerts and implementing corrective actions.
IV. AR-enhanced learning interfaces: Augmented Reality tools are developed to overlay instructional content onto the 3D environment, accessible via headsets or mobile devices. These guide users through assembly procedures, maintenance tasks, and safety drills, blending spatial awareness with procedural instructions (Eversberg & Lambrecht, 2023).
V. Sustainability metrics integration: LCSA tools are embedded within the Digital Twin to quantify environmental performance indicators, such as carbon footprint and resource efficiency. Training modules use these metrics to teach decision-making that balances productivity and sustainability.
VI. Iterative co-development with stakeholders: Training scenarios and Digital Twin functionalities are co-designed with engineers, supervisors, and operators. Feedback loops ensures that the system addresses real skill gaps, from basic machine operation to advanced process optimisation.

Expected Results and Discussion

As the IndustriSphere project is currently in its initiation phase, the anticipated outcomes will gradually emerge as the platform is developed, piloted, and refined. One of the primary expectations is that training cycles for new operators will become significantly shorter compared to conventional methods. The ability to practice complex operational procedures within a safe, high-fidelity virtual environment will accelerate skill acquisition, reducing the need for prolonged shadowing and extended on-the-job trial periods.

Another anticipated benefit is the reduction of production disruptions during training. By shifting a substantial portion of onboarding and skills development to the Digital Twin platform, the project will aim to limit interruptions to live operations. This approach will lower opportunity costs and minimise material waste resulting from trainee errors, thereby improving overall production efficiency (Eversberg & Lambrecht, 2023).

Safety preparedness is also projected to improve through simulation-based exposure to hazardous scenarios. By allowing operators to experience and respond to simulated emergencies, the system will strengthen safety awareness and readiness, leading to faster and more accurate responses in real-world situations. Additionally, the Digital Twin will serve as a repository of best-practice workflows, enabling experienced staff to capture and share procedural expertise. This function will facilitate more effective knowledge retention and transfer across shifts and departments.

A further anticipated outcome relates to sustainability awareness. With Life Cycle Sustainability Assessment (LCSA) metrics embedded into the training modules, operators will be able to observe the environmental implications of their operational choices in real time. This will encourage more resource-efficient behaviours and strengthen the integration of sustainability into everyday decision-making (Luo et al., 2025).

Over the course of the project, these outcomes are expected to evolve in scope and depth as the system matures, additional datasets are integrated, and training modules are refined through continuous stakeholder feedback. A longitudinal evaluation framework will be applied to track both operational performance and workforce development indicators, ensuring that the anticipated impacts are validated and leveraged for ongoing improvement.

The anticipated outcomes of the IndustriSphere project highlight its potential to contribute meaningfully to both operational efficiency and workforce development within smart factory environments. By embedding training functionality into the very architecture of the Digital Twin, the project will seek to bridge the traditional gap between process optimisation and human capital development. This integrated approach will enable the simultaneous advancement of technical system performance and workforce competence, ensuring that gains in productivity are reinforced by corresponding improvements in operator skills.

A central implication of this approach is the ability to adapt the platform to a broad range of skill levels and job roles. As training modules are expanded and refined, it will be that the system will support diverse learning needs, from the onboarding of new machine operators to the upskilling of experienced engineers in advanced process optimisation. This flexibility will make the platform a sustainable, long-term resource for workforce development, capable of evolving in parallel with the physical production systems it mirrors.

Furthermore, the integration of sustainability metrics within the training environment will shift organisational culture towards greater environmental responsibility. By exposing operators to real-time Life Cycle Sustainability Assessment (LCSA) indicators during simulations, the platform has the potential to embed sustainability considerations into daily operational decision-making. Over time, this could lead to a more holistic view of performance, where environmental and economic factors are evaluated in tandem.

While these expectations are grounded in established findings from similar Industry 4.0 implementations, the project's novel focus on workforce training as a primary driver introduces opportunities for further exploration. Longitudinal observation and iterative refinement will be essential to fully realise the system's potential, particularly in understanding how continuous interaction with a Digital Twin environment shapes learning outcomes, operational behaviour, and strategic decision-making in the long term.

Ultimately, IndustriSphere will aim to serve as a replicable model for other industrial sectors seeking to combine operational excellence with agile, sustainability-conscious workforce development. The coming phases of the project will be critical in testing these assumptions, validating performance improvements, and defining best practices for integrating Digital Twins into the broader transformation strategies of Industry 4.0.

Conclusion

The IndustriSphere project represents a strategic step towards integrating advanced Industry 4.0 technologies with human capital development, offering a dual-purpose platform that simultaneously enhances operational decision-making and workforce training. By embedding training functionalities into the core architecture of the Digital Twin, the project moves beyond conventional applications of Digital Twins as passive monitoring tools, positioning them instead as active educational ecosystems. This approach will yield significant benefits, including shorter training cycles, reduced production disruptions, improved safety preparedness, better knowledge retention, and a stronger integration of sustainability into daily operations.

While the project is in its initiation phase, its design methodology, combining high-fidelity 3D modelling, real-time IoT data synchronisation, AI-driven predictive analytics, AR-based training interfaces, and embedded Life Cycle Sustainability Assessment metrics, lays a robust foundation for these anticipated outcomes. The iterative, stakeholder-driven development process further ensures that both operational and training objectives remain closely aligned with industry needs.

In the broader context of Industry 4.0, IndustriSphere offers a replicable model for smart factory transformation, demonstrating that the convergence of digital innovation and workforce development can be planned and executed in tandem. The project's longitudinal evaluation will be critical for validating its impacts, refining its methods, and establishing best practices that can inform similar initiatives across industrial sectors. Ultimately, the success of IndustriSphere could signal a shift in how Digital Twin technology is conceived and deployed—not only as a tool for process optimisation, but as a catalyst for cultivating skilled, agile, and sustainability-conscious industrial workforces.

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

The authors declare that OpenAI's ChatGPT (GPT-5) was used exclusively to enhance the clarity, grammar, and readability of this paper. All research content, ideas, analysis, and conclusions are the authors' own, with the AI providing no contribution to the study's intellectual or scientific substance.

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Challenges of Integrating Emerging Technologies in Libraries: Between the AI Race and the Imperative of Creative Industries Reform

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Abstract

The digital transformation of public libraries is a complex process, situated at the intersection of accelerated technological progress and the need for creative industries to adapt. The implementation of emerging technologies, particularly artificial intelligence (AI), presents both significant opportunities and challenges for the library ecosystem. On the one hand, AI is the guarantor of rapid access to knowledge, promising important steps towards the automation of operational processes and the improvement of the user experience through personalized solutions. On the other hand, this race for innovation comes with risks related to ethics, data security and the unprecedented transformation of librarians' professional skills. In this context, this paper analyses the practical and strategic challenges of integrating AI into libraries, based on the experience of ANBPR (anbpr.org.ro) within the SHIFT: MetamorphoSis of cultural Heritage Into augmented hypermedia assets For enhanced accessibiliTy and inclusion. The pre-pilot, representing a Romanian use case, led by ANBPR within the ANBPR BiblioPublica National Conference (11-12 November 2024, National Library of Romania), provided a space for analysis and dialogue on how the Romanian public library network can become a dynamic infrastructure for testing and validating the latest AI-based technological solutions. Through the presentations and technological demonstrations carried out during this pre-pilot – in particular those dedicated to the Romanian case study for libraries, facilitated by Iosif Tsangko, researcher in the field of artificial intelligence at the Technical University of Munich, technical partner within the SHIFT consortium - highlighted the importance of collaboration between libraries and technology partners in testing and implementing artificial intelligence solutions.

Keywords: emerging technologies, library ecosystems, library services, creative industries, AI race, SHIFT use case

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Introduction

Public libraries are in the midst of a complex period of change, involving persistent digitisation, the globalization of information sources and the development of hybrid knowledge ecosystems. In this environment, the use of artificial intelligence and other related technologies is transforming the logic of library services and the way libraries interact with creative industries. The potential of AI to automate tasks and personalize systems for users (Mhlanga, 2023) also raises concerns about transparency, security and the skills needed to achieve ethical and responsible intermediation of technologies (Floridi & Chiriatti, 2020).

The transition of public libraries to the digital age is one of the most complex and debated topics in information science and modern cultural studies. Under pressure from emerging technologies, particularly AI, libraries need to redefine their mission, services and value to their communities. In this sense, this article reflects on the potential obstacles to the introduction of new digital trends in library spaces, a territory that lies between two major forces: the "AI race" marked by the explosion of technological advances and the need to transform creative industries by introducing new models for the creation, distribution and conferral of value to cultural goods.

For terminological accuracy, the term emerging technologies refers to innovations that are recently instantiated but are likely to have a substantial socio-institutional impact (Rotolo et al., 2015). For libraries, such applications range from AI, augmented reality (AR) or blockchain to semantic technologies, any of which could profoundly change the ways in which information and interaction with it are structured.

Given a broad definition of artificial intelligence for this purpose, this article refers to a wider collection of algorithmic approaches and applications capable of emulating cognitive tasks, such as reasoning, learning or recognition, from a human perspective (Russell & Norvig, 2021). In libraries, AI is currently seen both as a means of optimizing operational processes (e.g. automatic cataloguing, assisted translation, personalized recommendations) and as a driver of innovation in terms of user interaction (Fernández-Ramos & Calzada-Prado, 2022).

The concept of creative industries includes sectors of the economy that combine creativity, culture and technology. The creative industries ecosystem not only produces economic benefits, but also symbolic values (UNESCO, 2022). In the digital age, these industries are in dire need of reform. New forms of cultural consumption and new ways of monetizing content are emerging. Libraries must play the role of intermediary between producers and users.

Therefore, the main objective of this article is to analyze the intersection between technological innovation and the need for cultural and organizational adjustment. The example of the SHIFT pre-pilot project initiated and coordinated by ANBPR in Romania provides an excellent vantage point from which to observe this intersection. The event illustrated the potential of AI in opening up cultural heritage and personalizing services for users, but it also highlighted the complex ethical, strategic and professional issues that libraries need to address (Crihana, 2024).

In consequence, this article attempts to construct a theoretical and empirical framework for understanding how libraries can serve as dynamic infrastructures for testing and validating emerging technologies, while maintaining the dual pressures of technological races and cultural responsibilities involved in reforming creative industries.

The Race for Artificial Intelligence and Libraries

Globally, libraries are under pressure to introduce AI to respond to new information and collection demands. They use AI in many aspects of their work: semantic searches and chatbots in user interaction (Fernández Raños & Cal Zadan Biao, 2024) that provide better predictions of community needs. However, the literature draws attention to the "AI race" that may perpetuate its own inequalities and institutionalize dependence on giant technology companies (Crawford, 2021). In libraries, these tensions are expressed as dilemmas about data sovereignty, transparent algorithms and their impact on freedom of access to information.

The most visible projects involving AI and libraries come from national library organisations and university coalitions. For example, the Library of Congress in the United States has undertaken projects involving automatic image recognition for the digitization of massive archive volumes (using convolutional neural networks to extract metadata and improve accessibility) and even occasional experiments in text digitization with mixed results (Library of Congress, 2021).

Across Europe, there are AI-based projects such as EuropeanaTech. These investigate, for example, how machine learning can be used for the automatic classification of digital objects and the generation of descriptions accessible to users with disabilities (Europeana Foundation, 2022). These examples show that libraries are not just consumers of technology but are also living laboratories where the relevance of AI applications can be tested in cultural and educational contexts.

In Romania, interest in integrating AI with libraries has been boosted by European initiatives such as the SHIFT pre-pilot, which took place at the BiblioPublica 2024 conference. Here, with practical examples from the Technical University of Munich, demonstrations were given to show how AI algorithms can be used to create augmented versions of cultural assets that are accessible to everyone, not just those with full sight or hearing (Crihana, 2024). In the ANBPR network, AI-based SHIFT solutions were tested that could provide individual tools for both curators and readers, thus easing the workload of staff.

Such cases confirm that the "race for AI" in libraries is more than a global trend – it is also our local situation now, with direct implications for how communities interact with and come to terms with their knowledge.

Reform of the Creative Industries and Its Interdependence With the Library Sector

The pressure of digitization and new models of cultural consumption is being felt strongly by the creative industries. As infrastructures for access to and democratization of culture, libraries are in a unique position to mediate between technology and the public (UNESCO, 2022). If the creative industries are to undergo major reform, libraries, as strategic partners in the dissemination and reuse of digital content, must be taken into account. Therefore, even this year, the National Library of Romania invited a number of librarians from across Europe to participate in workshops and presentations. Those who understand intellectual property law or how to best prepare materials for digital conversion were particularly welcome, as there was a certain degree of. Vargo and Lusch (2017) and Lindestrom (2013) write that co-creation and open innovation approaches can generate shared value between libraries and the cultural sector.

Case Study: The Shift Project and a Pre-pilot in Romania

An example that further illustrates this point is the European project entitled SHIFT: MetamorphoSis of cultural Heritage Into augmented hypermedia assets For enhanced accessibiliTy and inclusion. As part of this project, ANBPR carried out a pre-pilot in November 2004 at BiblioPublica Conference entitled Public Library Network - a dynamic support infrastructure for sustainable development priorities. This event, co-organized by ANBPR in collaboration with the National Library of Romania, also achieved a standard of quality well above what is normally expected from library conferences. The SHIFT project contributed significantly to these results. Not only did it bring in SHIFT's technical partner, the Technical University of Munich, but by sharing its experiences and perspectives, it made significant contributions to other partners in terms of the direction they took on key issues. The professional meeting in Bucharest also demonstrated how libraries can serve as a testing ground for AI solutions that are applicable to creating personalized cultural heritage experiences with users and highlighted the need for cooperation between librarians and IT experts, as well as digital literacy skills among communities (Crihana, 2024).

Scaled Methodological Questions

The integration of emerging technology, especially AI, into library infrastructure cannot be reduced to a question of practical and operational benefits. This process must also be viewed in strategic terms - and those strategies must be ethically grounded. The use case of the SHIFT pre-pilot organized by ANBPR within the BiblioPublica 2024 Conference in Bucharest perfectly illustrates this point: the technology demonstrations carried out together with the Technical University of Munich proved not only the ability of AI to make cultural heritage available, but also the complex challenges related to data, transparency and skills that librarians need to mediate in these processes (Crihana, 2024). But one of the most frequently debated topics in the literature is ethics in algorithms. AI models operate by training on large data sets, and the quality and variety of this data significantly influences the objectivity of the results. The dangers involved in creating algorithmic biases or perpetuating structural inequalities are already well known (Crawford, 2021; Jobin et al., 2019). However, when we think about libraries whose mission is to ensure equal access to information for all, adopting technologies that could generate discriminatory results is simply not in line with the core principles of that profession. This is why, during the SHIFT pre-pilot and technical demonstrations, a continuous dialogue was established between people who want to use AI as part of new levels of cultural heritage development and librarians responsible for guiding this process in an ethical and transparent manner.

Data Security and Sovereignty

Another important aspect is data protection and management. As libraries collect and manage large amounts of user data, the integration of AI into this process requires additional processing, analysis and storage of this data. But if there are no clear data protection frameworks for AI-based work, as suggested by the articles cited in the literature, this vulnerability would not only pose risks to institutions in terms of law and ethics, but could also affect their reputation (Floridi & Chiriatti, 2020).

In Romania, BiblioPublica Conference has shown that public libraries are aware of such risks and want to establish technological links to comply with security and privacy standards. They do not simply want a service provider to manage everything for them, but rather one they can

rely on if things go wrong. Libraries are therefore beginning to see that they need to become active agents in negotiating the terms for using AI machines and protecting the data sovereignty of their customer communities.

Professional Skills and Institutional Resilience

Digital transformation requires a significant shift in professional skills. Today, librarians are not only mediators of knowledge in the traditional sense, but also intermediaries for digital technologies, able to understand and explain the principles behind how an AI machine works to the average user. Given the lack of recent developments, it is imperative for librarians to acquire these new skills or adapt. Recent research indicates that training and retraining will be necessary for librarians if they are to adapt to the changed circumstances (Azevedo & Santos, 2021).

In this regard, the SHIFT pre-pilot initiated and coordinated by ANBPR Romnia (www.anbpr.org.ro) in its capacity as a use case provider also had a learning dimension. It provided library staff with direct contacts with AI experts so that the practical applicability of the technologies became clear to them. This approach is therefore in line with UNESCO's recommendations (2022), which emphasize the importance of human resource development as a prerequisite for success in digitization.

Strategic Challenges of Sustainability

But there are also strategic challenges if we want the innovation process of large global countries to be sustainable. This is not surprising, as it has not been effectively tried outside campuses across the country. According to Bertot et al. (2016), libraries are ecosystems of innovation. They integrate research, social services, production, technical support and managerial expertise.

However, the absence or inadequacy of public policies populating the landscape will prevent AI from feeding and developing itself. The SHIFT pre-pilot showed how numerous European collaborations could overcome these limitations. It demonstrated that international partners can bring access to talent and infrastructure that would otherwise be difficult to obtain outside transnational partnerships. In conclusion, the strategic and ethical issues of AI integration in libraries are inseparable from these practical aspects of such processes. The SHIFT example illustrates that empirical complexity requires accompanying ethics; it is no longer able to fulfil its role on its own, as it can in professionalism cultivated in new territories. Libraries must embody democratic, inclusive and flexible organizations in order to fulfil their social responsibilities, as Raymond Rapp's review points out.

Conclusions and Development Perspectives

In recent literature, libraries are increasingly conceptualized as innovation ecosystems (Bertot et al., 2022). In Romania, the SHIFT experience indicates that libraries can act as “knowledge brokers” and mediators between communities and emerging technologies. In this model, their function is to be more than mere data repositories: they serve as experimental spaces where solutions can be tried out without risk before being implemented on a large scale.

The challenges of integrating new technologies and AI into libraries are, on the one hand, to accelerate the “AI era” within traditional industries (at this stage, truly the IT era, we are

mainly talking about network and software companies); on the other hand, with the future reform needed for business model issues. Whose development trajectory is being rationalized?

The ANBPR's experience in the SHIFT project proves that libraries can play a crucial role in shaping inclusive digital ecosystems, with a skills base, strong strategic partnerships and ethical governance. In the future, the success of AI integration in libraries will largely depend on their ability to function simultaneously as experimental platforms, creative spaces and catalysts for cultural innovation.

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Exploring the Role of Emerging Technologies in Chemistry Education: A Study on Student Engagement and Equity

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Abstract

In the century of digitalism, the use of technology in education is transforming traditional pedagogy in science subjects such as chemistry, which typically involve abstract concepts and complex molecular structures. The study explores how new digital technologies such as virtual labs, augmented reality (AR), virtual reality (VR) and artificial intelligence (AI) are enriching students' engagement, understanding and critical thinking in chemistry learning. A quantitative research project was conducted to survey 163 students in grades 7–11 to measure their perceptions of the effectiveness of technology in enhancing their learning experience. Results showed that 65% of students reported increased engagement in technology lessons, explaining that they enjoyed the lessons because the virtual labs were interactive and the AR/VR experiences were immersive. The equipment allowed students to visualize chemical reactions and molecular structures in three dimensions, bridging theory and practice. In addition, 53% of students agreed that virtual labs helped them think critically and solve problems more effectively by enabling safe experiments and manipulation of variables. The study identified some pressing issues such as device shortages, system malfunctions, and teacher readiness. These impacts represented a digital divide in education in under-resourced schools. To ensure equal access and effective use of computer-based chemistry learning materials, the study concluded with policy implications for legislators and educators.

Keywords: augmented reality (AR), virtual reality (VR), artificial intelligence (AI), chemistry education

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Introduction

Traditional chemistry instruction often relies on lectures, textbook diagrams, and limited laboratory access. These methods are insufficient to engage all learners, particularly when teaching concepts like molecular geometry, reaction mechanisms, and quantum chemistry. Many students struggle not due to a lack of intelligence, but due to the abstract nature of the content and a lack of visualization tools. Modern technology provides promising solutions, yet the integration of these tools into the classroom remains inconsistent. Issues such as limited access, lack of teacher training, and misalignment with curricula continue to hinder progress. This dissertation investigates how to close the gaps and capitalize on opportunities created by technology to transform chemistry education. We are living in an era of digital transformation that is affecting all aspects of life, including aspects of teaching and learning. Teaching now extends beyond four walls of a room and innovations in education are happening due to phenomena such as augmented reality, virtual labs and simulations, artificial intelligence (AI) tutors, and gamified learning. The unfortunate truth is that although new technologies and capabilities emerge, many chemistry courses at colleges and universities or high schools are taught using traditional means that are often teacher-centred. Physical processes based on chemical principles-such as the concept of atomic orbitals or distributions of an electron cloud or thermodynamic pathways- are developed using two-dimensional (2D) diagrams or static lectures – neither of which represent an effective way of allowing all learners, especially those who have difficulty overcoming chemical abstractions, to create conceptual understanding.

While there are advantages of teaching chemistry in these conventional ways, we have also noticed that the traditionally-used methods of chemistry education don't work for all modern students. The more complex the subject of chemistry, the more abstract it becomes for students--and concepts like molecular interactions, thermodynamics, and reaction mechanisms are difficult to absorb when they are only presented in lectures and textbooks. Laboratory work is essential to chemical education, but it can sometimes diminish when we do not have sufficient resource opportunities, or in the case of the lab, time or safety factors to consider. All these variable pressures show us that there is a need to reform and explore new non-standard teaching methods, in regards to reasonable solutions as well as designing fun, interesting, and how to include as effectively and easily as possible different learners, in order to make it captivating to learn.

This research is guided by the following key question*: How does the integration of technology impact students' ability to apply chemical knowledge in practical contexts, and how do these effects vary across different grades and school types?*

Literature Review

Use of technology in the teaching of chemistry rests upon a variety of theoretical models regarding how to best integrate digital tools into the teaching and learning processes.

TPACK Framework

In the context of chemistry education, when considering TPACK, teachers will choose technological tools that deliberately integrate into the curriculum they are delivering and deliver the intended teaching and learning objectives. For example, when teaching the shape of molecules teachers will use augmented reality apps like Elements 4D or MoleculAR, to

allow students to visualize and manipulate molecules in 3D space. Considering TPACK, CK is the understanding of chemical bonds and the structure of molecules, PK is the development of inquiry tasks that recognize the nature of student's research approach to learning, and TK is the effective use of AR to improve the quality of learning.

Chittleborough (2014) states the TPACK framework is useful in the science context to understand that abstract scientific concepts benefit from multimodal representation, and Dos Santos (2023) explains that teachers with TPACK knowledge and understanding can be more adaptable to the ever-changing educational technology environmental factors. Mishra and Koehler (2006) explain, continuous professional learning is necessary to develop and practice TPACK, particularly in Chemistry education because technology is constantly being refined.

SAMR Framework

The SAMR Model, developed by Dr. Ruben Puentedura (2006), has defined four stages in which technology can be integrated into teaching practice: substitution, augmentation, modification, and re-invention. As a framework, this hierarchical model enables educators to consider their level of technology use and how deep or transformational the learning task is.

Educational Software

The introduction of specifically designed educational software, such as CocoSoft is fundamentally changing the practice of teaching analytical chemistry. This software does not compete with online data, rather it makes it easier for students to engage in ways that do not burden them through unnecessary repetition, such as data collection and analysis of chromatograms or composing reports (Cocovi-Solberg & Miró, 2015). By simplifying the process, students are capable of engaging with the content in the most meaningful way, as well as developing skills, understanding how to interpret results and planning experiments.

Kazakhstani Researchers on Digital Chemistry Education

Increasingly, there is a focus on how digital technologies can enhance the professional competencies of future chemistry teachers in Kazakhstan. The researchers at O. Zhanibekov South Kazakhstan Pedagogical University, Karmanova et al. (2024), completed a study examining the impact of utilizing digital platforms (e.g., ZOOM) and gamified learning with pre-service teachers, in terms of pedagogical and technological preparedness in teaching chemistry.

Methodology

Research Design

This mixed-methods inquiry explicitly took a quantitative and qualitative stance on understanding the role of technology in chemistry education. We sought to investigate the role of technology in students' learning experiences and to understand teachers' views and actions regarding teachers' digital practices. We utilized three different methods: a survey for students, an experimental lesson measured using a pre- and post-test design, and a survey questionnaire for teachers. The approach provided a triangulated perspective of the research topic.

Participants

A total of 152 students from Grades 7 to 11 took part in the student survey. Participants were drawn from diverse school types across Kazakhstan, including public schools, private institutions, and specialized centers. This sample allowed for broad representation of students' digital learning experiences. An intact Grade 8 class of 26 students was selected to participate in an experimental technology-integrated chemistry lesson. The group was chosen based on accessibility, availability of technological infrastructure, and teacher cooperation. These students completed both pre- and post-tests related to the lesson.

Data Collection

Student Questionnaire

The questionnaire was distributed digitally via Google Forms. Responses were anonymous, and students completed it within 10 minutes during a designated class period. A pilot with 10 students was conducted to ensure clarity and reliability. The instrument achieved a Cronbach's alpha score above 0.80, indicating strong internal consistency.

Data were collected through a structured survey, administered via Google Forms. It consisted of 13 questions. These questions were designed to assess specific aspects of student experiences with technology in chemical education, including engagement, understanding, skill development, and cooperation.

The main features of the process of collecting data are as follows:

Survey Design

The items were framed to assess engagement, comprehension, and the perceived collaboration facilitated by technology in chemistry classrooms. Both positively and negatively worded items were included in order to provide a balanced view of the students' experience and avoid response bias.

Survey Distribution

The electronic format of the survey was chosen to ensure convenience and accessibility, allowing respondents to participate at any time convenient for them.

Measured Variables

Engagement: Items focus on how technology engages students' attention and fosters their interest in chemistry. For example, "How engaging are virtual labs for learning chemistry?" Skills Development: Questions ask about how tools like virtual labs and augmented/virtual reality help develop problem-solving and critical thinking skills. For instance, "To what extent do virtual labs help understand complex chemical concepts?"

Experimental Lesson With Pre- and Post-test

An experimental lesson was designed to assess how digital tools affect learning outcomes. The topic was "Acids and Bases", aligned with the national Grade 8 chemistry curriculum. Digital Tools Used:

- A virtual laboratory simulation platform
- An interactive quiz/game app (e.g., Kahoot, Quizizz)
- Multimedia content (animations and visuals)

Pre-test and Post-test

A 15-question multiple-choice test was administered before and after the lesson. The test was based on Bloom's taxonomy and evaluated students' knowledge and understanding of acids and bases. Each student completed both tests in 10–12 minutes.

Additional Observations

The classroom teacher recorded notes on student engagement, behavior, and digital interaction during the lesson to support qualitative analysis.

Data Analysis

Quantitative data from both the student survey and the experimental pre/post-test were analyzed using SPSS (version 26). Descriptive statistics (mean, standard deviation, frequency) were used to summarize survey results. Paired sample t-tests were conducted on the experimental group's pre-test and post-test scores to evaluate the effectiveness of the technology-based lesson.

Results

The research question was addressed using a mixed-methods approach that combined experimental design, survey analysis, and advanced statistical testing. The focus was to understand whether the integration of technology improves students' ability to apply chemistry knowledge in real-world scenarios and whether these outcomes differ depending on the student's grade level or age group.

The main source of data came from a pre- and post-test comparison between a control group taught with traditional methods and an experimental group that experienced a lesson enhanced by modern technologies such as augmented reality (AR), virtual labs, simulations, and gamified tools. The results showed that the technology- enhanced group demonstrated a notable improvement in post-test scores, indicating an increase in their ability to apply chemical knowledge. For example, students were better able to connect atomic-level interactions with real-life chemical reactions after participating in immersive AR/VR experiences.

Table 1
Results of Pre and Post-tests in a Traditional Method Group

Student	Pre-test	Post-test
Student 1	6	7
Student 2	6	7
Student 3	7	7
Student 4	7	7
Student 5	6	7
Student 6	7	7
Student 7	6	7
Student 8	7	7
Student 9	7	7
Student 10	7	7
Student 11	6	7
Student 12	6	7
Student 13	7	7
Student 14	7	7
Student 15	6	7

Table 2
Results of Pre and Post-tests in the Tech Method Group

Student	Pre-test	Post-test
Student 1	6	8
Student 2	6	8
Student 3	7	8
Student 4	7	8
Student 5	7	8
Student 6	6	8
Student 7	6	8
Student 8	6	8
Student 9	7	8
Student 10	6	8
Student 11	6	8
Student 12	6	8
Student 13	6	8
Student 14	6	8
Student 15	7	8
Student 16	7	8
Student 17	6	8
Student 18	6	8

Pre- and post-test results revealed a statistically significant improvement in the performance of the technology-integrated group, supporting the positive impact of digital tools on students' ability to apply chemical concepts. As shown in Table 3, the mean post-test score of the experimental group increased substantially compared to the traditional group, with higher gains in both average and median values. These results provide clear quantitative evidence

that technology-enhanced instruction contributed to deeper conceptual understanding and practical knowledge application.

Table 3

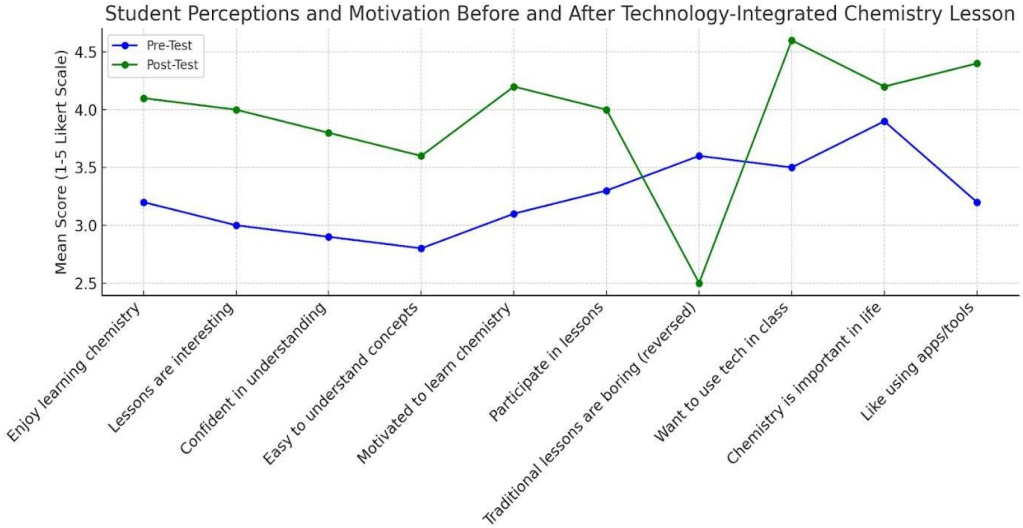
Descriptive Statistics

Item	N	Missing	Mean	Median	Std Dev	Min	Max
item 1	163	24	2.47	2	1.22	1	5
item 2	163	24	3.49	3	1.08	1	5
item 3	163	24	3.87	4	1.11	1	5
item 4	163	24	3.67	4	0.929	1	5
item 5	163	24	3.96	4	0.981	1	5
item 6	163	24	3.73	4	1.3	1	5
item 7	163	24	3.73	4	1.11	1	5
item 8	163	24	3.66	4	1.16	1	5
item 9	163	24	3.64	4	0.954	1	5
item 10	163	24	4.0	4	1.01	1	5
item 11	163	24	3.92	4	0.93	1	5
item 12	163	24	3.17	3	1.5	1	5
item 13	163	24	2.45	2	1.29	1	5

Supporting this finding, the student survey revealed that 67% of students indicated that their retention of knowledge improved through technology-enhanced lessons, and 70% reported that AR/VR simulators helped them apply chemical concepts in real- world contexts. One student expressed: “I used to try and understand how reactions happen at the atomic level—it was hard, but after seeing it in VR, my understanding was instant.” Another commented, “Using AR to explore molecules was so fun and different—I felt like I was actually inside the molecule!” These qualitative responses provide insight into the cognitive benefits of using interactive and visual learning environments, highlighting how technology fosters a deeper connection between theoretical knowledge and practical application.

Figure 1

Analysis of Student Questionnaire (A part)



In summary, the findings demonstrate that the integration of technology significantly enhances students’ ability to apply chemical knowledge in practical contexts. These benefits

were observed across all grade levels, although the school type possibly reflecting differences in infrastructure, device availability, or teacher training influenced the extent of the benefit. The results validate the use of immersive technologies like AR/VR and simulations in chemistry education, offering strong support for continued integration of digital tools in science classrooms to promote applied learning and deeper conceptual understanding.

Discussion

The integration of AR tools in our study is in line with Abdinejad et al. (2021), who found that AR technologies not only increase students' engagement but also improve their ability to apply chemical knowledge to practical scenarios, such as understanding molecular processes. Sharma et al. (2021) discusses how AI and interactive bots can be used to improve student learning in chemistry by fostering problem-solving and active participation in experiments. Chiu and Linn (2012) investigate how visualizations in chemistry support knowledge integration, which can vary across different age groups. Methodological alignment:

1. The pre- and post-test assessed knowledge application before and after the intervention.
2. The survey collected student perceptions of how technology affected motivation and engagement.

Limitations

While this study provides valuable insights, there are several limitations that should be considered when interpreting the findings:

Sample Size and Scope

The investigation was conducted with small samples of students in the grades of 7 – 11 across few schools. The sample was adequate for the current exercise for preliminary understanding, but larger-scale studies across more diverse and greater populations would certainly provide evidence for generalizability. Future studies should incorporate schools from more varied areas and socio-economic demographic to better understand the impact of technology on chemistry education.

Short-Term Focus

This research studied technology's immediate impact on student engagement, cognition, and skill-building. In order to understand longer-term impacts of technology on learning outcomes and readiness to enter a career, longitudinal research is necessary to explore the long-term implications of using technology often. Future studies need to monitor students over longer periods of time to determine the ways technology affects academic performance, critical thinking, and skill development into the workplace.

Reliance on Self-Reported Data

This research relied upon student surveys heavily. Surveys can be distorted by personal biases or misunderstandings. While surveys can provide some insight into the perceptions of students, they do not always reflect real learning outcomes and behaviors. Future studies should combine self-reported data with other data types, such as classroom observations,

performance-based assessments, and/or interviews with teachers to gain a better understanding.

Technological Challenges

Some students expressed challenges with navigating the more complicated tools of the study, which may have affected their perceptions of the technology's value. Technical distractions, including lag on the software, complicated user interfaces, and limited pre-usage training, often interrupted learning. Therefore, better more intuitive designs, easier user interfaces, and training for students and teachers are critical technical barriers to removing when enhancing technology use in the classroom

Conclusions

This research investigated the integration of digital technology into chemistry education, with the goal of evaluating its impact on student learning, understanding teacher perceptions, and identifying practical barriers to implementation. The study used a mixed-methods design, combining pre- and post-tests, student and teacher questionnaires, and statistical analyses to provide a comprehensive understanding of technology use in chemistry classrooms.

The research question explored how technology affects students' ability to apply chemical knowledge, and whether these outcomes differ by grade level or age. The findings revealed that students who participated in technology-integrated lessons featuring tools such as AR/VR, simulations, gamification, and AI platforms demonstrated improved ability to apply chemical concepts in practical contexts. This was confirmed through pre- and post-test comparisons. However, the statistical analysis (MANCOVA) showed that grade level and age did not have a significant effect, while school type had a notable influence on engagement and skill development. This suggests that while technology benefits students broadly, its impact may be influenced by the resources and infrastructure available in different school environments.

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

The authors confirms that ChatGPT, an AI-assisted language model, was used only to edit and refine the words of the manuscript. Its use was limited to grammar and spelling checks and paraphrasing sentences for enhanced clarity and accuracy. The author also confirms that there was no use of AI or AI-based technologies in the development of content material for the manuscript. All work, ideas, procedures, findings, analyses, and discussions constitute original work by the author from the meticulous and systematic conduct of the research.

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OpenAI's Adaptive 3D Periodic Table With Braille: Revolutionizing Chemistry Education for the Visually Impaired

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Abstract

In our developing times, the development of technological tools has a special impact on the field of education. In particular, it is necessary to use various technological tools to ensure the education of students with special needs. However, even with better tools, Kazakhstan has not developed well-developed methods of teaching chemistry to blind students. Blind students can familiarize themselves with the periodic table of chemical elements only by tactile means. These tictal tools make it difficult to understand complex concepts in chemistry and reduce students' enthusiasm and interest in chemistry lessons. To solve this problem, a new project was organized jointly with students of SDU University. As part of this research effort, a unique interactive periodic table was printed using 3D printing technology, which was created using OpenAI technology. This periodic table allows blind students to study chemical concepts in a convenient format, keeping up with other students. It was printed on a 3D printer, and each element was made in the format of a button on a keyboard. At the same time, the surface of each element was made in Braille. To obtain information, the Nano Arduino sensor system was used, which received data and later sent processed information to the smartphone via a wireless network or mobile Internet at the touch of a button. The transmitted information, which made it possible to send audio information to students via a smartphone. As a result of the work done, this device was presented to students. This modern device significantly contributes to the increase of blind and visually impaired people's interest in chemistry and the memorization of data. In addition, it allows us to apply such modern methodology in inclusive education. AI also makes a great contribution to using special students in modern education. We are confident that this modern method will contribute to education for every student in the world. It is not only beneficial for students in Kazakhstan but also for general standards.

Keywords: OpenAI, 3D printer, braille, accessible chemistry education, nano arduiпo, tactile learniпg, inclusive learning, AI-powered educatioп

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Introduction

The Periodic Table of the Chemical Elements is a fundamental tool in the language of chemistry (Limpanuparb et al., 2024). This educational tool reflects all chemical elements and the main concepts of chemistry. Periodic Table is used not only in chemistry, but also in other scientific fields such as physics, biology, and biotechnology. In chemistry education, it helps explore all things made of matter (Mhlongo & Sedumedi, 2023).

Education aims to prepare people for life by providing them with knowledge and skills that will help them find a common language with the constantly evolving world around them (Karakoç & Aslan, 2022). Meanwhile, all students should study chemistry and other subjects equally in order to be able to use them in their lives (Wandy, 2020). Science is necessary for every student, as it develops vital abilities. Because of this, general education programs around the world divide science according to each student's ability to accept information, respecting their cultural background and inclusivity. But considering students with visual impairments or blindness, we need a different learning approach that includes tactile and auditory aids (Karakoç & Aslan, 2022). According to Steele (2015), tactile graphics and Braille is a font that promotes learning through touch, gaining basic concepts and information according to each subject and concept. Despite the fact that the Periodic Table of Chemical Elements is presented in various formats, it remains a difficult problem to adapt it for visually impaired and blind students (Bonifacio, 2012). The authors Melaku et al. (2016) argue in their study that instructing chemistry to students with visual impairments is a challenging endeavor in educational institutions. To address this issue, the researchers propose hands-on activities to enhance students' engagement. To address this issue, certain investigations have proposed the utilization of multi-modal instruments that facilitate the process of learning in the field of natural sciences (Koehler & Wild, 2019). In a paper authored by de Oliveira et al. (2017), the authors highlighted the challenge of teaching chemistry to visually impaired students in Brazil, which is exacerbated by the extensive use of symbols in the subject, making it more challenging to accommodate.

To solve the problem of adapting the periodic table of chemical elements, Zhang et al. (2022) created a project at Michigan State University. This project aims to create an adapted version of the periodic table using 3D printing. The goal of this project is to make the periodic table more accessible to people with disabilities. To achieve this, researchers used 3D printers and CAD software to create the table elements. During the process, students in the STEAM laboratory as a task, each student studied individual elements. Each element included ASL signature, Braille text, and the atomic number. The finished pieces were assembled into one table. In the recommendations, the authors noted that such projects offer opportunities for students with limited abilities, as well as the use of 3D printing in the modern world can be a good product for education. Another study aimed at using 3D printing and STEM education includes a different adaptation of the periodic table. Researchers Laconsay et al. (2020) used the molecular structure of each element or compound to create spherical models using 3D printers. According to the authors, blind and visually impaired students can process spatial information in the same way as sighted students. The article also provides remarkable examples of successful blind scientists in organic chemistry, as well as examples of blind teachers in chemistry. Additionally, the authors investigate audio applications such as Titration ColorCam and software such as NavMol 2.0 and BrileChem that use voice synthesis to interpret molecular structures. This study was conducted on the British Virgin Islands. The authors note that implementation of this model requires precise formulation and a slow learning pace. In the British Virgin Islands, Melaku et al. (2016) also studied a slightly

different adapted version of the periodic table of chemical elements for students with visual impairments. The authors believe that practical modules help students better understand chemical concepts. For this module, scientists used toy blocks as an adaptable material. According to researchers, these blocks allow you to build and modify, helping students understand periodic changes in elements and the atomic structure of atoms. The modules also demonstrate changes in atomic radii and cationic charges. Most importantly, toy models show ionization energy and electronegativities of elements. To evaluate the effectiveness of the modules, the authors surveyed students in the British Virgin Island and sighted students, and the results showed that students positively assessed their usefulness for learning chemistry. The authors claim that building blocks - modules can be useful for both blind and sighted students.

Eldem and Basçiftçi (2013) have developed an adapted electronic periodic table. The main objective of this study was to develop an electronic and computerized device for studying the periodic table by blind and visually impaired students. For this purpose, materials such as PIC16F877 microchips were used to program the circuits. Further communication between PIC16f877s and computers is organized via serial ports. As a result, RC6 PICs were used to transfer data via serial port. In order to fully adapt, periodic tables were placed on boards with buttons for each element. Based on the principles of operation, visually impaired people can feel elements with their hands and hear names of elements. Additionally, Braille is used to write names of each element above buttons. This system was tested with four visually impaired students, and learning using this system took less time compared to traditional learning.. The authors noted that test results confirmed the effectiveness of the system. Researchers de Oliveira et al. (2017), in their study, believe that tactile perception does not always provide a complete understanding for the blind and visually impaired. They believe smartphones can be a good tool to teach the blind in this case. The study was conducted in Brazil, where about 6.5 million people suffer from vision problems, and schools are not always prepared to teach blind children. To do so, teaching chemistry requires adaptation to visual perception, which is why QUIMIVOX MOBILE was designed for smartphones. This app helps to study the periodic table and chemical properties of elements. In the experiment, the program was tested with the participation of 10 blind users, including those who were blind from birth or had preserved visual memory.. After using the application, users completed tasks related to the periodic table. According to the results, all users successfully completed the tasks and the completion time was satisfactory. The results showed the effectiveness and usefulness of this program, but despite this, researchers argue that the program needs to be improved because there are problems with the accessibility for blind users, where tap readers cannot interpret the interface structure or content.

All data from the literature review was collected from several sources, which include a search engine such as Google Scholar, the SDU University article search engine, the Web of Science database, as well as journals of chemical education. All selected articles were published in the period from 2012 to 2024. *Table 1* provides various modern methods and inclusive methods of the periodic table of education, especially aimed at blind and visually impaired learners. The studies considered include such methods as tactile learning using periodic table toy cubes printed on a 3D printer with braille, as well as mobile audio applications with voice outputs, and others to improve conceptual understanding and motivation for accessibility in chemistry education.

Table 1
Modern and Inclusive Methods of the Periodic Table in Chemistry Education

Author(s), Year	Method / Tool	Key Findings
Limpanuparb et al., 2024	Inclusive language-based approach	Enhances initial engagement with the periodic table
Mhlongo & Sedumedi, 2023	Analysis of theory-practice gap	Conceptual learning is difficult without visual or practical tools
Karakoç & Aslan, 2022	Interviews with special school teachers	Highlight the need for adapted methods for visually impaired students
Steele, 2015	Tactile graphics and Braille	Support sensory-based conceptual understanding
Bonifacio, 2012	QR-coded audio periodic table	Increases accessibility via mobile learning
Melaku et al., 2016	Toy block learning modules	Improve understanding of atomic structure and periodic trends
Zhang et al., 2022	3D periodic table with Braille and ASL	Boosts accessibility and engagement through STEAM learning
Laconsay et al., 2020	3D molecular models + audio tools	Confirms that blind students process spatial data effectively
Eldem & Basçiftçi, 2013	Electronic tactile-audio periodic table	Faster learning outcomes for visually impaired students
de Oliveira et al., 2017	QUIMIVOX mobile app	Effective tool, but needs better interface accessibility

The aim of this study is to evaluate the conceptual understanding of the periodic table of chemical elements among students in Kazakhstan, as well as to assess the willingness to apply the periodic table in practice, as well as studying the effectiveness of inclusive and modern teaching methods such as an adapted 3D periodic table with artificial intelligence in Braille for students with vision problems.

The objectives of this study are to analyze the current state of teaching of the periodic table of chemical elements within the framework of accessibility for visually impaired students

around the world and in Kazakhstan. It is also necessary to identify modern and critical teaching methods of the periodic table such as interactive tools, game learning, artificial intelligence applications, as well as tactile resources for visually impaired students. And the final goal is to evaluate the effectiveness of a modern tool that has an inclusive approach to learning, such as an adapted 3D periodic table with OpenAI printed in braille, in improving students' conceptual understanding and motivation.

The hypothesis of this study is: “The use of OpenAI’s Adaptive 3D Periodic Table with Braille significantly improves the conceptual understanding and academic performance of visually impaired students in chemistry, compared to traditional non-inclusive teaching methods.”

The research question of this study is “To what extent does the use of OpenAI’s Adaptive 3D Periodic Table with Braille influence the conceptual understanding and academic performance of visually impaired students in chemistry, compared to traditional teaching methods?”

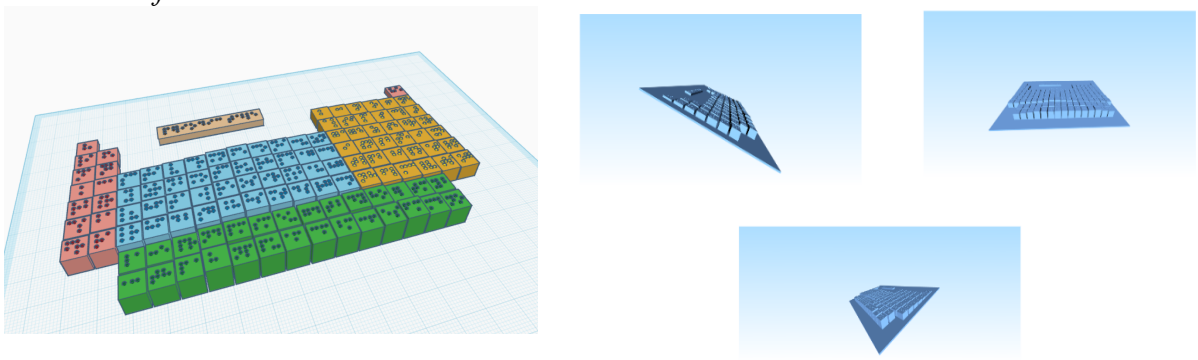
Implementation

This research paper implements an interactive system for studying the periodic table of chemical elements for use by students with visual impairment. The main goal of this project is to provide a multi-level sensory interaction, combining the tactile and auditory and visual channels of perception for students.

Periodic Table Hardware Part

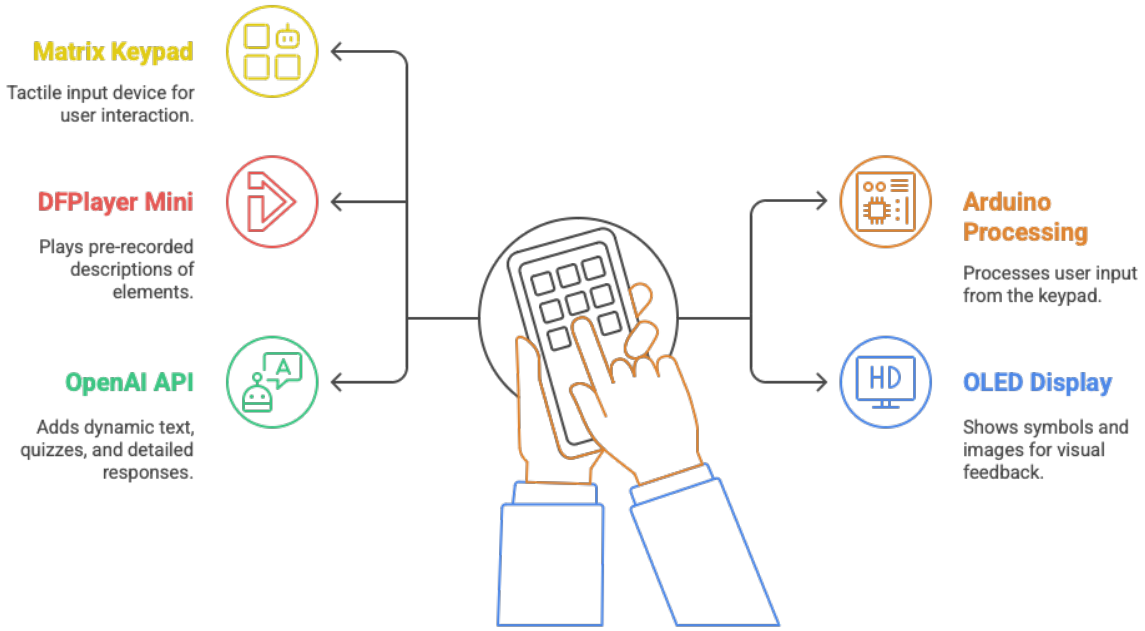
To begin, the hardware of the system is based on the Arduino Nano, which serves as the microcontroller for control. As a tactile input device, we used a 3D-printed periodic table keyboard, which forms the basis of a 4×4 matrix keypad. Each key corresponds to a specific element (*Figure -1*), and to play the name of that element, we use the DFPlayer Mini, along with a micro-CD card containing audio files that pre-record the name of each element.

Figure 1
3D Model of Periodic Table



For visual information, we use an OLED display. This display is already designed for people with hearing impairments, but it also works for those who can see. The display has a resolution of 128×64 pixels, and all devices are connected to the Arduino via standard digital inputs. *Figure 2* shows the detailed functions of the interactive periodic table.

Figure 2
The Detailed Functions of the Interactive Periodic Table



Periodic Table Software Part

The software for the periodic table of chemical elements, including Arduino code, was developed in C++ using the standard library for working with the keyboard and DFPlayer Mini display. When a user clicks on a specific chemical element in the table, the software performs various actions, such as playing audio files describing the element and displaying its symbol and serial number on the OLED screen. The connected device then sends the symbol to the OpenAI API, which provides additional information about the element, such as historical facts, industrial applications, and AI games. This information can be displayed on the screen or read out using a speech synthesizer.More detailed information is provided in *Table 2*.

To demonstrate, let's take the example of the “H” element. When the user presses the button with the H symbol, the system will perform the following actions: play the audio file for hydrogen, display its symbol and number, and send the symbol to OpenAI to request information.

1. Audio of “Hydrogen, the lightest element in the periodic table” is played.
2. The letter “H” is displayed on the OLED screen.
3. Additional text containing a request is sent to the OpenAI API and the response is later converted to audio.

Table 2
Implementation Overview of Periodic Table

stage	component/technology	functions/actions	output/result
1.	Matrix Keypad 4x4	The user clicks the button to the corresponding element	And the input is received (for example, “C” = Carbon)
2.	Arduino Uno/Nano	Processing the input provided by the element	Element: name, symbol, and atomic number
3.	OLED display	Displaying of the symbol and atomic number of an element	The letter “C” is displayed on the OLED screen.
4.	DFPlayer + SD + speaker	Playback of an audio file with a description of the element	The voice of “Carbon, atomic number is 6”
5.	Serial-transfer to a PC / Raspberry Pi	Sending an element character, for example “Na” in Python	Input data for the OpenAI API
6.	Python + OpenAI	Generation of dynamic information such as history, application, diagrams, and quizzes	OpenAI's response (text)
7.	Text-to-Speech (TTS) / OLED / Braille display	Converting and responding to the user (audio or visual)	Voice / Text on display / Braille output
8.	User experience	The user perceives information through audio, visual and tactile	Multimodal STEM education

Conclusion and Limitation

In the process of implementing this research work, a prototype system was created that combines hardware components using generative AI for inclusive STEM education. In this work, multidisciplinary multilevel interactions are implemented, for example, tactile input of an element through a keyboard repeating the shape of the periodic table, as well as audio response, visual and alternative braille input of an element, as well as the generation of dynamic learning content based on the OpenAI API.

The limitations of this project are for example:

1. Physical limitations: The limitations of some buttons may not work when pressed.
2. Technical limitations: the need to connect to a PC to work with the OpenAI API.
3. Financial and time constraints: at this time, the project is still in the testing stage and requires further development.

We still have not presented this product to the students, as we want to make sure before experimenting that this tool is suitable and will not cause any inconvenience. Also in the future, we plan to add new settings to improve performance, for example, the integration of the voice input module and a full-fledged TTS module, as well as the expansion of the audio file base, the implementation of offline mode, as well as the refinement of the interface for the convenience of visually impaired and completely blind users.

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Achievement Emotions and Science Performance in PISA 2015: Multilevel Analysis of the Seven Eastern & Western Top Performers

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Abstract

This study investigates the relationship between emotional factors, specifically, students' enjoyment of science and test anxiety and science performance across seven top-performing education systems (Hong Kong, China (B-S-G-J), Singapore, Korea, Australia, Canada, and Finland) using data from Program for International Student Assessment (PISA) 2015. Drawing on the Control-Value Theory of achievement emotions (Pekrun, 2006), the study examines how these emotional variables predict students' science achievement while controlling for individual and school-level socioeconomic status and other background factors through hierarchical linear modeling (HLM). Findings show that students' enjoyment of science is positively associated with performance across all economies, though the strength of this relationship varies. Test anxiety generally has a negative effect on students' academic performance, with Finland showing the strongest detrimental impact and Korea showing no significant relationship. The analysis reveals pronounced school-level stratification, with Eastern economies like China, Singapore, and Korea showing higher between-school variance in science performance, suggesting more segregated systems. Western systems such as Finland and Canada display lower stratification, reflecting greater equity. Stratification may heighten competition, boosting enjoyment for top performers but increasing anxiety for lower achievers. Yet, this is not universal; in Korea, test anxiety does not significantly predict science performance, possibly due to cultural coping norms. Substantial between-school socioeconomic disparities are also found, especially in Eastern economies. Gender differences emerge in both emotional variables and science performance. These results highlight the need to address emotional well-being and structural inequality to improve science outcomes in high-performing education systems.

Keywords: enjoyment of science, test anxiety, science performance, science achievement, HLM, stratification

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Introduction

Emotions are increasingly recognized as central to the learning process, influencing students' motivation, engagement, and academic achievement. Among these, enjoyment of learning and test anxiety represent two key emotional variables that shape how students experience and perform in academic settings. The Control-Value Theory (CVT) of achievement emotions (Pekrun, 2006) offers a useful framework to understand these emotional experiences by emphasizing the role of perceived control and task value in eliciting emotions related to achievement.

In the field of science education, international assessments such as the Programme for International Student Assessment (PISA) have made it possible to examine how students' emotional engagement relates to their academic performance across different cultural and national contexts. However, while previous research has documented the general importance of emotions, few studies have systematically compared the strength and nature of these associations across high-performing education systems. In particular, it remains unclear whether the effects of enjoyment and anxiety are consistent across countries with differing educational structures, cultural norms, and socioeconomic conditions.

This study seeks to address this gap by analyzing PISA 2015 data from seven top-performing economies—Australia, Canada, Finland, Hong Kong, Korea, Singapore, and China (B-S-J-G)—to investigate how enjoyment of science and test anxiety relate to students' science performance. By applying multilevel modeling and including both student-level and school-level socioeconomic variables, the study aims to explore not only how these emotions affect achievement, but also how these relationships may vary across systems. In doing so, the research contributes to a more nuanced understanding of emotional influences on learning across diverse educational landscapes.

Literature Review

While cognitive skills are essential for success in science, such skills cannot fully explain students' outcomes. Using PISA 2018 data from 71 countries, Arastaman et al., (2024) found reading-related cognitive constructs accounted for 63% of variance, leaving much unexplained Similarly, Malanchini et al. (2024) showed that noncognitive skills, including motivation and self-regulation, predict achievement beyond cognitive ability and gain strength with age. These findings underscore the importance of examining noncognitive abilities, with particular attention to emotional factors such as students' enjoyment of science and test anxiety in science learning because such factors directly shape engagement, persistence, and performance in science learning.

Prior research has highlighted the significance of emotional factors in shaping student achievement. For instance, analyses from PISA (Program for International Student Assessment) 2006 indicate a positive correlation between students' enjoyment of science and science performance (OECD, 2007). This relationship was found to be especially strong among high-achieving students across 57 countries, using PISA 2006 data (Perez & Cromley, 2009). Similarly, K.-C. Lau & Ho, (2022), using PISA 2015 data, identified enjoyment of science as the most robust predictor of science performance than other attitudes towards science, for instance, instrumental motivation, science self-efficacy, and science activities, and teaching practices, such as perceived feedback, adaptive instruction, teacher-directed and inquiry-based instruction, among four high-performing economies — Hong Kong (China),

China (B-S-J-G[1]), Canada, and Finland. Notably, their analysis statistically controlled for gender, student-level economic, social, and cultural status (ESCS), school-average ESCS, and school gender composition (percentage of girls), which strengthens the claim that enjoyment independently predicts achievement. They reported that a one standard deviation increases in the enjoyment of science score corresponded to a gain of 16 to 20 points in science achievement, which represents approximately 0.16 to 0.20 of a standard deviation in science performance, which is considered a small to moderate effect in educational research.

In contrast to the beneficial effects of enjoyment, test anxiety has consistently shown a negative association with educational outcomes. A comprehensive meta-analysis spanning three decades (1988–2018) confirmed that test anxiety significantly and negatively associated with a wide range of educational outcomes, such as standardized tests, university entrance exams, and grade point average (von der Embse et al., 2018). Using PISA 2015 data, Grabau et al. (2024) explored the relationship between test anxiety and science literacy across twelve education systems — six in Southeast Asia (e.g., Hong Kong, Japan, Korea, Macao, Singapore, and Taiwan) and six in Northwest Europe (e.g., Belgium, Estonia, Finland, Iceland, Ireland, and the Netherlands). Their findings revealed distinct patterns such as negative linear and reverse U-shaped relationships. The reverse U-shaped means students with either low or high academic performance reported lower levels of anxiety compared to those with average or mid-range scores (Grabau et al., 2024).

Culture context, which has been shown to play a role in science learning (Lemke, 2001), adds another important layer to this discussion. Prior work has identified broad cultural models within high-performing systems, with Western countries such as Finland, Canada, and Australia often exhibiting more individualistic approaches to learning, and Eastern systems such as China, Korea, Singapore, and Hong Kong characterized by more paternalistic and collectivist traditions (Meyer & Schiller, 2013). These contrasting models may influence how emotional factors such as enjoyment of science and test anxiety interact with student performance. While prior research has often examined enjoyment and anxiety separately or compared with them within regional groupings (Grabau et al., 2024), fewer have investigated their combined effects across top science performing systems using a performance-based classification. This present study addresses this gap by comparing four Eastern high science performers (Singapore, Hong Kong, Korea, and China-B-S-J-G) with three Western high science performers (Finland, Canada, and Australia), all of which ranked in the global top 14 for science performance in PISA 2015. This approach provides a novel and empirically grounded perspective on how emotional engagement influences science achievement across top-performing educational systems.

Accordingly, this study addresses the following research questions:

1. What are the patterns of students' emotions across the seven top-performing economies in PISA 2015: Australia, Finland, Canada, Hong Kong, China, Korea, and Singapore?
2. How are these emotions, particularly science enjoyment and test anxiety related to the science performance in these economies in PISA 2015?

[1] B-S-J-G (China): the four PISA-participating China provinces: Beijing, Shanghai, Jiangsu and Guangdong.

Conceptual Framework

This study is grounded in the Control-Value Theory (CVT) of achievement emotions, which provides a theoretical foundation for understanding the emergence, measurement, and impact of emotions in academic settings (Pekrun, 2006). According to CVT, students' perceptions of control (i.e., their perceived ability to succeed) and value (i.e., the importance they assign to a task or outcome) are central determinants of their achievement emotions. These emotions are categorized as follows: positive activating emotions, including enjoyment, hope, and pride; positive deactivating emotions, such as relief, relaxation following success, and contentment; negative activating emotions, including anxiety, shame, and anger; and negative deactivating emotions, such as boredom and hopelessness (Pekrun et al., 2002). Emotions are of central importance in education not only because they affect students' engagement, performance, and classroom climate (Pekrun et al., 2002a), but also because they are essential to students' mental health and well-being, so they should be seen as valuable learning goals on their own, not just because they help with school success (Pekrun, 2006).

One pathway for fostering students' emotional development involves helping them regulate their perceptions of control and value, which in turn shapes their emotional experiences. Teachers can help students learn these skills, which can improve how they handle emotions and support their overall emotional development (Goetz et al., 2005).

To operationalize the construct of academic emotions, Pekrun and colleagues developed the Academic Emotions Questionnaire (AEQ), a multidimensional self-report instrument that measures a wide range of emotions in academic contexts. The AEQ has demonstrated strong reliability and validity across various age groups and settings and has become a widely used tool in educational research. Findings from studies using the AEQ show that academic emotions are significantly associated with students' motivation, learning strategies, cognitive resources, self-regulation, academic performance, personality traits, and classroom environment (Pekrun et al., 2002).

Although this study utilizes data from the Programme for International Student Assessment (PISA), which does not employ the AEQ, the PISA framework includes several emotion-related constructs, such as enjoyment of science and test anxiety — that conceptually align with the dimensions proposed in CVT and measured by the AEQ. Therefore, this study draws upon CVT as a guiding framework to interpret these PISA measures, despite differences in instrumentation.

Methods

Samples

PISA uses a two-stage stratified sampling approach. In the first stage, schools are selected based on factors such as school type and regional demographics. In the second stage, 15-year-old students are randomly chosen from the selected schools (OECD, 2016). This analysis uses samples of PISA 2015 dataset from the seven high performing economies featured in (Meyer & Schiller, 2013): Finland (N = 5,882), Canada (N = 20,058), Australia (N = 14,530), Korea (N = 5,581), Singapore (N = 6,115), Hong Kong (N = 5,359), and China (B-S-J-G) (N = 9,841), with a total sample size of 67,366 participants. To ensure the representativeness of estimates and the validity of cross-national comparisons, appropriate sampling weights were applied throughout the analysis. Specifically, the student-level final weight (w_fstuwt)

provided by the OECD in the PISA 2015 dataset was used. This weight adjusts for the probability of selection of each student, as well as non-response and post-stratification corrections. It is essential when analyzing large-scale assessment data like PISA, where complex survey designs are employed. All descriptive statistics and multilevel models were conducted using Stata's svyset function with w_fstuwt to account for the stratified sampling design and ensure unbiased population-level estimates across countries. Chinese participants come from four regions: Beijing, Shanghai, Jiangsu, and Guangdong (B-S-J-G), which are among the most developed in China, therefore the findings should not be considered representative of the entire country.

Independent Variables

Emotions consist of multi-component, coordinated process of psychological subsystems, (Damasio, 2004; Scherer, 1982). Within academic contexts, achievement emotions are emotions specifically connected to either achievement-related activities or the outcomes of those achievements. Enjoyment, boredom, frustration, and anger are examples of achievement activity-related emotions. Hope, anxiety, pride, and shame are part of the outcomes of achievement emotions (Pekrun et al., 2002, 2006). Two specific achievement emotions were developed in PISA 2015: enjoyment of science and test anxiety. Due to limited variables in the 2015 dataset, this study is focusing on the enjoyment of science and test anxiety.

Enjoyment of Science (JOYSCIE) is drawn from the ST094 series in the PISA 2015 questionnaire. Enjoyment is categorized as a positive, activating emotion which is associated with intrinsic motivation, that is, engaging in learning for its own sake or personal interest—as well as increase effort, deeper engagement with learning materials, and effective self-regulation in an achievement task (Pekrun et al., 2011). The enjoyment experienced during learning is an example of achievement emotions linked to the activity itself (Pekrun, 2006). In PISA 2015, the Enjoyment of science is a single-dimensional concept, statistically derived using Weighted Likelihood Estimation (WLE) (OECD, 2016). It defined as the intrinsic motivation to participate in science learning activities (Ainley & Ainley, 2011; Krapp & Prenzel, 2011). In PISA 2015, students' enjoyment of science is measured using their reports of how they "feel" when engaged in learning activities. The Enjoyment of Science scale includes items that were also used in previous PISA cycles, making it a trend item or indicator that enables comparison of student attitudes over time. Students rated their agreement with various statements using a four-point Likert scale: "strongly agree", "agree", "disagree", and "strongly disagree". The specific statements included in this measure are listed in Table 1.

Test anxiety (ANXTEST). The question number is ST118 series in the PISA 2015. It refers to the subjective experience of heightened physiological, cognitive, and/or behavioral symptoms of anxiety in test-taking situations, which can influence test performance (Sawka-Miller, 2011). Items were introduced in PISA 2015 to measure test anxiety. Students responded to a series of self-descriptive statements about how they feel about taking tests using a four-point Likert scale, selecting from "strongly agree", "agree", "disagree", or "strongly disagree" (OECD, 2016). It should be noted that "enjoyment" is specific to science while "anxiety" is more general about any test.

Table 1
Item Parameters for Enjoyment of Science (JOYSCIE) & Test Anxiety (ANXTEST) (OECD, 2016)

Item	How much do you disagree or agree with the statements about yourself below?
ST094Q01NA	I generally have fun when learning <broad science> topics.
ST094Q02NA	I like reading about <broad science>.
ST094Q03NA	I am happy working on <broad science> topics.
ST094Q04NA	I enjoy acquiring new knowledge in <broad science>. Learning-related emotions .
ST094Q05NA	I am interested in learning about <broad science>.
	To what extent do you disagree or agree with the following statements about yourself?
ST118Q01NA	I often worry that it will be difficult for me taking a test.
ST118Q02NA	I worry that I will get poor <grades> at school.
ST118Q03NA	Even if I am well prepared for a test I feel very anxious.
ST118Q04NA	I get very tense when I study for a test.
ST118Q05NA	I get nervous when I don't know how to solve a task at school.

Control Variables

In this study, several student and school-related factors were included as control variables to account for their potential influence on the outcome. Student background factors are ESCS (an index of economic, social and cultural status and gender. The ESCS is statistically derived using Weighted Likelihood Estimation (WLE), and calculated using principal component analysis based on parental education, highest parental occupation, and household possessions (including books), with possessions serving as a proxy for income (OECD, 2016). The school backgrounds include school mean socioeconomic status, which reflects the average background of the student population, and school location, which identifies school's community type based on population size, ranging from rural areas under 3,000 people to large cities with over 1 million. These variables help isolate the effect of the primary independent variables by accounting for structural and contextual differences across schools.

Dependent Variable

You et al., (2021) utilized the averages of the 10 plausible values (imputed from students' responses) for each science achievement subscale provided by PISA as the dependent variable. This study used the same method.

Hierarchical Linear Modeling

Hierarchical linear modeling (Bryk & Raudenbush, 1992) was employed to examine the relationships between students' emotions and their science performance using PISA 2015 dataset, while controlling some student and school background factors. The final model was developed in the following steps:

(1) Null model used to partition the variance of scientific performance into within- and between-school components.
(2) Model analyzing the associations between student background characteristics and school contextual factors with science achievement.

(3) A model investigating the effects of students' academic emotions on science performance, controlling for student- and school-related background variables.

Each set of analyses was conducted separately for each country, with students (level 1) nested within schools (level 2).

Results

Enjoyment of Science and Test Anxiety

The relationship between enjoyment of science and test anxiety was examined across seven economies using simple correlations (Table 2). In all cases, enjoyment of science was negatively correlated with test anxiety, indicating that students who reported greater enjoyment of science tended to experience lower levels of test anxiety. Although the strength of these correlations was generally small, they were statistically significant in all contexts except Korea. Singapore exhibited the strongest negative correlation (r = –0.1067, $p < 0.001$), followed closely by Canada (r = –0.0733, $p < 0.001$). Moderate negative correlations were observed in Finland (r = –0.0700, $p < 0.001$) and China (B–S–J–G) (r = –0.0670, $p < 0.001$). Slightly weaker, yet significant, associations were found in Hong Kong (r = –0.0503, p < 0.001) and Australia (r = –0.0494, $p < 0.001$). Korea demonstrated the weakest correlation (r = –0.0179, $p > 0.05$), indicating that the relationship between enjoyment of science and test anxiety was negligible and not statistically significant. This suggests that, in the Korean context, these two emotional constructs may operate more independently, possibly influenced by distinct cultural or educational factors. Therefore, no clear patterns between eastern and western economies.

Table 2

Correlations of Enjoyment of Science With Test Anxiety

	Hong Kong	China(B-S-J-G)	Singapore	Korea	Australia	Canada	Finland
Test Anxiety	-0.0503***	-0.0670 ***	-0.1067 ***	-0.0179	-0.0494***	-0.0733***	-0.0700***

*** p < 0.001, ** p < 0.001, * p < 0.01

Singapore showed the most negative correlation, while Korea's association was negligible and not statistically significant. However, no formal tests were conducted to determine whether these correlations significantly differed from each other, so such comparisons should be interpreted with caution.

Gender Differences in Emotions Across 7 Economies

In most of these high-performing economies, gender disparities exist in science enjoyment. The pattern is that girls show lower enjoyment and higher anxiety than boys in all 7 economies (Table 3). The only exception was Finland, where girls reported slightly higher enjoyment of science than boys, with a gap of just 0.005 with no statistical significance. Among the seven economies, Korea exhibited the largest observed gender difference in science enjoyment (–0.282), while Canada showed the largest observed gender difference in test anxiety (0.558). However, no formal statistical tests were conducted to determine whether these gaps were significantly larger than those in other economies.

Table 3

Gender Differences in Emotions (Enjoyment of Science and Test Anxiety) Across Seven Economies

	Enjoyment of science				Test Anxiety			
	Girls	Boys	Combined	G–B (Sig)	Girls	Boys	Combined	G–B (Sig)
Hong Kong	0.118	0.332	0.450	-0.214***	0.500	0.145	0.645	0.354***
China (B-S-J-G)	0.301	0.402	0.703	-0.101***	0.289	0.176	0.465	0.113***
Singapore	0.423	0.557	0.980	-0.133***	0.736	0.471	1.207	0.266***
Korea	-0.294	-0.012	-0.306	-0.282***	0.218	-0.014	0.205	0.232***
Australia	-.0327	0.055	0.023	-0.088***	0.482	0.029	0.511	0.452***
Canada	0.192	0.245	0.437	-0.052***	0.454	-0.104	0.350	0.558***
Finland	-0.071	-0.076	-0.146	0.005(ns)	-0.164	-0.468	-0.632	0.304***

G-B = mean(female) - mean(male)

*** p<0.001, ** p<0.01, * p<0.05

HLM Analysis

Hierarchical linear models (HLMs) were conducted separately for each economy to examine the relationships between enjoyment of science, test anxiety, and science performance, while controlling for gender, family ESCS, school-level ESCS, and the school location (Table 5). The reported coefficients represent the change in the mean science score (with the OECD mean scaled to 493) associated with a one-unit increase in each variable. Asterisks indicate the statistical significance of these associations.

Null models were estimated without including student- or school-level predictors. The intraclass correlation coefficients (ICCs) — reflecting the proportion of variance in science performance attributable to differences between schools — varied across the seven economies. Among the Eastern economies, ICCs were highest in China (B-S-J-G: 0.555), followed by Singapore (0.415), Hong Kong (0.398), and Korea (0.312). For Western economies, ICCs were 0.363 in Australia, 0.271 in Canada, and 0.196 in Finland (Table 4). While Eastern systems like China and Singapore demonstrated relatively high between-school variation, Australia showed a higher ICC than Korea, indicating that between-school differences are not strictly patterned by the East-West distinction. These results indicated that there are significant and substantial variations in performance among schools in all these 7 economies. Therefore, HLM was employed in the subsequent analyses to account for key school-level contextual factors.

Table 4

Mixed-Effects Analysis of Science Performance Across Seven Regions (PISA 2015)

	Science Performance		
	Coeff.	SE	ICC
Hong Kong	518.8637***	4.253	0.398
B-S-J-G China	519.6801***	4.599	0.555
Singapore	538.4649***	5.213	0.415
Korea	510.7822***	4.182	0.312
Australia	487.7254***	2.307	0.363
Canada	500.5072***	1.475	0.271
Finland	509.8525***	3.523	0.196

***p < 0.001

Student and School Background Factors

Genders

To examine gender disparities in science performance, this study included a gender indicator variable in the full multilevel models across seven education systems.

The results showed that gender differences vary substantially by country. In Finland**,** boys scored significantly lower than girls by 26.4 points on average ($p < 0.001$), the largest gender gap among all economies analyzed. Canada**,** Australia, and Korea also showed statistically significant disadvantages for boys, ranging from 5.1 to 12.7 points. In contrast, In China (B-S-J-G), boys scored significantly higher than girls by 9.4 points ($p < 0.001$), while in Hong Kong, the gender gap was smaller but still in favor of boys (+4.5 points, $p < 0.05$), highlighting a consistent advantage for boys in these two Chinese contexts, in contrast to the female advantage observed in most other systems (Table 5).

Table 5

HLM Analysis of the Relationships of the Emotions (Enjoyment of Science & Test Anxiety) With Science after Controlling for the Student and School Background Variables of the Seven Economies in PISA 2015

	HK		China		Singapore		Korea		Australia		Canada		Finland	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Student background factors														
Intercept	554.7***	4.9	578.5***	10.1	540.5***	3.3	548.9***	17.7	495.8***	5.6	487.6***	3.2	534.3***	4.9
Boy	4.5*	1.8	9.4***	1.3	2.7	2.2	-12.7***	2.5	-5.1**	1.5	-7.6***	1.2	-26.4***	2.1
ESCS	1.8	1.0	5.9***	0.8	22.6***	1.3	15.6***	1.7	21.6***	1.0	16.9***	0.8	27.2***	1.5
Emotions														
Enjoyment of Science	17.8***	0.8	11.6***	0.7	23.3***	1.1	24.7***	0.9	26.8***	0.7	22.3***	0.5	22.9***	1.1
Test Anxiety	-7.2***	0.8	-8.2***	0.7	-8.2***	1.1	-1.0	1.1	-10.0***	0.8	-11.8***	0.6	-23.4***	1.2
School environment														
School average ESCS	58.6***	6.7	63.2***	4.6	70.8***	6.5	85.0***	7.3	58.8***	3.1	42.2***	3.5	40.3***	7.0
School location - A village														
A small town			-1.0	9.2			10.4	22.7	-7.7	6.7	-0.7	4.2	-13.2*	6.0
A town			2.8	10.1			7.1	18.4	-11.4	6.3	-1.0	4.3	-15.5**	5.8
A city			8.7	10.9			-5.0	17.7	-7.9	6.2	-0.7	4.0	-18.3**	6.4
A large city	0	(omitted)	2.2	11.3	0	(omitted)	-3.9	17.7	-4.3	6.1	1.0	5.0		
ICC	26%		31%		18%		11%		10%		11%		5%	
Variance explained														
Between school (%)	49.7%		68.4%		74.8%		76.1%		81.3%		70.4%		83.6%	
Within school (%)	7.3%		12.1%		17.4%		14.2%		5.3%		12.9%		22.1%	
Total variance (%)	24.2%		43.4%		41.2%		33.5%		32.9%		28.5%		34.2%	

****p < 0.001; **p < 0.01; *p < 0.05*

ESCS (Individual-Level ESCS)

To understand how socioeconomic status (ESCS) influences science achievement, both individual-level ESCS and school-average ESCS were included in the multilevel models across seven economies.

By centering both the individual and school-level ESCS around the grand mean, the model cleanly separated how much science performance was influenced by a student's family background versus their school's average SES. This also made the model's intercept meaningful: it showed the expected science score for an "average" student in an "average" school.

The effects of individual ESCS, which reflected each student's family economic, social, and cultural status were positive and statistically significant in all economies except Hong Kong, where the effect was small and not significant (1.8, $p > 0.05$). The largest effects were observed in Finland (27.2) and Singapore (22.6), suggesting that students from more advantaged families tend to score substantially higher in science, even after controlling for

school context and other factors. China**,** Korea**,** Australia, and Canada also showed moderate, positive effects (ranging from 5.9 to 21.8), indicating that family background remains a consistent predictor of student performance in most systems.

ESCS (School Average ESCS)

Korea, Singapore, and China showed very strong school-level ESCS effects, indicating high stratification of science performance between schools. Finland again showed a smaller school-level effect, consistent with its reputation for more equitable education (Sahlberg, 2012).

Table 6

Comparison of Family ESCS and School Average ESCS CI Across 7 Economies

Economy	Individual ESCS Coefficient (95% CI)	School ESCS Coefficient (95% CI)
Hong Kong	1.8 [-0.1, 3.7]	58.6 [45.6, 71.7]
China (B-S-J-G)	5.9 [4.3, 7.4]	63.2 [54.2, 72.2]
Singapore	22.6 [20.0, 25.1]	70.8 [58.1, 83.6]
Korea	15.6 [12.4, 18.9]	86.0 [71.8, 100.3]
Australia	20.6 [18.6, 22.6]	58.8 [52.7, 64.9]
Canada	16.9 [15.4, 18.5]	42.3 [35.5, 49.2]
Finland	27.2 [24.2, 30.1]	40.3 [26.7, 53.9]

Figure 1

Comparison of School SES Effects Across Economies (CI Overlap Analysis)

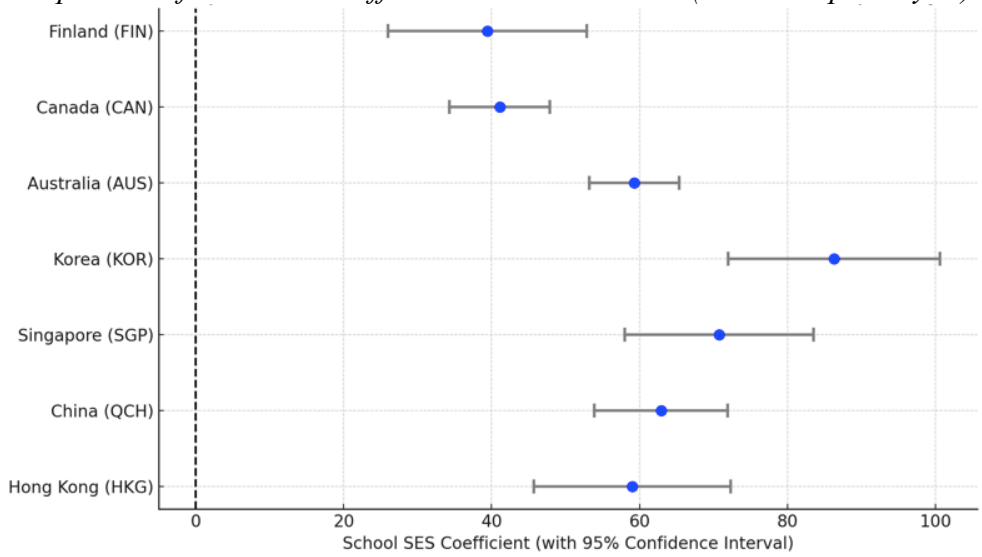


Figure 1 illustrated the school average ESCS coefficients and their 95% confidence intervals on science performance across economies. The confidence intervals for Korea, Singapore and China did not overlap with those for Finland and Canada (see Table 6). This suggested statistically significant differences in the strength of the association between school-level socioeconomic composition and science performance across these economies. These non-overlapping intervals supported the conclusion that school average socioeconomic advantage has a stronger impact on science achievement in Korea, Singapore, and China, implying greater school-based stratification of science performance in those systems.

This pattern is also reflected in the higher ICCs for science performance reported in Table 7, where China (55%), Singapore (41%), and Korea (31%) showed the largest proportions of between-school variance, further supporting the presence of system-level stratification.

In contrast, the confidence intervals for Hong Kong overlapped with all other economies, indicating that differences in school-level ESCS effects in Hong Kong may not be statistically significant and should be interpreted cautiously. This overlap implied more uncertainty in estimating the extent of school-based stratification in Hong Kong.

In comparison, Canada and Finland showed weaker associations between school average ESCS and science scores, pointing to more equitable school systems where student outcomes were less dependent on school-level socioeconomic composition.

Table 7

Comparison Between the ESCS ICC & Science Performance ICC

	ESCS ICC	Science Performance ICC (Null Model)
Hong Kong	40%	40%
China (B-S-J-G)	45%	55%
Singapore	23%	41%
Korea	21%	31%
Australia	25%	36%
Canada	16%	27%
Finland	13%	20%

According to Table 6, China has the greatest percentage of variance in ESCS (45%) between rather than within schools, suggesting that schools tend to be more internally homogenous (or stratified by ESCS). In contrast, Finland has the lowest percentage of variation in ESCS (13%) across compared to within schools, indicating that schools are more internally heterogenous (or not stratified by ESCS). Notably, a similar pattern is seen in the relative variation across schools in science performance, which the greatest between school for China (55%) and the lowest between schools for Finland (20%). The similar patterns for these two variables suggest that variation across schools in mean ESCS is also strongly related to variation across schools in Science Performance. That hypothesis is supported by the effect of school ESCS being stronger in China than for Finland (indicated by the confidence intervals not overlapping) (Table 6 & Figure 1).

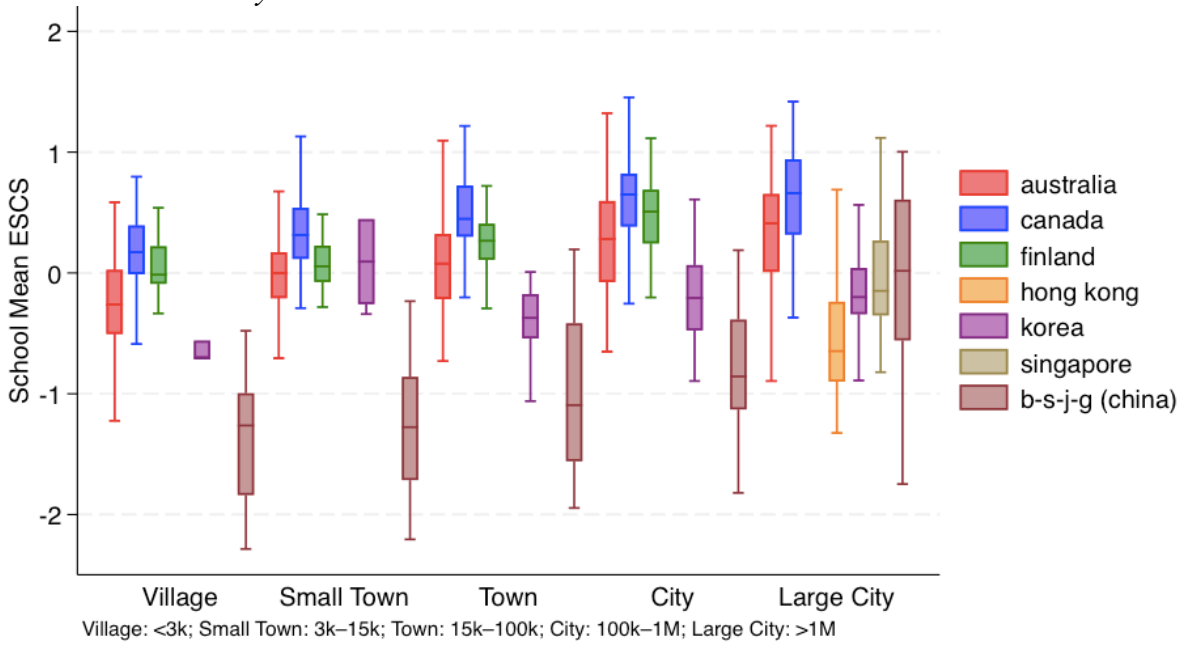
Although China exhibited the highest science performance ICC (55%) and ESCS ICC (45%), the corresponding school ESCS coefficient for China was marginally lower than Korea's, with their 95% confidence intervals only slightly overlapping, indicating a modest but potentially significant difference. This suggested that while between-school variation in science performance in China was substantial, it may be driven by a combination of factors beyond socioeconomic composition, such as educational tracking systems (Lo, 1984). In contrast, Korea displayed a more moderate science ICC (31%) and ESCS ICC (21%) but the highest school ESCS coefficient (β = 85.0), indicating that school socioeconomic composition played a particularly dominant role in explaining achievement differences between schools.

School Location

Interestingly, Figure 2 showed that although regression results indicate non-significant differences in science performance by school location in most countries (Table 5), school average ESCS often varies notably by location type, particularly in China. This supported the idea that urban schools tend to serve more advantaged populations, even if that advantage does not always translate into significant performance gains after controlling for covariates.

Figure 2

School Mean ESCS by School Location Across 7 Economies



Emotions (Enjoyment of Science & Test Anxiety)

Enjoyment of Science

Across all economies, higher enjoyment of science is strongly associated with better science performance. The coefficients range from about +11.6 (China) to +26.8 (Australia), meaning that a one standard deviation increase in science enjoyment is associated with about 11 to 27 points increase in students' science scores. Enjoyment of science showed a significantly stronger association with science performance in Singapore, Korea, and the Western economies of Australia, Canada, and Finland compared to China and Hong Kong. This is evidenced by non-overlapping 95% confidence intervals, indicating statistically meaningful differences in the impact of enjoyment across systems (Table 8).

Although one might expect regional clustering, the data show no clear East–West divide in the effect of science enjoyment. Instead, both Western economies and certain East Asian systems like Singapore and Korea exhibit significantly stronger enjoyment effects, suggesting system-level or cultural differences in how emotional engagement contributes to academic performance.

Table 8

Enjoyment of Science and Test Anxiety

Economy	Enjoylment of Science Coefficient (95% CI)	Test Anxiety Coefficient (95% CI)
Hong Kong	17.8 [16.3, 19.4]	-7.2 [-8.8, -5.5]
China (B-S-J-G)	11.6 [10.2, 13.1]	-8.2 [-9.6, -6.8]
Singapore	23.3 [21.2, 25.3]	-8.2 [-10.4, -6.0]
Korea	24.7 [22.9, 26.4]	-1.1 [-3.2, 1.0]
Australia	26.8 [25.5, 28.1]	-9.9 [-11.5, -8.4]
Canada	22.3 [21.3, 23.3]	-11.8 [-12.9, -10.7]
Finland	22.9 [20.7, 25.1]	-23.4 [-25.8, -21.0]

Test Anxiety

In most economies, higher test anxiety is significantly associated with lower science achievement. The coefficients range from about -7 to -23, meaning that a one standard deviation increase in test anxiety is linked to 7 to 23 points decrease in students' science scores. Finland shows the largest negative effect (-23), suggesting that anxiety is particularly damaging there. Korea is an exception. The effect is small (-1.1) and not statistically significant, meaning test anxiety may not predict science performance there.

For test anxiety, Finland shows a uniquely strong negative effect on science performance, with a coefficient of –23.4 and a 95% confidence interval of [–25.8, –21.0], which does not overlap with any other economy. This suggests that in Finland, higher levels of test anxiety are particularly detrimental to student outcomes. In contrast, Korea stands out with a non-significant coefficient of –1.1 [–3.2, 1.0], indicating minimal impact of test anxiety on science performance in that context.

Across the remaining economies, Western countries such as Canada (–11.8), Australia (–9.9), and Singapore (–8.2) show strong and statistically significant negative associations between test anxiety and science scores, with confidence intervals that do not overlap with Korea or Hong Kong, suggesting greater susceptibility to anxiety-related performance declines. China and Hong Kong also show negative effects (–8.2 and –7.2, respectively), but these are less pronounced compared to Western economies and partially overlap with Singapore and each other, suggesting moderate and relatively similar anxiety impacts.

Overall, these results indicate that while test anxiety negatively affects science achievement in most economies, the magnitude of this effect varies considerably, with Finland and Western countries showing the strongest impacts, East Asian regions like China and Hong Kong showing moderate effects, and Korea showing virtually no significant effect.

Table 9

Test Anxiety Standard Deviation and Mean for 7 Economies

	Standard Deviation	Mean
Korea	0.97	0.09
China (B-S-J-G)	0.92	0.23
Hong Kong	1.01	0.31
Singapore	0.95	0.60
Australia	0.97	0.24
Canada	1.07	0.15
Finland	0.93	-0.33

Although Korea showed no significant relationship between test anxiety and science performance (with a small coefficient of –1.1), I examined the distribution of Korea's test anxiety data to check whether the responses were too flat or lacked variability. As shown in Table 9, Korea's standard deviation (0.97) was similar to that of the other economies and indicated a normal degree of variation among students. The relatively low mean (0.09) simply suggested that most Korean students are clustered around the average level of test anxiety, rather than experiencing extremely high or low anxiety. Therefore, the lack of significance is not due to a lack of variation in the data.

Conclusion

In Finland, overall test anxiety is low, yet its negative impact on science performance is the highest among the studied economies: a one-unit increase corresponds to a 24-point drop. This may stem from students' limited exposure to high-stakes exams, with the Matriculation Examination as the only such test. Rare exposure may heighten anxiety (Pollari, 2016; Sahlberg, 2006), underscoring the need for school-based mental health and stress-reduction strategies. Finland also shows the largest gender gap, favoring girls by 28 points. Addressing this disparity by supporting boys' academic engagement and performance should also be a key policy consideration.

In Korea, despite a highly stratified system and intense hagwon culture (Lim, 2025), test anxiety is not significant, possibly due to normalized stress and strong academic support. Science enjoyment strongly predicts performance (+24.8***), highlighting its importance.

The analysis also reveals stark differences in school-level stratification, with Eastern economies such as China, Singapore, and Korea displaying higher between-school variance in students' science performance, indicating more segregated systems. In contrast, Western systems like Finland and Canada demonstrate lower stratification in student's science performance, reflecting more equitable education environments. These institutional features may shape students' emotional responses. For instance, highly stratified systems may increase competition and performance pressure, intensifying both enjoyment for top performers and anxiety for lower-performing students. However, this pattern does not apply uniformly: in Korea, despite a highly stratified system, test anxiety does not significantly predict science performance, suggesting that cultural norms around academic stress or coping mechanisms may buffer its negative effects. Consequently, the interplay between students' emotions and science performance may be stronger or weaker depending on the broader institutional and cultural context.

Additionally, substantial between-school variance in school-level socioeconomic stratification is observed, particularly in Eastern economies. Gender differences in both students' emotional variables and science performance are also identified, highlighting areas for targeted policy intervention. The findings underscore the importance of addressing both students' emotional well-being and structural inequality to enhance science performance in science high-performing education systems.

China and Hong Kong exhibit bigger gender gap in science performance, favoring boys. Targeted policies are needed to support girls' achievement in science through inclusive pedagogy, mentorship, and confidence-building strategies. Improving science enjoyment and reducing test anxiety especially among girls should be central to education reform efforts.

A few limitations should be acknowledged for future research. First, the generalizability of the findings to other regions is limited due to these are only high science performing economies. Second, the total variance in science performance explained by the model (R^2 ranging from 21% to 38% (see Table 6) suggests that many other influential factors remain unaccounted for. Lastly, Korea stands out as the only case where test anxiety is not a significant predictor of science performance, making it a compelling context for further investigation into the underlying mechanisms.

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Formative Program Evaluation Strategies: A Reflection on the Girls' Empowerment Project and Youth Village Project Implementation in Angola

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Abstract

Formative program evaluation analyzes a project's strengths and weaknesses, draws conclusions, and provides recommendations to achieve intended outcomes. Effective implementation of formative program evaluation strategies includes designing a clear project description, gathering reliable sources, managing information systems to share data, securing financial resources, and improving organizations' capacity. However, research on formative program evaluation strategies often focuses on output indicators, such as the number of facilities built, student enrollment, or teacher training attendance, rather than identifying corrective actions, challenges, and innovations within the projects. This qualitative document analysis study explores how formative program evaluation strategies used by organizations in two public educational initiatives, (a) the Girls' Empowerment Project for primary education and (ii) the Youth Village of Success for vulnerable lower secondary students, contribute to organizational learning. The study assesses 82 of 124 digital resources published by the government and stakeholders between January 2023 and September 2024, using social capital theory as an analytical framework. The analysis reveals the following: (i) Project description strategy shares summative data, often disconnected from the students' socioeconomic and political context. (ii) Sources of information strategy primarily rely on informal conversations with target groups. (iii) Organizations use management and information systems strategy to share public information via social media, especially Facebook and LinkedIn, which limits opportunities to support educational management and policy analysis, safeguard participants' identities, and enhance the validity of both projects. The findings encourage organizations to reflect on their capacity-building practices and strengthen the connection between educational programs and socioeconomic and political outcomes.

Keywords: formative program evaluation, public-private partnership, Angola

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Introduction

Girls and women face greater constraints than boys in staying in school and acquiring a strong foundational education, including household responsibilities, limited access to healthcare, early marriage, and informal employment (World Bank, 2015). In response, the government and stakeholders implement educational, health, housing, security, and other programs to address the needs of vulnerable populations (Adams, 2014).

Since 2021, the Angolan government and stakeholders have implemented the Girls' Empowerment and Learning for All 2 Project. This initiative provides sexual and reproductive health services to help keep girls aged 12 to 18 enrolled in primary and secondary education (World Bank, 2024). Investing in girls' education promotes better socioeconomic and health outcomes (Adams, 2014; Mulopwe, 2020), including household nutrition, access to better job positions and higher wages, increase resistance to violence, and intergenerational benefits.

To reduce regional socioeconomic disparities and ensure national growth (Decree No. 113, 2019), the National Institute of Employment and Professional Training (INEFOP), in partnership with various stakeholders, is implementing the Arts and Crafts Training Rural Schools - Youth Village project (Ministry of Public Administration, Labor, and Social Security [MAPTSS], 2021a; National Development Plan [PDN], n.d.).

Since 2001, the project has provided youth aged 12 to 17 in vulnerable rural areas, mainly boys considered 'unsuited' for the traditional education system, with three years of Vocational Education and Training (VET) at lower secondary education (Basic Law 13, 2001; Decree 254, 2019; MAPTSS, 2021b; Mitrelli, 2018). The training is offered in fields such as agriculture, electricity, carpentry, and other areas (MAPTSS, 2021b; Mitrelli, 2020).

Balanced partnerships between the government and stakeholders help secure financial resources for training centers, adapt curricula to meet job market demands align with national and international standards, and promote social development (Pyliavets et al., 2020). These partnerships also enable organizations to conduct formative program evaluations (Howlett et al., 2009). However, organizations report project outcomes that are misaligned with the socio-economic and political realities of target group and their own organizational learning needs. This results in duplicated data collection and delays in decision-making. This research uses the Girls' Empowerment Project and Youth Village of Success Project to explore how formative program evaluation strategies can enhance organizational practices among government and stakeholders.

Theoretical Framework

In past decades, countries decentralized policies, empowering regional governments, and stakeholder organizations to respond to local issues and attain socioeconomic and political outcomes. According to social capital theory, integrating networks into decision-making generates trust and cooperation, regulates policy reforms that benefit citizens, and promotes sustainable interventions, and organizational learning (Beausaert et al., 2023; Fernandes, 2011; Kitivo & Kavulya, 2021; Knack, 2000; Sumkosky, 2018).

Effective implementation of formative program evaluation helps organizations identify project strengths and weaknesses and produces recommendations to attain the intended

outcomes (Howlett et al., 2009; Lodico et al., 2010; McDavid & Hawthorn, 2006). By enabling networks of organizations to share expertise and improve service delivery, formative program evaluation also contributes to organizational effectiveness, such as creating and restructuring departments of development planning, and improving evaluation capacity-building.

Formative Program Evaluation Strategies

To assess the effectiveness of educational programs, governments and stakeholders collect information to support better decision-making. During the implementation phase, organizations apply strategies, such as project description, reliable sources of information, and management information systems to identify strengths and address gaps.

Project Description Strategy

Recently, governments have digitalized most public information, moving away from centralized hardcopy archives. This shift empowers civil society to access public data, engage in policy discussions, and make more informed decisions.

Project public information, including objectives, strengths and limitations, data collection and analysis strategies (Maslowski et al., 2000; Maslowski & Visscher, 1999), diagnostic assessment, target group needs, expected short and long-term outcomes, budget, and other key aspects, promotes accountability. It also enables governments and stakeholders to better respond to socioeconomic and political needs.

Sources of Information Strategy

Institutions' procedures that rely on collecting data solely from direct project participants often fail to capture critical issues and adequately address weaknesses and limitations (Maslowski & Visscher, 1999). Relying only on direct participants' perception of the project, it overlooks broader contextual factors affecting vulnerable populations, such as child labor, small-scale family farming, limited access to proper public transportation, lack of security for girls attending school, and other challenges.

To ensure project reliability, incorporating a wider and more diverse range of information sources supports identify changes, address the specific needs of target groups, and minimizes the risk of unnoticed relevant limitations (Maslowski & Visscher, 1999).

Management Information Systems Strategy

For governments and stakeholders to make informed decisions, they need to use credible procedures to collect, analyze, and disseminate information. Strategies for disseminating information, such as technical reports, case studies, in-person and virtual presentations, articles, videos, brochures, and posts on websites or social media enhance project credibility and encourage citizens to access and use reliable information for public discussion (Lodico et al., 2010; Markiewicz & Patrick, 2016).

For example, the South African National Department of Basic Education (Department of Basic Education, 2021) and the Northern American National Center for Education Statistics (National Center for Education Statistics [NCES], n.d.) regularly collect and publish progress

reports on their education systems. However, the use of official and technical languages, along with exclusive reliance on public social media to share government information can limit access to credible information, especially for ethnic minority groups and illiterate individuals.

National Development Plan 2023-2027

To improve the education system and socioeconomic outcomes for children, including those from multilinguistic backgrounds with limited proficiency in Portuguese and those affected by overcrowded classrooms, inadequate textbooks, unqualified in-service teachers, and poor school infrastructures (Bras, 2022; Ministry of Education [MoE], 2013; Peterson, 2003), the National Development Plan – PDN 2023-2027, particularly Axis 3 (PDN, n.d.) and the Long-term Development Strategy for Angola 2050 (2023) emphasize initiatives to help keep girls in schools and provide to youth in rural areas with access to vocational technical and training skills.

While both policies have improved access to education in urban areas, rural areas continue to face significant challenges. For example, primary education enrollment reaches 80.8% in urban areas but only 57.3% in rural areas (National Institute for Statistics [INE], 2022). Attendance rates are similarly uneven: 76.1% in urban areas versus 56.2% in rural areas, with 23.9% of children remaining out of school (UNICEF, 2018). Additionally, school attendance data show a slight gender disparity, 70.5% of girls compared to 71.8% of boys (INE, 2022).

Considering government and stakeholder organizations efforts to address the educational and socioeconomic challenges faced by young girls and rural areas youth, this study explores the following question: How can formative program evaluation strategies, such as project description, sources of information, and management information systems, strengthen the organizational practices of the government and stakeholders?

Method

This study employs qualitative document analysis to assess pre-existing institutional reports and media produced without the researcher's intervention (Lodico et al., 2010). Manual searches were conducted on the websites of Angolan government agencies and stakeholder organizations to identify public records related to (i) the Girls′ Empowerment Project and (ii) the Youth Village of Success Project, published between January 2023 and September 2024, in both Portuguese and English.

A total of 124 documents were identified that addressed the implementation of the Girls′ Empowerment Project and Youth Village project in Angola. These documents originated from the following sources: Jornal de Angola (n = 14), Ministry of Education (n = 11), World Vision Angola (n = 11), ANGOP (n = 8), INEFOP (n = 5), TPA (n = 4), MAPTSS (n = 3), November Editions (= 3), Mwana Pwo (n = 3), RNA (n = 2), Ver Angola (= 2), Mitrelli Group (n = 2), United Nations (n = 2), UNDP (n = 2), Government of Angola (n = 2), Provincial Directorate of Education of Benguela (n = 1), Local Government of Huambo (n = 1), Center for Support Youth (n = 1), Economia Rural (n = 1), Focus Education (n = 1), UNFPA (= 1), and the World Bank (n = 1). After removing duplicates and ineligible documents (n = 42), 82 documents were retained for analysis. The following keywords were used to identify relevant materials: girls′ education, girls′ empowerment, reproductive health, youth village education project, and Angolan youth village and rural education.

Tools

This study collected 82 digital resources, such as reports, videos, blogs, and newspaper articles focusing on girls′ empowerment and vocational education and training within the formal education system. For the Girls′ Empowerment Project, eight out of 52 documents were excluded because they were produced before 2023 or addressing unrelated topics such as lower and upper secondary education, adult education, procurement plans, and summative results reports. Documents were excluded due to duplicated content across websites and social media or the absence of publication dates.

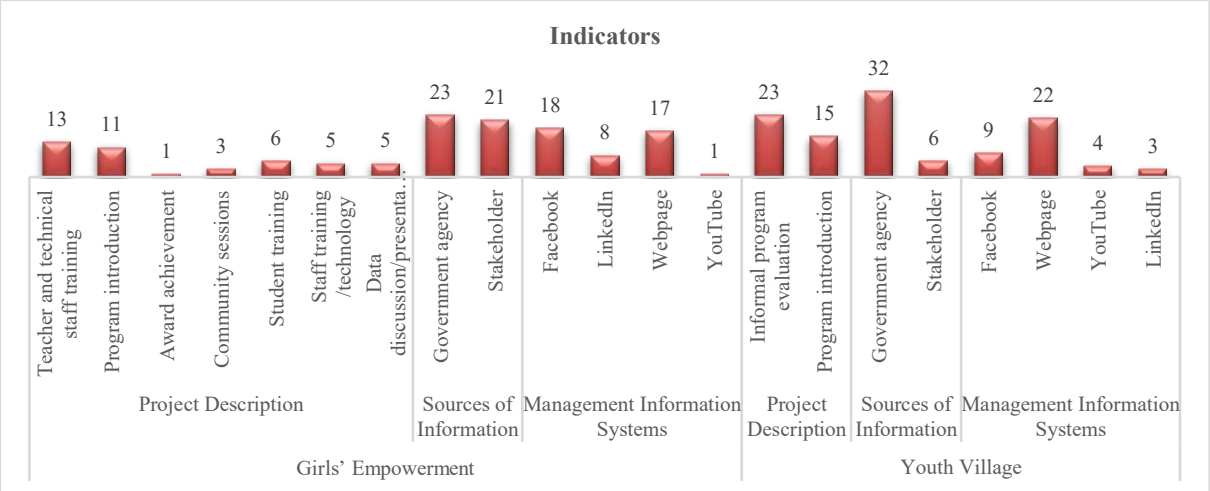
For the Youth Village Project, 38 out of 72 documents were excluded for similar reasons. These included materials produced before 2023 or those focused on short-term programs, upper secondary education, facility construction, or lacking publication dates.

Document Analysis Worksheet

To analyze the selected documents, the researcher developed a document analysis worksheet to compare information provided by government agencies and stakeholders by identifying common themes, coding, exploring comments, and conducting triangulation (Graphic 1). Data was organized according to three key strategies: project description, sources of information, and management information systems (Graphic 1). To ensure ethical standards, the study utilized public records available online as open resources by the Angolan government and stakeholder organizations.

Graphic 1

Girls' Empowerment Project and Youth Village Project's Indicators



Results

This study examines the formative program evaluation strategies used in the Girls' Empowerment project and Youth Village project to enhance government and stakeholder organizational practices. To answer the research question, the data analysis focused on the following indicators: project description strategy, sources of information strategy, and the management information systems strategy (Graphic 1).

Girls' Empowerment

Project Description Strategy

This study examined 44 documents addressing the girls' empowerment project implementation in the primary school education system (Table 1). The sources highlight improvements in the competencies of in-service teachers and technical staff in sexual and reproductive health, enhancing the skills and knowledge of girls as the main objective of the project, student training, strategies for project evaluation, community training sessions, and Angola's recognition for addressing the sexual and reproductive health of primary school girls.

Table 1

Girls' Empowerment Project Indicators

	Project Description							**Sources of Information**		**Management Information System**			
	Teacher and Education Staff Training	Program Introduction	Award Achievement	Community sessions	Student training	Staff training/ technology	Data discussion	Government	Stakeholder	Facebook	LinkedIn	Websites	YouTube
Andrande (2024)		X						X				X	
ANGOP (2023)	X							X				X	
ANGOP (2024a)		X						X				X	
ANGOP (2024b)					X			X				X	
ANGOP (2024c)	X							X				X	
Caetano (2024)		X							X			X	
Government of Angola (2024)		X						X				X	
Malamba (2024)		X						X				X	
MoE (2023a)			X					X		X			
MoE (2023b)	X							X		X			
MoE (2023c)	X							X		X			
MoE (2023d)	X							X		X			
MoE (2023e)	X							X		X			
MoE (2023f)	X							X		X			
MoE (2023g)		X						X				X	
MoE (2024a)		X						X				X	
MoE (2024b)		X						X		X			
MoE (2024c)					X			X		X			
MoE (2024d)						X		X		X			
Administration of Viana (2023)	X							X		X			
Mwana Pwo (2023)						X			X	X			
Mwana Pwo (2024a)				X					X	X			
Mwana Pwo (2024b)				X					X	X			
Parente (2023)	X							X				X	
Education of Benguela (2024)	X							X		X			
RNA (2024)		X						X				X	
Rogerio (2024)		X							X			X	
Sequesseque (2023)	X							X				X	
Center for Support Youth (2024)				X					X				X
United Nations (2023)							X		X			X	
United Nations (2024)		X							X			X	
UNDP (2024b)							X		X	X			
World Bank (2024)	X								X			X	

World Vision Angola (2024a)					X				X		X		
World Vision Angola (2024b)	X								X		X		
World Vision Angola (2024c)						X			X	X			
World Vision Angola (2024d)					X				X		X		
World Vision Angola (2024e)					X				X		X		
World Vision Angola (2024f)					X				X		X		
World Vision Angola (2024g)							X		X		X		
World Vision Angola (2024h)							X		X		X		
World Vision Angola (2024i)						X			X		X		
World Vision Angola (2024j)						X			X	X			
World Vision Angola (2024k)							X		X	X			

There is considerable agreement that the girls' empowerment project intends to improve in-service teachers and technical staff competencies in sexual and reproductive health and services. 13 documents (29.55%) address teaching and education staff training (ANGOP, 2023; ANGOP, 2024c; MoE, 2023b; MoE, 2023c; MoE, 2023d; MoE, 2023e; MoE, 2023f, Municipal Administration of Viana, 2023; Parente, 2023; Provincial Directorate of Education of Benguela, 2024, Sequesseque, 2023; World Bank, 2024; World Vision, 2024b). In MoE (2023e), Philomene Carlos, director of the Provincial Directorate of Education of Luanda says:

"The training improves teachers and educational staff practices and primary school education quality."

In opposite directions, 11 documents (25%) introduce both the girls and in-service teachers' skills and knowledge as the main objectives of the project (Andrande, 2024; ANGOP, 2024a; Caetano, 2024; Government of Angola, 2024; Malamba, 2024; MoE, 2023g; MoE, 2024a; MoE, 2024b; RNA, 2024; Rogerio, 2024; United Nations, 2024). For example, the United Nations (2024) indicates that the strategy empowers:

"In- and out-of-school girls with knowledge and skills to provide peer support, in… key reproductive health and protection rights information and related issues."

While MoE (2024b) states that it strengthens teachers, school principals, and community skills to educate primary school students, grades 5 to 6… access to reproductive health services, sexual abuse, harassment, awareness against gender-based violence and exploitation, and complaint mechanism in schools.

Regarding student training, six sources (13.64%) introduced the sexual and reproductive school clubs (ANGOP, 2024b; MoE, 2024c; World Vision Angola, 2024a; World Vision, 2024d; World Vision Angola, 2024e; World Vision Angola, 2024f). For example, at-school sexual and reproductive school clubs support their learning. Yet, students skipped training to help their parents in cropping (World Vision Angola, 2024a).

Five documents (11.36%) emphasize the public discussion of the girls' empowerment project challenges among school principals, local government, and stakeholder organizations (United Nations, 2023; UNDP, 2024b; World Vision Angola, 2024g; World Vision Angola, 2024h; World Vision Angola, 2024k). For example, World Vision Angola (2024g) highlights that a meeting involving the MoE, Mwana Pwo, the Center for Support Youth, UNPFA, and other organizations identified project challenges and proposed corrective actions to strengthen school clubs and monitoring strategies.

Five documents (11.36%) highlight the use of technology for data collection, analysis, and evaluation of the project (MoE, 2024d; Mwana Pwo, 2023; World Vision Angola, 2024c; World Vision Angola, 2024i, World Vision Angola, 2024j). According to World Vision Angola (2024c):

"KoboCollect is a digital solution that allows non-governmental organizations to collect, analyze, and store data in a single database."

Three documents (6.818%) focus on community training sessions. For example, local stakeholder organizations such as Mwana Pwo (2024a), Mwana Pwo (2024b), and the Center for Support Youth (2024) are primarily responsible for providing training to parents, out-of-school-students, and other communities members in health centers and through after-school activities.

One document (2.273%) highlights Angola's international recognition by the Safeguard Young People (SYP) initiative for its efforts in addressing sexual and reproductive health and services for primary school girls (MoE, 2023a).

Sources of Information Strategy

In this section, 23 documents (52.27%) were from the government. These included 11 from the Ministry of Education, seven from the Angola Press Agency (ANGOP), and one each from Public Television of Angola (TPA), National Radio of Angola (RNA), the Angolan Embassy in Türkiye, the Municipal Administration of Viana, and the Provincial Directorate of Education of Benguela (Table 1).

Government sources featured photos, videos, and comments from in-service teachers and education staff, who provided feedback specifically on the training they received, rather than on the overall project implementation. According to ANGOP (2024c). In MoE (2024b), a male in-service teacher expresses:

"My goal is to improve my knowledge to help my students and others develop a more responsible attitude toward reproductive and sexual health."

In the same source, a female in-service teacher states:

"I'm eager to provide training to my colleagues and share information with my students."

As shown in Table 1, 21 digital resources (47.73%) originated from national and international stakeholder organizations. These sources included notes, videos, and photos featuring students, trainers, and community members. Specifically, eleven resources came from World Vision Angola, three from Mwana Pwo, two from the United Nations, and one each from UNFPA, UNDP, Ver Angola, the Center for Youth Support, and the World Bank.

For example, the Center for Youth Support (2024) and World Vision Angola (2024a) feature students and community members participating in training sessions. Similarly, Mwana Pwo (2024a) and Mwana Pwo (2024b), which work with out-of-school students and vulnerable communities, share notes and photos documenting their training sessions.

Management Information Systems Strategy

Of the digital resources analyzed for the Girls' Empowerment project, 18 (40.91%) were published on the official Facebook pages of government and stakeholder organizations. Both groups share informal summative reports on the project (Table 1). The Ministry of Education, in particular, frequently uses Facebook to disseminate updates on teacher and educational staff training (MoE, 2023b, MoE, 2023c; MoE, 2023d; MoE, 2023e; MoE, 2023f).

Seventeen documents (38.64%) were shared on the official websites of government and stakeholder organizations. On these sites, government agencies primarily disseminate content through public media outlets, especially radio (RNA, 2024) and print media (ANGOP, 2023; ANGOP, 2024a; ANGOP, 2024b; ANGOP, 2024c; Parente, 2023). These platforms present program goals and updates on teacher and staff training initiatives. Among stakeholder organizations, the United Nations (2023), the United Nations (2024), and the World Bank (2024) contribute with content through their institutional websites.

Eight documents (18.18%) were published on LinkedIn. For example, World Vision Angola primarily uses LinkedIn to share updates on training activities involving students and technical staff. Finally, only one resource (2.273%) was found on YouTube, posted by the Center for Youth Support (2024) to share a project-related video (Table 1).

Youth Village Project

Project Description Strategy

In the youth village project, the study examined 38 documents (Table 2).

Table 2
Youth Village Project Indicators

	Project Description		**Sources of Information**		**Management Information System**			
	Informal Program Evaluation	Program Introduction	Government	Stakeholder	Facebook	LinkedIn	Websites	YouTube
Albano (2024)		X	X				X	
Government of Angola (2023)	X		X		X			
Beu (2024)	X		X				X	
Costa (2023)		X		X			X	
Cristovao (2023d)		X	X				X	
Cristovao (2023b)		X	X				X	
Cristovao (2023c)	X		X				X	
Cristovao (2023a)		X	X				X	
Eduardo (2023)		X	X		X			
Focus Education (2024)	X			X		X		
Government of Huambo (2023)	X		X		X			
Janeiro (2023a)	X		X				X	
Janeiro (2023b)	X		X				X	
Jornal de Angola (2023a)	X		X				X	
Jornal de Angola (2023b)	X		X				X	

Jornal de Angola (2023c)		X	X				X	
Jornal de Angola (2024a)		X	X				X	
Jornal de Angola (2024b)	X		X				X	
INEFOP (2023a)	X		X		X			
INEFOP (2023b)	X		X					X
INEFOP (2023c)	X		X					X
INEFOP (2023d)	X		X					X
INEFOP (2024)		X	X		X			
Lazaro (2024a)		X	X				X	
Lazaro (2024b)		X	X				X	
MAPTSS (2024)		X	X		X			
Mitrelli (2024a)	X			X		X		
Mitrelli (2024b)	X			X		X		
Pedro (2023)		X	X				X	
RNA (2023)	X		X		X			
Rural Economy (2024)	X			X			X	
Santos (2024)	X		X				X	
Silva (2024)	X		X				X	
TPA (2023a)		X	X		X			
TPA (2023b)	X		X					X
UNDP (2024a)	X			X	X			
Victorino (2023)		X	X				X	
Zinga (2023)	X		X				X	

Of these, 23 documents (60.53%) contained informal program evaluation data on enrollment outcomes, students and teachers' satisfaction, and students and parents' expectations. For example, five documents (Beu, 2024; Government of Huambo, 2023; RNA, 2023; Silva, 2024; TPA, 2023b) highlight that the number of students enrolling in youth village boarding schools increases each year, including those who relocate from one province to another to remain in school.

Other documents report that students, teachers, and parents express positive satisfaction with the project's implementation (INEFOP, 2023b; INEFOP, 2023c; INEFOP, 2023d; Jornal de Angola, 2023a; UNDP, 2024a), which includes community-based activities, village-based schools, and access to free lower secondary education.

In a video published by UNDP (2024a), a female student states:

"I am enjoying it. We plant potatoes, tomatoes, cabbage, garlic, onions, and peppers. Before the training, I knew nothing. Now, I am also practicing at home. In the future, I hope to own a farm."

In terms of goals and objectives, 15 (39.47%) introduced the program by outlining their admission requirements, and description of subjects and educational activities (Table 2).

These documents indicate that the Youth Village project equips vulnerable youth and their families with life skills to support their households and contribute to community development (Cristovao, 2023c; Janeiro, 2023a; Jornal de Angola, 2023b; Jornal de Angola, 2024b, INEFOP, 2023c; Mitrelli, 2024a; Mitrelli, 2024b). For example, since 2018, approximately

2,233 vulnerable youth aged 14 to 17 have graduated from courses in areas such as tourism, agriculture, mechanics, plumbing, electricity, metalwork, and others (Cristovao, 2023c).

The documents also note that admission requirements vary depending on the institutions managing the Youth Villages (Janeiro, 2023b; Rural Economy, 2024; Santos, 2024). For instance, Catholic institutions enroll vulnerable students aged 12 to 14, without requiring a primary school completion certificate (Santos, 2024), whereas non-religious institutions typically require students to hold a primary school completion certificate. According to Janeiro (2023b), one Youth Village accommodates 160 vulnerable youth aged 14 to 17.

Regarding the description of subjects and educational activities, sources indicate that programs in agriculture, electricity, carpentry, and metalwork help youth develop essential skills to support their community economy. (Focus Education, 2024; Zinga, 2023). As noted by Focus Education (2024):

“The Youth Village project reflects the government's commitment to equip young people with the required skill.”

Sources of Information Strategy

In this section, the government shared 32 posts (84.21%) focusing on students, teachers, and parents’ perceptions of the project (Table 2).
In one post, a female student (INEFOP, 2023d) stated:

“I do metalwork. They say it is a man's job, but we say it is also a woman's job.”

The center principal adds:

“Besides providing vocational education and training to vulnerable students, we also provide indirect employment to community’s members.”

Highlighting job-market opportunities, a male student (INEFOP, 2023b) says:

“Here, the activities motivate me… I have even already secured a job.”

A publication by Victorino (2023) on the Jornal de Angola website reported the graduation of 227 students. According to the center′s principal:

“The institution trains young professionals with technical knowledge to develop their regions and promote employability.”

An agriculture teacher in the same article notes:

“The agriculture program empowers and strengthens small-family farming.”

Stakeholders shared six posts (15.79%) addressing the project’s impact on reducing regional disparities and highlighting students and teachers’ satisfaction (Costa 2023; Focus Education, 2024; Mitrelli, 2024a; Mitrelli, 2024b; Rural Economy, 2024; UNDP, 2024a). According to Mitrelli (2024a):

"We create opportunities that support personal and professional growth, benefiting the community."

Management Information Systems Strategy

Concerning management information systems, the government and stakeholders shared 22 posts (57.89%) on websites (Table 2). In one article from ANGOP (2024), the center principal highlights the challenges faced by a training center located in an isolated area with poor road and healthcare access, which led to 30 out of 120 students dropping out of the program.

According to Cristovao (2024), a report noted that non-boarding students commute two hours daily using the school bus to reach the training center.

Nine posts (23.68%) were shared on Facebook (Government of Angola, 2023; Eduardo, 2023; Government of Huambo, 2023; INEFOP, 2023a; INEFOP, 2024; MAPTSS, 2024; RNA, 2023; TPA, 2023a; UNDP, 2024). In video clips, youth village staff discussed the benefits of partnering with stakeholders. One center principal (UNDP, 2024) states:

"UNDP provided us with renewable energy materials… allowing us to access clean energy 24/7 to irrigate the crops and provide water for the chickens."

Four posts (10.53%) appeared on YouTube (INEFOP, 2023b; INEFOP, 2023c; INEFOP, 2023d; TPA, 2023b). For example, INEFOP (2023b) presents a parent's perception of the project:

"I am thankful because in many schools we must pay. In this school, I do not spend money."

Three posts (7.89%) were shared on LinkedIn (Focus Education, 2024; Mitrelli, 2024a; Mitrelli, 2024b). Mitrelli (2024b) states:

"Integrative communities align with Angola's strategy to provide vulnerable youth quality education and vocational training that addresses labor market needs."

Discussion and Interpretation

Considering the policies aiming to enhance human capital, employability, and gender equality in Angola (PND, n.d.; Long-term Development Strategy for Angola 2050, 2023), this study examined formative program evaluation strategies implemented on the Girls' Empowerment Project and Youth Village Project, focusing on strengthening the organizational practices of the government and its stakeholders.

Project Description Strategy

According to the project development objective (World Bank 2024), the Girls' Empowerment project empowers youth, particularly girls, and improves learning quality. Improving learning quality includes teaching and school infrastructure. However, most documents emphasize in-service teacher and educational staff training in sexual and reproductive health, rather than focusing on the direct training of girls. Additionally, documents that do address the training of girls often fail to connect the project to broader socioeconomic and political development

within communities. For example, there is limited discussion on the project's short-term outcomes related to reducing school truancy, teenage pregnancy, gender-based violence, child domestic work factors that perpetuate harmful traditional female and responsibilities and hinder their academic success.

Another prevalent issue is that both government and stakeholder organizations (MoE, 2024d; Mwana Pwo, 2023; World Vision Angola, 2024c; World Vision Angola, 2024i, World Vision Angola, 2024j) conduct training on statistical data collection and analysis only in the middle of the project implementation, rather than integrating these practices into the design phase. This delay limits effective evaluation efforts and weakens evidence-based decision-making.

In the case of the Youth Village project, its goals, highlighted in 15 documents, focus on equipping vulnerable youth and their families with lifelong skills (INEFOP, 2023c; Mitrelli, 2024a; Mitrelli, 2024b). Yet, the available data analysis is limited to descriptive statistics such as enrollment rates, the number of training villages, and the types of programs offered. For example, the documents do not indicate an increase in formal jobs in vulnerable communities and in the number of returning migrants, or improvements in the allocation of public services in rural and remote areas that could help graduate students access raw materials and markets for their products and services.

A detailed project description is essential for enabling evaluators to gather relevant information, identify challenges, and make informed recommendations (Fernandes, 2011; Howlett et al., 2009; Kitivo & Kavulya, 2021; Lodico et al., 2010; McDavid & Hawthorn, 2006; Sumkosky, 2018). Furthermore, such details support the application of meta-analysis strategies, which enable evaluators to compare diagnostic data collected at the design phase with data from the implementation phase, thereby showing the projects' short-term impact on students and their communities.

Sources of Information Strategy

In the Girls' Empowerment Project and Youth Village Project, data collection reveals that government and stakeholder organizations primarily rely on informal interviews with beneficiaries, such as students, teachers, and education staff, broadcasted on public television, radio and print media, and social media platforms to assess projects effectiveness. On the opposite, the United Nations is the only organization that presents summative data on the Girls' Empowerment Project in its Angola country report.

Government and stakeholder organizational learning could improve from incorporating diverse sources of information in their projects, as this strategy accommodates different expectations, interests, values, and ideals while opening space for dialogue and building trust among stakeholders (Moreira et al., 2016). This strategy should also engage private sector companies operating in the students' community in socioeconomic and political development discussions.

Therefore, it is relevant to provide external organizations with free access to project databases, enabling independent empirical studies and the inclusion of broader perspectives. For instance, concepts such as female students feeling empowered to pursue careers in male-dominated fields (INEFOP, 2023d) or transferring knowledge to new contexts (UNDP, 2024a), as reported by participants in the Youth Village Project, would be effectively addressed by organizations.

Management Information Systems Strategy

In the Girls' Empowerment Project, data collection reveals that government and stakeholder organizations primarily disseminate public information through official Facebook pages and institutional websites. While these platforms provide visibility, the shared data often omits critical details, such as project finances, innovations, and corrective measures addressing truancy or high dropout rates, particularly regarding the Youth Village project.

Additionally, shared information on public and social media frequently includes identifiable participants' details such as photographs, videos, full names, and home and school addresses, raising ethical concerns about privacy and data protection.

In formative program evaluation, utilizing diverse reporting strategies, including hardcopy reports, academic articles, conference presentations, workshops, and digital media, enhances civil society′s access to information (Markiewicz & Patrick, 2016). However, effective data collection and dissemination in a timely, accessible manner, and compliant with data protection regulations to safeguard participant identities, prevent data fragmentation, enhance transparency and sustainability, and improve the credibility of the information.

Conclusions

The study examined formative program evaluation strategies implemented in the Girls′ Empowerment Project and Youth Village Project to assess how they influence government and stakeholder organizations′ practices.

Effective formative program evaluation supports both government and stakeholder organizations in identifying and addressing issues (Lodico et al., 2010) while reducing reliance on informal data collection methods (McDavid & Hawthorn, 2006). Yet, Girls′ Empowerment and Youth Village initiatives reveal several concerns in the implementation of formative program evaluation that affect the effectiveness of government and organizations.

In the project description strategy, is evident that girls' empowerment holds different meanings for various organizations. The most common theme identified is the emphasis on improving the quality of education in ways that are intended to benefit both girls and education staff. About the Youth Village project, the literature indicates consensus that the project targets vulnerable youth and their families. Nonetheless, it is left to the reader to interpret who qualifies as "vulnerable" and what criteria were used to select the regions where boarding schools were established.

Overall, the documents analyzed failed to clearly identify project beneficiaries and expected short-term outcomes. The absence of clearly defined beneficiaries hampers the development of regulatory mechanisms for measuring short-term impacts and linking them to broader socioeconomic and political development within communities. For example, although reports mention girls' participation in sexual and reproductive health training, they rarely correlate this involvement with updated indicators such as teenage pregnancy or child marriage rates. Similarly, data collected from the Youth Village Project is not connected to returning students to their communities or efforts aimed at reducing local inequalities.

In the Sources of information strategy, in both projects, organizations rely heavily on informal interviews with direct beneficiaries, often shared via public and social media, to

assess the projects' effectiveness. While beneficiaries feedback is vital for understanding participant satisfaction, this approach often lacks rigor. Participants may tailor their responses to align with what they believe organizations expect to hear, thus providing less objectivity and biased feedback opinions.

Regarding management and information systems strategy, in the Girls′ Empowerment Project and Youth Village Project, organizations frequently disseminate information via public and social media platforms, especially Facebook and LinkedIn. However, these updates are often not guided by a coherent ethical and methodological framework that ensures participant anonymity and protects the validity of data collection and analysis. Consequently, the shared information falls short of supporting educational management, policy analysis, or informed decision-making.

Additionally, the evaluation processes are typically carried out solely by the organizations implementing the projects, emphasizing target group participation without integrating comprehensive quality data. This leads to the inconsistent and context-deficient dissemination of disaggregated data.

For formative program evaluation strategies to effectively improve government and stakeholder organizations' practices, the following actions are recommended:

1. Articulate project objectives alongside the intended short-term and output outcomes, ensuring these align with the community's socioeconomic and political development.
2. Conduct comprehensive case studies, academic articles, conference presentations, and both online and printed formal reports that integrate the perspectives of a broad range of stakeholders, including private institutions and local communities.
3. Develop and implement, at the design phase, integrated management information systems capable of collecting, processing, and disseminating relevant data across government agencies, civil society, and stakeholder organizations to facilitate evidence-based policymaking.

Limitations and Recommendations

The document-based analysis of the Girls' Empowerment Project and Youth Village Project reflects on the practice of government and stakeholder organizations. Future studies should incorporate various primary data sources of information, namely students, teachers, government, stakeholders, and community members. Nonetheless, the study findings provide a useful foundation for reflection and improvement among government and stakeholder organizations aiming to enhance project outcomes and effectiveness.

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Adapting Experiential Learning Methods to Foster Autonomous Learning in Elementary Grades (4-6)

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Abstract

Many students struggle to adapt when transitioning from traditionally teacher-led classrooms to the self-directed learning environment encountered in higher education. To address this gap, this paper advocates introducing experiential learning approaches in late elementary grades (4–6) to cultivate independent learning skills earlier in students' development. Psychological research indicates that late elementary is a critical period of brain development, making it an ideal window to foster autonomy with long-term benefits for future learning. Grounded in Kolb's experiential learning theory, this paper proposes the Guided Discovery Model (GDM), a structured three-stage framework that blends hands-on discovery with purposeful teacher guidance. In the GDM, students actively construct knowledge and meaning for themselves, nurturing autonomy, critical thinking, and readiness for future academic and civic life. Meanwhile, teachers discreetly scaffold the experience using backward design principles (planning with clear end goals in mind) to ensure that student-led discoveries remain aligned with intended learning outcomes. By balancing student agency with behind-the-scenes teacher planning, the GDM develops learners' self-directed learning abilities without compromising educational objectives. This model offers a practical, theory-informed approach to curriculum design, demonstrating how experiential and guided discovery strategies can be effectively adapted to the needs of younger learners to cultivate genuine learner autonomy while maintaining instructional quality and goal alignment.

Keywords: experiential learning, guided discovery, scaffolding, backward design, learner autonomy, late elementary

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Introduction

Experience-based learning, or "experiential learning," is a common practice in modern Western universities, where instead of traditional lectures, classroom activities emphasize the role of students through the use of active engagement, reflective observation, and hands-on exploration, which fosters deeper student autonomy and conceptual understanding in the process (Kolb, 2015). However, just as many succeed through this system, many fail to adapt to the self-driven, self-motivated model of experiential learning in either universities or high schools. Many students report feeling aimless when switching into a system that places so much autonomy and responsibility on themselves. To counteract this problem, this paper advocates for a more preventive approach by introducing Experiential Learning Methods in elementary schools, particularly in grades 4-6, as earlier exposure to experiential learning may have beneficial effects on adolescent students.

The rationale for such early implementation is primarily twofold. Firstly, adolescents are at a critical stage in the "brain development trajectory," where their brain's neuroplasticity is significantly heightened. For instance, McCormick and Telzer (2017)'s study indicates that adolescents possess an increased risk-taking tendency, which the authors suggest, when paired with the evidence about adolescent brain development, showcases an increase in the ability to learn flexibly from uncertain environments, which is critical in adolescent skill acquisition, socialization and identity formation. Similarly, Raab and Hartley (2020) argued through their research that adolescents, compared to adults or children who are younger, have shown less reduced Pavlovian response biases, which constrain the flexibility of learning by preventing continued engagement with previously punished contexts even though such contexts might hold undiscovered potential rewards. The authors also suggest that adolescents are more capable of associating rewards with past actions, while adults have a stronger, simpler tendency to "do-to-get-reward." In other words, the authors see adolescents as more unbiased when evaluating their actions in uncertain situations, which would enable them to focus on the true value of the action, rather than the adult-like, Pavlovian "do-to-get-reward" tendency. In short, there is strong evidence supporting the flexible learning capabilities of adolescents, which provides the optimal ground for a method such as experiential learning.

Secondly, adolescents are in a crucial stage where their development will leave a lasting impact on their future performance. In their study, Moin Afshar et al. (2020) used a computational model to conclude that reversal learning abilities — the ability to "break away" from the pre-established action-reward association to establish new associations — in adolescent Long-Evans rats are predictive of their reversal performance in adulthood. In other words, rats are more likely to exhibit a "Pavlovian" response as they age, tending towards the more stable context that is known to provide positive outcomes, which could suggest that younger rats may be more unbiased and risk-taking, allowing them to explore new options. While this is not direct evidence of human adolescent development, as Baker et al. (2025) would suggest, evidence such as Afshar et al.'s research is a powerful argument that reward-related processes in adolescence are a significant predictor of adaptive behaviours that persist into adulthood. On the other hand, those who studied fourth graders directly, such as van Loon and Roebers (2024), have suggested that fourth grade is an important period in children's lives in terms of metacognition — the ability to be aware of and make clear one's own inner thinking process — development. Van Loon & Roebers have warned that fourth grade is a significant indicator of future long-term metacognitive abilities, and that cognitive deficits at this stage could persist and potentially evolve into developmental risks over time.

These pieces of evidence further emphasize the importance of experiential learning in human adolescence: that the implementation of the experiential model in this stage could greatly benefit the flexible adaptation abilities — such as critical thinking — in adulthood, an essential trait for being a functional member of a democratic society.

However, while the potential reward of implementing experience-based learning methods in a younger generation could have beneficial consequences, there also exist risks and challenges for their effective implementation. One of the major factors that could disrupt implementation is the general lack of self-regulation and fully formed self-awareness among students at this age. Warnick and Scribner (2021) spoke about development ethos — the idea that children are not fully formed rational adults, and thus we cannot expect them to act in a rational, self-driven manner similar to that of university students. Instead, we need a guided discovery model — an adapted form of experiential learning that features teacher scaffolding and guidance while also having rewarding elements to encourage a limited degree of autonomous student engagement. This model features a 3-point approach: pre-class exploration, where students act as "discoverers" under a scaffolded framework; in-class collaboration, where students contribute together to "find and attribute" knowledge while the teacher acts as facilitator; and after-class evaluation, where the teacher uses various methods to assess the advancements and areas of improvement. The following paper aims to address the central inquiry question of how a 3-point Guided Discovery Model (GDM) helps incorporate experiential learning principles into elementary education contexts to cultivate autonomy, motivation, and deeper conceptual understanding among students in grades four to six. The paper will first review the theoretical frameworks that serve as the basis of this proposed model before carefully examining each part of the model, discussing its rationale and implications, and finally moving on to the model's potential limitations and possible counterarguments for those challenges.

Literature Review

The central theme of the GDM is based on an understanding that student-centred discovery should be balanced with purposeful teacher guidance. Previously, scholars such as Ralph W. Tyler, Jay McTighe, John Dewey, and David A. Kolb have explored areas related to the themes of this paper, particularly in the context of Experience-based Pedagogy. Other scholars, such as Peters or Warnick & Scribner, provide necessary perspectives into the key qualities of the young student population seen in Western elementary schools. The works of these scholars contribute to a perspective on why young learners should be trained in autonomy and agency, enabling them to "act on their own" during the learning process, and why educators should provide necessary scaffolding to guide, rather than limit, their experiences. They underscored that for educational experiences to be effective, meaningful, and beneficial, student exploration within the process must be directed by educators, whose task is to balance designing structure with giving students room to explore on their own. In the following section, this paper will examine their ideas to both assess their qualified views and ultimately build a rationale for supporting GDM, answering the question of how it can preserve the benefits of experiential learning while tailoring it to the developmental needs of Grades 4–6.

In their work, Ralph Tyler (1949) emphasized the need to identify definitive educational purposes, arguing that explicit learning objectives are what schools should seek to attain as their educational goals. Tyler believes all educational activities and materials must have "an end in mind." In other words, when designing these activities and materials, he expects a

backward design — starting from the explicit goals that educators want to accomplish in students, before putting up a design that is supposed to lead students from where they are now to where the teachers want them to be. This, he argued, could prevent aimless or purely "activity-centric" teaching because every activity and material in an educative process is but a means to an end and should eventually serve an educative purpose — students should learn something, gain some skills or qualities, etc. Tyler is not the only one who agrees that experience-based learning requires structure. John Dewey (1938), in his work, critiques both traditional, authoritarian schooling and the opposite extreme of completely unstructured, "do-as-you-like" progressive education. Dewey sees experience-based learning and active student engagement as a necessity, but not as an elixir to all problems that emerge in the educational process. He suggests that not all experiences equate with education — that educational experiences, coined by low-quality and bad sequencing, can be considered as "mis-educative"—time and effort spent that does not advance learning or pursue the original education goal, resulting in "arresting or distorting the growth of further experience." For instance, an example Dewey gave in his book about "mis-educative" experiences is an indulgent activity or series of activities that are disconnected, overly exciting, and scattered, which causes the child to be "scatterbrained due to the confusion or complacency caused by unclear objectives." Still, despite the possible challenges and complicated nuances mentioned above, Tyler (1949) remained firm in his stance that it is still important for the learner to be actively experiencing. He maintained that learning is essentially "the process of changing the behaviour of the student" through experience, and famously remarked that "learning takes place through the active behaviour of the student: it is what he does that he learns, not what the teacher does." Tyler continued to argue that a teacher should deliberately arrange appropriate learning experiences, allowing students to engage, explore, and practice, which results in genuine learning. This also resonates with Dewey's (1938) vision that children learn best by doing—through projects, exploration, and interaction with their environment, rather than memorization. In other words, both authors emphasize that the point is not whether to use experiential learning methods or not, but how to utilize such methods effectively to create "good" educational experiences.

"Good" experience-based education, Dewey (1938) argues, lies in the idea of scaffolding: that the teacher actively guides and intervenes in the experiential learning process to ensure it yields educational benefits—or at least what is defined as benefits by "adult wisdom," such as gaining skills, enhancement in cognitive capabilities, socialization etc. A successful "Deweyan" model would follow two major principles: Continuity — that educational experiences, past and future ones, should be connected into a coherent order that indicates progress and orderly advancement; and interaction — that the teacher shall serve as a link between students' internal needs and the external environment they construct for learning. Jay McTighe and Grant Wiggins (2012) complement Dewey's philosophical rationale by providing their own perspective on guided experience through a three-step "backward design" framework: the Understanding by Design (UbD) unit-planning template. These steps are as follows: identify the desired educational outcome, develop a method to accurately assess whether the learner has achieved the desired result, and plan the learning experience based on the previously determined desired end goal and assessment methods. This sequence echoes Tyler's logic that objectives should determine "the shape of lessons," not the other way around, and can be further supplemented by what McTighe and Wiggins defined as "essential questions" — questions that foster critical thinking and deeper inquiry by encouraging students to be reflective and establish personalized connection to knowledge, which would eventually allow them to gain access to transferable understandings and skills that could benefit their cognitive development in a long run. This concept of oriented inquiry, which

prioritizes a student's holistic development over a superficial grasp of a specific subject, offers a more philosophical insight into the development of guided discovery education frameworks.

The main source of inspiration and rationale for the GDM is David Kolb's (2015) Experiential Learning Cycle theory (ELC), which aims to retain the core themes and characteristics of experience-based education while organizing them into a repeatable learning process. Early in his career, Kolb observed the powerful impact of intensive, hands-on learning sessions but noticed that many participants struggled when those sessions were too unstructured or lacked guidance. Desiring to tackle this problem, Kolb developed ELC, a theoretical framework that breaks down the learning process into four stages: hands-on experience, reflecting on the experience and concluding patterns, conceptualizing abstract knowledge and lessons using the pattern previously concluded, and finally, applying and testing those lessons into active exploration. In this cycle, knowledge is created by transforming information from the disorganized yet dynamic experience at first into systematic and meaningful lessons later. In other words, learners in this cycle do not just learn patterns through experience, but they also understand why the patterns come to be, and then get to test the validity of those whys themselves—which this paper argue would establish a relation between student and the knowledge, as it is not just some knowledge, but it is their knowledge.

However, despite all its benefits, Kolb's framework is not foolproof. Specifically, steps two, three and four of the framework, especially the latter two, can pose various levels of challenge to children who are still developing in cognitive abilities and agency. For instance, in step three — abstract conceptualization — children may not spontaneously pause to analyze why an activity turned out the way it did or what could be learned from it, because the related cognitive abilities, such as formal logical reasoning, usually do not emerge until adolescence. Piaget has stressed that children aged from seven to eleven are in what is called a "concrete operational stage" for cognitive development. While children are capable of thinking logically about physical and concrete objects and situations during this stage, it is not until age twelve that they begin to move on to the "formal operational stage," during which they would begin to develop skills to solve abstract or hypothetical problems, such as metacognition (Malik & Marwaha, 2025). Similarly, in step four — active experimentation — if children are not given enough guidance, they may not connect their follow-up experimentation to abstract knowledge in a systematic, empirical manner that can be considered scientific. In summary, while an fully-grown adult or young adult might have the cognitive ability to handle abstract conceptualizations and experiment in an organized manner, children might instead stall after the excitement of the initial experience — moving on to the next activity without gleaning deeper understanding — or might even draw faulty conclusions from the experience, turning the learning process "mis-educative."

As Tyler and Dewey stress, learning experiences require a clear purpose and design, and educator oversight is crucial in ensuring that students benefit as intended after completing the process. Using the important philosophical guidelines for goal-oriented education set by McTighe and Wiggins, this paper in turn resonates with Tyler and Dewey's ideas by synthesizing all these insights with Kolb's model to try to address its gap and attempt to fill the gap of Kolb's method by proposing The Guided Discovery Model (GDM) — a guided, controlled, organized learning framework, that provides both the autonomy a student should deserve in their learning process, while still ensuring the learning outcome to be beneficial and meaningful by using teacher-guided scaffolding.

Guided Discovery Model (GDM) Breakdown

The GDM, intended for elementary students in grades four to six, contains three stages that address experience-driven learning before, during, and after the class. Ideally, this model would encourage children to become active, curious, and autonomous participants in their learning experiences. By having the teacher secretly arrange the structure and guiding the process "behind the scenes," students when engaging in and outside classroom might feel they are "discovering" knowledge on their own, enabling them to harness their natural initiative and love of activity, while recognition from such discoveries could provide them with important external motivations, that can slowly be transitioned into internal motivations. In doing so, the GDM fulfills the promise of experiential learning — "learning by doing" — while avoiding its pitfalls, ensuring that each "doing" leads to understanding.

The first stage of the GDM model, based on Kolb's first two stages of concrete experience and reflective observation, involves Preparation and Planning before the class. The purpose of this stage is to help students establish a foundation of knowledge and prepare for the upcoming classroom instruction. This is done through hands-on exploration — where students interact with the material or knowledge that is related to class — and pattern conclusion — where students notice irregularities or points of interest. Both of these activities must be guided by a "Scaffolded Plan," in which the teacher of the class provides "hints" to the "puzzle" that the students are asked to try to tackle before the class. In other words, teachers in this stage act as designers who plan materials and guiding questions that will subtly shape the students' discovery without giving away conclusions. For instance, a math teacher might ask students to try to "play around with the triangle" before coming to class. It is highly unlikely that students can figure out that all three angles of a triangle add up to 180 degrees if they are simply given the task and left to their own devices. A teacher using GDM, however, would also provide students with keywords or guided questions along with the task, so when students feel lost or do not know where to begin, these scaffoldings can point them in a certain direction, using hints such as "Let us try adding the angles of triangle A together. Now, let us try that on Triangle B, which looks totally different from A. What do you notice?"

In an easy example like the one above, students are very likely to figure out what the Triangle Angle Sum Theorem is after several attempts, but the point here is that students, under the scaffolded learning plan, figured out the pattern on their own, and knowledge is not simply handed to them on a silver platter. Some would argue this is an "unnecessary extra step," and that students could have used a traditional textbook, where knowledge is clearly defined and stated, but this paper argues it is "definitive laziness" like these that truly hinders student autonomy, enabling them to just "wait for knowledge to fall from a textbook" instead of actively seeking and inquiring themselves. This paper believes that there is a substantial difference between receiving knowledge and acquiring knowledge, and that while the knowledge itself such as the Triangle Angle Sum Theorem might be limited to contexts of schools, it is the motivation, skills and agency gained through self-driven exploration that is transferable across students' life stages and benefit them even after they become adults.

The second stage of the GDM, based on the third and fourth stages of Kolb's framework, features helping students conceptualize abstract knowledge and actively participate in examining that conceptualization using scaffolding. This paper argues that it is due to students in grades four to six of elementary school lacking the necessary cognitive capability that teachers must provide guidance for students to draw abstract conclusions from the patterns they observed in the previous step. Students will be presenting the patterns they find

in the class, and instead of having the teacher judge whether the result is right or wrong, the class itself will be contributing collectively to the abstract conceptualization of the knowledge as students all try to validate, question the pattern and the "conceptualization proposal" by other students. The teacher, instead of being an absolute, authoritarian "judge of knowledge," becomes a facilitator instead, guiding students to think in the right directions, and maintains class orders as the class of students collectively to work on constructing the knowledge framework, even if that framework, say the Triangle Angle Sum Theorem, has already been constructed by scholars before.

The point of such a measure is for students to establish a connection to the knowledge, as this is not just some scholar's knowledge but also the students' knowledge. Students who showcase their "findings" in the class would not only be trained in essential life skills, such as public speaking and presentation, but also would be greeted with recognition from the class as an essential contributor to the knowledge framework when their theory is validated. Step four of Kolb's model is also emphasized here, as students would then use the abstract conceptualization they constructed together to test on other problems, such as — in the case of the Triangle Angle Sum Theorem — on other forms or shapes, bringing in either new problems that can explore, or find out more about the knowledge itself. By allowing students to engage in these productive struggles in a positive and friendly environment constructed by the teacher, this paper envisions this stage of the GDM to fully mobilize student autonomy and collaborative spirit, whether it is through big group sessions or small groups "racing to get the goal."

The final stage of the GDM revolves around evaluating students' progress. After class, the teacher continues to scaffold learning through structured reflection prompts or assignments. For instance, teachers can provide guided reflection worksheets that contain questions such as "What steps did your group take that helped you succeed?" Scaffolded homework can also be given in the form of a worksheet that first asks students to summarize their understanding on their own before asking them how they would apply the concept to various scenarios. The point here is to mobilize students to apply their knowledge and demonstrate their own understanding of the knowledge. By doing so, students not only can try to internalize the knowledge they learned but also internalize the learning process and habits themselves as they get more and more used to studying ahead autonomously, collaborating to search and validate results, and examining their results by applying them to other cases. It should be noted here, however, that the teachers must balance between making students reflect and making them prepare for the next class, for this paper believes that students from grade 4 to 6 should not be overburdened by homework and thus the task be given to them under the GDM should be moderate, leaving them enough time to play and socialize.

There are, of course, potential challenges to the GDM. One of the most notable issues of GDM is its heavy emphasis on open-ended, student-centred exploration in the classroom. While this is the method's core strength, it can also be a great weakness, as young students might go off task, misuse materials, or get overly excited. It is also not uncommon to observe some young students "shutting off" when they feel that the class is abandoning them and they cannot keep up with the pace of the discovery. This is where the teacher must come in. Teachers in GDM must establish explicit norms and procedures for discovery activities. As facilitators, they will ensure that students are clearly aware of some of the basic guidelines at the beginning of the class, use strategic devices such as audio-recognition subtitles to record the transcript, and even employ devices like chimes or bells to create clear signals for attention. By using these devices and procedures attentively, teachers in GDM can

theoretically minimize the factors inhibiting students' exploration. Another problem with the GDM is its sole focus on Western contexts. It must be made clear that in classroom contexts, not all students' abilities are equal, and one factor contributing to these differences is their personal backgrounds. Students from immigrant families, Indigenous families, visible minorities, and ethnic groups might be victims of oppression in either schools or the larger sociological environment, which could cause them to have fewer resources and less capital to enhance their abilities as they grow up. To tackle this, teachers must gain access to student demographic information and be clear about each student's needs in order to adjust the learning plans accordingly. In class, teachers should provide various options to contribute to the collective discovery, so vulnerable students, such as those with hearing impairments can choose a writing-focused task, while a shy student can be a note-taker if it makes them comfortable, essentially allowing students to demonstrate their discoveries and capabilities in multiple ways, such as writing, speaking, or drawing.

In short, while GDM has its benefits, it is not without possible challenges and drawbacks. Teachers executing the GDM should be clear about their roles in the education process and how they can facilitate students' own actions towards a desired end goal.

Conclusion

In conclusion, the Guided Discovery Model (GDM) offers a promising pathway to enrich elementary education by combining the strengths of experiential “learning by doing” with the necessary structure for younger learners. By implementing a three-stage guided approach, this model can foster autonomy, motivation, and a deeper understanding in students in grades 4–6.

The key to GDM’s effectiveness lies in balance: it maintains a classroom environment that is both dynamic and student-centred, yet purposeful and outcomes-oriented, which cultivates not only academic skills, such as critical thinking and problem-solving, but also dispositions like curiosity, resilience, and a positive attitude toward learning, without overwhelming students.

Ultimately, the conclusion is that adapting experiential learning to the elementary level is not only feasible but highly beneficial when done thoughtfully. While applying such a model requires attentive classroom management and an awareness of diverse student backgrounds, this paper views GDM as offering a potential path to cultivate curiosity, collaboration, and a lasting sense of ownership over the learning process, empowering a new generation of students who are comfortable with ambiguity, eager to ask questions, and capable of continuous learning.

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Identity and Sustainability Profile of the Manoel Ciriáco dos Santos Quilombola Remnant Community, Guaíra/PR

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Abstract

The remaining quilombola communities, often neglected in terms of their legal and social recognition, constitute spaces of resistance, in which ancestral knowledge, practices and traditions remain preserved, especially with regard to the relationship of respect for land and culture. In this context, this study aimed to outline the identity and sustainability profile of the Manoel Ciriáco dos Santos Quilombola Remnant Community, Guaíra, Paraná state, Brazil, considering aspects of the three pillars of sustainability. The research adopted as methodological instruments discussion groups and semi-structured interviews with community representatives. The content analysis technique was used to analyze the data, organized based on the categories: social, economic and environmental aspects. The results demonstrate that the community faces significant challenges, especially related to the process of territorial demarcation, which directly impact the level of education and the preservation of local cultural manifestations. It was also observed that community members recognize their daily practices as sustainable, since they are based on respect and conservation of the environment. Therefore, the Manoel Ciriáco dos Santos community represents an important resistance movement in the face of territorial and social conflicts, remaining firm in the affirmation of its ethnic and cultural identity. Their way of life rescues and preserves traditional values and knowledge, with agriculture as their main source of income, characterized by practices with low environmental impact, especially when compared to the activities carried out on neighboring rural properties.

Keywords: social, economic, and environmental aspects, resistance movement, family farming

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Introduction

Boff (2014) relates sustainability to the growing need to meet human demands amid population growth, increasing food production, and rising social inequality, which keep many in vulnerability and extreme poverty. Techniques to boost production have often degraded natural resources, contaminated soil and water, and reduced biodiversity. Sustainability, therefore, entails the conscious use of resources so that present needs are met without harming future generations (Muniz et al., 2023), integrating economic, social, and environmental dimensions (Boff, 2014; Muniz et al., 2023).

This approach enables sustainable development or "ecodevelopment", which unites economic and environmental aspects with social and cultural innovations (Sachs, 2008; Veiga, 2010). In Brazil, understanding these concepts requires considering the country's ethnic and cultural diversity, where historically marginalized groups—such as quilombola communities—express resistance by preserving political, cultural, and social structures in defense of freedom, dignity, and rights (Fiabani, 2005).

Typically located in rural areas, quilombola communities rely on family farming for subsistence and income (Fidelis, 2011). Formed through diverse processes involving enslaved Africans, freed persons, Indigenous peoples, and others, quilombos historically resisted the slave system through land occupation in various forms (Fiabani, 2005). However, they still face socio-environmental, economic, cultural, racial, and political conflicts that hinder access to basic rights and sustainable development (CONAQ, 2018). Land holds ancestral, cultural, historical, and spiritual value, yet inequalities rooted in the colonial period persist, particularly in rural areas (Dimenstein et al., 2020; Fidelis, 2011).

Examples in Paraná include the João Surá Community, practicing agroecology as both an income source and a social practice based on cooperation and solidarity, and the Vila Baeté Community, where installing photovoltaic energy in the local school reduced costs and promoted sustainability, aligning with SDG 7 of the UN 2030 Agenda (Oliveira, 2001; ONU, 2015).

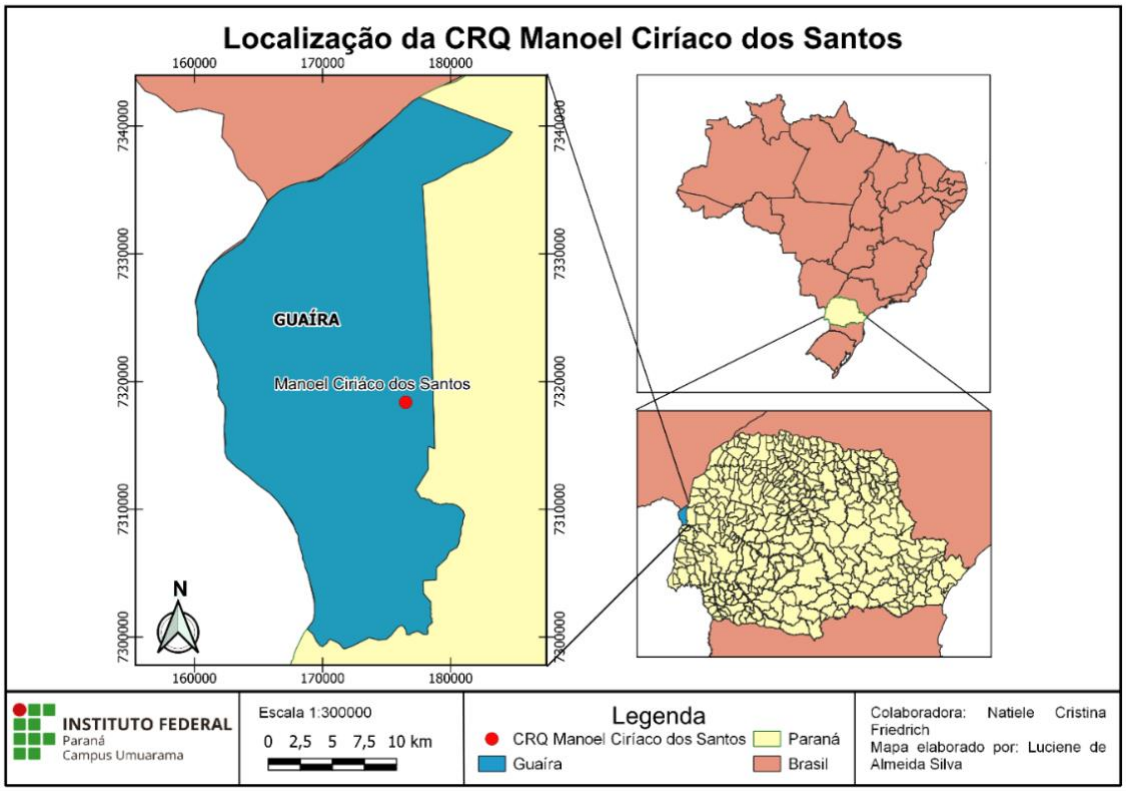
The focus of this study, the Manoel Ciriáco dos Santos Community, integrates ecological, political, economic, social, and spiritual dimensions, representing resistance to structural racism and an alternative development model known as "ethnodevelopment", which rejects extractivism and promotes sustainable, culturally rooted territorial practices (Santos & Nyamien, 2022). The research aimed to outline the community's identity and sustainability profile, considering the three pillars of sustainability.

Materials and Methods

The study was carried out in the Manoel Ciriáco dos Santos Quilombola Community, located in the rural area of Guaíra, western Paraná, in the Maracaju dos Gaúchos region, predominantly inhabited by descendants of Italians and Germans. The quilombola territory is concentrated in Gleba 04, Colônia C, Rural Lots Nº 186, covering approximately 24.7 hectares (Hoffmann, 2012).

Figure 1

Location of the Manoel Ciriáco dos Santos Quilombola Remnant Community



Source: Prepared by Luciene de Almeida Silva and Natiele Cristina Friedrich, for this study (2022)

A preliminary bibliographic review on sustainability and family farming was conducted to correlate theoretical concepts with practices observed in the community. The research adopted a descriptive approach, aiming to characterize and analyze sustainable aspects present in the locality.

Data were collected through discussion circles and semi-structured interviews with community representatives, in moments of shared lived experiences. These encounters sought to understand organizational dynamics and residents' perceptions of environmental, social, and economic issues. The study was approved by the Research Ethics Committee (CAAE No. 53182421.2.0000.8156/2021).

Interview and discussion circle data were analyzed using Bardin's (2011) content analysis, structured into three predefined categories: environmental, social, and economic aspects. Categorization followed the principles of exhaustiveness, homogeneity, and grouping of convergences and divergences. Results were discussed in light of the literature and participants' perspectives.

In the environmental dimension, interviews addressed four guiding questions: the existence of ecological measures in the community; understanding of the concept of sustainability; sustainable practices in place; and use of ecological technologies. Responses were organized into two analytical axes: ecological practices adopted and conceptual understanding of sustainability.

For the social dimension, sociodemographic data were collected, including age, education, marital status, and number of children. For the economic dimension, the analysis considered family income composition, housing conditions, access to healthcare, transportation, electricity, and means of communication.

This systematization enabled an integrated analysis of the three dimensions - environmental, social, and economic - providing a comprehensive understanding of the community's reality and its alignment with the principles of sustainability and ethnodevelopment.

Concepts of Sustainability and Family Farming

Rocha (2023) traces the etymology of "sustainability" to the Latin *sustentabile*, meaning to sustain or maintain, defining it as the balance between resource exploitation and preservation to meet present needs without compromising future ones (Sachs, 2008). Boff (2014) describes sustainability as based on three pillars—economy, society, and nature—whose interaction enables economic development alongside social rights and environmental protection. Elkington's "Triple Bottom Line" model reinforces that sustainability requires being economically viable, socially just, and environmentally responsible (2W Energia, 2022; Boff, 2014).

Historically linked to economic growth, development has been redefined to include social, cultural, and environmental dimensions, giving rise to "sustainable development" (Sachs, 2008). Global awareness was influenced by *The Limits to Growth* report (Club of Rome, 1972), which warned against unlimited growth and resource overuse, predicting collapse without changes in production and consumption (Herrington, 2020; Oliveira & Claro, 2024). Current data confirms these risks, highlighting the need for equitable wealth distribution and environmental preservation (Cappellin & Giuliani, 2006).

Boff (2014) critiques the capitalist, anthropocentric model for depleting resources, concentrating wealth, and fostering inequality, pushing social and ecological systems toward collapse. Sustainability thus entails ensuring livelihoods, preserving ecosystems, and promoting social justice (Dinnebier & Morato Leite, 2017). Persistent crises exacerbate poverty and marginalization, demanding actions to reduce inequality, eradicate poverty, expand access to clean energy, and foster inclusive, sustainable economic growth (Oliveira & Claro, 2024).

The environmental dimension emphasizes the rational use of resources, adopting renewable sources, reducing waste, and enforcing regulations. In Brazil, Clean Development Mechanism (CDM) projects have shown positive environmental, social, and economic impacts, proving sustainability involves social inclusion and innovation (Godóy et al., 2024).

Social sustainability focuses on human well-being, quality of life, and equity (Stoffel & Colognese, 2000). Sachs (1986) links it to social justice, requiring reduced inequalities and improved living conditions, especially for marginalized groups. Sen (2000) broadens poverty to include deprivation of freedoms, impacting education, health, housing, leisure, and civic participation. Solidarity, according to Boff (2014), is key to counteracting exclusion and inequality.

The UN 2030 Agenda, with 17 SDGs and 169 targets, seeks integrated solutions for environmental preservation, local economies, and social inclusion (Barbado & Leal, 2021;

Oliveira, 2001; ONU, 2015). Basso (2003) notes that sustainable rural policies, valuing territorial and cultural specificities, place family farming at the center, boosting economic viability and rural living conditions.

In Brazil, the concept of family farming gained traction in the 1990s through agrarian reform movements, becoming institutionalized via PRONAF (Brasil, 1996). Abramovay (1998) emphasizes that it is defined less by property size than by family-managed production, valuing labor, diversity, food sovereignty, and sociocultural continuity. Family farming combines ownership, management, and labor within kinship structures (Wanderley, 2009).

Despite challenges from agribusiness expansion, family farming remains relevant, shifting from subsistence to a driver of sustainable rural development (Meneghatti et al., n.d.). PRONAF has strengthened this role, with record funding in 2023/2024 (R$ 71.6 billion), fostering sustainable practices and social inclusion (Gambetta & Pereira, 2023).

In quilombola communities, family farming is central to livelihoods and cultural reproduction (Fidelis, 2011). Their agriculture blends traditional knowledge with sustainable resource use (Bráz, 2022), aligning with SDGs by ensuring food security, income, and cultural resistance (Santos & Nyamien, 2022).

Sustainability vs. Quilombola Communities: The Case of the Manoel Ciriáco dos Santos Community

In the context of family farming associated with the principles of sustainability, it is essential to consider economic, social, and environmental aspects in an integrated manner. According to Abramovay (1998), rural establishments based on family farming should adopt productive practices that ensure ecological balance, thereby fostering sustainable development in rural territories.

In this regard, quilombola communities, as traditional groups historically excluded from formal development processes, continuously seek social inclusion and the improvement of their living conditions. From this perspective, studying the sustainable practices adopted by these populations has proven to be fundamental to understanding both the challenges and the potential of sustainable development applied to quilombola family farming.

In the specific case of the Manoel Ciriáco dos Santos Quilombola Remnant Community, which is the subject of this research, the analysis of the three pillars of sustainability (environmental, social, and economic) revealed the need for methodological approaches that are sensitive and adapted to local socio-cultural dynamics. During the interviews, it was observed that participants sometimes showed resistance or difficulty in maintaining a linear and continuous discourse, which at times compromised the flow of dialogue. This scenario required the adoption of complementary methodological strategies, particularly mediation through culturally appropriate perception and communication tools, such as community dialogue circles.

All the visits to the community were essential to building a broader and deeper understanding of the local reality, allowing access to information that would not have been fully captured through formal interviews alone. Particularly noteworthy was the role of meetings held in the community hall – a space traditionally dedicated to cultural activities, gatherings, and moments of socialization – as favorable environments for the development of more

spontaneous, open conversations rich in information. During these occasions, narratives emerged that contributed significantly to understanding the processes of social organization, productive practices, and the perceptions of the quilombola people regarding the environmental, social, and economic issues that shape their reality.

Perception of Environmental Aspects of the Manoel Ciriáco dos Santos Quilombola Remnant Community

In the environmental category, members of the Manoel Ciriáco dos Santos Quilombola Remnant Community identified as sustainable practices: vegetable cultivation, fish farming, photovoltaic solar energy, and pesticide-free agriculture.

Residents reported that, at the time of the community's formation, much of Guaíra's territory was forested, later deforested for soy, corn, and pasture. They perceive neighboring properties' agriculture as distinct from family farming due to monoculture, mechanization, and chemical input use. Legally, however, Federal Law No. 11.326/2006 defines family farming by management, family labor, and income from rural activity, not by the absence of such practices (Brasil, 2006).

For the community, the communal vegetable garden exemplifies sustainable agriculture, aligning family farming with the appreciation of sociocultural diversity as a strategy for rural identity building and solidarity (Meneghatti et al., n.d.). Pesticide-free farming is viewed as environmental preservation, reflecting awareness of the negative impacts of fertilizers and pesticides, which - despite boosting productivity - cause environmental degradation, resource pollution, and serious health risks to workers and consumers (IBGE, 2015). Since 2008, Brazil has been the world's largest pesticide consumer, with Paraná ranking third nationally (UFPR, 2022).

Linked to the dominant agricultural model, pesticide expansion has become a public health issue, with impacts such as respiratory diseases, cancer, endocrine disorders, genetic damage, and biodiversity loss (Carneiro et al., 2015). Although the community equates pesticide-free practices with organic production, official recognition requires certification, absent in this case.

When asked about sustainability, some residents associated it with environmental preservation and considered the community sustainable, though most lacked a clear definition. This gap reflects the absence of structured Environmental Education (EE), crucial for building critical, collective awareness and driving practices aligned with socio-environmental challenges (Rodrigues & Costa, 2004). EE fosters citizenship and social transformation by enabling the identification of structural causes of environmental problems and developing collaborative solutions (Sorrentino et al., 2005). For Jacobi (2003), sustainability is transdisciplinary and cross-sectoral, depending on integrating diverse knowledge systems, especially in education, so that society incorporates them into daily actions.

Perception of Social Aspects of the Manoel Ciriáco dos Santos Quilombola Remnant Community

Formal education emerges as a key driver of personal, social, and economic transformation, as well as a tool for promoting social justice by fostering critical citizens engaged in social, economic, and political processes (IBGE, 2015).

The interview data (Table 1) show that all respondents wished to have continued their studies but pointed to early entry into the labor market, racial prejudice, and, in some cases, health issues as causes for dropout.

Table 1
Profile of the Interviewees, Residents of the Manoel Ciriáco dos Santos Quilombola Remnant Community

Interviewee	Education Level	Age	Marital Status	Number of children
1	Complete secondary education	21 to 30 years old	Single	0
2	Incomplete primary education	51 to 60 years old	Married	2
3	Incomplete secondary education	21 to 30 years old	Common-law marriage	1
4	Complete secondary education	18 to 20 years old	Common-law marriage	1
5	Incomplete primary education	61 to 70 years old	Widow	3
6	Complete secondary education	31 to 40 years old	Single	1
7	Incomplete primary education	31 to 40 years old	Common-law marriage	2
8	Complete primary education	61 to 70 years old	Married	2
9	Complete secondary education	41 to 50 years old	Married	6
10	Complete secondary education	51 to 60 years old	Married	3

Source: Author's own work (2022)

Similar findings appear in Rocha and Silva (2016), who highlight structural barriers such as the lack of nearby schools and racial discrimination, which hinder permanence and success.

In this regard, the account of Interviewee 9 illustrates, in a compelling manner, how structural and institutional racism was present in the school trajectory of community members, even before the official recognition of the community as quilombola:

> **Interviewer**: Before the conflicts caused by the recognition as a quilombo and the demarcation of lands, how was coexistence with the society of Guaíra? Did you always identify prejudiced attitudes? **Interviewee 9**: I'll tell you the truth. Around here, there was always a lot of prejudice, because we've been saying since school days; we were still children, and we suffered inside the schools — the teacher didn't teach us properly, they taught the white people; they didn't teach Black people, there

> weren't many of us and conditions were poor, there were no resources, so we were humiliated, mainly for being Black. We didn't even learn our own history in the classroom, I never heard about the Quilombo, about the community, our culture — we never learned that in school; we learned it from our grandparents, father, mother, and among ourselves. (Interviewee 9, 2022)

The narrative reflects how invisibilization of Black history, along with exclusionary teaching, reinforced marginalization from childhood. The absence of content on quilombola identity and Afro-Brazilian history deepened the denial of belonging.

Land demarcation intensified discrimination, with reports of segregation in schools and on buses. This reveals the persistence of structural racism, expressed in rights denial, unequal education, and difficulty in institutional recognition. Anti-racist education, valuing diversity and strengthening ethno-racial identity, is essential for overcoming these inequalities.

Almeida (2019) defines this as "institutional racism", whereby normalized practices in power structures perpetuate marginalization. The recognition process was led by the Clóvis Moura Working Group (GTCM), whose visits strengthened identity reconstruction and led to certification by the Palmares Cultural Foundation (Ribeiro, 2018).

Quilombola education extends beyond schools, encompassing traditional knowledge and practices passed through generations. All interviewees cited participation in handicraft and culinary courses, and storytelling as key to transmitting values and collective memory—an example of UNESCO's (2006) intangible cultural heritage. Family and community ties shape education alongside formal schooling.

José Maria, son of Manoel Ciriáco, was remembered as a spiritual leader and cultural reference. His death weakened cultural transmission, especially among youth. Capoeira, once active with berimbau and atabaque (Figure 2), has declined and is no longer practiced (2022), indicating a break in intergenerational transmission.

Figure 2

"Capoeira" Circles in the Manoel Ciriáco dos Santos Quilombola Remnant Community



Source: Archive of the Manoel Ciriáco dos Santos Quilombola Community (2022)

Regarding the community's religious practices, interviewees highlighted the worship of Umbanda and Candomblé, African-based religions traditional among quilombola remnants. However, over the years, in search of greater acceptance and social integration in Guaíra's society, there was a gradual shift toward Catholicism. Subsequently, some community members also began affiliating with Evangelical churches, evidencing transformations in the local religious landscape.

The Manoel Ciriáco dos Santos Quilombola Remnant Community stands out for its solidarity and cultural preservation, in stark contrast to the historical marginalization it has faced. Among the cultural expressions present in the community, "capoeira" and African-based religions – manifested through dance, song, play, games, and rituals – play a central role. These practices preserve the history of enslaved Africans and constitute cultural elements embedded in Brazil since the colonial period, representing fundamental symbols of Afro-Brazilian resistance and identity (Franco, 2021; Silva, 2019).

It was found that these cultural elements are a fundamental part of the identity of the Manoel Ciriáco dos Santos Quilombola Remnant Community. However, over its history, such expressions have faced adverse reactions, intensified by land conflicts arising from demarcations, during which the community faced numerous threats. Notably, in the account of Interviewee 9, the influence of the external environment on the transformation of the local cultural pattern is evident:

> **Interviewer**: Regarding the community's culture, do you believe there have been losses due to external influence? **Interviewee 9**: We lost a lot; I remember from when I was a child and compared to today, due to the lack of cultural support, being a Traditional Quilombola community with its customs, we lost much of that. Today, we are working on rescuing all of it, but it is still slow. And to say as well, the municipality, in terms of Culture, is very weak or pretends not to see. We knocked on the municipality's door regarding culture here in Guaíra, and you can see it; ours is the only one near the municipality of Guaíra. (Interviewee 9, 2022)

Additionally, community members reported incidents involving the use of religious elements of Afro-Brazilian culture against them. Several "spiritual works" were found on quilombola lands, provoking resentment and fear among residents, who felt violated by the appropriation and negative manipulation of their culture. These actions, seemingly premeditated to destabilize the quilombola movement, culminated in unfounded accusations that the quilombolas themselves were carrying out such spiritual works to attract attention, further intensifying mistrust and internal conflict.

In this context, Ribeiro (2018) reports an incident of a "spiritual work" directed at community leaders, in which a coffin containing a dead black chicken, "pinga" (sugarcane liquor), candles, sand, and a cross was found at the back of quilombola property, along with an inscription bearing the name of the quilombola leader and the predicted date of his death. The author highlights the intentional use of Umbanda elements as a form of intimidation and threat against the community. During conversations, quilombolas mentioned having found various objects buried or hidden on their lands and frequently observed traces of burnt colored candles near their homes.

In the interviews, when asked about experiences of racism, seven interviewees confirmed having faced discriminatory situations, describing episodes of segregation, inequality, and

explicit manifestations of racial prejudice. Informal conversations provided a deeper understanding of the racism faced by the community, evidencing the persistence of this problem in their daily lives.

According to Campos and Lima (2024), racism transcends individual attitudes, constituting a collective, social, and institutional manifestation that maintains privileges for those positioned at the top of the racial hierarchy. This form of discrimination has a material basis linked to the economy, power, and unequal distribution of resources, functioning as a mechanism that perpetuates inequalities and ensures benefits for dominant groups.

In addition to the direct attacks suffered by the quilombolas of the Manoel Ciriáco dos Santos community, racism also disrupted internal relations within the community itself. The fear and insecurity arising from the threats led some members to leave the territory. Consequently, internal debates emerged regarding the recognition as a quilombo and the land demarcation process, revealing divergences over these matters. Social injustices also have subjective repercussions on individuals, as the fear of racism affects personal identity recognition, potentially causing mental confusion, distress, anxiety, and depression (Almeida, 2019; Dimenstein et al., 2020).

In this sense, the recognition of quilombola identity was questioned by many members of the Manoel Ciriáco dos Santos community, who expressed concern about the potential escalation of tensions with neighbors. As for overcoming racism, there was an almost complete absence of hope, as expressed by Interviewee 2:

> **Interviewer**: Can the community bring knowledge about Black history? **Interviewee 2**: Yes. There are many stories about what we've been through in our lives. **Interviewer**: What does this contribute to society? **Interviewee 2**: It teaches the teacher, right, taking it outside. But racism… only God can end it, because it won't end. **Interviewer**: For you, can knowledge combat racism? **Interviewee 2**: It can reduce it, but end it completely? I don't think so. Only God Himself can intervene so it ends. Prejudice, my dear, is too much. (Interviewee 2, 2022)

It is worth noting that the Manoel Ciriáco dos Santos Quilombola Remnant Community regularly receives visits from educational institutions at different levels. During these visits, quilombolas conduct presentations and dialogue circles in which they share the community's historical trajectory (Figure 3). Throughout these interactions, they recount the conflicts faced by the community to convey knowledge to the visiting students, strengthen intercultural dialogue, and contribute to the appreciation and preservation of quilombola identity.

Figure 3
School Visit to the Manoel Ciriáco dos Santos Quilombola Remnant Community



Source: Archive of the Manoel Ciriáco dos Santos Quilombola Community (2022)

During the interviews, participants unanimously perceived that knowledge of Black history plays a fundamental role in the fight against racism. Although they expressed skepticism about the possibility of completely eradicating racism, all agreed that expanding historical knowledge can contribute significantly to its reduction.

The Perception of the Economic Aspects of the Manoel Ciriáco dos Santos Quilombola Remnant Community

Regarding the economic aspects of the Manoel Ciriáco dos Santos Quilombola Remnant Community, several elements were identified, as organized in Table 2.

Table 2
Economic Profile of the Interviewees, Residents of the Manoel Ciriáco dos Santos Quilombola Remnant Community

Interviewee	Vehicle	House building material	Access to electrical energy	Access to health	Access to internet
1	Car	Masonry	Yes	SUS*	Yes
2	Car	Masonry	Yes	SUS*	Yes
3	Motorcycle	Wood	Yes	SUS*	Yes
4	Motorcycle	Wood	Yes	SUS*	Yes
5	Car	Wood	Yes	SUS*	Yes
6	Motorcycle	Wood	Yes	SUS*	Yes
7	Car	Masonry	Yes	SUS*	Yes
8	Car	Masonry	Yes	SUS*	Yes
9	Car	Masonry	Yes	SUS*	Yes
10	Car	Masonry	Yes	SUS*	Yes

SUS* - Sistema Único de Saúde[1]
Source: Author's own work (2022)

In the accounts of quilombola community members, the relevance of public incentive policies promoted by the federal government was highlighted, especially housing programs. Initially, the houses were built with wooden structures and thatched or grass roofs, later evolving to asbestos coverings. From 2003 onwards, with the implementation of federal housing programs, some residents were benefited, enabling them to build masonry houses, which is a significant achievement and the fulfillment of a long-cherished dream for the community.

Regarding economic activities, the cultivation of small family gardens was identified, with agricultural production sold through contracts established under the Food Acquisition Program (Programa de Aquisição de Alimentos – PAA), linked to the public administration of the Municipality of Guaíra. The dynamics of this practice were detailed by Interviewee 2:

> **Interviewer**: So you've lived in the community all your life. What are the community's sources of income? **Interviewee 2**: I used to work first, hoeing for others, day labor, picking cotton, planting with a small machine, planting rice, soybeans, hoeing everything for others. **Interviewer**: Do you currently work? **Interviewee 2**: I work here in the community, but now I stay at home more, do some things, but really working a lot I can't anymore. **Interviewer**: How is the work and the earnings from it divided? **Interviewee 2**: Everyone has their own projects, right? Vegetable garden projects, each one in their own name, and when it's time to plant vegetables to deliver to the village, one helps the other to take them to the Indigenous

[1]The Sistema Único de Saúde (SUS) is Brazil's public health system that provides universal, free, and comprehensive healthcare services to all residents, guided by principles of equity and social participation.

> people. **Interviewer**: And do you deliver vegetables only to the Indigenous people? **Interviewee 2**: To the Indigenous, to schools, to the soup kitchen, and when there's surplus after the accounting is done, what's left they sell to the market, in town and donate to others. **Interviewer**: How does payment work? Does everyone get paid for the work? **Interviewee 2**: Yes, everyone; this year I don't know, but last year it was 4 thousand. **Interviewer**: Per month? **Interviewee 2**: Not per month, per year. **Interviewer**: 4 thousand per year? **Interviewee 2**: Per year. (Interviewee 2, 2022)

From the above, it is evident that the main source of income for the Manoel Ciriáco dos Santos quilombola remnant community comes from the cultivation and commercialization of family gardens. Additionally, income is supplemented through social security benefits, such as retirement and sickness aid, as well as the Bolsa Família Program, and, in some cases, work outside the community.

This socioeconomic scenario is similar to that found in other Brazilian quilombola communities. For example, Pedroso Junior et al. (2008), when investigating quilombola remnant communities in the Vale do Ribeira region (São Paulo), identified that the main source of household income was government benefits, such as pensions (40.5%) and Bolsa Família or Bolsa Escola (33%), followed by the sale of agricultural products (34.2%). Furthermore, the commercialization of forest-extracted products (23.1%) and income from occasional work on third-party farms (25.4%) also significantly contributed to the livelihood of about a quarter of the families analyzed (Pedroso Junior et al., 2008).

An important aspect to highlight is the negative impact of the COVID-19 pandemic on the economic structure of the Manoel Ciriáco dos Santos quilombola remnant community, particularly regarding contracts under the Food Acquisition Program (Programa de Aquisição de Alimentos – PAA), which were severely affected. The community's family units were unable to renew or establish new contracts for 2022, compromising their main source of local income. This situation reflects a broader scenario of worsening socioeconomic indicators in the country, which had already been in decline since the beginning of the government administration in 2019, as pointed out by Ribeiro-Silva et al. (2020).

In addition, even before the pandemic, the community faced difficulties paying electricity bills, especially those related to the water pump used for irrigating the gardens. Due to accumulated arrears, the utility company cut off electricity to this connection, directly affecting irrigation. Faced with the urgent need to maintain the gardens, the quilombolas broke the seal that prevented access to electricity and resumed using the service.

This problem was later resolved with the implementation of a solar photovoltaic energy generation system in the community (Figure 4), representing a significant step toward energy autonomy and the sustainability of agricultural activities carried out by residents.

Figure 4

Solar Photovoltaic Energy System Installed in the Manoel Ciriáco dos Santos Quilombola Community



Source: Author's archive (2022)

The photovoltaic system installed in the community is composed of 16 modules of 330 Wp, model CS6U-330P from the Canadian brand, and a 5 kW inverter from the Sofar brand, model 5KTLM-G2, integrated into the electrical connection responsible for irrigating the garden. The implementation of the distributed microgeneration system was completed in November 2020, with an expected monthly generation of approximately 590 kWh. This initiative brought significant benefits to the community, both in reducing costs associated with electricity consumption and in adopting a clean and renewable energy source. As shown in the consumption history (Figure 5), the system can almost entirely offset the electricity bill, leaving only the minimum fee and any excess charges when consumption exceeds the system's generation capacity.

Figure 5

Electricity Bill for the Irrigation System of the Manoel Ciriáco dos Santos Quilombola Community, August 2022



RM GRACIANO - 85000 01655 177000 IRRIGACAO
DIST MARACAJU DOS GAUCHOS - GUAIRA - PR - CEP: 85980-000
CPF [redacted]

Mês de referência: Agosto/2022
Unidade Consumidora: 92651801
Vencimento: 25/08/2022
VALOR A PAGAR: R$ 21,26
FAT-01-20223316185589-25

Responsabilidade da Manutenção de Iluminação Pública: Município 156

CENSO 2022. A PARTIR DE AGOSTO, ATENDA O RECENSEADOR DO IBGE.

Informações Técnicas

Nº Medidor: RG 0400152138 - MONOFASICO RURAL

Rural/Tin-Cultivo de Milho

Leitura Anterior	Leitura Atual	Medido	Constante de Multiplicação	Total Faturado	Consumo Médio Diário	Data de Emissão	Próxima Leitura Prevista
05/07/2022 4278	04/08/2022 4508	30 dias 235 kWh	1	30 kWh	7,83 kWh	03/08/2022	05/09/2022

Histórico de Consumo e Pagamento

Mês	kWh	Dt.Pgto.	Valor
07/2022	42		16,06
06/2022	87	01/07/2022	15,80
05/2022	30	01/07/2022	14,86
04/2022	107	01/07/2022	24,36
03/2022	313	24/03/2022	20,14
02/2022	246	24/03/2022	30,98
01/2022	352	28/01/2022	20,93
12/2021	132	28/01/2022	20,98
11/2021	172	18/01/2022	32,35
10/2021	366	28/10/2021	20,38
09/2021	351	28/10/2021	18,93
08/2021	231	28/10/2021	25,74

Informações Suplementares

Valores Faturados

NOTA FISCAL/CONTA DE ENERGIA ELÉTRICA Nº 265.381.228 - SÉRIE B
Emitida em 01/08/2022

Produto Descrição	Un.	Consumo	Valor Unitário	Valor Total	Base Calc.	Alíq. ICMS
ENERGIA ELET CONSUMO	kWh	30	0,255000	7,65	0,00	0,00%
ENERGIA ELET USO SISTEMA	kWh	30	0,306333	9,19	0,00	0,00%
ENERGIA TRIBUT DIFERENCIADA TE	kWh	200	0,243400	48,68	0,00	0,00%
ENERG TRIBUT DIFERENCIADA TUSD	kWh	200	0,252150	58,43	0,00	0,00%
ENERGIA TRIBUT DIF RS TE	kWh	5	0,096000	0,48	0,00	0,00%
ENERGIA TRIBUT DIF RS TUSD	kWh	5	0,116000	0,58	0,00	0,00%
SUBSIDIO TARIFARIO TE				0,48	0,00	0,00%
SUBSIDIO TARIFARIO TUSD				0,58	0,00	0,00%
ACRESCIMO MORATORIO				0,36		
JUROS CONTA ANTERIOR				1,74		
MULTA POR ATRASO NO PAGAMENTO				2,28		
COMP CONS MICRO/MINI GERACAO	kWh	205		-106,17		
SUBSIDIO TARIFARIO LIQUIDO				-1,02		

Source: COPEL (2022)

Solar photovoltaic energy is widely recognized as a clean and renewable source that uses solar radiation, which is an inexhaustible resource, to generate electricity, promoting not only cost reduction but also strengthening environmental sustainability. Hasegawa et al. (2020) demonstrate that photovoltaic systems significantly reduce energy expenses while preserving natural resources, reducing dependence on fossil fuels, and cutting pollutant emissions. Furthermore, adopting solar photovoltaic energy contributes to mitigating climate change by reducing greenhouse gas emissions and decreasing reliance on fossil fuels as energy sources (IBGE, 2015).

In this regard, energy efficiency, when associated with changes in consumption habits, aligns with the principle of conservation of energy, according to which “energy can be transformed or transferred, but never created or destroyed” (Feynman et al., 2008, p. 43), a concept that also has socioeconomic dimensions (Santos et al., 2006). Therefore, it is emphasized that sustainable development is intrinsically linked to improving the energy efficiency of systems, as such progress promotes economic, social, and environmental gains, constituting an essential path for fostering sustainability in traditional communities (Santos et al., 2025).

Thus, it can be stated that the implementation of the solar photovoltaic energy system in the Manoel Ciriáco dos Santos Quilombola Remnant Community not only reduced energy costs but also represented a significant step toward environmental sustainability and community autonomy, serving as an effective strategy for strengthening the socioeconomic structure while preserving natural resources.

Conclusion

The Manoel Ciriáco dos Santos Quilombola Remnant Community represents a movement of territorial and social resistance, affirming and preserving its ethnic and cultural identity through the recovery and maintenance of traditional knowledge, values, and practices.

Agriculture, the community's main source of income, is carried out using low environmental impact practices, causing less damage compared to neighboring properties and contributing to local sustainability.

Looking toward the future, the environmental dimension highlights the importance of the continuous implementation of Environmental Education projects, the promotion of the sustainable use of natural resources, and the creation of community spaces for ecological practices such as gardens, composting, and reforestation. Socially, it is essential to recover and strengthen cultural manifestations, value ethnic and cultural identity among young people, and promote events that revitalize collective memory and the sense of belonging.

From an economic perspective, it is necessary to expand public policies aimed at generating income and productive autonomy, encouraging the creation of cooperatives or solidarity economy networks within the community. The promotion of ethno-development emerges as a sustainable alternative to the traditional economic model, fostering development aligned with quilombola cultural and environmental specificities.

Finally, it is recommended to carry out new interdisciplinary studies to deepen knowledge about the community, strengthen dialogue between public authorities, academic institutions, and the community itself, as well as ensure continuous monitoring of actions, guaranteeing the active participation of quilombola members in decision-making processes. These measures are essential to ensure that the development of the Manoel Ciriáco dos Santos Community is sustainable, inclusive, and respectful of its history and identity.

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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 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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Extending Socio-Technical Theory: A Holistic View of Human – AI Interaction in Education

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Abstract

This article explores how the collaboration between internal stakeholders – educators, students, and administrators – and artificial intelligence (AI) can reform the field of education through the application of Sociotechnical Systems Theory (STS). A conceptual framework is illustrated and later described to outline how this alliance will work in practice. While emphasizing collaboration, the framework delineates the distinctive roles of internal stakeholders and AI applications. The framework proposes that educators and administrators should be the handlers of complex issues, balancing innovation with ethical consideration, critical thinking, problem-solving, and ensuring fairness for student satisfaction. At the same time, AI as a technical system is portrayed as the facilitator of routine tasks within the social system of education, including predicting class demand, scheduling, planning, technical support, preparation and assessment. The paper points out that inadequate technological infrastructure and a lack of training can pose significant challenges to successfully implementing this collaborative model. The article concludes with recommendations for implementing hybrid teaching models (combining AI tools and traditional teaching methods) to handle issues with IT disruptions, conducting periodic reviews of AI applications and outputs to ensure accuracy, fairness and transparency, and organizing AI training for all stakeholders.

Keywords: AI in education AIED, sociotechnical systems theory, internal stakeholders, educators, students, administrators

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Introduction

Decades of research on Artificial Intelligence (AI) and related technological advancements resulted in a transformative breakthrough a few years ago with the introduction of ChatGPT and similar software. While concerns regarding its responsible usage (e.g., privacy, security, originality issues) and its long-term implications persist (Amo et al., 2019; Min et al., 2024; Peters, 2022), AI has proven to be an undeniable technological force that is revolutionizing how the world operates and how individuals interact.

As AI becomes more integrated into society, it is critical to understand the interplay between technological advancements and the societal context in which they materialize. One of the representative theories that has explored this relationship is the socio-technical systems (STS) theory. Originating in the Tavistock Institute, STS theory examines how the technological and societal elements operate together to shape broader societal systems (Interaction Design Foundation, 2024a; Kudina & van de Poel, 2024). By placing technological development in the backdrop of societal contingencies, STS theory illustrates how societal forces and technological advancements interact closely to foster readiness for adoption.

One important societal domain where AI has had a profound impact is education, where the adoption of AI has been met with both optimism and concern. While some educators have raised concerns about the over-reliance on AI (Abbas et al., 2024; Bastani et al., 2024; Selwyn, 2022), others have focused on its benefits as well as the need for proper preparation and inclusion of AI in the educational backdrop (Celik et al., 2022; Su & Yang, 2023; Wang et al., 2023). Despite mixed reception, the consensus in the education landscape is that AI is a transformative and inevitable force that needs to be embraced.

As a result, a new domain of research is growing to study the impact of AI within the education system: AIED. Building on this line of thought, this paper aims to address the following research questions:

> Q1: How can the collaboration between AI and internal stakeholders of educational institutions redefine the traditional boundaries between social and technical systems?
> Q2: How can the Sociotechnical systems theory be applied to the educational institutions' internal stakeholders, including educators, students, and administrators?

By addressing these research questions, this paper seeks to contribute to the growing body of literature by proposing a framework that integrates STS into the evolving education ecosystem shaped by AI tools. This framework emphasizes the importance of critically evaluating AI outputs and highlights AI tools that can facilitate the processes of preparation, assessment, and critical thinking for all stakeholders involved. In doing so, it outlines a collaborative model between AI and various internal stakeholders in education (educators, students, and administrators) and underscores that AI is not a threat to job security for educators but a transformative tool capable of fostering meaningful innovation in education.

In what follows, the paper engages with the literature to highlight inadequate engagement on AIED–STS collaboration. The contribution section proposes a framework that aims to bridge this gap. Given that this is a new area of research, the limitations and challenges of the AIED–STS collaborative model are outlined. The paper concludes with recommendations and final remarks.

Socio-Technical Systems Approach (STS)

Researchers have used STS theory to underpin the cases of technology implementation in varied work settings (Bednar & Welch, 2020). The STS approach helps understand the shifts in work patterns and organizational activity over a period of time through the implementation of newer technologies (Mutch, 2008). Earlier studies assert that the foundation of socio-technical systems is based on three elements: technology, users, and institutions (Kroes et al., 2006). To this end, STS theory – rooted in general systems theory – outlines the contingencies between technology, social structures, context, and users and establishes how the technological and societal elements operate together to shape the societal systems (Interaction Design Foundation, 2024a; Kudina & van de Poel, 2024), for effective change management. While studying the interlinkage between the technological and organizational structures, researchers have emphasized various aspects of both technology and organization. Where one stream of the literature has overstated the material characteristics of technology (Orlikowski, 2007), the other stream overemphasizes the power vested in workplace policies – rules, norms, and alternative work choices available to the organizational actors – that fundamentally shapes the user's perception about the work activities (Geels, 2004: p. 899).

The STS theorization is an original work of researchers from the Tavistock Institute of the University of London (Trist, 1981). This team, led by Eric Trist, tried to study the effect of replacing manual labour practices in the coal mining field with technology. Although the team thought the new mechanized practices would result in increased productivity and time-saving, the initial results indicated a sharp decrease in production levels. According to Trist (1963), this polarized/contradictory outcome was a result of workers' inability to accept the drastic change in the work itself, and long-standing social practices associated with it. As mining jobs are hazardous and performed in distant, isolated locations, the workers developed a strong social bond with each other, including discussing work-related matters, sharing routine stories, collecting wages in person from the supervisors, and cleaning the site at the end of a working day. This routine was disrupted by technology implementation and pushed workers back into isolation due to a lack of interaction opportunities in the technological production process. While in this pioneering study, the technological implementation failed to deliver the desired results, it has duly highlighted the significance of the co-existence of social and technical systems where technology does not disrupt but supports and improves the existing social aspects of jobs (Kudina & van de Poel, 2024).

Against this historical backdrop, the STS perspective does still prove to be helpful in explaining the theoretical foundations of the human-technology interface, especially within the current pace of technological evolution, which includes the meteoric rise of Artificial Intelligence (AI). Since its inception around the mid-twentieth century, AI research has focused on the study of the human brain and steadily paved the way for today's technologies that are capable of learning from past data by emulating human thought processes (Interaction Design Foundation, 2024b). This further led to the development of algorithms keeping track of human interaction data, as well as offering new modes of interaction such as smart agents, intelligent systems, chatbots, and eventually, generative AI (Interaction Design Foundation, 2024b).

While this fast pace is fascinating on the technology front, the impact that AI has made on the social front is ripe for discussion. As a potentially disruptive force, AI is not only capable of learning, adapting, and interacting, but it's also autonomous and has the ability to transform society in the long run. To this end, the STS perspective may be useful in identifying AI as

part of the larger socio-technical systems and helping develop the institutions, culture, and governance associated with its growth (Kudina & van de Poel, 2024). As such, it may be fair to say that AI has emerged in the conditions ripe for its adoption – AI is not just technology but also a frame of mind.

Against this background, it would be important to recognize the role of AI in education. As one of the primary institutions in society, education constitutes the backbone of teaching and learning activities, developing the future generations' skills and knowledge in a wide variety of disciplines. There is no doubt that AI has already made an impact in the educational field. It is, therefore, crucial to examine the collaboration between AI and educators and how it is going to shape the new STS in light of the various economic, political, and social forces fuelling the change (Alshahrani et al., 2024; Linderoth et al., 2024; Williamson, 2024).

AI Technology in Education - AIED

The increasing use of educational technologies (EdTech) has dominated the second half of the twentieth century. Starting with simple information systems used for recording, storing, and disseminating data, and evolving through the use of collaborative technologies, social media, and virtual reality, all the way to the use of artificial intelligence (Alshahrani et al., 2024). The advanced capabilities of AI are considered an enormous support to educators and students alike since:

- For educators, AI has the potential to act as a personal assistant to help them plan and design the content, delivery, and assessment of learning more effectively (Celik et al., 2022; Keppler et al., 2024; Mollick & Mollick, 2024); and
- For students, AI may help ensure a more personalized learning experience and more effective retention and application of learning, provided it is designed to act as a learning aide or tutor (Abbas et al., 2024; Bastani et al., 2024; Su & Yang, 2023).

The growing use of AI has prompted researchers to conduct many studies to identify how educators make use of generative AI in their teaching-related activities, as well as its effectiveness. Keppler et al. (2024) conducted a case study of US high school teachers to determine how they made use of generative AI (if at all) as support in their course planning phase. Their findings showed that teachers were distinctly distributed into three groups of gen-AI usage, the first consisting of those who use gen-AI for input and output, the second of those who use gen-AI for output only, and the third of those who don't use gen-AI at all. In the terminology of the study, input seeking was defined as exploring or iterating thoughts and ideas as regards the course planning process, and output seeking was defined as generating materials or activities to be used as part of the class. Keppler et al. (2024) observed that the first group reported the highest productivity gains as regards their work quality and workload.

The fact that some educators are keen to adopt AI while others are AI-averse may be the result of their level of AI readiness. Wang et al. (2023) define AI readiness as "the state of preparedness among teachers in terms of their cognition, ability, vision, and ethical considerations with respect to the use of AI in education" (p.2). Their study further revealed that teachers with higher AI readiness perceived lower threats from AI and demonstrated higher levels of innovation about using AI in education, as well as higher job satisfaction. Similarly, Celik et al.'s (2022) study underscored the role of educators as orchestrators of the learning process and the need to incorporate the advantages of using AI in course planning, monitoring, and assessing student learning and performance rather than keeping away from and fearing AI's potential negative consequences.

Paper Contribution: Extended STS Framework

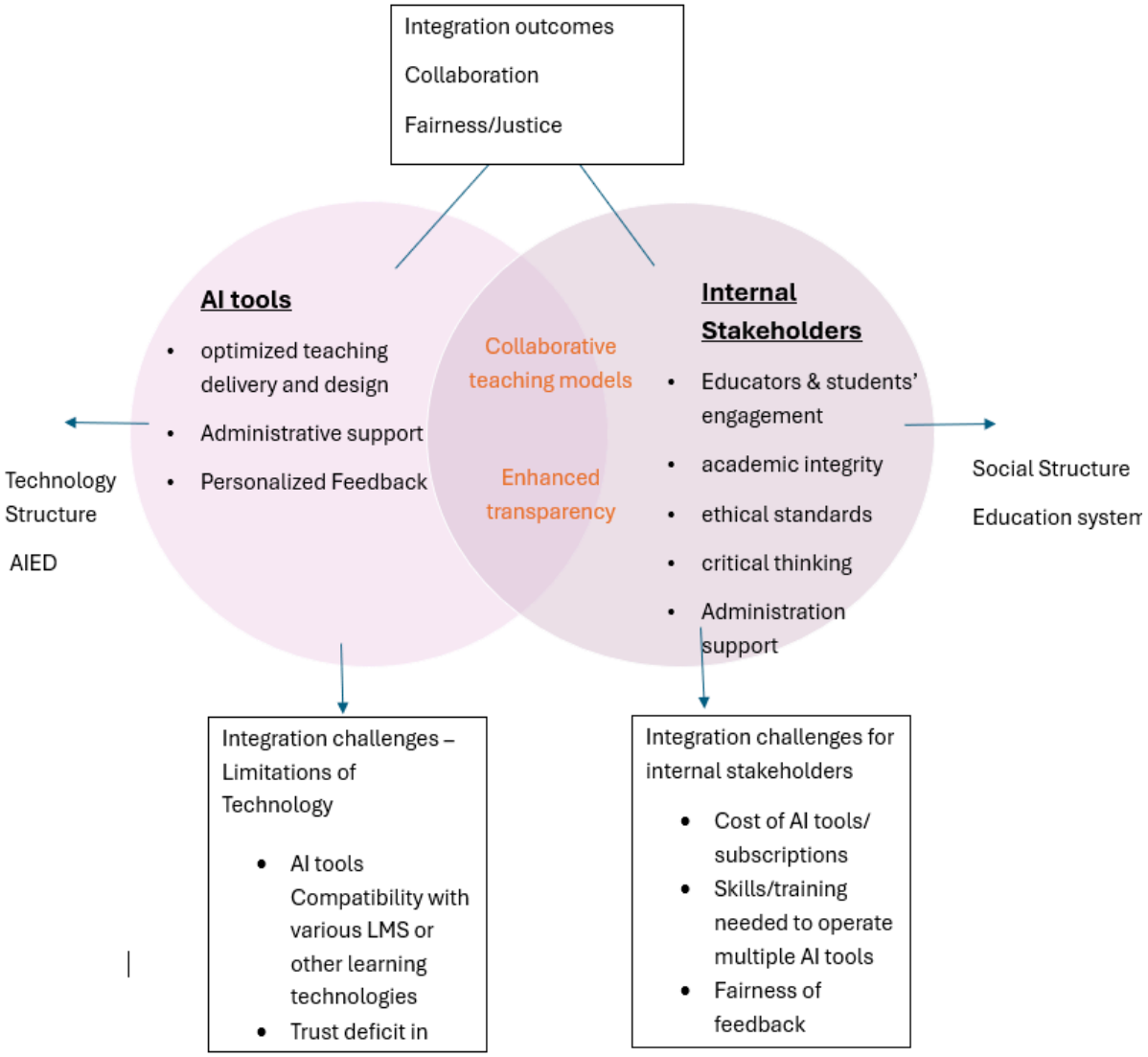
The main criticism of the role of AIED in its current form stems from its technological dominance, where many studies have overemphasized the power of technology and underscored the role of human agency and institutions in which these technologies are embedded. For instance, AIED has been viewed by some researchers as a replacement for educators in teaching roles (Solaiman et al., 2023), and the acquisition of advanced AI skills as the guarantors for the job security of professors (Umoru & Salami, 2024). This dominant view of AIED undermines the fact that AI technology is a part of a social system with the ability to impact or be impacted by the social aspects of teaching jobs. Furthermore, this technological determinism unintentionally positions AIED and educators against each other and prevents any possibility of collaboration.

While some recent studies have identified the need for adopting an STS approach to explore the role of AI as part of larger sociotechnical systems (Kudina & van de Poel, 2024), they have not specifically asked for locating the role of AI in the social structure of education. For most of these theorizations, the focus has been on the inclusion of AI as part of socio-technical systems. These studies have outlined the benefits that can be achieved by exploring the role of AI as embedded in social systems. According to them, "A socio-technical system perspective is important to better understand how AI systems function, what social and ethical challenges it raises, and how to best address these issues" (p. 02). Albeit useful, these theories do not provide a comprehensive account of AIED in their proposed integration of AI and sociotechnical systems.

This has led to a void in literature where one stream looks at the emerging role of AI in education (Umoru & Salami, 2024; Williamson, 2024), and the other suggests locating the role of AI as part of a bigger sociotechnical system generally and not specifically in the field of education (Kudina & van de Poel, 2024). To fill this gap, the article proposes the inclusion of AIED in the current STS theorization.

We illustrate our integration of AIED and STS in Figure 1. Our model does not present technology and social system of education as a threat to each other's existence or proclaim technology dominance over human agency and institutional social practices, and vice versa. Instead, the framework focuses on integrating both AI as a technical system and the field of education as a social system. The framework further highlights the potential benefits of this collaboration, specifically for internal stakeholders of the educational system, including educators, students, and administrators. The proposed framework also outlines some key challenges that warrant attention to ensure a successful AIED and STS collaboration.

Figure 1
Extended AIED – STS Framework Highlighting Human–AI Collaboration in Education



The authors further outline what integration outcomes can be achieved by combining AIED and STS in Table 1. The table clearly highlights the distinctive role of educators as handlers of complex issues such as ethics and fairness and promoters of critical thinking by applying innovative pedagogies. It also demonstrates how different AI applications/tools can support various aspects of classroom learning and educators' routine tasks, and other internal stakeholders, including students, administration, and management.

Table 1

The Framework for EdTech and Education System Collaboration

Internal Stakeholders' role/responsibilities	EdTech AI tools	Integration outcomes
Educators and AI Collaboration		
PowerPoints creation	beautiful.ai tome.app canva.com gamma.app simplified.com decktopus.com slidesai.io	Scope of Technology: Helps instructors create graphically appealing PowerPoint lectures that are a level up from the standard publisher's slides. The role of educators: Educators need to share design ideas, preferred lecture themes, etc., for the improved class experience
Lesson Plans	lessonplan.ai ChatGPT openai.com kahoot.com edmodo.com teachmateai.com chalk.com wizer.me albert.io classtime.com curipod.com	Scope of Technology: Personalized and creative lecture plans that incorporate class activities, worksheets, and gamification. AI tools can also help with curriculum design The role of educators: To ensure that the personalization of lessons is well aligned with the student level and learning and course outcomes. Educators must all ensure that in-class activities are not just engaging but also relevant and appropriate.
Lecture Recordings Asynchronous/online lectures	descript.com murf.ai synthesia.io speechelo.com wellsaidlabs.com Play.ht adobe.com ispringsolutions.com clipchamp.com naturalreaders.com	Scope of Technology: Provides voice-over support for any missed classes. These voice-over lectures can be added as additional support materials in the LMS. The role of educators: Ensuring the quality and standard of voice-over lecture. Educators must also offer support and allocate additional time to the students to clarify the topics covered using voice-over lectures.
Incorporating multimedia for student engagement	synthesia.io podcast.adobe.com Dall.E – OpenAI Chat GPT – OpenAI Edpuzzle.com Thinglink.com Genially.com	Scope of Technology: Provides interactive activities and tools, fun quizzes, and virtual tours. Incorporates multimedia in the presentations The role of educators: Educators must ensure the required level of technical support and authorization are in place for the incorporated multimedia

Additional readings and resources	Elicit - AI for Research elicit.com Scholarcy – AI Summarizer scholarcy.com zotero.org mendeley.com perplexity.ai semanticscholar.org researchrabbit.ai paperpile.com wolframalpha.com	Scope of Technology: Assist instructors in generating a reading list relevant to the weekly topics covered in classrooms. The role of educators: Educators need to review the reading lists generated by AI tools to ensure quality and relevance.
Feedback from the educators on assessments	Socrative.com essaygrader.ai testmarkr.com gradergood.com coursebox.ai	Scope of Technology: AI can help provide detailed feedback on written work as well assigning letter grades Role of Educators: Feeding a rubric or sharing the grading criteria deemed appropriate for the student level. If the students show concerns with the grading, instructors must review and provide a rationale for the assigned grade.
Administrators and AI Collaboration		
Predicting the class demand	peak.ai netguru.com/blog/ai-based-demand-forecasting	Scope of Technology: Helps administrative and managerial level employees to forecast the demand for classes accurately using machine learning- applications. Based on the real-time data about the class demand, the administration can allocate resources. The role of Administrators: Administrators need to feed the institutional data such as historical enrollment numbers, demographic trends, and external factors like policy changes or economic conditions into these AI-based tools to get an accurate prediction.
Scheduling	clickup.com edval.education timetabler.com	Scope of Technology: Helps administrators schedule classes based on the total enrollment number, instructor availability, preferences, etc. Assigning last-minute classes. The role of Schedulers: Schedulers need to confirm the instructor's availability and preferred dates/times/courses and feed that data to the AI tools. The schedulers must also consider student preferences in finalizing scheduling

Student queries	magicschool.ai eduaide.ai hyperwriteai.com Mailmaestro maestrolabs.com	Scope of Technology: Can provide real-time feedback on student queries. Chatbots/similar to administrative assistants, can help students with different topics even in the after hours. Can write email responses to the student e-mails The role of administrative staff: Summarizing the issue for the AI and reviewing the auto-generated responses for clarity. Being available for face-to-face discussion if the students need in person support.
Students and AI Collaboration		
Upward Feedback: from students to the educators.	feedbackfruits.com mote.com peardeck.com	Scope of Technology: Helps students share their reflections on course learning in live settings or provide audio feedback. The role of Educators: To improve the teaching methodology and formative lesson plans in real-time based on student feedback
Troubleshooting support for students	humanizeai.io toolplate.ai	Scope of Technology: Can provide stepwise instructions to resolve many class/subject-related issues, including brainstorming, project queries, coding, and programming challenges The role of Educators: Willing to follow up with students on the status of the problem and offer a meet-up session to discuss further steps.
Brainstorming ideas for the completion of coursework, assignments and other deliverables.	Chat GPT – OpenAI Notion AI Scite.ai Elicit.org	Scope of Technology: Generate a list of ideas to ensure creativity in student output. Helps students find trending topics to write about. Summarize key concepts from various articles and essays so the students can filter out relevant readings and materials. The role of Educators: To educate the students on the safe use of AI tools to balance the need for innovation with maintaining ethics and upholding academic integrity. Share AI best practices with the students.

Challenges and Limitations

Artificial intelligence provides critical opportunities for educators to transform how they interact with learners, and, as illustrated in this paper, socio-technical theory offers a solid framework for analyzing this interaction. However, as with every framework, it also has some key limitations and challenges that warrant critical reflection.

The first limitation lies in the difficulty of clearly defining the boundaries of the social system within the educational context. Unlike the technical system, which can be clearly defined by identifiable components such as algorithms and software, the educational ecosystem is comprised of diverse stakeholders (e.g., educators, administrators, policymakers, and students) with divergent goals and operational priorities. For example, educators may prioritize using AI to design a holistic pedagogy that improves the effectiveness of learning, while students may want an individualized learning platform that caters to different learning styles. On the administrative side, the focus may be on the efficiency of AI, cost-reduction, and compliance with institutional and governmental policies, while policymakers may concentrate on the flexibility of AI to address diversity, ethics, and inclusion issues in education (Kudina & van de Poel, 2024). In summary, these conflicting goals make it challenging to define the boundaries within the social system (Trist, 1981), and this ambiguity in social boundaries inevitably translates to practical challenges in designing an educational AI system that aligns with the goals of stakeholders. Moreover, a misaligned framework can lead to unintended consequences like fragmentation, stakeholder resistance and/or inadvertent exclusion in the adoption process.

Another limitation stems from the pace at which AI technologies evolve. The rapid acceleration in AI capabilities often outstrips the capacity of educational institutions and researchers to conduct comprehensive socio-technical analyses or update regulatory and pedagogical frameworks accordingly. As a result, institutions may adopt AI systems without fully understanding their long-term implications, and this will limit not only the adaptability of the STS framework but also the predictive power in anticipating unintended consequences like bias and inequity (Obermeyer et al., 2019). To address this, the socio-technical framework must be continuously refined at a sufficient pace and regularly updated to new challenges posed by emerging AI technologies.

Beyond these conceptual limitations, there are also some practical challenges in adopting this framework for the use of AI in education. A central challenge involves the varying levels of trust in AI among stakeholders within the educational ecosystem. The success of any AI initiative in education is heavily dependent on this trust, and when stakeholders harbour mistrust or skepticism regarding the effectiveness, fairness, or transparency of AI systems, adoption is likely to be slow and fragmented. Such hesitancy can undermine the efficiency and scalability of implementation efforts (Raisch & Krakowski, 2021).

Closely related to this is resistance to change, which often stems from perceived threats such as diminished professional autonomy, job displacement, or skill obsolescence (Umoru & Salami, 2024; Williamson, 2024). These concerns can foster active or passive resistance among stakeholders, further complicating and limiting the integration process. For example, educators may feel that algorithmic systems limit their pedagogical freedom or reduce their role to that of mere facilitators rather than knowledge creators. Administrative staff may worry that automation will render their roles redundant or significantly alter traditional workflows without adequate support or retraining. Even students may resist the shift toward

AI-mediated learning if they perceive it as impersonal, overly standardized, or lacking in empathy and human connection. Resistance can also emerge from a lack of clarity about the goals of AI implementation, inadequate communication from leadership, or prior negative experiences with poorly designed digital tools. When stakeholders feel excluded from the design or decision-making process, they are more likely to disengage or push back against adoption. Therefore, addressing resistance requires not only technical solutions but also thoughtful and careful change management strategies that prioritize transparency, inclusivity, and ongoing support.

Lastly, the proposed framework must critically engage with the ethical and social challenges posed by AI in educational settings, particularly issues related to fairness, inclusivity, accountability, and transparency. Without addressing these concerns, AI tools risk reinforcing existing inequities, particularly in under-resourced schools or regions where access to advanced technologies is limited. Moreover, the ethical implications of using AI to monitor, assess, or predict student performance must be carefully examined. While predictive analytics may offer insights into learning patterns or dropout risks, they also carry the potential for stigmatization, profiling, and over-surveillance, especially for students from marginalized backgrounds. There is a danger that such systems could perpetuate biases encoded in the data, leading to unfair treatment or reinforcing systemic disadvantages.

To mitigate the challenges and ensure successful adoption, it is critical to adopt a holistic approach that prioritizes stakeholder engagement and trust building. Encouraging the active involvement of every stakeholder, from educators to policymakers, in the design and implementation of AI systems can ensure optimal alignment. Furthermore, emphasis on transparency should bolster trust and address equity concerns. Additionally, providing training opportunities for educators should raise AI readiness and minimize feelings of threat. Lastly, continuous evaluation of the impact of AI education tools should minimize unintended consequences and better address emerging challenges.

Recommendations

Technical failures can disrupt the educational process. Therefore, the overdependence on AI systems without proper backup procedures can halt class activities during outages. It is recommended to implement hybrid teaching models where educators maintain the traditional teaching methods alongside using AI tools.

Another issue raised in this paper is the possible loss of human oversight and, consequently, the rise of errors in AI-generated assessments. This is a serious issue, especially if educators overly trust AI outputs without reviewing them before they are made available to the students. The recommendation is to have the educator audit the AI-generated assessments, and by doing so, the grading accuracy can be preserved and, at the same time, maintain the educator's involvement.

Regarding the biases in AI systems that can generate an unfair treatment of the students since AI models are often trained using datasets that do not include diversity or comprehensive students' backgrounds, the recommendation is to use only audited datasets that have been tested for diversity and students' backgrounds. This recommendation enhances fairness and promotes inclusivity.

Regarding the finding that educators may lack the skills and competencies to use AI effectively due to insufficient training and integration of AI tools into pedagogical practices, the recommendation is to provide ongoing professional development programs. With more knowledge about the AI functionalities, educators will feel empowered to leverage AI effectively.

As mentioned in this paper, many feel that AI-generated content might reduce students' creativity and critical thinking, especially if the students rely heavily on the use of AI. To avoid this issue, assignments must be designed to require human creativity and reasoning. Moon (2004) recommends that students submit a self-reflection paper after submitting a research paper explaining the mental process they followed to complete the research. This practice forces students to articulate their learning journey. Herreid (2011) suggests giving students a complex, real-world case study and asking the students to evaluate options, justifying their recommendations. Kuhn (2005) suggests having pairs of students confront each other with opposing perspectives on controversial topics and argue both sides.

Conclusion

The exponential growth of AI is an inspiring transformational change in the field of education, with unprecedented opportunities for personalized learning, efficient administrative support, and innovative pedagogical approaches. Reflecting this trend, a burgeoning field of research on the role of AI in Education (AIED) is also emerging. However, a critical limitation of this research lies in its reliance on technological determinism, which often overemphasizes the capabilities of technology while overlooking the role of human agency and institutional context (Kudina & van de Poel, 2024). To address this gap, this paper adopts a socio-technical systems (STS) perspective (Trist, 1981) that offers a comprehensive lens on the relationship between social and technical dimensions of the education system.

The resulting theoretical framework highlights several contributions to the growing research. First, it provides a map for aligning the diverse goals of various stakeholders, such as educators, students, administrators, and policymakers, which in turn can foster collaboration in the adoption of AI. Secondly, the STS perspective further facilitates collaboration between educators and AI by emphasizing the complementary and supportive role of AI tools in improving teaching methods and learning outcomes rather than positioning it as a disruptive force that might replace humans (educators and administrative personnel). Third, it helps to build trust and reduce resistance among stakeholders by addressing the social and cultural dimensions of AI adoption. Lastly, this framework incorporates ethical implications, which can ensure that AI tools are designed and implemented with issues like equity and diversity in mind.

In summary, the STS framework provides a dynamic and holistic view of AIED that can not only enhance the adoption of AI tools but also ensure ethical and equitable integration for all stakeholders. By situating AI as a component of broader sociotechnical systems, education can be reimagined as a collaborative ecosystem where technology supports human agency and institutional goals rather than replacing them.

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Exploratory Research on Integrated Teaching Modes in Modern Industrial Colleges: Taking the UE5 Landscape Editing Course as an Example

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Abstract

To address the urgent need for professionals who can adapt to rapid digital industrialization and economic shifts, this study redesigned vocational training by embedding real animated series production projects into a UE5 Landscape Editing course. Using a "production-oriented teaching" approach, students engaged in project-based learning that mirrored actual industry workflows, bridging classroom learning with real-world demands. The research combined quantitative and qualitative methods to assess effectiveness. Pre- and post-course evaluations measured 150 students' technical growth in tools like UE5 software and project completion rates, while surveys and interviews with students, instructors, and industry mentors provided deeper insights. Industry partners also evaluated final projects against professional standards. Results showed a 42% increase in students' software proficiency and 85% of projects meeting industry viability criteria. Employers praised improved problem-solving and teamwork skills. The model, dubbed the "Modern Chinese Apprenticeship," centers on three core elements: industry-defined skill frameworks, step-by-step process tasks, and hands-on practice. Early findings confirm the approach effectively prepares innovative, job-ready talent for digital industries. By grounding education in live production challenges, this framework offers a flexible template for aligning vocational programs with evolving economic priorities. Future research will examine long-term career outcomes and how the model adapts across different sectors.

Keywords: vocational education innovation, production-oriented pedagogy, industry-academia collaboration, modern Chinese apprenticeship model

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Introduction

On July 30, 2020, the General Office of the Ministry of Education and the General Office of the Ministry of Industry and Information Technology jointly issued the Notice on the "Guidelines for the Construction of Modern Industrial Colleges (Trial)", which explicitly requires: "Taking the urgent needs of regional industrial development as the guide, facing universities with distinct industry characteristics and close ties with industries, especially application-oriented universities, to establish a batch of modern industrial colleges." This provides policy guidance for vocational colleges to explore educational modernization and further deepen the integration of industry and education (Ye et al., 2021).

To thoroughly implement the spirit of the National Vocational Education Conference and the documents such as the "Several Opinions of the General Office of the State Council on Deepening the Integration of Industry and Education", "China Education Modernization 2035", and the "Action Plan for Improving the Quality and Excellence of Vocational Education (2020-2023)", and to better adapt to the country's accelerated digital development's demand for innovative talents and technological innovation, the School of Digital Art, centered around the layout of the "6+2+X" modern industrial system in Wuxi High-tech Zone and the requirements for systematically promoting the high-quality development of vocational education, seizes the opportunity of the construction of a high-level school in the Science and Technology College, faces the development direction of digital industrialization, takes fostering virtue and cultivating talents as the fundamental task, and focuses on student development. Relying on government and enterprise resources, giving full play to regional industrial advantages, and innovating in school-running characteristics, it proposes to jointly establish a modern industrial college - the "Xinwu Tianji Digital Industrial College" - through multi-subject cooperation with the high-tech zone government and leading enterprises. By innovating institutional mechanisms, it aims to build a community of shared destiny for the integration of industry and education among universities, local governments, and enterprises.

The construction of modern industrial colleges requires courses to be based on industry technology innovation projects, closely integrating industrial practices to innovate teaching content and methods, thereby posing new requirements for the innovation and reform of teaching modes (Zhou & Zhang, 2021). This paper takes the "UE Landscape Editing" course as an example to explore an integrated teaching mode under the background of modern industrial colleges.

Course Learner Analysis

The "UE5 Terrain Editing" course is a core technical-skill course for Digital Media Technology and Game Design majors. Terrain system design serves as the cornerstone of game scene development, directly impacting player immersion and engine performance. The course aims to cultivate students' ability to master the full workflow of UE5 terrain editing, from conceptual design to performance optimization, aligning with AAA-level project development standards in the gaming industry.

Students are second-year students in a three-year vocational college program. They have completed prerequisite courses such as Fundamentals of Computer Graphics, 3D Modeling Techniques, and Introduction to Game Engines, enabling them to perform basic geometric modeling, simple material texture mapping, and navigation of game engine interfaces. Although capable of sculpting single terrain modules, they struggle to construct

kilometer-scale layered terrain systems for open-world environments. While familiar with fundamental material texture principles, they lack mastery of LOD (Level of Detail) technology applications in terrain rendering.

Analysis of Teaching Challenges

The course involves multidisciplinary knowledge from systems engineering and safety engineering, with abstract concepts and weak interconnections that hinder students' ability to form systematic understanding. Engine mechanisms such as Nanite virtualized geometry and Z-curve decomposition are challenging to grasp intuitively. Traditional lecture-based teaching lacks visualized instruction and real-time feedback, leading to student disengagement. Practical engineering experience and teamwork training are insufficient, resulting in a disconnect between theoretical knowledge and industry requirements. Students struggle to meet workplace demands and lack preparation for advanced research. To address these issues, the teaching approach emphasizes three key strategies:

Systematic Cognitive Construction

For example, when adjusting terrain Scale parameters, students must simultaneously modify virtual texture resolution and lightmap density. This integrates practice across terrain sculpting, material blending, and lighting rendering modules. GPU performance analysis tools visually demonstrate the impact of parameter adjustments on frame rates, making abstract performance optimization principles tangible.

Industry Standard Integration

Incorporate corporate acceptance criteria into the curriculum, such as developing an “Enterprise Standard Simulator” plugin that allows students to compare their work against industry benchmarks in real time. Teachers employ visualized explanations and interactive feedback throughout pre-class, in-class, and post-class phases.

Practical Teamwork Development

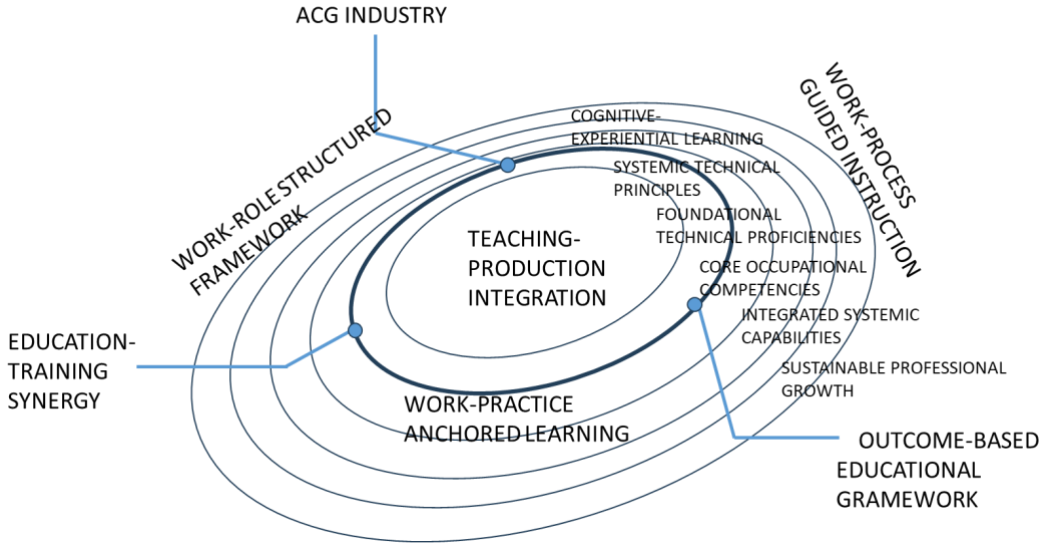
While theoretical knowledge is foundational, the course prioritizes project-based learning to bridge gaps between academia and industry. Through collaborative tasks mimicking real-world workflows, students gain hands-on experience with industry tools and develop teamwork skills essential for both employment and advanced research.

Integrated Teaching Model

To meet the demands of accelerated digital development and regional industrial transformation, this course adopts an integrated teaching model aimed at strengthening students' vocational competencies and sustainable development capabilities. By aligning closely with enterprise production workflows and job requirements, it introduces authentic “animation series” industry projects (as illustrated in Figure 1) to facilitate project-based learning. This approach supports independent inquiry, enables production-oriented teaching, and enhances students' practical and innovative capacities, ensuring seamless integration of professional qualities with corporate needs.

Figure 1

Talent Cultivation Model of the Modern Industrial College



The model constructs a "Chinese-style modern apprenticeship" talent cultivation framework characterized by "integration of education and training, outcome-oriented goals," framed by work structure, guided by work processes, and initiated through work practices. This fosters high-quality applied, composite, and innovative talents capable of adapting to and leading digital industrialization developments.

Multidisciplinary Integrated Teaching

With the rapid advancement of technologies such as 5G, big data, cloud computing, and artificial intelligence in recent years, emerging industries are flourishing, driving an increasing demand for cross-disciplinary talents (Liu, 2020) . Therefore, we focus on advancing the integration of technology and art within the digital economy sector, deepening professional connotation development, and strategically adjusting specialty structures to create characteristic professional clusters combining "art + new engineering" and "art + culture." This framework supports interdisciplinary convergence for digital industrialization, starting from innovative talent cultivation plans, curriculum systems, and pedagogical methods to establish discipline-specific standards aligned with talent development goals. The aim is to nurture high-quality applied, composite, and innovative talents required for digital industrialization.

In practice, our teaching team breaks disciplinary boundaries to construct a multidisciplinary knowledge system grounded in safety principles. By integrating cross-disciplinary content, we implement integrated teaching to enhance students' systematic understanding and comprehensive grasp of knowledge.

The industrial college currently offers four specialties: Animation Design, Film and Television Animation, Visual Communication Art Design, and New Media Art Design. Aligned with digital economy industries, we adhere to two professional development directions: "art + new engineering" and "art + culture," cultivating compound talents in visual interaction development, graphic visual applications, and virtual software development (Peng & Jiang, 2024). Rapid technological evolution in digital economy industries necessitates agile adjustments to specialty structures and talent cultivation directions within

professional clusters. Consequently, the Film and Television Animation program will be suspended in 2022, with the new Virtual Reality Technology Application specialty introduced.

The curriculum team designed a 10-week teaching process to master UE5 scene system principles and develop 3D spatial design thinking. This includes:

Phase 1: System Analysis and Structural Design under Scenario Context
Focus on mastering UE5 scene system principles and establishing 3D spatial design thinking.

Phase 2: Risk Control and Safety Design
Emphasize hazard source control and safety verification methods in terrain design.

Phase 3: Airworthiness Standards and Compliance Verification
Cover industry standard implementation and outcome validation methodologies.

Blended Online-Offline Teaching

The course team implements a blended online-offline learning model across pre-class, in-class, and post-class phases using digital platforms. Pre-class, instructors release learning resources on platforms like Chaoxing Learning to facilitate preliminary study. During class, interactive Q&A, real-time quizzes, and feedback are conducted via online tools, allowing dynamic adjustment of teaching priorities based on student responses. Post-class, assignments are collected, evaluated, and used to refine subsequent lesson focuses. This process refines the overall pedagogical approach.

Leveraging platforms such as Chaoxing Learning and institutional resources, the team uploads foundational toolkits, industry case libraries, and cutting-edge technical packages for supplementary learning, ensuring students connect theoretical knowledge with current industry developments.

Pre-class materials include airworthiness regulatory documents, system safety analysis standards, key references, and classic cases, enabling students to familiarize themselves with research tools and cultivate interest. The BOPPPS (Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, Summary) framework structures lessons, while heuristic teaching strategies engage students through case-based questioning. For example, displaying a screenshot of the snowy mountain terrain from Red Dead Redemption 2, instructors pose questions like, “How to achieve seamless kilometer-scale terrain loading in UE5?” Solutions guide students through real-time demonstrations of layered terrain sculpting and virtual texture mapping techniques.

Industry-Academia-Research Integrated Teaching

The UE5 Terrain Editing course emphasizes both theoretical knowledge and practical skills, aiming to cultivate students' terrain system design capabilities, performance optimization thinking, and industry standard awareness. Through industry-academia-research integrated teaching methods, the course aligns classroom instruction with cutting-edge technological advancements and strengthens connections between teaching processes and project practices, ultimately achieving industry-driven talent cultivation. While imparting foundational expertise, the curriculum emphasizes analysis of project-based practical cases and

school-enterprise collaborative education, enabling students to apply acquired knowledge and stay abreast of industry trends. Research advancements are incorporated to introduce future research directions and hot topics, enhancing students' learning motivation.

In school-enterprise collaborative education, authentic industry projects are integrated. Based on disciplinary characteristics and project production requirements, “diversified, real-scenario, and multi-dimensional” immersive practical training is implemented. This ensures curriculum content aligns with technological development, teaching processes connect with production workflows, and talent cultivation merges with industrial demands. Students' project management abilities and complex problem-solving skills are systematically enhanced, fostering holistic industry awareness and equipping them with vocational competencies required for industrial development.

An integrated teacher development center is established as a base for cultivating “dual-qualified teachers with both teaching and technical expertise.” The center allocates annual dedicated training funds to prioritize the development of promising mid-career teaching and technical backbone faculty, offering regular exchange seminars, technical training programs, and industry internship opportunities (e.g., visiting engineer positions) to create career development pathways. Dedicated incentive funds are provided to motivate faculty growth through evaluation and reward mechanisms, supporting joint instruction by school and enterprise mentors to build high-level teaching teams. Leveraging industry resources from partner enterprises, the center introduces industry standards to establish standardized vocational certification systems. Driven by disciplinary expertise, it develops “talent competency models” tailored to job roles, offering multi-dimensional skill certifications for students and professionals, alongside high-quality instructor certifications for educators.

Conclusion

This study addresses the disconnect between vocational education and industrial demands in the context of digital industrialization, using Unreal Engine 5 (UE5) terrain editing as a reform vehicle to establish a three-dimensional teaching model framework integrating “multidisciplinary, online-offline, and industry-academia-research fusion.” The research innovatively merges artistic design with engineering technology, achieving deep coupling between classroom learning and industry practices through embedded real animation production projects. Implementation adopts production-oriented pedagogy and the BOPPPS instructional structure, leveraging digital platforms like Chaoxing Learning to create a full-process optimization mechanism of “pre-class preview - in-class interaction - post-class feedback.”

Quantitative evaluations reveal that among 150 participating students, UE5 software operational skills improved by 42%, with 85% of course projects meeting industry feasibility standards. Employers' ratings of students' problem-solving and teamwork abilities increased by 40% and 25%, respectively. The study validates the effectiveness of the “modern Chinese apprenticeship” model, which anchors vocational education in authentic production scenarios through core elements such as industry skill frameworks, phased task design, and dual-mentor systems. This provides a replicable paradigm for cultivating innovative talents with both technical competence and professional literacy for the digital industry.

Future research will expand into smart manufacturing, virtual reality (VR), and other fields, exploring the construction of diversified vocational certification systems while deepening mechanisms for developing "dual-qualified teachers with both teaching and technical expertise." This aims to continuously optimize industry-academia-research collaborative innovation ecosystems, providing talent support for high-quality development in the digital art sector.

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LEARN: Improving Young Learners' Oral Performance Through AI-Guided Picture Conversations

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Abstract

Oral language development is a foundational skill in early literacy, yet traditional classroom interactions often provide limited opportunities for structured, interactive, and individualized oral practice. Research has shown that AI-powered language tools can enhance oral performance by providing adaptive, interactive, and real-time feedback, as well as sustained engagement. AI-driven conversation depends on pedagogically sound content design, particularly in how picture-based prompts are selected and structured. **LEARN** (**L**anguage automated **E**valuation by generating **A**nswers/questions from ca**R**too**N**s) is an AI-powered chatbot designed to improve the oral performance of young children in their mother tongue language (MTL). Jointly developed by the Singapore Institute of Technology (SIT) and the National Institute of Education, Nanyang Technological University (NIE-NTU), **LEARN** facilitates curriculum-aligned picture conversations for young learners, providing visual and verbal stimuli. The key component of its AI-driven conversation is the thematic picture selection based on (i) curriculum alignment, (ii) dynamic and action-based imagery, (iii) diversity and inclusion, and (iv) integration of progressive questioning. This paper presentation discusses the creation of picture-based prompts and pedagogical considerations for leveraging LEARN to facilitate oral performance in mother tongue language learning.

Keywords: AI-chatbot, thematic picture conversation, oral performance, mother tongue language

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Introduction

AI-powered chatbots have gained significant attention in education, particularly in language learning. These conversational agents have the potential to facilitate a learning context, provide customized and personalized learning experiences, and enable learners to control their advancement. Chen et al. (2021) provide a comprehensive analysis of the evolution of personalized language learning (PLL), examining trends, methodologies, and emerging research areas. The study identifies that adaptive learning technologies, including conversational agents, chatbots, and intelligent tutoring systems, have played a crucial role in tailoring language instruction to individual learners. The findings suggest that AI-driven tools and adaptive learning models continue to shape the future of PLL.

Xu et al. (2022) show that dialogic reading with a conversational AI agent enhances children's engagement and story comprehension comparable to human-led interactions. Recent studies have demonstrated that chatbot-mediated interaction promotes a learner-friendly environment, reducing anxiety and enhancing communicative confidence (Guo & Yan, 2025). Research has shown that learners exhibit a greater willingness to communicate after interacting with a chatbot (Ayedoun et al., 2019; Tai & Chen, 2023). AI-powered chatbots also serve as virtual teaching assistants, providing instant feedback, corrective suggestions, and conversation simulations that enhance oral language performance (Labadze et al., 2023). Oral language performance has a substantial impact on the overall language proficiency of young learners. AI-powered chatbots offer learners an interactive and engaging environment, providing a personalized learning experience. The integration of AI chatbots into instructional settings is crucial in optimizing language learning outcomes. This supports the growing potential of AI chatbots supplementing home-based educational activities among young learners.

In Singapore, adaptive learning technologies are increasingly integrated into educational frameworks. AI Singapore had launched the "AI in Education Grand Challenge," which aims to encourage the development of innovative approaches that use artificial intelligence to enhance Mother Tongue Language (MTL) learning for primary-level students in Singapore.

Project Objectives

LEARN (**L**anguage automated **E**valuation by generating **A**nswers/questions from ca**R**too**N**s) is an AI agent that aims to enhance the MTL learning environment at home to increase proficiency among Primary 1 and 2 students in Singapore. Jointly developed by the Singapore Institute of Technology (SIT) and the National Institute of Education (NIE), **LEARN** facilitates curriculum-aligned picture conversations for young learners, providing visual and verbal stimuli. This project aims to enhance MTL home-based learning by developing an AI platform that engages students in short conversations and offers personalized feedback. **LEARN** incorporates a gamification element to motivate, instill a desire to learn, and consequently improve students' MTL (Chinese, Malay, and Tamil) proficiencies. The project objectives include:

- To enable AI-supported multilingual oral practice in MTL (Chinese, Malay, and Tamil).
- To support task-oriented, picture-based conversational practice.
- To offer real-time, personalized feedback to increase learners' confidence in MTL use.
- To achieve pedagogical equivalence across languages through a unified framework.

The host institution, the Singapore Institute of Technology (SIT), does engineering and technical development of **LEARN**. It is based on the Visual Question Generation (VQG)/Visual Question Answering (VQA) and Dialogue Manager (DM) framework. SIT collaborated with 10 primary schools, involving a total of 659 MTL students from Primary 1 and 2 levels, for data collection and test-bedding activities. **LEARN** utilizes an online platform at www.underoneschool.com. Learners can access the online interface from home.

Design and Features

Multimodal Engagement

The key component of **LEARN**'s AI-driven conversation is the picture description tasks. The question-and-answer generation is done directly in each MTL. The Dialogue Manager generates questions in MTL, and students' answers are compared with AI-generated answers and picture descriptions in MTL. If the student's answer is incorrect, two follow-up questions are generated to advance dialogue between the two. If the student is unable to answer the questions after these two attempts, the correct answer will be provided. The integration of visual stimuli (picture prompts) and interactive AI-driven dialogues enhances cognitive processing, reinforcing both comprehension and verbal expression.

Contextualized and Scaffolded Learning

In **LEARN**, picture-based prompts are selected based on (i) thematic relevance and curriculum alignment, (ii) dynamic and action-based imagery, (iii) diversity and inclusion, and (iv) integration of progressive questioning. The selection of pictures for conversation follows a structured framework derived from the primary school curriculum, ensuring alignment with age-appropriate themes and language learning goals.

Through interaction with the chatbot, children engage in scaffolded discussions that promote vocabulary expansion, sentence construction, and expressive communication. The main characters in the cartoons are the general representation of the three major ethnic groups in Singapore. The characters are contextualized within familiar background scenes for the target users. This includes scenarios of activities at school, home/neighborhood, places of interest, and cultural celebrations. The chatbot images reflect varied cultural, linguistic, and social backgrounds, promoting equitable access to language learning among the three MTL. These images help young learners understand the different ethic groups and their cultural values in Singapore.

Figure 1

Main Characters From Different Ethnic Groups Used in Picture Prompts



As for thematic relevance, some of the picture prompts feature images of festive celebrations among different ethnic groups, such as preparing for Eid (Malay family), making Kolam (Indian family), and a birthday celebration for an elderly member (Chinese family). While all these festive celebrations hold significance within their respective ethnic groups, AI-driven dialogues are generated in all three mother tongue languages. This exercise expands learners' language corpus and enhances their understanding of the various cultural contexts in Singapore. This example is shown in Figure 2.

Figure 2

Picture Prompt Depicting a Scenario Celebrated by a Chinese Family



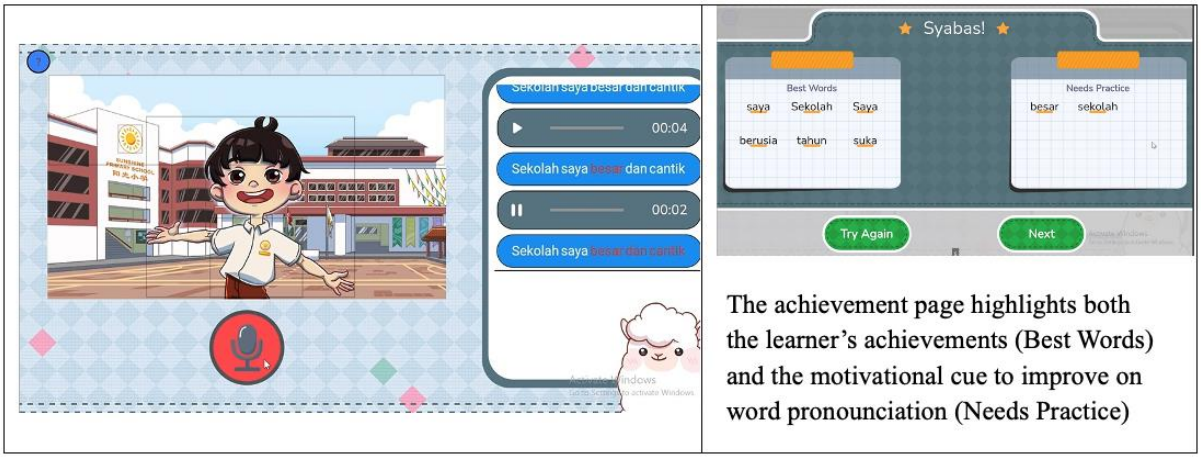
This picture prompt features an elderly member (in his 70s) of a Chinese family celebrating his birthday at a restaurant. There is a plate of longevity buns on the table, and some of the family members are wearing bright red outfits. These are significant cultural manifestations identified in the picture that would enhance the background knowledge of users from all three MTLs.

Word Bank – Vocabulary Expansion and Early Syntax Mastery

The AI-assisted picture in **LEARN** exposes young learners to new words, hence reinforcing semantic understanding. At the "word" level, it helps young learners to refine their pronunciation. At the "sentence" level, it helps learners to construct sentences by modelling correct speech patterns. The system is designed to detect errors in word pronunciation or sentence construction by utilizing its automatic speech recognition (ASR). Learners are allowed to record their voice multiple times until they are satisfied before submitting their answers. They are allowed to repeat a maximum of two attempts at answering. If both attempts are not successful, the correct answer will be generated. Each attempt will be followed by a motivational cue that acts as a reward to stimulate interest in the learning process. The reward system helps maintain learner engagement in the task at hand.

Figure 3

Facilitating Oral Performance Through Pronunciation



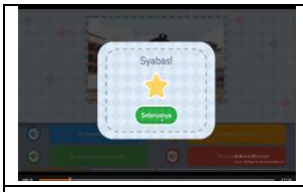
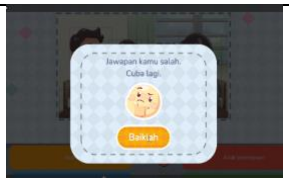
The achievement page highlights both the learner's achievements (Best Words) and the motivational cue to improve on word pronounciation (Needs Practice)

Multiple-Choice Questions and Task Selection

The integration of multiple-choice questions (MCQs) within AI-driven picture-based chatbot interactions serves as a pivotal mechanism for reinforcing cognitive and linguistic development in language learners. In **LEARN,** learners listen to an audio chatbot prompt and select the correct answer from four randomized options. Here, learners are engaged in structured decision-making processes. MCQs facilitate semantic precision and conceptual clarity, prompting the learners to critically analyse visual stimuli and select the most contextually appropriate linguistic expressions. This pedagogical strategy augments lexical acquisition by embedding vocabulary recognition within an interactive framework.

Through gamification, **LEARN** incorporates a real-time adaptive feedback mechanism within the AI chatbot system. This ensures that learners receive immediate corrective reinforcement, making the learning experience engaging and rewarding. There is an achievement page where learners can track the number of exercises completed, the time spent, and exercises with a perfect score.

Figure 4
Motivational Cues at Every Stage of Attempts

			
Syabas! Seterusnya. Well done! Next. This cue appears when the learner provides a correct answer.	*Syabas! Ok* Well done! Ok. This cue appears when the learner attains all correct answers for a given item.	*Jawapan kamu salah. Cuba lagi!* This cue appears when the learner answers incorrectly and is given another attempt.	*Jawapan kamu salah. Jawapan yang betul ialah.* This cue appears when the learner answers incorrectly on the second attempt. The correct answer will be generated.

LEARN enables learners to select simpler image descriptions that emphasize fundamental vocabulary and sentence structure. As they demonstrate competence, they can attempt other picture-based prompts that offer more complex scenarios, requiring advanced oral expression, to ensure incremental learning progression. The collection of picture prompts enables the system to introduce multi-layered scenarios that require more advanced linguistic skills, such as narrative cohesion, inference, and contextual adaptation.

For instance, initially, learners may engage in simple image prompts that feature a single subject matter requiring the use of nouns and basic descriptive phrases. As learners advance, the system integrates multi-action-based or multi-character visual stimuli, prompting responses that necessitate more sophisticated grammatical structures and discourse skills. The Question/Answer features gradually progress to ensure cognitive engagement, as learners refine sentence fluency and spontaneous conversational ability. Samples of picture prompts are shown in Figure 5.

Figure 5

Samples of Picture Prompts, Ranging From Simple to Complex Scenarios



Questions & Answers Features

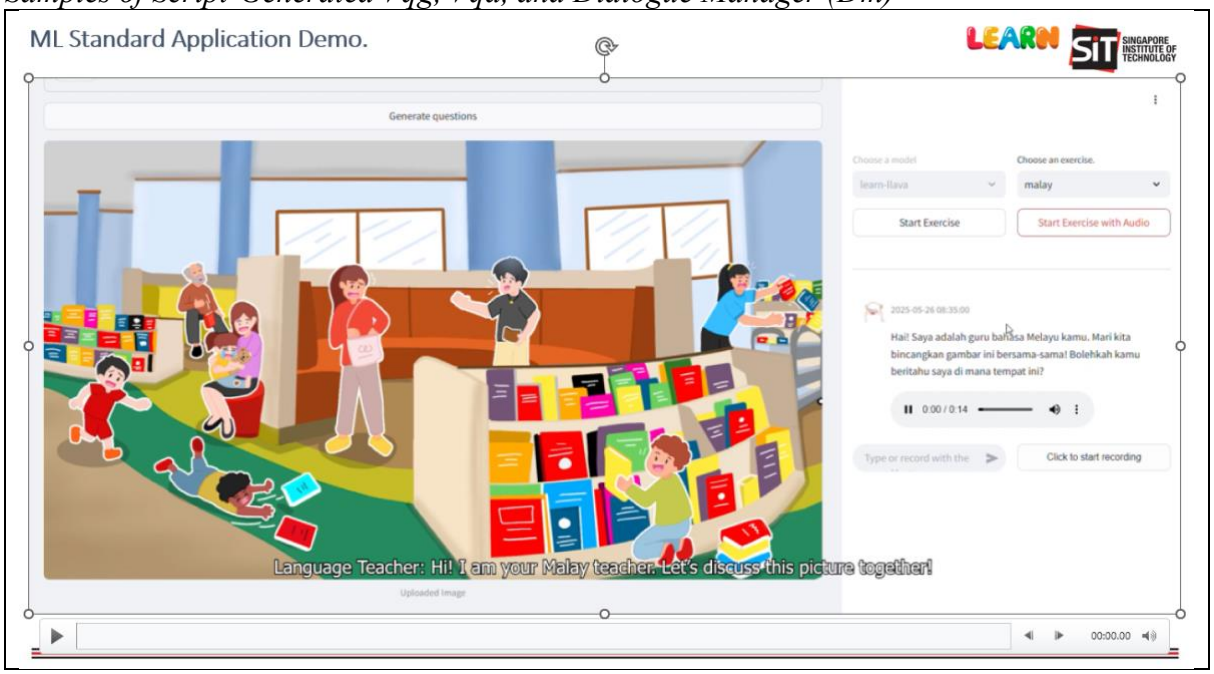
LEARN's chatbot enables learners to engage in a conversation through a Visual Question Generation (VQG)/Visual Question Answering (VQA) and Dialogue Manager (DM) framework. VQG enables the chatbot to generate contextually relevant questions based on an image, prompting learners to engage in structured conversations. Instead of simply describing an image, learners are encouraged to respond to the questions, fostering deeper cognitive engagement. This can be done by generating open-ended and inferential questions. This encourages learners to expand their responses, improving fluency and critical thinking. On the other hand, VQA allows the chatbot to interpret learners' responses and provide adaptive feedback based on the image content. If a learner describes an image inaccurately or incompletely, the system can guide them toward a more precise answer.

The Dialog Manager (DM) serves as the central control system, managing chatbot interactions to ensure coherent and context-based conversations. It manages turn-taking mechanics, personalized learning pathways, and error correction and reinforcement, providing instant feedback to refine pronunciation, grammar, and sentence structure. By integrating VQG, VQA, and DM, **LEARN** creates an immersive, adaptive, and engaging language learning experience. The incremental learning approach ensures that learners progress naturally, building confidence in oral performance.

The picture below serves as a demo for the application. It begins with an introduction provided by an AI-generated teacher's voice. The learner answers by recording his/her voice and submits it to the chatbot. Both visual and oral questions and answers are generated.

Figure 6

Samples of Script-Generated Vqg, Vqa, and Dialogue Manager (Dm)



Teacher	Hai! Saya adalah guru Bahasa Melayu kamu. Mari kita bincangkan gambar ini bersama-sama. Boleh kamu beritahu saya di manakah tempat ini? *Hi, I am your Malay Language teacher. Let's discuss this picture together. Can you tell me where this place is?*
Learner	Gambar ini di perpustakaan. *This picture is at a library.*
Teacher	Jawapan yang betul ialah, "Gambar ini menunjukkan sebuah perpustakaan." *The correct answer is "This picture shows a library."*
Teacher	Jika kamu perhatikan, kamu boleh melihat beberapa orang melakukan pelbagai aktiviti seperti membaca, berbincang dan bermain. Sekarang, lihat ke bahagian kiri gambar. Apakah yang dilakukan oleh budak lelaki yang berseluar merah di atas karpet? *If you observe, you can see a few people engaging in various activities, such as reading, discussing, and playing. Now, look at the left side of the picture. What is the boy wearing red shorts doing on the carpet?*
Learner	Dia sedang berlari. *He is running.*
Teacher	Jawapan yang baik. *That is a good answer.*
Teacher	Apakah yang akan kamu lakukan di perpustakaan? *What would you like to do in the library?*

Learner	Saya akan membaca buku. *I would read a book.*
Teacher	Bagus. Hari ini kamu telah belajar perkataan-perkataan baharu seperti; "perpustakaan, berlari, memandang, meminjam buku" dan yang lain-lain. Teruskan berlatih. Jumpa lagi! *Great job! Today you have learnt the following new words, for example, library, running, and borrowing books. Remember these words. Continue practicing and see you next week.*

Project Contributions

Among the key innovations of **LEARN** is the leveraging of machine learning and natural language processing (NLP), which allows learners to practice oral language performance through interactive conversations. The adaptive learning tailors educational content based on individual learner progress. This ensures personalized instruction that adapts to student needs. It promotes learners' autonomy and self-directed learning. Learners are allowed to repeat tasks and select tasks according to their learning progression.

The picture prompts are developed based on their relevance in the Singapore context and align with the primary school curriculum content. This includes scenarios with diverse age-appropriate themes and the infusion of values. Most of all, it meets the language learning goals.

The multimodal learning features enable image recognition, voice interaction, text, oral, and audio-based tutoring. The incorporation of VQG, VQA, and DM provides progressive questions that further ensure interactive learning progressions and oral performance. **LEARN** incorporates gamification and engagement strategies that use a reward system, progress tracking, and interactive challenges to enhance motivation and retention. This promotes confidence in oral performance, reduces anxiety, and makes MTL learning immersive for young learners.

Implications and Improvements

LEARN has launched its platform at www.underoneshool.com. The SIT team did a trial at a primary school involving 206 MTL students from Primary 1 and Primary 2. Students were given the audio-based multiple-choice question (MCQ) task and the oral-based question-and-answer task. Feedback gathered from the trial session showed that 6% of the total participants did not enjoy it. When asked about the difficulty level of the tasks, most respondents believe that the questions generated by the system are straightforward, whereas 20% find the questions generated by the system to be challenging. This implies that while most respondents enjoy using LEARN to improve their oral performance, some of them are challenged by the questions prompted by the chatbot.

Despite the innovation and contributions of LEARN, the AI-powered chatbot system, several limitations remain that could be addressed for improvement. One of the challenges is that AI-generated voices may struggle with ambiguous, nuanced, or multi-turn conversations, resulting in inaccurate or generic prompts or responses. This makes it less effective for learning nuanced languages. Additionally, natural language processing (NLP) limitations affect the ability to interpret idiomatic expressions, sarcasm, and cultural nuances, which are essential for human-like interactions.

The speech recognition technologies embedded in chatbots often fail to accurately assess pronunciation, especially for young learners with developing articulation skills. Young learners may provide fragmented or unconventional responses that are accepted as correct; however, AI chatbots may misinterpret them, leading to incorrect or generic feedback. This may lead to discouraging learners rather than guiding them constructively.

While chatbots can stimulate positive reinforcement, they lack proper emotional awareness, making it challenging to adjust tone dynamically based on the young learner's engagement level. Motivation in young learners is highly dependent on emotional connection. AI-driven interactions may sometimes feel mechanical rather than intuitive.

LEARN could integrate advanced NLP models that recognize child-specific speech patterns in the mother tongue language. By refining the multi-turn dialogue processing, LEARN can provide more adaptive and meaningful conversations tailored to young MTL learners. The responses from the AI chatbot could be adjusted based on tone, engagement levels, and learner frustration cues to improve emotional security in MTL learning.

LEARN could incorporate advanced speech recognition to support pronunciation, enhance AI-driven phonetic analysis, and provide accurate pronunciation feedback without discouraging young learners. This could also be achieved by implementing gradual speech correction models, rather than direct correction, which would help children progressively refine their spoken language.

Conclusion

The LEARN project showcases the design and development of an innovative AI platform for learning mother tongue languages. It addresses the current linguistic and educational landscape, supporting the language literacy of young learners.

The system holds significant potential for improving the oral performance of young learners, particularly through the integration of picture-based prompts, adaptive questioning, and multi-modal interactions. While LEARN fosters engagement, motivation, and oral proficiency, existing limitations necessitate further technological refinement. As technology continues to evolve, LEARN would hold significant potential in the educational landscape, particularly in mother-tongue language learning.

Acknowledgements

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SEPP: Security Education and Penetration-Testing Platform for IoT

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Abstract

The Internet of Things (IoT) is becoming a major part of our everyday lives, offering convenience and smarter solutions, but also bringing significant security challenges. While theoretical knowledge in IoT security is essential, studies have shown that practical content can be an essential part of internalizing understanding. To address this, we developed the Security Education and Penetration-Testing Platform (SEPP) as the practical component of an existing IoT security course at the Ostbayerische Technische Hochschule (OTH) Regensburg. SEPP uses real IoT devices like smart locks, cameras, and plugs, simulating a smart home environment to make learning interactive and engaging. Students can explore vulnerabilities, conduct penetration tests, and document their findings through structured exercises. By working on tasks like network scanning, analyzing data traffic, and simulating attacks, students gain a deeper understanding of IoT security risks. Initial tests show that this approach helps students apply their theoretical knowledge and significantly improve their practical skills. This paper explains how SEPP was built, the exercises it offers, and why it's an important step forward in teaching IoT security effectively. Furthermore, we aim to share the findings and tasks from this paper with other universities, providing them with a solid foundation to teach practical IoT security knowledge in their own courses.

Keywords: IoT, cyber security, hacking, education, SEPP

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Introduction

The Internet of Things (IoT) has transformed industries and daily life by connecting devices to enable smarter homes, businesses, and infrastructure. However, this rapid adoption has also introduced critical security risks, as IoT devices often lack of defense mechanisms against cyberattacks. Addressing these vulnerabilities is essential, particularly as IoT systems increasingly handle sensitive data like cameras or control critical processes.

Teaching IoT security to computer science students presents unique challenges. While theoretical instruction provides a foundational understanding, it often falls short of giving the students real-world examples in a practical way. This practice would enable the students to earn first experience in finding, analyzing and using vulnerabilities of IoT devices.

In response to this need, the Security Education and Penetration-Testing Platform (SEPP) was developed. This platform is equipped with various IoT devices, such as smart locks, cameras, plugs and light bulbs, offering students the opportunity to apply their theoretical knowledge. By discovering, documenting and testing device vulnerabilities, the SEPP project equips students with the necessary information to apply their theoretical knowledge and turn it into a practical skill. This paper deals with the establishment of the practical part (SEPP) in the IoT security course and describes the procedure in detail.

Background and Related Work

The dynamic and interconnected nature of IoT systems presents unique cybersecurity challenges. Addressing these requires educational approaches that go beyond theory, providing students with the opportunity to engage directly with the technologies these devices deliver like Bluetooth Low Energy, WLAN and USB.

Hands-on learning is especially effective in helping students grasp the complexities of IoT security. Research highlights that practical exercises focusing on vulnerabilities such as insecure communication and user tracking provide valuable insights into real-world risks (Kolias et al., 2016). These exercises allow students to see firsthand how security flaws manifest and how they can be mitigated.

Interactive and gamified approaches further enhance learning outcomes. Capture-The-Flag (CTF) competitions have been used to immerse students in cybersecurity scenarios, enabling them to analyze and exploit vulnerabilities in IoT systems (Legg et al., 2021). Such activities not only make learning engaging but also point out the importance of critical thinking.

Integrating IoT modules into technical courses has also proven effective in bridging the gap between theoretical and practical learning. For instance, incorporating IoT topics into a smart building curriculum gave students hands-on experience with real devices, significantly improving their understanding of IoT architectures and security principles (Sahrani et al., 2024).

Other studies have shown that practical engagement with commercial IoT devices provides a deeper understanding of real-world challenges. By conducting penetration tests on these devices, students not only identify vulnerabilities but also learn to document and communicate their findings effectively (Chothia & de Ruiter, 2016). This approach ensures that students are better prepared to address the evolving landscape of cybersecurity threats.

Hands-on oriented approaches are highly effective in IoT security education. By focusing on real-world scenarios, such as identifying hardware vulnerabilities, analyzing communication protocols, and addressing web application security flaws, students gain direct, practical experience with IoT systems. Such methods have been shown to significantly enhance understanding and technical skill, with studies reporting that 96% of participants improved their grasp of IoT cybersecurity concepts through structured, practical exercises (Oliveira, Jr. et al., 2022).

These findings underscore the critical role of hands-on, interactive learning in IoT security education. Practical experiences not only solidify theoretical knowledge but also prepare students to tackle the unique challenges posed by IoT ecosystems. Building on these insights, the SEPP platform integrates these proven strategies to deliver a comprehensive and immersive learning environment, ensuring students are equipped to meet the demands of modern cybersecurity.

Simulating a Smart Home With Physical Devices

Although research has shown that there are already various practical approaches to IoT security courses, most of them do not use a wider range of physical devices, which are continuously being developed to teach practical skills. To bridge this gap, the SEPP platform uses realistic devices that are already in use in many households.

Devices like light bulbs, plugs, smart locks and cameras are the top-sellers at big online stores like Amazon. For this reason, these devices are already integrated into the SEPP platform.

Handling these devices is fairly easy and most of the students do not even need any explanation to use them. But to make the platform even more intuitive, the hacking exercises will be designed similar to the use of a smart home.

To implement this, the devices get separated by two criteria: the technology they use (for example Bluetooth Low Energy) and the difficulty to hack them. The latter in particular makes it possible to design exercises that are beginner-friendly but become increasingly difficult as the course progresses while using different technologies.

In the later progress of the project, the platform is planned to be designed like an actual house. This approach aims to help students to become more deeply engaged in the given task by visualizing it. In addition, this also allows the project to implement a gamified approach.

For example, the exercises of the course could be designed to firstly challenge the students to determine if the WLAN of the house is secured and identify devices within the network. The following exercise might involve shutting off a smart plug to disable all devices connected to it.

The simulation of real-world examples within a smart home environment should allow the students to interact with the given material in a more interactive and practical way.

Preparation of the Platform

To realize the described platform in such a way that it functions smoothly and is immediately ready for use by students, a lot of preparation is required.

As this platform focuses on IoT devices, these had to be selected first. As almost no manufacturer discloses the existing vulnerabilities of a device and there is little information on the Internet about the specific devices, we carried out the security tests ourselves.

We decided to implement the following hardware to the platform for operating reasons:

- Ubiquiti Edge Router X. This router is used to pass Internet to the Raspberry Pi and to maintain various security settings for the university's main network.
- Raspberry Pi 4 Model B with Raspberry Pi OS (formerly Raspbian). This Raspberry acts as a router using RaspAP. This step is necessary to create your own network for the platform. This makes it easier to identify the relevant IoT devices and to avoid problems with networks that are actually in use.
- GreenNet Trendnet Switch TEG-S50g. The switch is used between the Ubiquiti Edge Router and the Raspberry Pi to connect these devices and to offer the possibility of integrating further LAN devices into the network.
- Microsoft Surface. This laptop is integrated into the platform to have easy access to the devices, configurations and the setup. In addition to Microsoft Windows 10 as the main operating system, a virtual machine for Kali Linux and Android are also installed.

In addition, we have currently integrated the following IoT devices into the platform to perform tasks or carry out further vulnerability checks:

- EIGHTREE Wifi Smart Plug 16A
- Nuki Smart Lock 3.0 Pro
- Wiko Smartphone with Android 6
- LurcarLE Cloud Wifi HD Video Camera
- Luminea WLAN Water Detector
- Pamalar Wifi Door / Window Sensor
- Yeelight (Xiaomi) S1 Smart Bulb
- Lepro LE A60 Smart Bulb
- TP-Link Tapo L510E Smart Bulb
- Inkbird Smart Air Quality Monitor
- Itius IR Motion Detector

Most of the devices can be updated, but since the users mostly do not want to pay for updates, the companies will not deliver free updates for a long period of time which results in various vulnerabilities. However, if updates are available, we do not recommend carrying them out in order to keep any vulnerabilities open within the framework of the platform.

Configuration

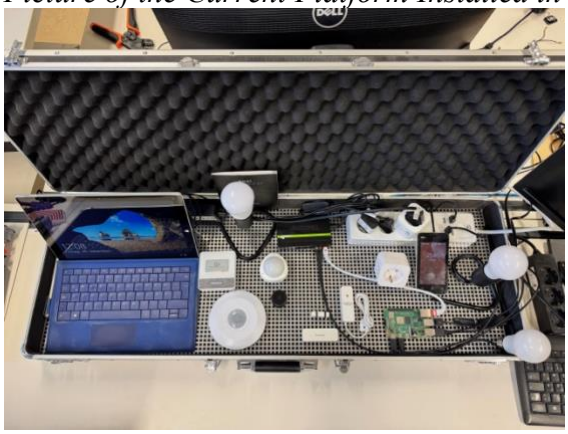
To configure all devices within the platform, we first set up the mentioned network using the Raspberry Pi and RaspAP. Then we connected the mentioned devices to the Raspberry Pi via WLAN or Bluetooth. This should be done step by step and the successful connection should then be checked individually for each device.

After all devices were successfully integrated into the platform, we started to look for vulnerabilities for each individual device to create tasks for the students from the findings.

To ensure a certain portability of the platform and an overview of it, we decided to temporarily install the entire configuration in a case.

Figure 1

Picture of the Current Platform Installed in a Case



Example Exercises

In this section, we provide a set of standalone tasks designed to help students explore and address key IoT security challenges. Rather than prescribing a fixed exercise sequence, these tasks allow users to flexibly combine and adapt them into exercises that best suit their learning objectives. In addition, these tasks cover key aspects of IoT security and enable practical exploration of vulnerabilities and network behavior.

Objective

By successfully attempting all given tasks, the students will be able to:

- Identify IoT devices within a local network
- Perform network scans to discover open TCP and UDP ports
- Analyze exchanged packages within the network
- Simulate a DoS attack by using SYN-flooding on an IoT device
- Controlling certain devices using terminal commands
- Perform Replay attacks using Python

Preparation

To find and make use of the given vulnerabilities, the following tools and devices were used within the tasks:

- Nmap - command line tool to scan a given network
- netcat - command line tool to send data through the network
- Wireshark - application to trace packages in the network traffic
- Scapy - python package to send, receive and analyze network packages
- telnet - command line tool to communicate with devices and computers

Tasks

The following tasks can be flexibly combined and are ideal for creating step-by-step instructions.

Network Scanning Using the EIGHTREE Smart Plug

Students start by finding out the relevant IP address range using either the ifconfig command for Linux and Mac operating systems or ipconfig for Windows. After accessing this necessary information, the students move on by identifying the IP address of the IoT devices and performing network scans using nmap -sn <IP address> range. At this point, either the name resolution of the desired device should be activated or the specific MAC address should be made available to the students. Subsequently, the scan results are used to list all open TCP and UDP ports for the given IP adress of the device (in our case, the EIGHTREE Smart Plug) by using nmap -sT -p <IP adress> for TCP ports and nmap -sU -p <IP adress> for UDP ports. This step provides fundamental knowledge to understand the communication of the device and recognize potential vulnerabilities.

Simulating a DoS Attack With the EIGHTREE Smart Plug

Using a partially completed Python script, students implement a SYN-flood attack on the IoT device. The script uses the Scapy Python library to generate and send a large number of spoofed SYN packets in a simple while True: loop. To do this, the script only needs the IP address of the device to be attacked and the corresponding open port. The relevant functions are the following:

```
Python:
ip = IP(src=RandIP(), dst=target_ip)

tcp = TCP(sport=RandShort(),
    dport=target_port, flags="S")
    #S for SYN package

pack = ip/tcp #Combines the ip and tcp package
send(pack)
```

The result will overwhelm the communication capabilities of the plug. Students observe the impact of the attack in real time, including its effect on the device's responsiveness and functionality using Wireshark. This task demonstrates how a DoS attack can disrupt an IoT device.

Analyse Network Traffic Using Wireshark

During the SYN-flood attack, students use Wireshark to monitor network traffic. They apply filters for the relevant IP adress by using ip.dst == <IP adress> for the destination IP and ip.src == <IP adress> to focus on packets sent to and from the IoT device, analyze the patterns of SYN and SYN-ACK packets, and observe how the attack exploits the device's communication protocols.

Investigating Packet Encryption

Students test the IoT device's communication security by sending custom UDP packets using netcat. By capturing and analyzing these packets in Wireshark, they determine whether the communication of the device is encrypted or transmitted in plain text. This task highlights potential risks of unencrypted data transmission.

Packet Analysis of App Commands

Using a smartphone app to control the the IoT device (for example, the EIGHTREE Smart Plug), students capture and analyze packets exchanged between the app and the IoT device within Wireshark. The captured traffic gets reviewed for encryption and replay attack vulnerabilities again using Wireshark.

This task allows students to consolidate their theoretical knowledge of network packets and encryption through a practical insight.

Controlling the Yeelight S1 Smart Bulb via Telnet

For this task, the students need to find the device and the open port(s) within the network using the described commands with nmap. After finding this necessary information, the packages send to the device using a device-specific application can be traced using Wireshark. If the packages sent to the devices are unencrypted, the students should be able to extract the commands to control the device. In the case of the Yeelight S1 Smart Bulb, the device can be turned on and off sending the following JSON commands directly through telnet:

```
Python:
telnet <IP adress> <Port> #connects to the device

{"id":0, "method": "set_power", "params":
   ["on", "smooth", 200]} #turns bulb on

{"id":0, "method": "set_power", "params":
   ["off", "smooth", 200]} #turns bulb off
```

Packages sent through this method can also be traced and reviewed using Wireshark. The method shown also provides the basic knowledge required for replay attacks.

Replay Attack Using Python and Scapy on the Yeelight S1 Smart Bulb

A replay attack works by capturing legitimate data packets and sending them again to trick a device into performing unintended actions. Using Python and the Scapy library makes it easy to simulate such attacks, as the library allows creating and transmitting a variety of packages. This provides a hands-on way to understand the mechanics and risks of replay attacks.

In order to carry out such an attack, it is necessary for the students to extract the correct commands from the package traffic beforehand. In the case of the Yeelight S1 Smart Bulb, we can use the JSON commands already shown in conjunction with Python.

The following Python script can perform a replay attack on the bulb:

```
Python:
from scapy.all import *
from scapy.layers.inet import IP, TCP

#IP and port of the lamp
ip = "XXX"
port = XXX

json_command = 'XXX' + '\r\n'
# \r\n required to terminate the message

# 3-Way Handshake: Initiate TCP session
syn = IP(dst=ip) / TCP(dport=port, flags="S")
syn_ack = sr1(syn)

# 3-Way Handshake: ACK for the handshake
ack = IP(dst=ip) / TCP(dport=port,
    sport=syn_ack[TCP].dport, flags="A",
    seq=syn_ack.ack, ack=syn_ack.seq + 1)
send(ack)

#Send the JSON command
push_ack = IP(dst=ip) / TCP(dport=port,
        sport=syn_ack[TCP].dport,
        flags="PA", seq=syn_ack.ack,
        ack=syn_ack.seq + 1) / json_command
send(push_ack)

#Close the TCP session
fin = IP(dst=ip) / TCP(dport=port,
    sport=syn_ack[TCP].dport, flags="FA",
    seq=syn_ack.ack + len(json_command),
    ack=syn_ack.seq + 1)
fin_ack = sr1(fin)

ack = IP(dst=ip) / TCP(dport=port,
    sport=syn_ack[TCP].dport, flags="A",
    seq=fin_ack.ack, ack=fin_ack.seq + 1)
```

After successfully performing the replay attack shown, students should have a deeper understanding of the relevance of vulnerabilities and encryption as well as Python in conjunction with the Scapy package.

Evaluation

To evaluate the tasks shown, we bundled them into two exercises and carried each out with a test group of nine students. For both exercises, rough instructions were created, which contained gap scripts for Python and instructions on when to use nmap, for example. The

students came from an IoT security course, for which the practical content is planned for the future. Accordingly, the students have already gained theoretical knowledge on the topics shown.

In the first exercise, the students had to use nmap to find the IP address and the open port of the EIGHTREE Smart Plug. The data traffic was then observed and analyzed using Wireshark. Finally, the Python commands were used to simulate a DoS attack and the data traffic was observed again using Wireshark.

For the second exercise, the described task was chosen to control via telnet and perform the replay using Python attack on the Yeelight S1 Smart Bulb. Here, too, the relevant information such as IP address, port and commands had to be determined first.

The results of the two test groups showed that all tasks were successfully completed with the instructions. As a result, the students were able to apply their theoretical knowledge in practice and significantly deepen it.

The bundling of some tasks into exercise sheets also made it possible to cover some relevant areas such as nmap, netcat, telnet, Scapy/Python and Wireshark at the same time.

Unfortunately, we noticed that there were problems with the EIGHTREE Smart Plug from the first exercise. When too many participants tried to access it at the same time, an unintentional DoS occurred and the plug refused to work. This could also occur with other IoT devices and must be observed in subsequent exercises. One solution would be, for example, to limit the number of participants per device and set up additional platforms.

Perspectives of Intrusion and Response

In the training of security experts, it is becoming increasingly important to explain defense strategies on the basis of attacks. This is especially true as attackers and defenders are in a constant race in practice. Attackers exploit vulnerabilities in systems and processes to compromise data or impair services and much more. In contrast, IT security experts in the defense sector, also known as the blue team, pursue the goal of ensuring the integrity, confidentiality and availability of information. Due to the ever-growing complexity of modern IT infrastructures, coordinated and holistic approaches to security are becoming increasingly important. An essential component of this is monitoring, detection and damage limitation in the event of an attack. Understanding the cause and effect of attacks from the perspective of system protectors and using the knowledge gained to integrate and evaluate prevention strategies and measures offers an efficient way of combining correlated topics.

Conclusion and Outlooks

In conclusion, this evaluation underlines the relevance of practical exercises to theoretical content, especially in the field of IoT security. However, such practical exercises must be well prepared and continuously improved to ensure a seamless process for the students.

Further improvements are necessary to resolve problems such as unintentional DoS attacks. One way of solving this could be to build additional platforms, for example. This attempt would allow us to limit the number of participants per platform and also allow students to work in groups, which could increase the learning effect.

In addition, other devices have already been purchased, such as programmable USB sticks, Arduinos and some Micro:Bit's. In the future, we want to use these devices to demonstrate even more ways in which vulnerabilities can be exploited (e.g. bad USB). The Aurduino and Micro:Bit devices could also be used to create an interface between IoT devices for control or to simulate IoT devices.

Devices like the smart lock, a camera and a variety of sensors (air, light, moisture) are already integrated into the platform, which are currently being checked for security gaps to create further tasks.

Testing and adding additional devices should also cover more relevant areas and could offer tasks like:

- Bluetooth / Bluetooth Low-Energy hacking
- Man in the Middle attacks
- Bad USB
- Brute Force
- Injections
- Insecure Webserver

Through the ongoing integration of further devices and tasks, the existing platform should provide an even more comprehensive insight into existing vulnerabilities. The aim is to cover as many technologies as possible, especially as more modern devices often have more than one interface and the security risk is therefore constantly increasing.

The future inclusion of defense measures to monitor, detect and prevent self-perpetrated attacks holds great potential in the training of CS experts. By gamifying the techniques of both the attacker and the defender, cause and effect as well as advanced attack and prevention techniques can be taught in an understandable and hands-on way.

Due to the rapid and continuous development of new IoT devices, it will become increasingly important to keep a critical eye on the security vulnerabilities of these very devices in the future. With this work-in-progress paper, we will try to keep up to date with these developments and include or investigate both old and new vulnerabilities.

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Sociological Factors Influencing Sexual Abuse Among Secondary School Adolescents in Rivers State, Nigeria: Implications for Counselling

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Abstract

This study investigated sociological factors influencing sexual abuse among secondary school adolescents in Rivers State, Nigeria with a view of establishing implications for counselling. Two research questions and four hypotheses were answered and tested respectively. The study adopted ex-post facto design. As at the time of the study, the marginal estimate of the population of adolescents in Rivers State was about 1,587,864. The sample of the study comprised 1,000 adolescents. The study adopted multi-stage sampling procedure firstly, to select 10 Local Government Areas out of the 23 Local Government Areas in Rivers State, Nigeria. The instrument for the study is Contact and Non-contact Sexual Abuse Inventory (CNSAI). This is a non-cognitive instrument which was adapted from Finkelhor's Sexual Abuse Scale (SAS) and Odemelam's Students' Sexual Behaviour Inventory (SSBI). The instrument was validated by three experts and the reliability was established using Cronbach Alpha method. CNSAI had reliability coefficient of 0.71. Mean and Standard deviation were used in answering the research questions while 2-way ANOVA was used to test the hypotheses. The study established that adolescents from both low and high socio-economic status were involved in sexual abuse as well as those in their early and late adolescence. However, adolescents from low socio-economic status are more at risk as well as those in their early adolescence. Among the recommendations made were that the government should make provision for stipends to indigent adolescents to assist them in taking care of their personal needs. Again, parents should start early to introduce sexuality education as well as discuss the menace of sexual abuse with their children. Furthermore, government should hasten court proceedings involving sexual abuse so that the offenders can be promptly subjected to the full weight of the law.

Keywords: sexual abuse, socio-economic status, age

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Introduction

Children are heritage from God and so require love, care and affection. They are fragile, hence depend on adults for welfare and survival. Their fragile nature makes them in need of special protection and care. It emphasizes the responsibility of family members, guardians and significant others towards their upkeep. Some parents and guardians have handled this responsibility with much levity as we hear of incidences of sexual abuse of children in the media. In low and middle-income nations like Nigeria, children and adolescent sexual abuse is often underestimated, underemphasized and most times not reported (Bukola et al., 2021). In a study among the three main ethnic groups in Nigeria (Yoruba, Igbo, Hausa), it was discovered that sexual abuse on a child below the age of 18 by an adult male was common among the three ethnic groups (Aderinto, 2010).

Gonzalez et al. (2023) gave a very comprehensive definition of child sexual abuse as the involvement of dependent, developmentally immature children and adolescents in sexual activities which they do not fully comprehend, to which they are unable to give consent, or that violate the social taboos of the family roles. It is also sexual activity between a minor and the older person in which the dominant position of the older person is used to coerce or exploit the younger (Robyn in Ernest-Ehibudu, 2021). Here sexual abuse is viewed as a matter of age and the use of force. In a situation where there is much age disparity and force is applied in the issue of sex then it tantamount to sexual abuse. World Health Organization (WHO) in Regional Committee for Africa, 54 (2011), estimates that globally some 40 million children aged 0-14 years suffer some form of abuse and neglect requiring health and social care. According to Van Horne et al. (2018) each year, millions of children are investigated by Child Protective Services for child abuse and neglect. In 2014, over 3.2 million children were subjects of child maltreatment reports, of those, 20% were found to have evidence of maltreatment. Bukola et al. (2021) reports that one in 10 children would be sexually abused before their 18th birthday/ about one in seven girls and one in 25 boys would be sexually abuse before they turn 18.

The clinical definition of sexual abuse is related to the definitions given so far but the guiding principle is whether the encounter has traumatic impact on the child. It is not all sexual encounters experienced by adolescents that do have traumatic effects. According to Ernest-Ehibudu (2009), there are three factors that are useful in clinically differentiating abusive from non-abusive acts - power differential, knowledge differential and gratification differential. These three factors are likely to be interrelated. However, the presence of any of these factors should raise concerns that the sexual encounter is abusive.

Power differential was defined by Ritch in Ernest-Ehibudu (2021) as implying that one party (the offender) controls the other (the victim) and that the sexual encounter is not mutually conceived and undertaken. Power can be derived from the role relationship between offender and victim. For example, if the offender is the victim's father, the victim will usually feel obligated to do as the offender says. Similarly, persons in authority positions, such as a teacher, minister, Boys' scout leader, coach etc, are in roles that connote power. Thus, sexual activities between these individuals and their charges are abusive. According to Patrick and Caroline in Ernest-Ehibudu (2021), power can also be derived from the larger size or more advanced capability of the offender, in which case the victim may be manipulated, physically intimidated or forced to comply with the sexual activity. Power may also arise out of the offender's superior capability to psychologically manipulate the victim (which in turn may be

related to the offender's role or superior size). The offender may bribe, cajole or trick the victim into co-operation.

The second factor is knowledge differential. Eva in Ernest-Ehibudu (2021), opined that the act is considered abusive when one party (the offender) has a more sophisticated understanding of the significance and implications of the sexual encounter. Knowledge differential implies that the offender is either older, more developmentally advanced or more intelligent than the victim. Generally, clinicians expect the offender to be at least five years older than the victim for the act to be deemed predatory. When the victim is an adolescent, some persons define the encounter as abusive only if the offender is at least 10 years older (Kelly in Ernest-Ehibudu, 2021). Thus, a consensual relationship between a 12-year old and a 16-year old would not be regarded as abusive, if other case factors support that conclusion. Generally, the younger the child, the less able he/she is to appreciate the meaning and potential consequences of sexual relationships, especially one with an adult.

The third factor is gratification differential. Ethol in Ernest-Ehibudu (2021), defined this as "the sex offender attempting to sexually gratify or satisfy him/herself". In most but not all sexual victimizations, this is actually the case. The goal of the encounter is not mutual sexual gratification, although perpetrators may attempt to arouse their victims because such a situation is arousing to them. Alternatively, they may delude themselves into believing that their goal is to sexually satisfy their victims. Nevertheless, the primary purpose of the sexual activity is to obtain gratification for the perpetrator.

There are two types of sexual abuse- contact and non-contact sexual abuse. Sexual abuse can happen in person or online. Contact sexual abuse is where an abuser makes physical contact with a child's sexual organs. This includes:

- Touching or fondling the child's body, attempts to have the child arouse the adult, or touch his or her body or kissing in a sexual way.
- The adult rubbing his or her genitals against the child's body in a sexual way.
- Touching the child's genitals with the mouth or having the child touch the adult's genitals with the mouth.
- Having anal or vaginal penetration by penile or other body parts or digital object and complete anal or vaginal intercourse.

Non-contact sexual abuse is where a child is abused without the sexual organs being touched by the abuser. This can be in person or online. It includes:

- Exposing or flashing
- Showing pornography
- Exposing a child to sexual acts
- Making them masturbate
- Forcing a child to make, view or share child abuse images or videos
- Forcing a child to take part in sexual activities or conversations online or through a smartphone

Child sexual abuse can occur in a variety of settings including home, school, church, sports arena etc. most sexual abuse offenders are acquainted with their victims: approximately 30% are relatives of the child, most often fathers, brothers, uncles, cousins, around 60% are acquaintances such as friends of the family, baby sitters, neighbours. Strangers are the offenders in approximately 10% of child sexual abuse cases (Whealin & Barnett, 2007).

Gonzalez in Ernest-Ehibudu (2009) opines that the greatest risk to children do not come from strangers but from friends and family relations. Most children are abused by someone they know and trust. Abuse typically occurs after the "grooming stage". This is a period when the offender often develops a relationship with the targeted victim and his/her family, enjoying family activities, gaining acceptance, earning trust and waiting for time alone with the child. The word pedophile is commonly used indiscriminately to anyone who sexually abuses a child but child sexual offenders are not pedophiles unless they have strong sexual interest in pre-pubescent children (Blaney & Millon, 2009).

Studies on the prevalence of sexual abuse have been conducted. Boys can be victims of sexual abuse, their perpetrators can be males or females. Many people believe that male victimization is more under-reported than female, in part because of societal failure to identify the behaviour as abusive. Moreover, the boy himself may not define the behaviour as sexual victimization but as sexual experience, especially, if it involves a female offender. American Association of University Women (1998), found out that boys were less likely than girls to report sexual abuse because of the fear of retribution, the social stigma against homosexual behaviour, the desire to appear self-reliant and the concern about loss of independence following disclosure.

Pagare (2004) conducted a study to assess the magnitude and pattern of sexual abuse among inmates of observation home in Delhi. A total of 189 boys aged 6-18 years were assessed for sexual abuse using Finkelhor's scale and Child Maltreatment History Self-Report followed by clinical examination using American Medical Association's guidelines. On clinical examination, 61.1% showed physical signs and 40.2% showed behavioural signs of sexual abuse. In a study of male college students, Fromuth and Burkhart in Ernest-Ehibudu (2009), found that prevalence estimates of childhood sexual abuse were directly related to the definition of abuse. Prevalence was 22% when either a graded age differential or coercion was required, 14% when only the former was required and 10% when both were required. Prevalence fell further to 8% when physical contact sexual abuse was included.

Female children are much more likely than their male counterparts to be sexually abused. The 2006 WHO Report on violence against children estimated that in 2002, approximately 150 million girls and 73 million boys were subjected to contact sexual abuse worldwide (Bukola et al, 2021). According to Audu in Onyishi (2022), in a study from Maiduguri, North-East of Nigeria, sexual assault rate of 77.7% was reported among female children, with sexual assault being more likely in girls younger than 12 years. Maduakolam et al. (2023), carried out research on knowledge and experience of sexual violence among female adolescents in Enugu State during the Covid-19 Pandemic and found out the majority of perpetuators were uncles (40.4%) and cousins (28.6%).

Sexual abuse is illegal in all countries about which information is available. The laws may differ in details but, all set an age-typical between the typical onset of puberty and the age of maturity under which all sexual contacts with an adult is termed abusive. Notwithstanding, above this age, sexual contact may be judged abusive depending on the use of violence, coercion or the type of relationship involved. Child sexual abuse is a social problem with adverse consequences to the abused child and the society at large. It can cause infections and sexually-transmitted diseases. Depending on the age, size of the child and the degree of force used, child sexual abuse may cause internal lacerations and bleeding. In severe cases, damage to internal organs may occur, which may cause death in some.

According to Onyekuru (2021), adolescents are people in the period of transition from childhood to adulthood, starting from around 10-12 years old, up to 18-21 years old. He opines that they are people in their adolescent period which can be defined biologically as the physical transition marked by the onset of puberty and the termination of physical growth, cognitively, as changes in the ability to think abstractly and multi-dimensionally or socially, as a period of preparation for adult roles (Obidigbo & Obidigbo in Onyekuru, 2021). Adolescents in secondary schools do not have the same age. Some could be in their early adolescent period while others are in their late adolescent period. They come from different parental backgrounds with different levels of income and status. Hence, the variables of this study are socio-economic status and age.

Socio-economic status can be defined as the grouping of people with similar occupational, educational and economic characteristics (Santrock, 2005). It is also defined as the unequal distribution among members of society of attributes, qualities, possession that are regarded within the society as desirable (Iwuoha, 2000). Socio-economic status carries with it certain inequalities. Generally, members of a society have

1. Occupations that vary in prestige with some individuals having more access than others to higher status occupations,
2. Different levels of educational attainment with some individuals having more access than others to better education,
3. Different economic resources, and
4. Different of powers to influence a community's institutions. These differences in the ability to control resources and to participate in society's rewards produce unequal opportunities for adolescents. (Bornstein & Bradley, 2003)

The number of visible different socio-economic statuses depends on the community's size and complexity. In most investigators' description of socio-economic status two categories low and middle are used although as many as five categories can be delineated. Sometimes low socio-economic status is described as low-income work class or blue collar, for example factory, manual labourer, welfare recipients, maintenance worker. Sometimes the middle category is described as middle income managerial or white collar for example sales person, manager, and Professionals (doctor, lawyer, teacher, accountant etc). Professionals at the pinnacle of their field, high-level corporate executives, political leaders and wealthy individuals are among those in the upper set/category.

The incidence of sexual abuse is very rampant both in told and untold stories. It is a serious problem in many countries across the globe. This can pose harmful effects and hamper adolescent's propensity to learn. Therefore, it is against this background that the researchers conceived the idea to investigate sociological factors of sexual abuse among adolescents in Rivers State, Nigeria with a view of proffering counselling implications.

Research Questions

The following research questions were answered in this study.

1. What is the influence of socio-economic status (low and middle) sexual abuse among secondary school adolescents?
2. How does age (early and late adolescence) influence sexual abuse among secondary school adolescents?

Hypotheses

The following null hypotheses which were tested at 0.05 level of significance, were formulated to guide the study.

1. Secondary school adolescents from low and middle socio-economic status do not differ significantly in their experience of sexual abuse as measured by their mean scores.
2. The interaction effect of socio-economic status on sexual abuse is not significant.
3. Early and late adolescents do not differ significantly in their experience of sexual abuse as measured by their mean scores.
4. The interaction effect of age on sexual abuse is not significant.

Methodology

The research design of this study is ex-post facto design because it involves collecting and analyzing data from variables which are already in place without manipulating any of them in order to find out how some of them relate to the variables under study. The population of the study consists of all the adolescents residing in Rivers State, Nigeria. As at the time of the study, the marginal estimate of the population of adolescents in Rivers State is about 1,587.864. The sample of the study comprised 1,000 adolescents. The study adopted multi-stage sampling procedure firstly, to select 10 Local Government Areas out of the 23 Local Government Areas in Rivers State, Nigeria. The schools in Rivers State were grouped according to their Local Governments Areas where they are located. Using the disproportionate sampling technique, the researchers drew three schools from the 10 Local Government Areas thereby arriving at 30 schools from which the sample was drawn for the study. The instrument for the study is Contact and Non-contact Sexual Abuse Inventory (CNSAI). This is a non-cognitive instrument which was adapted from Finkelhor's Sexual Abuse Scale (SAS) and Odemelam's Students' Sexual Behaviour Inventory (SSBI). The instrument consists of two sections A, B, and C. Section A is designed to elicit demographic data from the students on socio-economic status and age. Section B contains 20 items, which focus on contact dimension of child sexual abuse. Out of these 20 items, 5 items are negatively keyed while 15 items are positively keyed. Section C contains 20 items, which focus on non-contact dimension of child sexual abuse. Out of these 20 items, 5 items are negatively keyed while 15 items are positively keyed. The items of the instrument were responded to on a 5-point likert scale of Always, Often, Sometimes, Rarely and Never weighted 5, 4, 3, 2, 1 respectively for the positively-keyed item and vice versa for the negatively-keyed ones. The instrument was validated by three experts and the reliability established using Cronbach Alpha method. CNSAI had reliability coefficient of 0.71. The instrument was administered and collated. Mean and Standard deviation was used in answering the research questions while 2-way ANOVA was used to test the hypotheses.

Results and Discussion

The results and discussion were made following the research questions.

Research Question 1: What is the influence of socio-economic status (low and middle) on sexual abuse among secondary school adolescents?

This research question was analyzed using mean and standard deviation. The results obtained were presented in Table 1.

Table 1
Mean Score and Standard Deviation of Low and Middle Socio-Economic Status on Sexual Abuse of Secondary School Adolescents

Socio-economic status	**Number**	**Mean**	**Std. D.**
Low	618	64.12	20.13
Middle	382	50.04	15.14

Table 1 shows that adolescents from low socio-economic status of adolescents had a mean score of 64.12 and standard deviation of 20.13 while the adolescents from middle socio-economic status had a mean of 50.04 and standard deviation of 15.14. the mean of adolescents from low socio-economic status is higher than that of their counterpart from middle socio-economic status. This indicates that adolescents from low socio-economic status are more prone to sexual abuse compared to those from middle socio-economic status home. This finding is in agreement with the study carried out by Bolen (2001) which established that children and adolescents from low socio-economic background are at a high risk of experiencing sexual abuse. This result was anticipated since poor parents who are facing hardship may not be able to carter for their children's needs. Those children may be vulnerable to sexual abuse perpetrators who may want to provide for their material needs.

Research Question 2: How does age (early and late adolescence) influence sexual abuse among secondary school adolescents?

This research question was analyzed using mean and standard deviation. The results obtained were presented in Table 2.

Table 2
Mean Score and Standard Deviation of Early and Late Adolescence on Sexual Abuse

Age	**Number**	**Mean**	**Std. D.**
Early Adolescence	308	60.68	17.603
Late Adolescence	692	51.70	20.053

Table 2 shows that the respective mean score and standard deviation for early adolescence were 60.68 and 17.60 while that of late adolescence were 51.70 and 20.05. These mean values indicate that the early adolescence had a higher mean score than the late adolescence. This finding corroborates the findings of Bolen (1998) which stated that risk of sexual abuse for Caucasians increase almost yearly over time with slight increase during pre-adolescence and early adolescence. This research finding is not surprising to the researchers because adolescents within the early period of adolescence normally experience identity problems. They are also faced with a lot of decisions to take on relationship. Some of them would expect to be treated as adults and thus could predispose them to sexual abuse.

Hypothesis 1: Secondary school adolescents from low and middle socio-economic status do not differ significantly in their experience of sexual abuse as measured by their mean scores.

These null hypotheses were analyzed and tested using 2-way ANOVA. The result obtained were summarized in Table 3.

Table 3
Summary of 2-Way Anova on the Influence of Socio-Economic Status on Sexual Abuse Among Secondary School Adolescents.

Sources of Variation	Sum of Sq.	Df.	Mean Sq.	Cal. F	Crit. F	Result
Main effects	60218.232	2	30109.116	97.696	3.00	Significant
A	57852.788	1	57852.788	7.717	3.85	Significant
B	12023.958	1	12023.958	9.014	3.85	Significant
Interaction Effect A*B	4035.683	1	4035.683	4.095	3.85	Significant
Explained	64253.915	3	21417.971	69.496	2.61	Significant
Residual	306958.689	996	308.191			
Total	371212.604	999	371.584			

Table 3 showed that the calculated F-value for socio-economic status (A) 7.72 is greater than the corresponding critical F-value of 3.85 at 1 and 996 degrees of freedom at 0.05 level of significance. The null hypothesis is rejected. There is therefore significant influence of socio-economic status on sexual abuse among secondary school adolescents. Table 3 also showed that the calculated F-value for sexual abuse (B) 9.01 is greater than the corresponding critical F-value of 3.85 at 1 and 996 degrees of freedom at 0.05 level of significance. This indicated that there is significant influence of sexual abuse among secondary school adolescents. Furthermore, the table showed that the calculated F-value for interaction effect of socio-economic status and sexual abuse 4.10 is greater than the corresponding F-value of 3.85 at degrees of freedom of 1 and 996 at 0.05 level of significance. Hence, there is significant interaction effect.

Hypothesis 3: Early and late adolescents do not differ significantly in their experience of sexual abuse as measured by their mean scores.

The null hypotheses were analyzed and tested using 2-way ANOVA. The result obtained were summarized in Table 4.

Table 4
Summary of 2-Way Anova on the Influence of Age on Contact and Non-contact Forms of Sexual Abuse Among Secondary School Adolescents.

Sources of Variation	Sum of Sq.	Df.	Mean Sq.	Cal. F	Crit. F	Result
Main effects	3756.227	2	1778.113	5.091	3.00	Significant
Age (A)	1391.783	1	1290.783	6.210	3.85	Significant
Sexual Abuse (B)	2262.444	1	2265.958	3.982	3.85	Significant
Interaction Effect A*B	4035.683	1	46.177	3.930	3.85	Significant
Explained	3808.404	3	1257.462	23.143	2.61	Significant
Residual	367410.200	996	358.886			
Total	371212.604	999	371.584			

A critical look at Table 4 showed that the calculated F-value for age (A) 6.21 is greater than the corresponding critical F-value of 3.85 at 1 and 996 degrees of freedom at 0.05 level of significance. The null hypothesis is rejected. There is therefore significant influence of age on contact/ non-contact sexual abuse among secondary school adolescents. Table 4 also showed that the calculated F-value for contact and non-contact (B) 9.01 is greater than the corresponding critical F-value of 3.98 is greater than the corresponding critical F value of 3.85 at 1 and 996 degrees of freedom at 0.05 level of significance. This indicated that there is significant influence of contact and non-contact dimension of sexual abuse among secondary school adolescents.

Again, the table showed that there is interaction effect of age on contact/non-contact sexual abuse among adolescents. This is because the calculated F-value of 3.85 is greater than the corresponding F-value of 3.85 at degrees of freedom of 1 and 996 at 0.05 level of significance. Hence, there is significant interaction effect.

Child sexual abuse is a public health and human rights issue that should be given adequate attention. The myriad of effects on the child should necessitate concerns of the international community to this silent emergency. There should be awareness campaigns, advocacy and heightened education. The Child's Right Act should be domesticated and upheld.

Conclusion

Implications for Counselling

The findings of this research has shown that adolescents of all ages and from low and medium socio-economic status are predisposed to sexual abuse. Hence, the counselling implications are:

1. Sexual abuse victims could manifest myriad of behavioural problems. Hence, counsellors should probe more to find out if sexual abuse could be the causal factor for some undesirable behaviours.
2. They should be more supportive, nonjudgmental and establish a safe environment that fosters trust. They can initiate sexual abuse awareness campaigns as a prophylactic intervention.
3. Counsellors can organize seminars and workshops to enlighten adolescents.
4. Counsellors can collaborate with multidisciplinary teams like parents, teachers, healthcare providers to ensure co-ordinated and holistic care. During Parents Teachers Association meetings, counsellors could use that medium to enlighten parents on the prevalence of this social malady.

Recommendations

The following are recommended.

1. The government should establish workable poverty alleviation programmes that would assist parents to make reasonable income to cater for their children.
2. They should make provision for stipends to indigent adolescents to assist them in taking care of their personal needs.
3. Counselling is needed to assist victims of sexual abuse and so establishment of counselling centres should be made compulsory at all educational levels.

4. Parents and guardians should start early to talk to their children about the menace of sexual abuse. They should learn training strategies that would enable them monitor their adolescents properly.
5. The government should expedite any sexual abuse case so that the offenders can be subjected to the full weight of the law without much delay.

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AI-Enabled Industry-Collaborative Assessment (AI-ICAM): Advancing Pedagogy and University–Industry Collaboration

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Abstract

This paper presents the AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM), developed to integrate artificial intelligence into higher education assessment through authentic, industry-aligned tasks. Drawing on three case studies, the research examines how AI can enhance assessment design, delivery, and outcomes in partnership with industry stakeholders. The first case, an undergraduate sustainability and digital marketing module, demonstrated how students leveraged AI for creative campaign assets, improving alignment with client sustainability goals. The second case, a multidisciplinary "Biz-a-thon" innovation sprint with a financial technology partner, showed how AI-supported rapid prototyping improved time efficiency, presentation quality, and professional polish under time constraints. The third case, a curated podcast series with industry leaders, revealed that even indirect AI exposure through expert discourse could stimulate student engagement with emerging tools and trends. Cross-case analysis identified common benefits of AI integration, including enhanced creativity, efficiency, and professionalism, alongside variations in impact depending on whether AI use was direct or indirect. The findings highlight the importance of strategic alignment between AI capabilities, assessment objectives, and industry needs, underpinned by a culture of trust, ethical practice, and openness to innovation. The paper concludes with practical recommendations for refining AI-ICAM and advancing university–industry collaboration in assessment.

Keywords: artificial intelligence, higher education, assessment innovation, industry collaboration, sustainability education

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Introduction

Assessment in higher education is undergoing significant change, yet many traditional approaches remain slow, rigid, and misaligned with professional demands. Brown (2022) noted that assessment methods have not kept pace with pedagogical advances, limiting responsiveness and flexibility. Examinations and fixed assignments tend to promote surface learning and reduce opportunities for authentic, applied learning tasks (Parmigiani et al., 2024). High-stakes summative exams have been shown to increase stress and may undermine real-world skill development (French et al., 2024). A lack of workplace-related, practical assessments contributes to a persistent graduate skills gap (Meylani, 2024; Whittaker, 2016). Embedding industry feedback and perspectives into assessment design has been found to strengthen alignment between academic learning and employability needs (Jackson et al., 2023; Richardson & Henschke, 2010).

In response to these challenges, universities are under increasing pressure to align assessment practices with professional competencies and the United Nations Sustainable Development Goals (SDGs). Artificial intelligence (AI) is emerging as a powerful enabler of personalised, adaptive, and real-time evaluation across disciplines. AI systems have been shown to tailor learning content and feedback to individual student needs, improving engagement and outcomes (Luo et al., 2025; Merino-Campos, 2025; Zhao, 2024). Adaptive learning systems are proving effective across fields including information technology, natural sciences, humanities, and agriculture (Li et al., 2024). AI-driven natural language processing tools now deliver immediate, nuanced, and scalable feedback, addressing the limitations of traditional grading (Gao et al., 2024; Kochmar et al., 2020). Frameworks such as Synthetic Educational Feedback Loops (SEFL) and related AI-enhanced systems have demonstrated high-quality, rapid assessment capabilities in varied learning contexts (Darvishi et al., 2024; Kovari, 2025).

Generative AI has also shown potential to improve both cognitive and emotional aspects of learning by providing supportive, personalised feedback that reduces negative affective responses (Alsaiari et al., 2025; Crompton & Burke, 2023). In writing and translation contexts, AI feedback has been shown to be reliable and effective, particularly when combined with human input (Luo et al., 2025). AI-enhanced collaborative learning environments have been linked to improved student performance, deeper engagement, and more effective peer interactions (Bond et al., 2024; Khong & Tanner, 2024).

This paper proposes the AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM), which integrates AI-driven assessment with meaningful industry collaboration. Grounded in Constructive Alignment Theory and developed using a Design Science approach, the model aims to be scalable, ethical, and adaptable across disciplines.

Given the limitations of traditional assessment, the evolving capabilities of AI, and the increasing imperative for meaningful university–industry partnerships, this study is guided by the following research question:

How can AI be leveraged to design an assessment model in higher education that supports inclusive, adaptive pedagogy while fostering effective collaboration between universities and industry?

Aligning Assessment With Global and Professional Goals: Strategic Imperatives

The design of contemporary assessment models must begin with clarity about the learning outcomes they seek to achieve. Increasingly, these outcomes extend beyond disciplinary knowledge to encompass global competencies, sustainable development priorities, and workplace readiness. The United Nations Sustainable Development Goals (SDGs) provide a globally recognised framework for embedding sustainability principles into curricula, ensuring graduates are prepared to address complex societal and environmental challenges (Leal Filho et al., 2019). Embedding SDG-oriented learning outcomes in assessment has been shown to foster systems thinking, ethical reasoning, and the capacity for responsible innovation (Findler et al., 2019).

The call for responsible leadership competencies in higher education has gained momentum, with scholars emphasising skills such as ethical decision-making, stakeholder engagement, and sustainability literacy (Pless et al., 2012). Such competencies are increasingly prioritised by accreditation bodies and employers, who view them as essential for navigating interconnected global systems (Laasch et al., 2023; Pless & Maak, 2011). Research in management education confirms that embedding responsible leadership within assessment design supports ethical practice and contributes to long-term value creation in both public and private sectors (Maak et al., 2016).

Employer expectations are shifting towards graduates who can demonstrate transferable skills, adaptability, and cross-disciplinary collaboration (Jackson, 2016). This aligns with findings from employability research that link workplace success to problem-solving, digital literacy, and the ability to operate in diverse teams (Clarke, 2018). Studies show that structured career development learning embedded into curricula has a significant positive effect on students' perceived employability over time (Ho et al., 2023). Likewise, employability frameworks are evolving to emphasise 21st-century competencies such as adaptability, collaboration, and innovation, which can be directly supported by aligned assessment models (Eimer & Bohndick, 2023; Zainudden et al., 2022). This evolution strengthens the case for assessments that explicitly measure skills transferable across sectors and geographies (Tight, 2023). Accrediting agencies are responding to these demands by integrating industry-relevant competencies into their standards, which encourages assessment models that evaluate both technical and interpersonal capabilities (Coates et al., 2016).

Regulatory frameworks further reinforce the alignment of academic outcomes with professional standards, enhancing accountability and public trust. Evidence shows that transparent links between learning outcomes, industry needs, and assessment criteria strengthen graduate readiness and foster productive university–industry relationships (Oliver, 2015). These expectations extend beyond sector-specific qualifications to encompass societal contributions, with sustainability and employability increasingly recognised as quality benchmarks in higher education (Janssens et al., 2022). In this context, embedding employability into assessment is not only about job readiness but also about preparing graduates to adapt and thrive amid rapidly shifting labour market demands (Ho et al., 2023; Tight, 2023).

Taken together, these perspectives make clear that aligning assessment with global and professional goals is not merely an academic exercise but a strategic imperative. By grounding assessment in sustainability priorities, leadership competencies, and employer

needs, universities can deliver graduates who are equipped to navigate complex challenges and contribute meaningfully to both their professions and society at large.

Building on these strategic imperatives, the next section outlines the pedagogical mechanisms of constructive alignment and co-creation that operationalise these goals in assessment.

Constructive Alignment and Knowledge Co-creation: Pedagogical Implementation

Constructive alignment, introduced by Biggs and Tang (2011), remains one of the most influential principles in assessment design. It advocates for a deliberate connection between intended learning outcomes, teaching activities, and assessment tasks so that all components work together to promote the desired competencies. This alignment transforms assessment from a final measurement into an integral part of the learning process, guiding students toward clearly articulated objectives and encouraging self-regulated learning (Boud & Molloy, 2013).

Within university–industry partnerships, constructive alignment becomes a vehicle for operationalising global and professional priorities in practical, discipline-specific contexts. Industry collaboration ensures that assessment criteria reflect current workplace practices, technologies, and problem-solving requirements (Perkmann et al., 2013). In such arrangements, students engage with authentic, applied challenges such as live client projects or industry-led simulations that mirror professional environments and test both technical and transferable skills (Jackson, 2016). When these partnerships are sustained over time, evidence suggests they contribute not only to immediate skill acquisition but also to improved graduate employability and long-term career outcomes (Ho et al., 2023; Huang, 2025).

Knowledge co-creation extends this alignment beyond curricular content to the design and delivery of assessment itself. Industry experts contribute applied insights and emerging trends, while academic staff ensure disciplinary depth, critical thinking, and methodological rigour (Ankrah & AL-Tabbaa, 2015). Co-created tasks, such as consultancy briefs, prototypes, or policy proposals, demand that students integrate theoretical understanding with practical execution, fostering innovation and adaptability (Bovill, 2020). Such collaboration often drives curriculum innovation, as insights from real-world contexts inform the continual updating of teaching content and assessment formats (Eimer & Bohndick, 2023).

Embedding co-creation in assessment design also supports diversity and inclusivity. By involving stakeholders from different sectors and communities, assessments can incorporate varied cultural perspectives, making them more equitable and reflective of global work contexts (Healey et al., 2014; Morris et al., 2021). This inclusivity promotes graduate preparedness for cross-cultural collaboration and strengthens the university's societal role (Robinson et al., 2020). Additionally, when industry and academia jointly shape assessments, they create an environment of mutual trust and sustained collaboration, with long-term benefits for both curriculum relevance and institutional networks (Huang, 2025).

Constructive alignment coupled with co-creation helps institutions demonstrate the measurable impact of their graduates' capabilities to accrediting bodies and employers. Universities that successfully integrate academic rigour with industry relevance not only enhance their reputation but also create a sustainable feedback loop between education and professional practice (Oliver, 2015). In this way, constructive alignment becomes both a pedagogical strategy and a bridge between higher education and the evolving demands of the

labour market, strengthening both employability outcomes and the adaptability of higher education systems (Eimer & Bohndick, 2023).

Embedding co-creation in assessment design also supports diversity, inclusivity, and cultural responsiveness. It recognises that institutional culture and industry norms shape how competencies are valued and assessed, requiring higher education to bridge academic and professional cultural expectations (Healey et al., 2014; Hofstede et al., 2010).

Taken together, these mechanisms motivate the integration of AI to deliver timely feedback and authentic performance evidence at scale, which the subsequent section synthesises.

Artificial Intelligence in Assessment: Innovation, Ethics, and Organisational Culture

A synthesis is developed by examining how AI extends aligned, co-created assessments via adaptive feedback and analytics, with ethical safeguards maintained. Recent advancements in artificial intelligence are transforming higher education assessment by offering immediate, adaptive, and highly personalized feedback. The design of contemporary assessment models must begin with clarity about the learning outcomes they seek to achieve. AI-powered systems using natural language processing and predictive analytics have demonstrated their effectiveness in delivering tailored feedback that supports diverse learning needs across multiple disciplines (Luo et al., 2025; Merino-Campos, 2025).

These tools have been applied successfully in fields such as medical education, where AI aids in simulating clinical scenarios and offering instant guidance; in engineering, where student agency is fostered through interactive adaptive systems; and in the humanities, where machine-mediated feedback promotes deeper reflection and engagement (Darvishi et al., 2024; Gao et al., 2024; Khong & Tanner, 2024). The shift from static assessment models to AI-augmented feedback loops enhances student learning outcomes and increases engagement, with systematic reviews highlighting substantial gains in motivation, metacognitive skills, and emotional support (Bond et al., 2024; Crompton & Burke, 2023; Weidlich, 2025).

Beyond student benefits, AI-enabled feedback loops create reciprocal value for educators and industry stakeholders. For educators, AI analytics provide granular insights into learning trajectories, enabling data-driven adjustments to curriculum and teaching strategies in real time (Zawacki-Richter et al., 2019). For industry partners, aggregated performance data, when ethically managed, offers valuable intelligence on graduate skill readiness, aligning recruitment and training initiatives with evolving workplace demands (Ferreira-Meyers, 2025). These feedback cycles strengthen the partnership between higher education and industry, ensuring curricula remain relevant while fostering sustained collaboration.

Ethical AI integration is essential to realising these benefits without compromising trust. Studies underscore the need for transparent algorithmic design, mitigation of bias, and clear communication of AI's role in assessment (Holmes et al., 2023; Webb et al., 2023). Responsible governance frameworks recommend stakeholder co-design of AI tools, regular audits of algorithmic fairness, and the inclusion of ethical AI literacy within faculty and student development programmes (Nazaretsky et al., 2025). Such measures ensure that AI adoption aligns with both institutional values and regulatory requirements, particularly around data privacy and equitable learning opportunities.

Emerging frameworks offer practical roadmaps for embedding AI into assessment design, emphasising transparency, accountability, and ethical governance—key considerations for scalable implementation (Bulut et al., 2024; Ilieva, 2025; Sajja et al., 2024). Empirical research shows that AI-generated adaptive feedback improves performance and interest in technical subjects, especially compared to traditional static feedback approaches (Bauer et al., 2025). Broader investigations demonstrate how combining AI and learning analytics supports data-driven pedagogical decisions and personalised interventions (Banihashem et al., 2022; Caspari-Sadeghi, 2022; Sajja et al., 2024).

The successful adoption of AI-enabled assessment requires not only robust technical infrastructure but also a supportive organisational culture that fosters trust, openness to innovation, and shared ethical commitments across academic and industry stakeholders (Holmes et al., 2023; Zawacki-Richter et al., 2019). Cultural readiness has been identified as a critical enabler in the diffusion of educational technologies, influencing not only the willingness of educators and students to engage with AI-driven tools but also the depth and sustainability of their integration (Kirkwood & Price, 2014; Teräs, 2022). In higher education, cultures that embrace experimentation, interdisciplinary collaboration, and reflective practice are more likely to leverage AI in ways that enhance learning outcomes while maintaining academic integrity (Nazaretsky et al., 2025; Webb et al., 2023). From an industry partnership perspective, a culture of co-creation and mutual respect ensures that AI-enabled assessment innovations remain aligned with real-world professional demands and ethical standards (Ankrah & AL-Tabbaa, 2015; Perkmann et al., 2013). This alignment extends to embedding shared values around data privacy, fairness, and transparency, which are increasingly seen as prerequisites for stakeholder buy-in and long-term collaboration (Fu & Weng, 2024; Holmes et al., 2023; Sajja et al., 2024). Without these cultural foundations, even the most advanced AI systems risk underutilisation or rejection, underscoring the need for institutions to invest as much in cultivating adaptive, ethically grounded cultures as in acquiring technological capabilities.

Altogether, the literature underscores AI's potential to address longstanding limitations of traditional assessment. When implemented ethically, it enables tailored, scalable feedback, supporting student autonomy and engagement while delivering actionable insights for educators and industry. Realising this potential depends on cultivating an organisational culture that values trust, openness to innovation, and shared ethical responsibility among academic and industry partners. This foundation strengthens the alignment between innovative inputs and effective assessment outcomes, positioning AI as both a pedagogical tool and a strategic driver of higher education–industry synergy.

Methods

Research Design

This study adopts a Design Science Research (DSR) approach to develop and validate the AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM). DSR is particularly suited for creating and evaluating artefacts that solve identified problems within a practical context (Hevner et al., 2004). In line with DSR principles, the research process followed an iterative cycle of problem identification, artefact development, evaluation, and refinement.

The design process was grounded in Constructive Alignment Theory (Biggs & Tang, 2011), principles of knowledge co-creation between higher education and industry (Ankrah & AL-

Tabbaa, 2015; Perkmann et al., 2013), and frameworks for ethical AI integration in education (Holmes et al., 2023; Webb et al., 2023). The model was also informed by the literature on employability and sustainable development in higher education (Ho et al., 2023; Leal Filho et al., 2019).

Table 1 summarises the AI-ICAM's core components, their theoretical foundations, practical objectives, and supporting literature. This mapping establishes conceptual clarity and links the model directly to peer-reviewed evidence.

Table 1

Alignment of AI-ICAM Components With Research Foundations and Practical Objectives

Framework Component	Theoretical Foundation	Practical Objective	Supporting Literature
Constructive Alignment	Biggs and Tang's (2011) alignment theory; Boud & Molloy (2013) on assessment as learning	Ensure coherent link between learning outcomes, teaching, and assessment to promote deep learning	Biggs and Tang (2011); Boud and Molloy (2013); Perkmann et al. (2013)
Industry Co-Creation	Stakeholder theory in higher education–industry collaboration (Ankrah & AL-Tabbaa, 2015)	Integrate authentic, workplace-relevant tasks into assessment	Ho et al. (2023); Huang (2025); Jackson (2016)
Ethical AI Integration	Responsible AI frameworks (Holmes et al., 2023; Webb et al., 2023)	Maintain transparency, fairness, and accountability in AI-enabled assessment	Nazaretsky et al. (2025); Zawacki-Richter et al. (2019)
AI-Driven Feedback Loops	Feedback literacy and SEFL model (Crompton & Burke, 2023; Kovari, 2025)	Provide real-time, personalised feedback that benefits both students and educators	Darvishi et al. (2024); Gao et al. (2024); Luo et al. (2025)
SDG Alignment	Education for Sustainable Development (Findler et al., 2019; Leal Filho et al., 2019)	Equip graduates with sustainability competencies and global problem-solving skills	Eimer and Bohndick, (2023); Pless et al. (2012); Zainudden et al. (2022)

Methodological Steps

Following DSR guidelines, the development of the AI-ICAM proceeded through six interconnected phases:

1. **Problem Identification**. A systematic literature review and stakeholder needs analysis identified persistent gaps in higher education assessment, including misalignment with professional demands, limited use of authentic assessment tasks, and underutilisation of AI in feedback provision (Brown, 2022; Parmigiani et al., 2024; Whittaker, 2016).
2. **Objective Definition**. Drawing on sustainability and employability frameworks (Ho et al., 2023; Leal Filho et al., 2019), the objectives were defined as:
    (a) align assessment with global and professional competencies;
    (b) integrate industry collaboration into assessment design; and
    (c) implement ethical, AI-enabled adaptive feedback systems.
3. **Framework Design**. Using constructive alignment as the organising principle, assessment tasks, learning activities, and outcomes were mapped to industry-validated competencies, SDGs, and ethical AI standards.

4. **Integration of AI Tools**. AI applications were selected for their capacity to provide real-time, personalised feedback, facilitate learning analytics, and scale to large cohorts. This selection was guided by current empirical findings on AI in higher education assessment (Bulut et al., 2024; Luo et al., 2025).
5. **Validation with Stakeholders**. The model was piloted through three case studies in the School of Business. These case studies provided evidence on the AI-ICAM's practical applicability, highlighting curriculum innovation, improvements in feedback quality, and enhanced graduate employability outcomes.
6. **Evaluation and Refinement**. Data from the case studies (student performance analytics, industry partner feedback on graduate skills, and curriculum documentation) informed iterative refinements to the model.

Table 2 outlines these methodological steps, detailing the description, key activities, outputs, and supporting literature for each phase.

Table 2
Methodological Steps for Developing the AI-ICAM Framework Using a Design Science Approach

Phase	Purpose	Key Activities	Outputs
1. Problem Identification	Identify persistent challenges in higher education assessment	Systematic literature review; stakeholder needs analysis from policy documents and institutional reports	Evidence base highlighting misalignment with professional demands, lack of authentic tasks, limited AI use
2. Objective Definition	Establish strategic and pedagogical aims for AI-ICAM	Map goals to sustainability, employability, and industry collaboration frameworks	Defined objectives for alignment with competencies, integration of industry, and ethical AI feedback
3. Framework Design	Develop structure for AI-ICAM grounded in theory	Apply constructive alignment principles to link learning outcomes, activities, and assessments	Drafted model with mapped competencies to SDGs, industry standards, and ethical AI principles
4. Integration of AI Tools	Select and embed AI capabilities	Evaluate AI tools for feedback speed, adaptivity, scalability, and ethical compliance	Integrated AI applications providing real-time personalised feedback and learning analytics
5. Validation via Case Studies	Test AI-ICAM in authentic educational contexts	Implement three case studies within the School of Business, each involving collaboration with different industry partners.	Evidence of curriculum innovation, enhanced feedback, improved graduate employability
6. Evaluation and Refinement	Assess effectiveness and refine model	Analyse case study results; align outcomes with objectives; update model components	Revised AI-ICAM with enhanced alignment, industry relevance, and ethical safeguards

Data Sources and Stakeholders

To support a robust, multi-perspective validation of the AI-ICAM model, data were drawn from three principal stakeholder groups. Academic staff provided evaluative reflections on pedagogical alignment, constructive alignment with intended learning outcomes, and the feasibility of integrating AI-enabled assessment within existing curricula. Industry partners

contributed feedback on professional relevance, graduate employability, and the authenticity of assessment tasks, with insights drawn from documented site visit reports and existing consultation summaries. Student perspectives were captured through course evaluation data and reflective submissions, focusing on their experiences of feedback quality, inclusivity, and engagement with the AI-supported assessment processes.

Ethical Considerations

This study did not involve the collection of new human participant data; all evidence was derived from secondary institutional sources. As this study relied exclusively on secondary data, case study documentation, and reflective accounts from participating stakeholders, no primary data involving identifiable personal information were collected. All stakeholder feedback, including insights from industry site visits and academic reflections, was drawn from pre-existing institutional records and anonymised course evaluations in compliance with university data governance policies. The analysis adhered to the ethical principles of transparency, confidentiality, and responsible use of stakeholder contributions. Where industry partner perspectives were incorporated, care was taken to avoid disclosure of proprietary or commercially sensitive information. The integration of AI tools into the assessment model was guided by responsible AI frameworks to ensure transparency, fairness, and the minimisation of bias, aligning with established ethical standards in educational research.

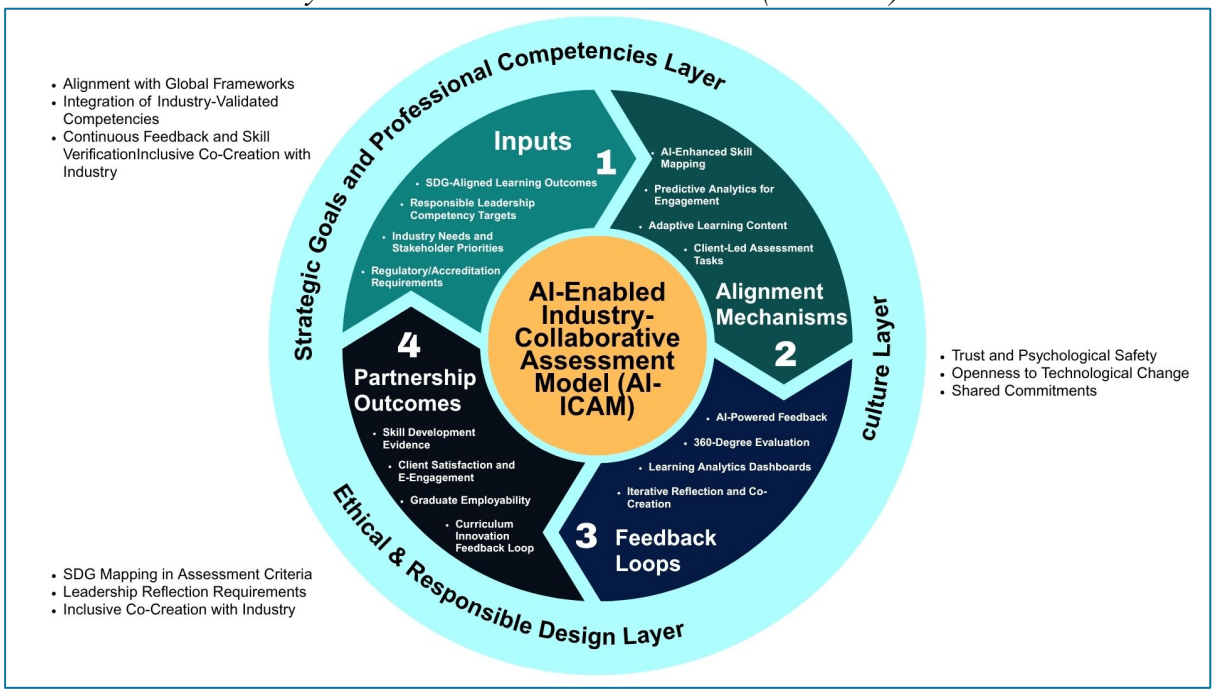
The AI-ICAM Model

Figure 1 shows the AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM), developed through a six-phase Design Science Research process. The model combines four elements: constructive alignment, industry co-creation, ethical AI integration, and AI-driven feedback loops within a culture of innovation. This structure links global and professional competency goals, including the United Nations Sustainable Development Goals, with authentic, industry-informed assessment.

Inputs include SDG-aligned learning outcomes, responsible leadership competencies, and industry priorities. These inform Alignment Mechanisms such as AI-enhanced skill mapping, adaptive content, and predictive analytics. Feedback Loops, powered by AI analytics and stakeholder evaluation, drive continuous refinement. Partnership Outcomes such as curriculum innovation, graduate employability, and evidence of skill development maintain relevance for academia and industry.

Grounded in a culture of trust, openness, and ethical responsibility, AI-ICAM ensures transparent, fair, and context-responsive AI integration. It provides a scalable, adaptable framework for transforming assessment into a collaborative process bridging higher education and the future workplace.

Figure 1
The AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM)



Results

Guided by AI-ICAM (Figure 1), the following cases illustrate how collaboration with industry partners and AI-supported feedback altered assessment design, delivery, and evidencing of outcomes.

Case Study 1: Sustainability and Digital Marketing in Practice Module (Live Client: IGS)

This case study applied the AI-ICAM framework within a undergraduate digital marketing module in collaboration with Intelligent Growth Solutions (IGS), a sustainable agriculture technology company. Assessment centred on a live client consultancy report, requiring students to design sustainability-focused digital marketing strategies aligned with the UN Sustainable Development Goals (SDGs).

Students were encouraged to incorporate AI tools into their creative process, including generating mock-up visuals for campaigns and experimenting with AI-generated music to test potential emotional and branding effects. These AI applications supported the development of more engaging and innovative client deliverables. Industry partner feedback highlighted the originality of student outputs and the alignment with IGS's sustainability messaging.

The organisational culture at IGS, rooted in sustainability-driven innovation, directly influenced students' approach to campaign development. This cultural emphasis encouraged solutions that went beyond conventional marketing tactics to incorporate ecological values and long-term social impact.

The live consultancy assessment retained its summative brief but introduced two AI-supported formative checkpoints: (1) early concept scoping with AI-generated mock-ups and tutor feedback, and (2) mid-cycle alignment to SDG targets using an AI-assisted checklist.

This shifted time on task from final-week polishing to earlier iteration, improved coherence with sustainability criteria in the rubric, and produced client-ready assets that evidenced alignment.

While AI was not yet used for data analytics or campaign simulation in this iteration, academic staff identified this as a valuable opportunity for future development. The proposed next step involves integrating AI-driven analytics for formative testing of campaign concepts, enabling a more evidence-based iteration process prior to final client delivery.

Case Study 2: Biz-a-thon Event With NCR Atleos

The Biz-a-thon, an intensive innovation sprint, was co-designed with NCR Atleos to replicate real-world product development and sustainability challenges in the financial technology sector. Multidisciplinary student teams proposed sustainable digital solutions for self-service banking, aligning with NCR Atleos' corporate strategy and the UN Sustainable Development Goals (SDGs), directly reflecting the SDG alignment and industry co-creation components of AI-ICAM.

In preparatory workshops and during the event, students were introduced to AI tools and example prompts to support rapid ideation and creative output. Many teams used AI to generate campaign visuals, promotional mock-ups, and short-form videos, applying the AI-driven feedback loop principle by iterating concepts quickly and enhancing the persuasiveness of final presentations. This rapid prototyping enabled more time for problem analysis, solution refinement, and integration of sustainability considerations, strengthening the constructive alignment between assessment criteria and deliverables.

Industry evaluators praised the creativity and polish of outputs, noting that AI-assisted production elevated presentation standards under tight time constraints. While AI was not yet applied for advanced functions such as feasibility analysis or impact modelling, its role in supporting communication design, collaborative workflows, and professional delivery was clear.

The sprint combined a timed presentation with an evidence pack, using AI for prototyping and storyboard generation to externalise ideas early and apply rubric indicators on feasibility and sustainability during iteration. This improved clarity and made feedback traceable to criteria rather than subjective impressions.

The Biz-a-thon reflected NCR Atleos' fast-paced, collaborative culture, rewarding agility, creativity, and calculated risk-taking. Planned future iterations will embed AI more deeply into assessment, incorporating real-time feasibility evaluation, sustainability impact modelling, and adaptive feedback to fully operationalise the feedback loop and ethical AI integration elements of AI-ICAM.

Case Study 3: Conversations With Industry Leaders Podcast Integration

As part of the Search Marketing and Sustainability and Digital Marketing in Practice modules, the Conversations with Industry Leaders podcast was created and embedded as formative learning resources. The curated episodes featured in-depth discussions with recognised experts, including a leading search marketing strategist and senior executives from NCR

Atleos, on the transformative impact of artificial intelligence in digital marketing, sustainability innovation, and corporate responsibility.

This activity aligned with AI-ICAM's industry co-creation and ethical AI integration elements by providing authentic, current perspectives that directly supported learning outcomes on emerging technologies, ethical leadership, and sustainable business practice. The flexible, accessible podcast format promoted inclusive learning and extended student engagement with real-world expertise beyond the classroom, encouraging varied learning styles.

Engagement metrics and informal student feedback showed increased interest in industry trends and greater application of professional insights in coursework. Staff observed these discussions enhanced students' strategic thinking in AI-assisted tasks, such as audience targeting, sustainability messaging, and campaign optimisation, linking to the model's feedback loop principle by influencing decision-making in related assessments.

The episodes also exposed students to varied organisational cultures in digital adoption, sustainability integration, and AI ethics. This reinforced AI-ICAM's emphasis on cultural context as a driver of effective assessment innovation, showing how organisational values shape the implementation of emerging technologies and sustainability strategies.

While AI tools were not directly embedded into the podcast activity, this case demonstrates how industry-embedded multimedia content can indirectly strengthen AI literacy and integration across projects. Future iterations could incorporate targeted AI tools for reflective analysis, enabling students to draw stronger connections between expert insights and their own project work, further operationalising AI-ICAM's feedback and alignment mechanisms.

Cross-Case Analysis

Across all three cases, the integration of AI within the AI-ICAM framework consistently enhanced creativity, time-efficiency, and the professional quality of student outputs. In Case Studies 1 and 2, AI was applied directly to content creation, enabling rapid production of high-quality visuals, multimedia assets, and presentation materials that elevated client deliverables and industry pitches. In contrast, Case Study 3 employed indirect integration, where exposure to industry-led discussions on AI and sustainability informed students' strategic thinking and shaped application of AI tools in assessments. Variations in AI use highlight differing levels of technological maturity within assessment contexts—from creative augmentation in design-focused tasks to strategic influence in knowledge application activities. Collectively, these findings indicate that deeper, more systematic embedding of AI within formative and summative assessment processes could strengthen the adaptive feedback loops central to the AI-ICAM model, particularly through real-time feasibility testing, sustainability impact modelling, and expanded ethical AI literacy.

A synthesis of results across the three case studies is presented in Table 3, highlighting common themes, variations in AI integration, and implications for further refinement of the AI-ICAM framework.

Table 3
Summary of Case Study Findings and AI-ICAM Implications

Case Study	Context & Stakeholders	AI Integration Type	Key Outcomes	Implications for AI-ICAM Refinement	Cultural & Strategic Considerations
Sustainability and Digital Marketing in Practice (IGS)	Postgraduate digital marketing module; live client consultancy with sustainable agriculture technology company	**Direct:** AI used for creative outputs (mock-up visuals, AI-generated music)	Enhanced creativity and originality; stronger alignment with client sustainability messaging	Integrate AI-driven analytics for formative campaign testing to support evidence-based iteration	Demonstrated openness from industry partner to student-led innovation; fostered cross-disciplinary dialogue on sustainability culture
Biz-a-thon with NCR Atleos	Multidisciplinary innovation sprint with financial technology industry partner	**Direct:** AI for rapid production of visuals, videos, and slide design in time-limited environment	Increased time-efficiency; improved presentation polish; industry recognition of professional quality	Extend AI use to real-time feasibility testing, sustainability impact modelling, and adaptive feedback	Culture of high-paced collaboration and innovation readiness facilitated rapid adoption of AI tools
Conversations with Industry Leaders Podcast	Search Marketing and Digital Strategy modules; curated industry expert episodes on AI and sustainability	**Indirect:** Industry insights informed student strategic thinking and application of AI in other tasks	Increased engagement with emerging trends; improved integration of professional perspectives in coursework	Develop structured reflective tasks linking industry insights to explicit AI use in assessments	Supported creation of a learning culture valuing continuous professional engagement and cross-sector knowledge sharing

Discussion

Interpretation of Key Findings

The study specifies three assessment levers through which AI-enabled industry collaboration operates: design (earlier, rubric-aligned iteration with authentic constraints), delivery (timely, AI-assisted formative checkpoints that rebalance time on task), and evidence (traceable artefacts and feedback linking explicitly to professional standards and SDG targets). Articulating these levers clarifies not only that collaboration matters but how it reconfigures assessment practice.

The findings from the three case studies collectively demonstrate that the AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM) is capable of enhancing the quality, relevance, and inclusivity of assessment in higher education. Across contexts, AI contributed to creativity, time-efficiency, and professional output quality, validating its role as both a pedagogical and strategic enabler. Direct AI integration, as seen in the Sustainability and

Digital Marketing module (Case Study 1) and the Biz-a-thon event (Case Study 2), enabled students to rapidly prototype communication assets, refine presentation materials, and explore novel creative strategies. In contrast, the Conversations with Industry Leaders podcast (Case Study 3) illustrated that even indirect AI exposure, when mediated through authentic industry discourse, can influence student thinking and stimulate adoption of AI tools in other projects.

These variations underscore a central premise of AI-ICAM: the value of AI in assessment is not confined to direct application during task completion but extends to shaping students' strategic thinking, digital literacy, and adaptability. A critical enabling factor across all three cases was the shared culture of innovation fostered between academic staff, students, and industry partners. This culture, which is characterised by trust, openness to experimentation, and receptiveness to emerging technologies, appeared to accelerate AI adoption and deepen its pedagogical impact (Holmes et al., 2023; Webb et al., 2023; Zawacki-Richter et al., 2019). Moreover, the integration of industry collaboration across all cases reinforced assessment authenticity, bridging the gap between academic requirements and professional expectations while embedding sector-specific cultural norms into the learning process (Ho et al., 2023; Jackson, 2016; Perkmann et al., 2013).

Integrating AI-ICAM Into Broader Practice

Adopting the AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM) at scale requires aligning institutional priorities, curriculum design, and industry engagement. The model's Inputs, which include SDG-aligned learning outcomes, responsible leadership competencies, and industry-validated priorities, provide a foundation for curriculum review. Mapping current programmes against these inputs can reveal gaps in global alignment and accreditation readiness.

Alignment Mechanisms such as AI-enhanced skill mapping, predictive analytics, and adaptive learning content offer practical tools for enhancing relevance and inclusivity. To extend their impact, these mechanisms should be integrated into institutional systems and supported by staff training to help educators interpret and act on AI-driven insights.

The model's Feedback Loops, including AI-powered feedback, 360-degree evaluation, and iterative co-creation, support continuous refinement of assessment. Applied across disciplines, they allow educators and industry partners to respond rapidly to learner needs while maintaining ethical and responsible AI use.

Partnership Outcomes, which include skill development evidence, graduate employability, and curriculum innovation, signal the importance of sustained collaboration. Embedding industry engagement as a standard assessment practice ensures outputs remain relevant to evolving professional contexts.

The outer layers of AI-ICAM emphasise three conditions for successful integration: strategic alignment with global frameworks and professional competencies, embedding ethical and responsible design principles, and fostering a culture of trust, openness, and shared commitment to innovation. Without these, technical components risk being underused or resisted.

By linking each adoption step to both structural components and cultural enablers, AI-ICAM provides a transferable framework for transforming assessment into a dynamic, collaborative process that bridges academic learning with the demands of the future workplace.

Conclusion and Implications

This study set out to investigate how artificial intelligence can be leveraged to design assessment in higher education that is inclusive, adaptive, and authentically connected to industry collaboration. The AI-Enabled Industry-Collaborative Assessment Model (AI-ICAM) addresses this aim by integrating AI capabilities with constructive alignment, co-creation with industry partners, and a culture of innovation. Across three case studies, both direct and indirect AI integration enhanced creativity, time efficiency, and professional presentation quality, while also strengthening student engagement with sustainability and employability goals.

Theoretically, AI-ICAM extends assessment design literature by explicitly incorporating culture as a structural layer, positioning organisational trust, openness to experimentation, and alignment of ethical values as central enablers of AI adoption. This cultural dimension advances constructive alignment theory by recognising the socio-cultural context as a driver of assessment effectiveness.

Practically, the findings highlight three strategic priorities for higher education institutions: (1) align investment in AI infrastructure with strategies to cultivate an innovation-oriented and ethically grounded culture, (2) embed iterative feedback loops supported by AI analytics to refine outputs in real time, and (3) formalise sustained industry collaboration as a mechanism for ensuring authentic, current, and sector-relevant assessment practices.

The AI-ICAM offers a scalable, adaptable template for disciplines and sectors seeking to integrate AI-enabled assessment. Limitations include the focus on three case studies within specific programme contexts, suggesting the need for broader, cross-disciplinary validation. Future research should examine longitudinal impacts on graduate employability and test AI-ICAM in diverse cultural and institutional settings to explore its adaptability and boundary conditions. With thoughtful implementation, AI-ICAM can transform assessment into a dynamic, collaborative process that bridges higher education with the evolving demands of the future workplace.

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The Impact of AI-Driven Scaffolding on Learning Loss and Autonomy in Eleventh Graders

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Abstract

The study aimed to investigate the impact of Al-driven education in implementing a scaffolding strategy which was based on AI in addressing educational loss and enhancing autonomy among eleventh grade students in Palestine. A quasi-experimental approach was employed, with the study population comprising all eleventh-grade students. The sample included (45) female students, divided into two groups: an experimental group of (22) students and a control group of (23) students. An English language skills tests and an autonomy scale were developed and administered pre- and post- intervention. A one-way Analysis of Covariance (ANCOVA) was performed to analyze the scores of students for both instruments. The results revealed significant differences in the responses of the participants on the English language skills tests, favoring the experimental group according to the the adjusted mean scores for each group. Additionally, there were statistically significant differences on the autonomy scale, also in favor of the experimental group as the the adjusted mean scores for each group. These findings underscore the effectiveness of implementing scaffolding strategy which was driven by AI in both mitigating educational loss and fostering autonomy among eleventh-grade students. The researcher recommends establishing policies that integrate Al-driven scaffolding strategies into regular classroom instruction to enhance learner autonomy and address skills deficits. Policymakers should develop a national framework that plan and then apply AI-based scaffolding strategy to address the learning gaps. Stakeholders should conduct longitudinal studies to examine the sustained impact of Al-driven scaffolding on learner autonomy and recovery in diverse educational settings.

Keywords: Al-driven education, scaffolding, educational loss, autonomy, eleventh grade

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Introduction

AI has become the tool used to penetrate the existing area of society and interfere with different segments to become the post-industrial development of many sections influencing and changing human lives (Konecki & Biškupić, 2023; Vacarelu, 2023). AI is also likely to cause a significant disruption on the education industry where universities and other institutions have started applying AI in instructional a learning, assessment, administrative and research activities to get the best results (Hwang et al., 2020). However, together with desire, the implementation of AI in higher Learning assumes a phenomenon of a set of advantages and disadvantages that require further research (Leoste et al., 2021).

Based on the article by Hsiao and Chang (2023), it is evident that the AI utilization could be employed as the learning technique that could ease the pressure focused in the teacher and student as well as increase the amount of learning. Combined with the current trends in education such as the digitalization of resources, game adaptation and learning personalization AI offers a great number of advancement opportunities. For instance, the profile making models have been used systematically to develop reactive and adaptive tutorials for promoting pl and as a way of dealing with teacher availability through ITS (Hsiao & Chang, 2023). These ITSs offer personalized learning experiences in four key ways: copying student inputs, distributing the proper tasks, providing feedbacks and outlining the manners in which learner will interact with the computer (Dai et al., 2020).

In the context of using artificial intelligence in education, it is clear to conclude that the use of Technologies of artificial intelligence adds views on how the teaching and learning processes can be innovated. The Intelligent tutoring systems and others can help instructors to reduce their workload by performing some of those tasks on behalf of the instructors, further, delivering unique learning process for each learner and offering immediate response and evaluation for the learners. On the same note, the possibility of using AI solutions in education can by no means negate the problem of the educational crisis, let alone such extrinsic factors as the COVID-19 and economical volatility. Although the various types of AI are helpful for maintaining continuity and increasing the engagement of learning, society must realize how disrupted learning is due to the pandemic.

In the last few years, the existing educational system in Palestine failed to overcome several hurdles due to external factors even though the worst was the COVID-19 pandemic. Even from the start of the year, the students have not been able to learn consecutively for an entire year calendar and school due to disruptions from the pandemic affecting accumulation of learning loss. These interruptions have in combination with the control of the economy, teachers' strikes, and regional conflict led to deteriorations in the fundamental language skills such as reading, writing, speaking and listening. Further, the student struggles in understanding knowledge area like grammar, factual knowledge resulting to slow progress.

As a consequence of these cumulative factors, students have experienced a decline in essential language skills, particularly in the four key areas of language acquisition: comprehension which include, reading, writing, speaking and listening. This has not only affected grammatical competence, but also the growth of the students 'vocabularies as well as their general fluency of speech. The incorporation of blended learning, which was supposed to help learners maintain continuity, has more frequently failed to address the learners 'needs in an effective manner and thus has served to exacerbate learners 'decline of their linguistic abilities. This kind of educational loss—lost in a number of ways simultaneously—

underscores the need to now intervene to ameliorate these deficits in order to help children get back to where they need to be.

To mitigate the effects of previous interruptions on successful formative teaching, many strategies can be employed to improve students' performance and their language abilities. Consequently, it is evident that homework assignments, periodic quizzes, and diagnostic exams are essential for providing practice beyond the classroom and identifying areas that want further intervention. Furthermore, when the working group addressed various tasks and the application of IT technologies in pedagogical practices, student engagement may be enhanced due to the emphasis on an active teaching-learning process, which would motivate students to study. The management of group classes, peer engagement, and constructive feedback revitalizes students' motivation and facilitates language acquisition (Munawar, 2019).

Scaffolding is a highly regarded approach for mitigating educational loss, as it offers pupils a comprehensive foundation for incremental learning. This strategy enables educators to develop instructional strategies that align with individual students' learning requirements while also promoting independence and self-motivated learning methods. The scaffolding technique empowers students to enhance their linguistic proficiency in reading, writing, grammar, and vocabulary, while also augmenting their confidence in the language employed. In the present research, the preferred methodology will analyze the possibility of using the AI-driven education in the realization of the scaffolding strategy as one of the methods to reduce educational loss alongside increasing English language skill proficiency in students (Narina, 2022).

Vygotsky's sociocultural theory (1978) of the scaffolding method refers to how much support is given to a student till he has sufficient strength to keep the process by himself and be more self-conducted in the classroom setup. With the assistance of modern AI devices, teachers will be capable of successfully addressing the needs of students in the educational framework and producing learning content and products together with improving problem-solving capabilities. Therefore, this study will focus on the creation of awareness of the two-in-one solution policy of increasing augmented integrated AI to do away with educational loss and maximize the autonomy of students.

Statement of the Problem

The educational loss in Palestine is caused by a number of reasons/factors that are interconnected. These factors include poverty, poor infrastructure, and resource inaccessibility. Moreover, the education system has also been affected greatly by the occupation, as the schools have been closed and limits are imposed. Bsharat et al. (2024) add political instability and occupation to the list of mammoth obstacles in the way of the effective provision and use of educational resources. This instability harms both students and teachers and makes it impossible to bring about long-term plans in educational development. Adding to this problem is the condition of the educational infrastructure that tends to be outdated, is overcrowded, and does not contain modern technology (Hussein et al., 2024). This paper examines the role of AI-based scaffolding techniques and support to reduce such losses and promote independence. In particular, it aims at discussing the question of whether these strategies improve the language proficiency of students and their learning autonomy.

Hypothesis of the Study

Hypothesis 1: There are no statistically significant differences at the significance level ($\alpha \leq 0.05$) between the responses of the experimental group and the control group on the English language skills test attributed to the teaching method (scaffolding strategy vs, traditional method).

Hypothesis 2: There are no statistically significant differences at the significance level ($\alpha \leq 0.05$) between the responses of the experimental group and the control group on the Autonomy Scale attributed to the teaching method (scaffolding strategy vs. traditional teaching).

Objectives of the Study

1- To evaluate the impact of Al-driven scaffolding strategies in mitigating educational loss among eleventh-grade students.
2- To assess the impact of these strategies on enhancing students' autonomy in learning.

Significance of the Study

This study is significant for several reasons:

1. It contributes to the body of knowledge on Al applications in education, particularly in addressing educational loss and fostering autonomy.
2. It provides practical insights for educators and policymakers on implementing scaffolding strategies in secondary education.
3. It aids in designing interventions that support students' recovery from educational disruptions while preparing them for self-directed learning.

Limitations of the Study

- Population: Eleventh-grade students in Palestine
- Place: Farahat secondary school /Bethlehem Directorate
- Time: The study is conducted over the first semester of the academic year (2024/2025)

Study Terms

Scaffolding strategy: A teaching method that involves providing tailored support to students to help them achieve learning objectives and gradually transferring responsibility to the students. Alrawili et al. (2020) stated that it refers to

> temporary support or assistance, provided by a teacher, peer, parent, or computer, that permits a learner to perform a complex task or process that he or she would be unable to do alone -- the technique builds knowledge/skills until learners can stand on their own, similar to scaffolding on a building.

AI-Driven education refers to integrating artificial intelligence technologies into educational systems to enhance learning experiences and outcomes. These systems use data-driven algorithms, adaptive learning environments, and intelligent tutoring to tailor educational content to individual needs, automate repetitive tasks, and offer real-time feedback. AI in education also supports decision-making, facilitates resource allocation, and fosters

personalized teaching methods, addressing diverse student abilities and challenges. This approach enhances accessibility and efficiency across educational frameworks (IEEE Xplore, 2024).

Educational loss refers to Educational loss is described as the negative impact on students' learning outcomes and skill development due to disruption in the schooling process such as school closure periods, disasters, or lack of sufficient educational opportunities. This situation can greatly affect the educational advancement, the mental wellbeing and even future productivity. The COVID-19 crisis exposed these problems quite vividly, especially in poorly endowed areas where the lack of online education availability worsened the already existing inequalities (Meinck et al., 2022; UNICEF, 2022).

Autonomy: The ability of students to take charge of their own learning including setting goals, managing time, and evaluating their progress. In an educational context, autonomy is often linked to a student's ability to take responsibility for their own learning, make decisions about what and how they learn, and engage in self-directed activities (Deci & Ryan, 2000).

Eleventh grade is part of the secondary education system in Palestine (16-17 year old students). It is the schoolastic year that precedes Tawjihi in which students take the General Education Certificate Examination. During this year, students specialize in tracks such as scientific, literary, or vocational streams. The eleventh grade aims to prepare students for their final year of secondary education, influencing their higher education and career decisions (Ministry of Education, Palestine, 2020).

Study Results

This section presents the results of the study based on the research questions aimed at examining the impact of scaffolding strategy driven by AI on improving English language skills and enhancing autonomy. Below are the findings of the study.

1. Results Related to the First Hypothesis:

Hypothesis (1): There are no statistically significant differences at the significance level ($\alpha \leq 0.05$) between the responses of the experimental group and the control group on the English language skills test attributed to the teaching method (scaffolding strategy vs, traditional method)

To test this hypothesis, the means and standard deviations of the responses from the experimental and control groups were calculated, as shown in Table (1):

Table 1
Means and Standard Deviations of the Experimental and Control Group Students' Scores on the Pre-test and Post-test for English Language Skills

Group	Students No.	Pre- test		Post- test	
		Mean	Standard Deviation	Mean	Standard Deviation
Experimental	22	27.87	14.67	45.77	15.42
Control	23	28.64	14.43	929.6	8.81

It is evident from Table (1) that the mean scores for the responses of both groups on the post-test of English language skills were (45.77) for the experimental group and (29.69) for the control group, with standard deviations of (15.42) and (8.81) for the experimental and control groups, respectively. To determine the differences in favor of either group, a one-way Analysis of Covariance (ANCOVA) was conducted after controlling for the pre-test effect, as shown in Table (2):

Table 2
ANCOVA Analysis of Student Performance on English Language Skills Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Pre (covariate)	5233.586	1	5233.586	173.457	.000
Groups	2607.980	1	2607.980	86.436	.000
Error	1267.235	42	30.172		
Total	73234.000	45			
Corrected Total	9313.644	44			

It is shown in Table (2) that there were statistically significant differences at the ($\alpha \leq 0.05$) significance level between the scores of the experimental and control groups on the English language skills test. F value was (86.436) and the significant level was (.000). Signifying that rejecting the null hypothesis and accepting the alternative one. To determine the source of these differences, table (3) below shows the adjusted mean scores for each group.

Table 3
Estimated Marginal Means

The two groups	Mean	Std. Error
Control group	30.24	1.15
Eperimental Group	45.48	1.17

As shown in the table, the differences favored the experimental group, which was taught using the scaffolding strategy driven by AI, as it obtained a higher mean score of (45.48) compared to the control group with(30.241) as a mean score.

2. Results Related to the Second Hypothesis:

Hypothesis (2): There are no statistically significant differences at the significance level ($\alpha \leq 0.05$) between the responses of the experimental group and the control group on the Autonomy Scale attributed to the teaching method (scaffolding strategy vs. traditional teaching).

To test the second hypothesis, the means and standard deviations of the responses from the experimental and control groups were calculated, as shown in Table (4):

Table 4

Means and Standard Deviations of the Experimental and Control Group Students' Scores on the Pre-test and Post-test for the Autonomy Scale

Group	Students No.	Pre- test		Post- test	
		Standard Deviation	Mean	Standard Deviation	Mean
Experimental	22	0.94	2.55	0.71	3.95
Control	23	0.63	2.14	0.77	2.39

It is evident from Table (4) that the mean scores for the responses of both groups on the post-test of the Autonomy Scale were (3.95) for the experimental group and (2.39) for the control group, with standard deviations of (0.71) and (0.77) for the experimental and control groups, respectively. To determine the differences in favor of either group, a one-way Analysis of Covariance (ANCOVA) was conducted after controlling for the pre-test effect, as shown in Table (5):

Table 5

ANCOVA Analysis of Student Performance on the Autonomy Scale

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Pre (covariate)	.256	1	.256	.467	.498
Groups	5.609	1	5.609	10.245	.003
Error	22.994	42	.547		
Total	439.726	45			
Corrected Total	37.003	44			

It is shown in Table (5) that there were statistically significant differences at the (0.05) significance level between the scores of the experimental and control groups on the Autonomy Scale; F value was (10.25) and the significant level was (0.003). That is to say, rejecting the null hypothesis and accepting the alternative one. To identify the source of these differences, table (6) below shows the adjusted mean scores for each group.

Table 6
Estimated Marginal Means

The two groups	Mean	Std. Error
Control group	2.52	0.18
Eperimental Group	3.49	0.19

The data in the table indicate a preference for the experimental group, which was taught using the scaffolding strategy which was driven by AI, as it obtained a higher mean score of (3.49) compared to the control group with (2.52) as a mean score.

Discussion of the Results

This section presents a comprehensive analysis of the study's findings, contextualises them within the framework of relevant literature. Each research question is addressed individually, summarizing key results and contrasting them with findings from previous studies. This synthesis highlights similarities and discrepancies, providing a nuanced understanding of how this study contributes to the field of scaffolding strategies in education.

Results for the Impact of Scaffolding Strategy on English Language Skills

The study's findings indicate a statistically significant improvement in the English language skills of students in the experimental group, who were taught using the Al-driven scaffolding strategy, compared to the control group, which followed traditional teaching methods. The post-test mean score for the experimental group was notably higher, reflecting enhanced performance in all four key areas of language acquisition: reading, writing, listening, and speaking. This suggests that the scaffolding strategy, supported by Al, provided tailored guidance and adaptive learning experiences, enabling students to overcome their language learning challenges effectively.

A deeper analysis reveals that this improvement is attributable to several factors inherent to the scaffolding strategy. Firstly, the incremental learning approach, where tasks are broken down into manageable steps, likely helped students gradually build their language competencies. Secondly, the Al component ensured personalized feedback and adaptive learning paths, addressing individual needs and pacing the instruction to match each student's proficiency level. This synergy between scaffolding and Al likely created an optimal learning environment, fostering both engagement and mastery.

Those findings align with and build upon existing literature that underscores the effectiveness of scaffolding strategies in enhancing language skills. While Clark and Graves (2005) discussed in their research highlighted that structured scaffolding significantly improves comprehension skills during reading activities. This study corroborates those results by demonstrating similar enhancements in comprehension as part of the broader improvements in reading skills among the experimental group.

In addition, Ahmadi Safa and Motaghi (2024) reported that scaffolding strategies significantly improved listening comprehension in EFL contexts. The current study supports this by showing how scaffolding effectively bolstered listening abilities, likely due to guided

listening exercises and immediate Al- generated feedback tailored to the students' comprehension gaps.

Also, Hsiao and Chang (2023) emphasized the potential of intelligent tools in personalizing learning experiences and enhancing grades and assignment quantity. The Integration of Al-driven scaffolding in this study resonates with those findings, particularly in providing adaptive tasks, real- time feedback, and tailored recommendations. These features likely contributed to the students' improved proficiency across all skill areas.

While previous studies have explored scaffolding or Al in isolation, this study contributes uniquely by combining the two approaches. The use of Al amplifies the traditional scaffolding framework by automating feedback mechanisms, ensuring precise and timely guidance, and dynamically adjusting instructional content based on individual performance. This integration addresses the practical limitations of manual scaffolding, such as time constraints and variability in teacher expertise, thereby extending the applicability and efficiency of scaffolding strategies in classroom settings.

Moreover, the current study demonstrates the scalability of Al-driven scaffolding, making it feasible to implement in diverse educational contexts. This scalability is particularly significant in settings where language learning gaps are pronounced, as seen in the Palestinian education system, which has faced disruptions due to external challenges.

The findings underscore the potential of Al-enhanced scaffolding strategies in language education, especially in contexts where traditional teaching methods fall short in addressing individual learning needs. Future research could investigate the long-term effects of this approach on language retention and explore its application in other subject areas or different educational levels. Additionally, further studies might focus on optimizing the Al component to ensure culturally and contextually relevant feedback, enhancing its effectiveness across diverse learner populations.

Results for Enhancing Autonomy Through Scaffolding Strategy

The study's results demonstrated a statistically significant increase in autonomy among the experimental group. This indicates that the scaffolding strategy driven by Al effectively fostered self- directed learning. Students in the experimental group displayed greater independence in managing their learning activities, making decisions, and solving problems without direct intervention from the teacher. This increase in autonomy reflects the scaffolding approach's ability to gradually transfer responsibility from the educator to the learner, allowing students to take ownership of their educational journey. The Al component amplified this effect by providing real-time feedback, personalized learning pathways, and adaptive guidance, which encouraged students to engage actively in their learning processes. By addressing individual learning needs, the scaffolding strategy also likely reduced the cognitive load on students, enabling them to approach tasks more confidently and independently.

The findings that align with and build upon existing literature emphasizing how Scaffolding Strategy effectively enhance learner autonomy. Cortázar et al. (2021) highlighted in their findings the potential of scaffolding to promote critical thinking and learner autonomy. The current study aligns with this conclusion, demonstrating that scaffolding not only supports

knowledge acquisition but also empowers students to approach learning tasks with greater independence.

In addition, Vygotsky's Zone of Proximal Development (ZPD) in his theoretical framework (1978) underpins the scaffolding strategy, emphasizing that autonomy is achieved through guided learning that gradually shifts responsibility to the leaner. The results align with this theory, as students in the experimental group moved from dependent to independent learning behaviors during the intervention.

Simultaneously, Alavi and Esmaeilifard (2021) highlighted that scaffolding reduces language anxiety and fosters collaboration, which indirectly contributes to greater learner autonomy. Consistently, this study observed that students taught using the Al-driven scaffolding strategy showed higher confidence and self-reliance, which are critical components of autonomy.

The findings contrast with Chen and Law (2016), who argued that real-time "soft scaffolding" (adaptive, immediate teacher support) is essential for enhancing autonomy. According to their study, while pre-designed "hard scaffolding" (structured, pre-planned support) offers foundational guidance, it lacks the flexibility to address real-time learning challenges. This suggests that while the Al-driven scaffolding strategy in this study was effective, incorporating real-time teacher interventions alongside Al could further enhance learner autonomy.

Results for Addressing Educational Loss Through Scaffolding Strategy

The study demonstrated that the Al-driven scaffolding strategy effectively mitigated educational loss. Students in the experimental group exhibited marked improvements in their English language skills, recovering from the deficits caused by disruptions such as the COVID-19 pandemic. The scaffolding strategy provided incremental learning opportunities that enabled students to rebuild foundational skills in reading, writing, listening, and speaking.

Al played a crucial role by delivering personalized interventions and adapting learning tasks to the needs of each student. This targeted approach likely accelerated the recovery process by addressing specific areas of weakness and enabling students to regain lost competencies.

Pier et al. (2021) emphasized the importance of targeted interventions in combating learning loss during extended disruptions. The current study aligns with these findings, demonstrating that scaffolding strategies, especially when integrated with Al, can effectively address educational loss caused by crises.

In addition, Dai et al. (2020) highlighted the adaptability of Al tools in education, particularly their ability to provide immediate feedback and tailored learning experiences. This study reinforces their conclusion, showing how Al-driven scaffolding effectively supported students in regaining lost learning.

On the contrary, Eglitis et al. (2024) identified long academic breaks as a significant factor in educational loss but proposed recovery strategies that relied on traditional instructional methods. Unlike these strategies, the current study emphasizes the use of innovative, Al-enhanced scaffolding, which proved more effective in addressing complex learning disparities in a shorter time frame.

From the evidence presented, this study provides a significant contribution to the existing literature by demonstrating the dual impact of Al-driven scaffolding on learner autonomy and educational recovery. It bridges key gaps by offering innovative insights into integrating Al as a dynamic scaffolding tool and addressing contemporary educational challenges.

Key Contributions

1. Integration of Al and Scaffolding: Building on Vygotsky's concept of the Zone of Proximal Development (ZPD) (1978), the study incorporates Al as a flexible and responsive scaffolding mechanism. This integration not only enhances leaner autonomy but also supports skill recovery in a more personalized manner.
2. Addressing Contemporary Challenges: The study directly tackles the learning loss exacerbated by the COVID-19 pandemic, offering timely and practical applications of scaffolding strategies to mitigate educational setbacks in real-world crises.
3. Practical Implications: Findings suggest that combining pre-designed scaffolding frameworks with real-time, adaptive interventions can significantly enhance learning outcomes. This paves the way for more effective and scalable education strategies across diverse contexts.

Recommendations

1. Establish policies that integrate Al-driven scaffolding strategies into regular classroom instruction to foster autonomy and skill development.
2. Combine structured scaffolding with real-time adaptive interventions to maximize educational outcomes.
3. Develop teacher training programs to effectively implement and monitor Al-enhanced scaffolding tools.
4. Investigate the role of individual learner characteristics, such as prior knowledge and learning preferences, in moderating the effectiveness of Al-driven scaffolding strategies.
5. Explore the incorporation of real-time "soft scaffolding elements to refine the adaptability and responsiveness of Al tools.
6. Policymakers should develop a national framework that plan and then apply AI-based scaffolding strategy to address the learning gaps.
7. Stakeholders should conduct longitudinal studies to examine the sustained impact of Al-driven scaffolding on learner autonomy and recovery in diverse educational settings.

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An Examination of the Correlation Between Disaster Awareness and Psychological Preparedness: Advancing Disaster Education in Undergraduate Curricula

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Abstract

This study examines the relationship between disaster awareness and psychological preparedness among undergraduate students, emphasizing the need to integrate disaster education across all academic disciplines. While previous research has primarily focused on disciplines such as medicine, engineering, and emergency response, this study argues that disaster preparedness should be a fundamental part of higher education for students in all departments. Data were collected from 412 undergraduate students in Turkey using the Disaster Awareness Scale and the Psychological Preparedness for Disaster Threat Scale. A correlational research design was employed, and Pearson correlation analysis was conducted to assess the relationship between the two variables. The findings indicate a strong positive correlation, suggesting that students with higher disaster awareness exhibit greater emotional resilience and crisis management abilities. Additionally, students with prior disaster education demonstrated significantly higher preparedness levels, reinforcing the importance of structured educational interventions. However, using a convenience sampling method may limit the generalizability of the findings. Also, the study focuses on undergraduate students in Turkey, which may not fully represent other populations. This study contributes to the literature by providing empirical evidence supporting the expansion of disaster education beyond specialized fields. Emphasizing the role of psychological preparedness in disaster awareness offers valuable insights for curriculum developers, policymakers, and educators seeking to enhance disaster resilience.

Keywords: disaster awareness, disaster education, psychological preparedness, undergraduate students

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Introduction

Natural disasters have long been recognized as events with wide-ranging consequences for individuals and societies. In Turkey, disasters such as earthquakes, floods, and wildfires continue to result in serious harm, with recent examples like Kahramanmaraş earthquakes leaving thousands dead and causing billions of dollars in damage (Buyukoglu et al., 2024). These events highlight the economic and infrastructural devastation and the deep psychological impact on affected communities (Cinaroglu, 2024). Disaster awareness, which refers to individuals' understanding of natural hazards and their potential impacts, is vital in preparing for such events. However, studies suggest that awareness alone is insufficient. Psychological preparedness—the ability to regulate emotions, make stressful decisions, and recover mentally—has emerged as an essential yet underexplored component of disaster education (Saeed & Gargano, 2022; Zulch et al., 2012).

Despite its importance, psychological preparedness is often overlooked in Turkey's disaster management framework, which has historically emphasized post-disaster response rather than proactive risk mitigation and education (Barış, 2009). Moreover, university disaster education is frequently limited to disciplines like medicine or engineering, neglecting students from other fields who are equally at risk (Patel et al., 2017).

This study investigates the relationship between disaster awareness and psychological preparedness among undergraduate students in Turkey. By exploring how different dimensions of awareness—such as pre-disaster behaviors, post-disaster responses, and misconceptions—relate to students' emotional readiness, this research aims to provide evidence for a more holistic and inclusive approach to disaster education. In doing so, it contributes to the growing body of literature that advocates for integrating psychological preparedness into university curricula to build more resilient individuals and communities.

Literature Review

Disasters have multidimensional impacts on societies—economic, social, psychological, and environmental. In recent years, research has emphasized the growing need for structural preparedness and fostering individual-level awareness and psychological readiness (Hoffmann & Blecha, 2020). Disaster awareness is the knowledge and understanding individuals or communities have regarding natural hazards and their potential consequences (AFAD, n.d.). It includes knowing how to behave before, during, and after a disaster, and recognizing misinformation or misconceptions that may hinder effective response (Nogami & Yoshida, 2014).

Studies have shown that higher levels of disaster awareness contribute to better preparedness and risk-reducing behaviors (Titko & Ristvej, 2020). Cai et al. (2023) found that social environment and personal cognition significantly influence individuals' intentions to mitigate disaster risks. In the context of Turkey, however, disaster education has often remained limited to post-disaster response rather than preventive awareness (Barış, 2009). This gap is particularly evident in higher education settings, where disaster education is usually confined to disciplines such as medicine or engineering (Patel et al., 2017), neglecting the broader university population.

Psychological preparedness is another essential yet underrepresented concept in disaster literature. It refers to an individual's ability to anticipate and mentally cope with a disaster

through emotional regulation, decision-making under stress, and cognitive resilience (Zulch et al., 2012). Saeed and Gargano (2022) emphasized that psychological distress during disasters can hinder rational thinking and delay effective action, making psychological readiness a critical component of overall disaster preparedness. Despite this, most disaster education programs do not explicitly incorporate training or awareness related to emotional resilience (Morgado, 2020).

Furthermore, recent research highlights the dangers of false disaster beliefs and myths—such as panic, looting, and helplessness—that often spread through the media and public discourse. These beliefs can negatively influence individuals' risk perceptions and reduce their preparation motivation (Nogami & Yoshida, 2014). Integrating myth-busting and evidence-based communication into disaster education programs has been proposed as a solution (Öcal et al., 2016).

Qing et al. (2021) also suggest that preparedness levels vary depending on geographical features and environmental risks, reinforcing the need for context-specific disaster education strategies. Similarly, Qing et al. (2021) demonstrated that individuals with high disaster awareness reported greater life satisfaction and mental health, showing the broader well-being implications of preparedness.

Overall, the literature supports the integration of disaster awareness and psychological preparedness within university education. An interdisciplinary and inclusive approach that addresses factual knowledge and emotional resilience is needed to foster a disaster-resilient society (Rosenberg et al., 2022). This study builds on these findings by exploring the relationship between these two concepts among undergraduate students in Turkey, aiming to inform more holistic disaster education policies and practices.

Results

This study investigated the relationship between disaster awareness and psychological preparedness among 412 undergraduate students from diverse academic departments and year levels. Most participants were from the Social Sciences and Humanities (49.76%) and were in their junior year (49.76%).

Descriptive statistics showed moderate to high levels of disaster awareness. The highest average score was in the Disaster Education Awareness sub-dimension *(M* = 56.50, *SD* = 4.41), followed by Pre-Disaster Awareness (*M* = 34.34, *SD* = 3.48), False Disaster Awareness (M = 33.89, SD = 4.16), and Post-Disaster Awareness (*M* = 22.65, *SD* = 4.87). The overall Disaster Awareness Scale score was 147.37 (*SD* = 12.11).

Psychological preparedness scores were also moderate. Participants scored highest in managing the external situational environment (*M* = 26.19, *SD* = 4.89), followed by emotional and psychological response management (*M* = 25.51, *SD* = 6.74), and social environment management (*M* = 8.80, *SD* = 1.88). The total average for the Psychological Preparedness Scale was 60.50 (*SD* = 11.36).

Correlation analysis revealed significant positive relationships between disaster awareness and psychological preparedness. Specifically, disaster education awareness ($r = .257$, $p < .001$), pre-disaster awareness ($r = .257$, $p < .001$), false-disaster awareness ($r = .221$, $p < .001$), and post-disaster awareness ($r = .550$, $p < .001$) were all positively correlated with

psychological preparedness. Notably, post-disaster awareness showed the strongest correlation.

These findings suggest that increasing students' awareness at all phases of a disaster—before, during, and after—can improve their emotional and psychological readiness. Contrary to expectations, false-disaster awareness also showed a positive correlation, indicating that even inaccurate or partial information may contribute to a perceived sense of preparedness.

Interpretation of Findings

This study explored the relationship between disaster awareness and psychological preparedness for disaster threats. The findings revealed that various aspects of awareness—including disaster education, pre-disaster, false disaster, and post-disaster awareness—are significantly related to psychological preparedness factors such as management of the external situational environment, emotional and psychological responses, and social environment.

The results showed a significant relationship between disaster education awareness and all sub-factors of psychological preparedness. Individuals with disaster education awareness are more capable of managing their external environment during a disaster. It aligns with Hoffmann and Blecha (2020), who found that education improves preparedness. Aldemir (2023) also emphasized that disaster education supports effective resource management, including post-disaster aid distribution. Moreover, disaster education awareness was positively related to managing emotional responses. It implies that education may enhance emotional resilience, as Merdjanoff et al. (2022) and Iseri and Baltaci (2024) suggested. Even though Morgado (2020) did not explicitly focus on education, resilience was identified as a key factor in coping with disasters. Disaster education also plays a critical role in managing the social environment. Cong et al. (2023) found that social participation strengthens preparedness. Similarly, Cai et al. (2023) linked social norms and trust to cautious behavior. These findings support the idea that disaster education fosters stronger social ties and increases resilience. Seale et al. (2022) emphasized that community leaders' disaster knowledge contributes to collective preparedness. In addition, Breen et al. (2024) noted that educating youth helps boost their engagement with community safety.

A significant correlation was found between pre-disaster awareness and the ability to manage the external environment. People who are aware of disasters tend to use resources more effectively. The recent Turkish earthquakes showed the economic impact of disasters, reinforcing the need for proactive planning (Buyukoglu et al., 2024). Upadhyay et al. (2022) argued that agile planning enhances disaster response if implemented before the event. However, Johar et al. (2022) showed that awareness alone does not guarantee economic protection, especially for vulnerable populations. Barış (2009) also pointed out the limitations of centralized disaster strategies in Turkey. Emotionally, pre-disaster awareness contributes to psychological preparedness. Morgado (2020) emphasized the need for emotional regulation. However, awareness alone is insufficient. Cinaroglu (2024) found that psychological stress persisted despite awareness efforts. Even trained teams showed PTSD symptoms (Iseri & Baltaci, 2024). Therefore, awareness should be supported with mental health services. Socially, pre-disaster awareness helps individuals better utilize social support. Gim and Shin (2022) emphasized the role of social links in recovery. However, Yabe and Ukkusuri (2020) noted that wealth disparities affect people's acting ability. Barış (2009) also noted that Turkey's centralized system might hinder local participation. Awareness and

preparedness go hand-in-hand, but other factors such as social equity and psychological support must be considered (Güzel et al., 2024; Kyne, 2023; Qing et al., 2021).

The study found a positive relationship between false disaster awareness and psychological preparedness. It contradicts Nogami and Yoshida (2014), who argue that false information distorts risk perception. The current results suggest that exposure to exaggerated risks in the media may lead people to be overly cautious, increasing their preparedness levels—though based on inaccurate information. People with false awareness may still manage emotions better due to increased perceived risk. Tsai (2010) supports the idea that integrating beliefs and knowledge enhances understanding, which may explain this finding. However, while false information may create a sense of preparedness, it lacks scientific grounding and may fail in real disaster situations.

Post-disaster awareness was positively linked to psychological preparedness. Those with post-disaster awareness better manage external conditions and develop strategies. Seale et al. (2022) and Sloggy et al. (2021) confirmed that post-disaster information boosts environmental control and broader awareness, such as climate policy support. A significant connection was also found between post-disaster awareness and emotional response. While Merdjanoff et al. (2022) note the complex psychological impact of disasters, the current study suggests that post-disaster mindfulness contributes to readiness. However, this may vary depending on the disaster type. Regarding the social environment, post-disaster awareness supports social management. However, Berrebi et al. (2020) observed that internal collaboration may decline while dependency on external groups rises. It highlights the multifaceted nature of social ties post-disaster. Still, the positive correlation found in this study suggests that awareness helps foster supportive environments.

Conclusion

The findings emphasize the value of disaster education in fostering psychological preparedness. As theory alone is insufficient, disaster education must include simulations and hands-on training (Hasan et al., 2022; Sekerci et al., 2023). AFAD (n.d.) stresses the importance of the first 72 hours post-disaster, making practical training essential.

Psychological components should be integrated into curricula to reduce anxiety and build mental strength (Mishra & Suar, 2011). Such education is vital, especially for medical and nursing students (Erkin et al., 2024), but it should be mandatory for all students (Muttarak & Pothisiri, 2013).

Disaster education must be cross-disciplinary. Students from all backgrounds benefit from broader perspectives (Konur et al., 2024). Psychology, sociology, and public health must be included.

Digital tools like mobile apps, AI-based content, and simulations can enhance engagement and preparedness (Kahraman & Gülaçtı, 2023; Subarno & Dewi, 2022). Technology makes disaster education accessible and scalable.

Disaster education should reach communities, not just students. Schools, families, and local governments must collaborate (AFAD, n.d.). Community exercises can foster resilience.

Based on findings, disaster education should include drills and simulations, field studies and project-based learning, psychological preparedness training, and technology-enhanced learning.

Together, these contribute to resilience, reduce trauma risk, and create supportive environments. This study shows awareness supports preparedness, though causality is not claimed. Still, awareness remains a critical part of broader disaster strategies.

Recommendations for Further Research

This study investigates the best practices for disaster education on undergraduate students' awareness and psychological preparedness based on the relationship between disaster awareness and psychological preparedness.

Effective disaster education programs can increase personal and community readiness. Although the literature has already highlighted the significance of disaster education for health departments, similar training is required in other departments at the university level. It should be emphasized that these findings have no clear cause-and-effect relationship.

The results suggest that people's ability to manage psychological readiness may be correlated with their awareness of disasters, but further study is necessary to understand this relationship fully. Effective disaster education programs can potentially increase people's psychological readiness by enhancing their awareness. Additionally, all findings in this study are suitable for the selected sample. It may not be generalizable to the entire population. Therefore, in the future, experimental and longitudinal studies should be conducted with other groups representing each university department to clarify this relationship.

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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The Effect of Virtual Laboratory Combination With Hands-On Laboratory on Students' Learning

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Abstract

In physics education, laboratory experiments are a key component of the learning process, as they enable students to apply scientific theories in practice. However, traditional hands-on laboratories face great challenges due to large student enrollment and lack of class time and lab space. To address these challenges, this study implemented a blended learning approach that combines hands-on labs with virtual labs. The lab instruments and environment used in the virtual laboratory were created using 3D Unity WebGL. Participants in this study were first-year undergraduate students in China, divided into two groups. Students in the experimental group conducted the experiment in the virtual laboratory prior to their hands-on lab session, while the control group performed the same experiment in a traditional teaching laboratory without the participation in virtual laboratory. To assess the impact of the virtual laboratory in combination with the hands-on laboratory, we evaluated student engagement, lab scores, and attitudes toward the virtual learning experience. Our findings indicate that students in a blended learning environment were more engaged and achieved higher scores compared to those in a traditional setting. This supports previous research suggesting that virtual laboratories can effectively supplement traditional hands-on labs, providing students with greater flexibility and access to learning resources. The results of this study underscore the role of virtual laboratories in enhancing student motivation and overall learning experience.

Keywords: virtual laboratory, blended learning, physics education

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Introduction

In physics education, laboratory experiments are a key element of learning (Lunetta et al., 2007; Ma & Nickerson, 2006; Satterthwait, 2010; Singer et al., 2006), as they allow students to apply the scientific theories studied in lecture courses to practical situations. These laboratory experiences equip students with the skills to make predictions and test their hypotheses through experimentation, thereby enhancing their understanding of scientific facts and concepts while also boosting their motivation to learn science. Furthermore, hands-on laboratory work helps students develop essential practical skills, such as using laboratory equipment, making observations, taking measurements, and interpreting experimental results. Therefore, effective design and implementation of laboratory activities in physics are vital for creating meaningful learning experiences.

In traditional hands-on laboratories, students conduct experiments under the guidance of a lab instructor, who explains the theoretical background and procedures before they begin their work. Following these instructions, students collect and analyze experimental data, and report their findings in a lab report. This conventional laboratory practice offers students valuable hands-on experience in the use of laboratory equipment, and allows students to have face-to-face interactions with the lab instructor. However, traditional labs are often constrained by safety concerns, physical space, equipment, or budget, which can limit the types of experiments students can carry out.

The rapid development of internet technology has provided additional teaching strategies for laboratory experiments, with online education being one of the most exciting enhancements (Chen et al., 2010). Evidence from literature shows that the integration of online instructional technologies, such as simulations, animation, videos, and visualizations, with real practical work is very promising (Hofstein & Kind, 2012). Currently, there are two approaches to conduct the experiments online: virtual labs and remote labs. Virtual labs utilize software to simulate the lab processes and actions in physical laboratories. The adoption of virtual labs increased significantly during the global pandemic. Remote labs, on the other hand, enable students to control the lab equipment remotely through the Internet. Therefore, online laboratories provide students the opportunity to conduct experiments without the traditional constraints of time and location.

In this study, we assess the effectiveness of blended physics laboratory experiments in enhancing students' achievement levels compared to the traditional hands-on approach. Through a comparative analysis, our goal is to explore the role of virtual laboratories in physics education. The findings of this study will contribute to the ongoing discussion on the integration of virtual reality technology in teaching and learning activities.

Methodology

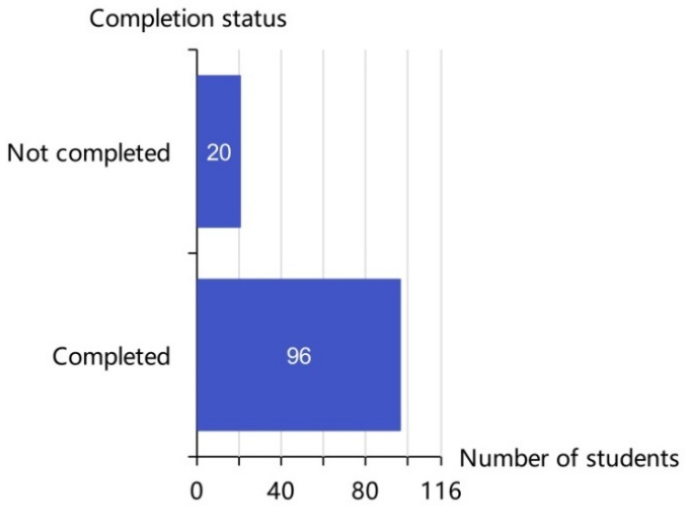
This study employed a quasi-experimental research design to investigate the effects of blended laboratory experiments on teaching physics. A total of 214 students participated in the laboratory experiments. The learning outcomes of two groups were compared based on their lab report scores: one group of 98 students served as the control group, completing the laboratory tasks in a traditional hands-on format, while the other group consisted of 116 students in the experimental group, who were taught through a combination of hands-on and virtual labs. After the experimental group completed all laboratory activities, a satisfaction survey was administered to gather their perceptions regarding the use of the virtual laboratory.

Results

Lab Engagement

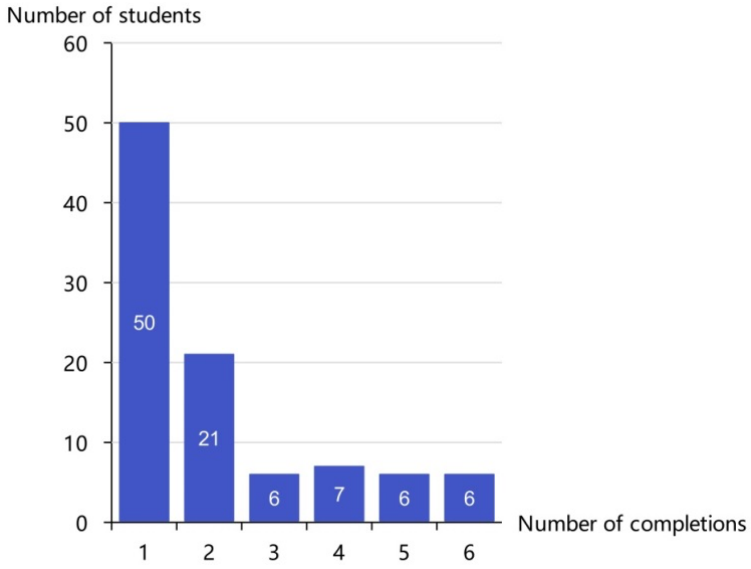
According to the activity completion report from the virtual laboratory platform, as shown in Figure 1, 96 students from the experimental group completed the virtual experiment, while 20 students did not. Thus, the virtual lab completion rate is approximately 83%. One possible reason for students not completing the virtual lab could be that the virtual lab was not mandatory and students' performance in the virtual lab did not contribute to their final lab scores.

Figure 1
Virtual Lab Completion Status



As shown in Figure 2, among the students who completed the virtual experiments, 50 students completed the experimental work once, while 49 students completed the experiments multiple times. The results revealed that over 40% of students in the experimental group were highly engaged with the virtual learning platform, completing labs multiple times.

Figure 2
Virtual Lab Completion Counts



Lab Performance

Students' lab performance was evaluated based on their lab report scores. After removing all students who scored 0, Table 1 presents the results of lab scores for students in the blended learning mode compared to those in the traditional hands-on lab mode. The mean score in the traditional lab format was 54, while the mean score in the blended format was 63. And the standard deviation of scores was 16.53 for the blended labs and 15.42 for the traditional labs. This indicates that although the mean score in the experimental group (blended format) was higher than that in the control group (traditional format), the experimental group had greater variability in their lab scores, reflecting a wider range of student performance.

Table 1
Student Lab Scores in Different Learning Modes

Laboratory Format	Statistics				
	Mean	Median	Min	Max	Standard deviation
Blended Laboratory Format	62.51	63	16	95	16.53
Traditional Laboratory Format	54.39	51.5	14	94	15.42

The following charts illustrate the frequency distribution of students' lab scores in both blended and hand-on laboratory formats. The range of scores was divided into intervals of width 4, and the number of scores falling into each interval was counted to determine the frequency. A normal distribution curve was plotted on top of each histogram to assess how closely the scores follow a normal distribution. The data revealed that in traditional hands-on lab, scores below 60 occurred frequently while scores higher than 80 were rare, suggesting a skewed distribution. However, in blended labs, the scores are approximately normally distributed, despite a high frequency of scores between 80 and 84. Furthermore, when comparing the score distribution in the traditional hands-on mode, it is evident that a higher percentage of students scored above 60 in the blended mode.

Figure 3
Student Lab Score Distribution in Hands-On Lab Mode

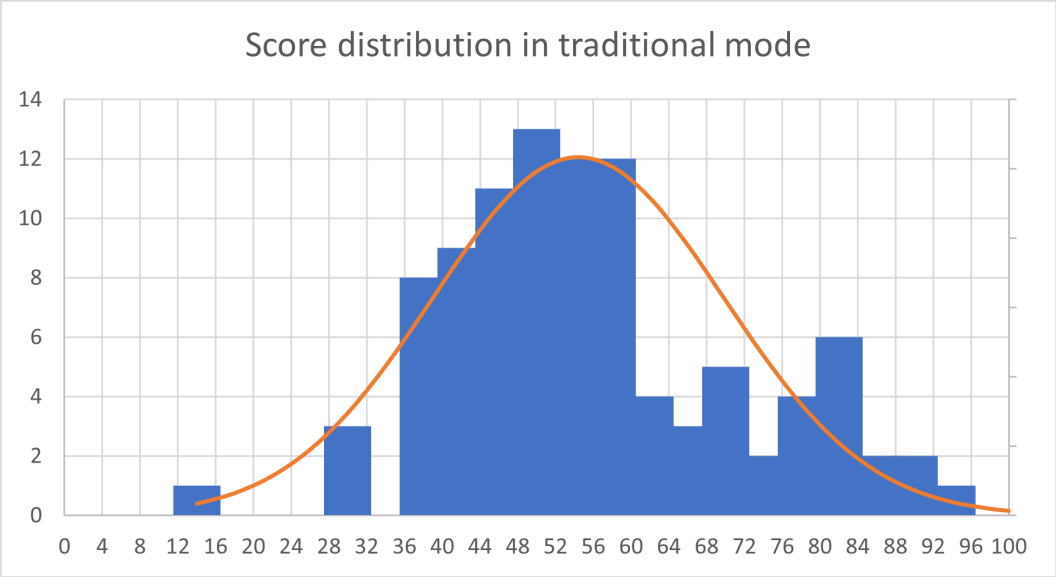
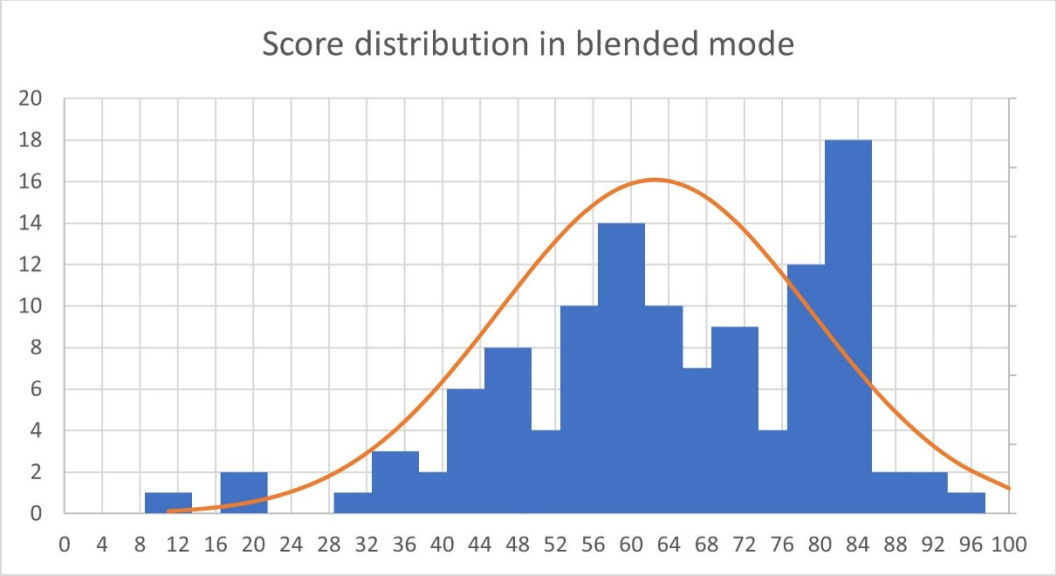


Figure 4
Student Lab Score Distribution in Blended Labs Mode



Since the lab scores from the control group are not normally distributed, a nonparametric Mann-Whitney U test was conducted to identify any significant differences in lab scores between the experimental and control groups. A significance level of $p = 0.05$ was chosen for the test. The results indicated a significant difference between the two groups ($U = 7758$, $p = 0.000007 < 0.05$).

Student Attitudes Towards the Use of Virtual Laboratory

At the end of the semester, a laboratory evaluation survey was given to students in the experimental group to collect their feedback on the virtual laboratory learning experience. There were ten Likert scale questions in the survey and students were asked to respond to each question using a four-point scale (e.g., 2 = Strongly Agree, 1 = Agree, 0 = Neutral, -1 = Disagree). A total of 58 students participated in the survey, and their responses were converted

into percentages for the evaluation of the virtual lab activities. Below are the students' answers to the survey questions.

Table 2

Student Responses Towards the Virtual Learning Experience

1. The virtual experiment helped me to learn physics concepts.			
Strongly Agree: 60%	Agree: 31%	Neutral: 7%	Disagree: 2%
2. The virtual experiment enabled me to work at my own pace.			
Strongly Agree: 59%	Agree: 34%	Neutral: 7%	Disagree: 0%
3. The virtual experiment was clear and easy to follow.			
Strongly Agree: 57%	Agree: 33%	Neutral: 10%	Disagree: 0%
4. Virtually performing an experiment helped me better understand the physics laws/principles behind the experiment.			
Strongly Agree: 62%	Agree: 26%	Neutral: 9%	Disagree: 3%
5. The virtual experiment stimulated my curiosity about physics.			
Strongly Agree: 55%	Agree: 31%	Neutral: 12%	Disagree: 2%
6. The virtual experiment helped me to become more confident in carrying out the real experiment.			
Strongly Agree: 57%	Agree: 33%	Neutral: 7%	Disagree: 3%
7. The quality of experimental learning is increased using virtual experiment.			
Strongly Agree: 55%	Agree: 31%	Neutral: 9%	Disagree: 5%
8. My knowledge and skills are enhanced after conducting the virtual experiment.			
Strongly Agree: 54%	Agree: 34%	Neutral: 10%	Disagree: 2%
9. I am satisfied with my learning experiences in the virtual lab.			
Strongly Agree: 48%	Agree: 36%	Neutral: 14%	Disagree: 2%
10. I prefer to participate in virtual lab compared to traditional lab.			
Strongly Agree: 42%	Agree: 28%	Neutral: 21%	Disagree: 9%

In general, Table 2 shows that the virtual laboratory learning experiences was evaluated positively by students. For all questions, an average of over 85% responded positively toward the use of virtual laboratory. Many of students were satisfied with the virtual experiment design and contents and they believed that the work carried out in the virtual laboratory improved their knowledge, skills and attitudes. Over 80% of students stated that practice in the virtual laboratory increased their confidence when performing real experiments.

The survey also included serval open-ended questions to collect students' feedback regarding their preferences, challenges and suggestions on the virtual learning experience. Below are some representative comments from the students: "What I like best is the pleasure of discovering new things while performing the virtual experiments." "I think the virtual experiment is interesting and it is helpful to understand the theories in physics." "The main challenge for me is to understand the process of doing an experiment, so I performed the virtual experiment before real lab to overcome the challenge." "I hope the virtual laboratory experiments could be more interactive."

Discussion

When comparing students' lab scores in two different learning modes, as shown in Table 1, the mean score of the experimental group was higher than that of the control group. The Mann-Whitney U test confirmed a significant difference in lab scores between the two groups. This difference may be attributed to the fact that students who did not practice the experiments before entering the physical lab lacked experience and prior knowledge, so they need longer time and more attention to comprehend but are limited by classroom teaching time and interaction frequency, their learning efficiency is lower. In contrast, students in the experimental group had the opportunity to conduct experiments in a virtual laboratory prior to their real lab sessions, allowing them to gain a deeper understanding of the underlying physics concepts and successfully complete their laboratory tasks. These findings align with the previous studies that integrating virtual labs with physical labs improved students' conceptual understanding, leading to enhanced learning outcomes (Aldosari & Ghita, 2022; Arista & Kuswanto, 2018; Bhatti et al., 2018; Sriadhi et al., 2019).

Furthermore, the distribution of student lab scores between the two groups highlights the effectiveness of the virtual laboratory on students' achievement. The proportion of high scores in the experimental group was greater than that in the control group, particularly for scores in the 76-84 range. 26% of students in the experimental group scored between 76 and 84, compared to only 11% of participants in the control group. This indicates that the combination of virtual and hands-on laboratory environments significantly enhanced students learning outcomes compared to using hands-on environment alone. This result confirms the findings of several earlier studies (Anam et al., 2019; Bortnik et al., 2017; Sari et al., 2019; Sugiharti & Limbong, 2018). In addition, results from the activity completion report indicate that students in the experimental group were highly engaged with the virtual laboratory experiments. 80% of the students completed the virtual laboratory experiments, and 40% of them completed the experiments multiple times.

Results from the student survey show that the virtual learning experience had a good level of appreciation by students. Most students from the experiment group were actively engaged with the virtual experiment and satisfied with their virtual learning experiences. They appreciated the self-paced learning environment which allows them to do experiments at their own pace. In addition, they felt the virtual laboratory was helpful to learn physics concepts and gain practical skills, which confirms the results from previous studies conducted by Darrah et al. (2014), Roblyer and Hughes (2019), and Sypsas et al. (2019).

Furthermore, students in the experiment group mentioned that performing the experiment virtually increased their interests toward the topics and their confidence and motivations for learning physics. This might be due to the virtual laboratory increased students' knowledge about the lab content and techniques, making the learning experience more interesting and fulfilling. Many studies have shown that students' motivation is positively and significantly related to their academic achievement (Skinner et al., 2017; Steinmayr et al., 2019; Taylor et al., 2014). Our study confirmed that the virtual laboratory effectively motivated students to learn, resulting in improved learning outcomes. Additionally, survey results indicate that the majority of students felt the virtual laboratory facilitated a deeper understanding of physics concepts and ideas, thereby enhancing the quality of their laboratory learning. Thus, the virtual laboratory can serve as an effective tool to better prepare students before they enter traditional labs by increasing their knowledge and confidence.

In general, the combination of virtual and hands-on laboratories has positively impacted students' learning outcomes in practical physics. Students can access the virtual laboratory multiple times to deepen their understanding and have more time and opportunities to complete the lab activities. However, in virtual laboratory, students lack the hands-on experiences with real equipment and collaborations with other students. Therefore, virtual laboratories could not replace hands-on laboratories but can be used as valuable supplements to hands-on learning process to improve students' learning outcomes in physics. In this study, we examined student engagement, lab scores, and attitudes to explore the effects of blended lab activities on learning physics. However, other factors such as student attendance, laboratory performance, and learning efficiency may also be influenced by the blended learning environment. Future research should investigate the impact of blended labs on these factors. Additionally, more studies, including pre-lab and post-lab quizzes or tests, are needed to assess students' learning performance and achievement due to the use of virtual laboratories.

Conclusions

In conclusion, this study provides strong evidence for the effectiveness of combining hands-on and virtual laboratory experiments to learn physics concepts. Analysis of lab report scores revealed that the mean score in the blended learning group was higher than that of the traditional learning group. Furthermore, the Mann-Whitney U-test indicated that the difference in means between the two groups was statistically significant. Regarding students' perceptions of the virtual laboratory, the findings showed a very high level of satisfaction among participants. The majority of students appreciated the flexibility to learn at their own pace and felt that the virtual laboratory enhanced their motivation, understanding, and mastery of knowledge and skills. These results confirm previous studies indicating that the integration of hands-on and virtual laboratory environments gives significantly better outcomes for student achievement compared to using hands-on laboratories alone. In terms of the limitations of this study, although lab report scores can reflect students' achievement, further research is needed to explore the impact of blended labs on other factors that contribute to student success.

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 in the writing of this 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 Role of Higher Education in Managing the Impacts of Climate Change, With a Focus on the Kurdistan Region, Iraq

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Abstract

The Kurdistan Region of Iraq is experiencing the impacts of climate change on its water resources, agriculture, human health, and natural environment. Higher education institutions (HEIs) must respond and fulfill their vital role in managing climate change's root causes and impacts in various sectors. The ultimate goal will be to develop and integrate climate education, training, research, and innovation to educate and empower dedicated professionals on the science of climate change and its policy, economic, and social dimensions. This paper outlines the impacts of climate change in the Kurdistan Region of Iraq. To enhance the role of higher education in this context, it advocates for introducing key concepts of sustainable development and climate change perspectives into HEIs' teaching and training programs. Additionally, it aims to advance HEIs' research interests by creating science-based, data-driven, and innovative solutions to effectively address the impacts of climate change on people's lives, the economy, and the environment. The paper also identifies essential elements that should be integrated into education, training, and research efforts in KRI higher education institutions. Finally, it presents several relevant, scientifically sound research outcomes that can serve as case studies, aimed at providing practical local solutions and advancing sustainable practices for managing challenges associated with water resource management, smart agriculture, early warning systems, and mapping natural hazards linked to climate change.

Keywords: higher education, climate change, management, sustainability, Kurdistan region of Iraq

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Introduction

The Earth's climate is changing rapidly, primarily due to the emissions from fossil fuels, particularly carbon dioxide, which traps heat in the Earth's atmosphere. This change is largely driven by anthropogenic activities related to industrialization and land use, both of which are influenced by population growth and consumerism (Baban, 2004a, 2004b; IPCC, 2001).

Climate change (CC) is urgent and time-sensitive. Therefore, radical and immediate actions must be taken by the government and society before reaching the "tipping point," beyond which the impacts of climate change become rapid and irreversible (IPCC 2018; McCowan, 2020). More recently, the IPCC in its 6th Assessment Report advised that "unless there are immediate, rapid and large-scale reductions in greenhouse gas emissions, limiting warming to close to 1.5°C or even 2°C will be beyond reach" (Lehtonen et al., 2019).

Higher Education Institutions (HEIs) represent key centres for teaching, learning, training, and research. They can play a critical role in understanding and managing climate change crises through their education, training, and research activities. Hence, they are important players in the formation of professionals, of services provided to communities and government, and are micro-societies and economies in their own right (Filho et al., 2023; McCowan, 2020).

This paper outlines the impacts of climate change in the Kurdistan Region of Iraq. To enhance the role of higher education in this context, it advocates for introducing key concepts of sustainable development and climate change perspectives into climate change education, training, and research (CCETR) programs at higher education institutions (HEIs). Additionally, it aims to advance the research interests of HEIs to develop science-based, data-driven, and innovative solutions that effectively address the impacts of climate change on people's lives, the economy, and the environment. The paper also identifies essential elements that should be integrated into education, training, and research efforts in higher education institutions in the Kurdistan Region of Iraq (KRI). Finally, it presents several relevant, scientifically sound research outcomes that can serve as case studies, providing practical solutions and advancing sustainable practices for managing challenges associated with water resource management, smart agriculture, early warning systems, and mapping natural hazards linked to climate change.

Higher Education Institutions and Climate Change

Higher Education Institutions' (HEIs) have a vital role in ensuring a sustainable future. HEIs relevance lies in their ability to apply theoretical knowledge to practical questions of mitigation and adaptation. This includes understanding the specific causes and impacts of climate change in identified locations, initiating and leading research, developing renewable energy technologies, and promoting sustainability through campus initiatives. HEIs are also expected to lead and contribute to public debate by disseminating the scientific "facts" about climate and by provoking reflection on the profound economic and political shifts required to address it (Filho et al., 2023; McCowan, 2020; Nosir, 2023).

Climate change education, training, and research (CCETR) must be grounded in a scientific understanding of socio-ecological systems and the ethical dimensions of human behaviour. Additionally, it should aim to foster the development of societies that are flexible, adaptable,

well-informed, innovative, and dedicated to sustainability and human well-being (Lehtonen et al., 2019).

Given the circumstances, the increasing demands to address climate change impacts present real opportunities for higher education institutions (HEIs) in the KRI and beyond to play a crucial role in the global effort to combat climate change by addressing its root causes.

The literature shows that some work has been conducted by HEIs on the climate itself and some of the Sustainable Development Goals (SDGs). Also, some other works have focused primarily on greening campuses (Atherton & Giurco, 2011; Benayas et al., 2010) and incorporating selected issues into the curriculum (Fahey, 2012; Filho, 2010; Molthan-Hill et al., 2019; Vaughter et al., 2013). Generally speaking, HEIs have yet to fulfil their fundamental role and articulate their contribution to managing climate change challenges (Hansen & Lehmann, 2006; McCowan, 2020).

A Methodology to Enhance and Guide KRI Higher Education Contributions to Managing the Impacts of Climate Change

HEIs hold a great potential to address complex problems, enabling students, researchers, and practitioners in the field to respond to climate change impacts and prevent future disasters.

This aspiration can be realized through HEIs using their capabilities to (McKeown and Hopkins, 2010; McCowan, 2020; Nosir, 2023; Stevenson et. al., 2017):

i. Develop a climate-resilient workforce by enabling students to become informed about climate science, acquire the necessary skills for the green economy, and cultivate attitudes and behaviors needed to engage effectively with climate solutions. Creating a sustainable future starts with educating and informing individuals that by cultivating a reverence for nature and a sense of responsibility to care for it, attitudes and habits foster sustainable behaviors that balance environmental, social, and economic needs so that all can prosper.
ii. Build capacities to promote sustainable development necessitates focusing the curriculum and a system-wide commitment on local and regional levels.
iii. Promote the necessary research and innovation to sustainably manage the impacts of climate change and to learn to manage risk, learn to live and function with risk, uncertainty, and rapid change.

Energizing the role of KRI Higher Education Institutions to develop an effective climate change education, training, and research (CCETR) needs to include the three main sections:

An Overview of the Climate Change Issues in the KRI

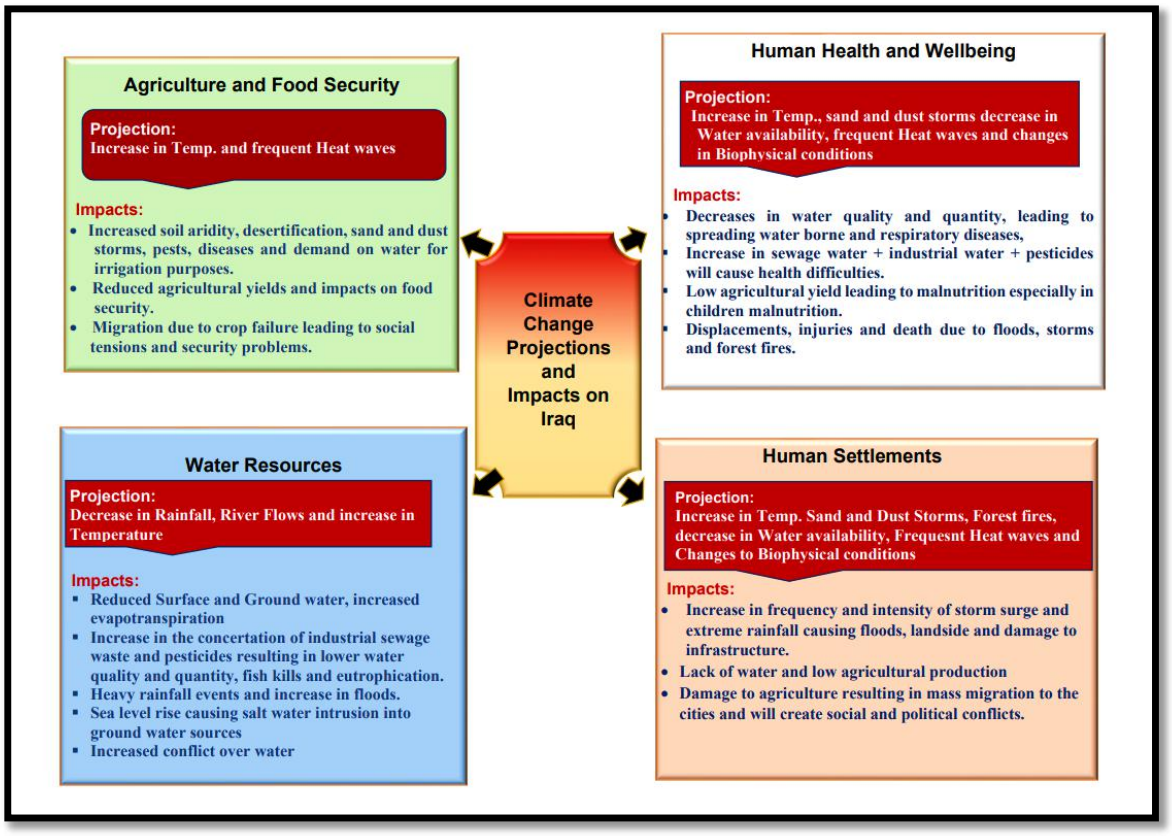
The KRI is currently facing several challenges associated with this phenomenon (Figure 1). These include the rapid expansion of the desertification process, frequent and intense dust storms, prolonged drought conditions, and heat waves, with temperatures frequently rising above 50°C (Figure 1) (Baban, 2024a; Janabi, 2013; Lelieveld et al., 2012). Consequently, this trend presents a challenge for agriculture, as FAO scientists believe that an increase of 1% in average temperature results in a 10% loss in agricultural productivity. Furthermore, as temperatures climb and evaporation increases, the demand for water rises, particularly among farmers who need to modernise their irrigation methods. Another problem associated with climate change is a shift in precipitation patterns. Rain used to fall with less intensity over

longer periods. However, of late, there has been less snow, and rainfall is more intense, preventing the land from absorbing rainwater and replenishing groundwater, while increasing flow and potentially causing erosion, landslides, and floods (Baban, 2024b; Hama et al., 2014). The expected changes in climate will affect society and have serious impacts on the economy, agriculture, health, and the environment (Baban, 2024a).

In the KRI, the current capacity for adaptation, mitigation, and resilience to climate change in various sectors, including natural resources, agriculture, health, and environment, is reactive, fragmented, marginal, and reliant on hard engineering approaches. The provisions are mainly focused on short-term relief, such as post-event compensation, repairing damaged infrastructure, and clean-up operations. Furthermore, they are also based on methods that estimate the economic impact of an event and not the necessary social, ecological, and environmental impacts. Hence, there is a pressing need for HEIs to develop a national capacity for, and to factor in the unavoidable consequences of climate change on the environment, economy, and society (Baban, 2024b). However, information poverty concerning climate change management through adaptation, mitigation, and resilience is a tangible challenge.

Figure 1

Climate Change Impacts in the KRI (Baban, 2024a)



At present, there is an absence of a national data depository for climate change-related events, where event occurrences can be recorded and quantified for post-analysis. The limited resource base, coupled with demands to prioritize responses to climate change consequences, necessitates enhancing the role of Higher Education to educate, inform, and develop science-based and data-driven solutions (Baban, 2024b).

Identifying and Engaging Relevant Concepts and Themes

Identifying relevant key concepts' themes and integrating them into HEIs' programs in climate change education, training, and research is a necessary step to start the process.

An obvious concept for advancing Climate Change Education, Training, and Research (CCETR) is sustainability. This is due to its holistic nature, encompassing key competencies such as systems thinking, strategic thinking, collaboration, critical thinking, self-awareness, and integrated problem-solving (Nosir, 2023; Rieckmann, 2018). Furthermore, sustainability pedagogies are typically place or issue-based and focus on improving local communities (Lelieveld et al., 2016). Such experiences not only develop students' knowledge and skills but also their disposition to make reasoned decisions and consider alternative, more sustainable ways of living (Nosir, 2023). Sustainability also serves as an optimal framework for advancing CCETR, as it can integrate the economic, social, and environmental dimensions of sustainability into the curriculum (Hedefalk et al., 2015), underscoring the interconnected nature of human development, well-being, equity, and environmental stewardship (Mochizuki & Bryan, 2015; Nosir, 2023).

The second concept is Climate change science and education (CCSE), which represents the intersection of disciplines like geography, meteorology, biology, physics, earth sciences, and chemistry. CCSE also includes effective communication skills about climate and climate change, attitudes, motivations, and beliefs needed to make informed and responsible decisions (Azevedo & Marques, 2017).

In terms of course and curriculum design, these should be restructured so that all subjects, from mathematics to literature, incorporate sustainability and climate change perspectives. For example, an economics course could explore circular economy models, while a design course could focus on sustainable architectural solutions (Filho et al., 2023).

Identifying and Integrating the Relevant Elements Into Education, Training and Research Programmes

Climate change education, training, and research (CCETR), by nature, encompasses all of the disciplinary areas, from natural sciences to social sciences and arts and humanities, in academic and professional courses. Also, in terms of research, it is endeavours to combat climate change and framing possible solutions, reflecting on the roots of the problem, including human nature interdependency (Lehtonen et al., 2019).

CCETR teaching and training will need to be grounded in sustainability and student-led inquiry as approaches for developing students' abilities to think, act, and reflect as local and global citizens striving to create a more sustainable world (Nosir, 2023).

The development and implementation approaches should view teaching, training, and research requirements through the lenses of climate change causes, impacts, mitigation, and adaptation. In addition to adopting innovative, problem-based methods that develop students' critical and creative thinking skills, as well as their ability to solve real-world problems. Finally, relevant case studies should be included and used to illuminate and disclose the causes, effects, and possible solutions (Nosir, 2023).

Education

Climate Change Education must be a cross-cutting component that permeates all aspects of university life. From the natural sciences to the humanities, Climate Change Education presents a blend of science, engineering, and socio-economic issues that can manage science-based concerns, such as natural causes and changes in the climate system, and address climate justice, including how groups like women and girls and indigenous peoples are differentially impacted. All disciplines have a role to play in educating responsible citizens and professionals committed to nature.

Climate change education should aim to develop students' knowledge, skills, and experiences on climate science, disaster risk reduction, environmental change, and solutions and action. In addition to the following key competences (Eilam & Widdop, 2019; Filho et. al., 2023; Kwauk, 2021; Nosir, 2023; Sheppard, 2012; UNESCO, 2016, 2021):

i. Developing a curriculum that encompasses climate science, ecosystems and biodiversity, climate justice, resilience building, post-carbon economies, and sustainable lifestyles.
ii. Developing specialized themes with the curriculum that have a focus on sustainable agriculture, water management, and advanced farming technologies suitable for arid environments.
iii. Promoting Systems thinking to facilitate understanding the interrelationships between natural, social, and economic systems.
iv. Fostering foresight and planning to enable anticipating future scenarios and designing sustainable policies.
v. Nurturing collaboration and problem solving to facilitate working in multidisciplinary teams to solve climate problems.
vi. Embedding Ethical and global responsibility to instigate making conscious decisions that take into account the well-being of the planet and future generations.
vii. Developing creativity and innovation to enable designing transformative solutions that advance sustainability.

Outreach and Training

HE, through their outreach and training, will need to develop programs to help the general public understand and address climate change's impacts. By raising awareness of the problem and supporting capacity and capability building, they can promote and encourage changes in attitudes and behaviours, focusing on adaptive change in preparing people to face the challenges of a changing climate.

HE can also directly engage in climate change outreach and training through discipline-led activities, interdisciplinary efforts, and collaborative work with local, national, and international stakeholders and partners (Filho et al., 2021a, 2021b; Filho et al., 2022; Filho et al., 2023).

More specifically, HEIs' outreach and training are required to:

- Provide Hands-on Training: Offering practical experience in smart and modern agricultural techniques, including hydroponics, vertical farming, and precision agriculture.
- Raise Awareness: Educating the public about the importance of sustainability, water and food security, and managing excessive consumption practices.

- Work with the media to shape perceptions and minimize the spread of climate change misinformation and disinformation, so that the public develops critical literacy skills to discern truth from falsehoods.

Research and Innovation

HEIs, through their research and innovation work, will need to focus their efforts on observed changes in climate, drivers of climate change, future climate change, risks and impacts, adaptation and mitigation strategies, socio-economic factors, policy and governance issues, and ethical considerations.

In terms of Research and Innovation programs**,** KRI HEIs will need to develop programs with a specific emphasis on (Holloway & Fortune, 2018; Kitagawa, 2017; McCowan, 2020; Preston et al., 2015):

1. Mitigation tools and actions to lessen the direct impact of climate change through reducing greenhouse gas emissions, investments in fossil fuel Companies, concerning fuel efficiency, carbon capture, etc., and changing the mindsets of society to encourage climate-friendly actions in daily lives.
2. Adaptation activities and tools to introduce adjustments to natural and human systems in response to the actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities.
3. Preparedness and resilience, which will involve application of knowledge to address required changes in lifestyles, agriculture, housing, healthcare, and so forth, both about capacity building and awareness raising, but also generation of new ideas and technologies.

More specifically, for the KRI, the author, through his involvement as a senior scientist, member of the high council for the environment in the KRI, and an active participant representing KRI Presidency in both COP27 and COP28, as the author for KRI COP29 regional priorities, identified the following as research priorities and conditions for:

i. Food Systems

Climate-smart agricultural technologies and practices such as land and water resources conservation, Drought Resistant Crops, precision and smart agriculture, agroecology, water-efficient irrigation, modern farming such as hydroponic renewable energy and energy efficiency, climate adapted crop types/varieties and livestock types/breeds, crop/livestock diversification, agro-forestry, integrated pest and disease management, post-harvest technologies, improved livestock management, fodder production and livestock feeding strategies.

ii. Water Resources Management

The adaptation actions focused on the water-agriculture-poverty nexus are critical for the KRI. Accordingly, there is a need for research and innovation to:

- Improve regional cooperation and at the national level to enhance water use efficiency and productivity jointly with demand management policies, and improve water allocation and appropriate valuation.
- Support the use of the best available hydro-climatic information to improve water resources management

- Promote sustainable utilization of groundwater and use of modern technologies in monitoring and controlling groundwater aquifers
- Develop water harvesting schemes.
- Modernize irrigation and drainage systems, manage salinity, and rehabilitate and update the operation of dams
- Repurpose public sector support and policies (including subsidies) toward sustainable outcomes in the water and agricultural sectors, and encourage investments in the agri-food sector
- Support the management of extreme events (integrated flood management, drought management).

iii. Renewables

The KRI will need to reassess its production and consumption of fossil fuels, examine possible mitigation and adaptation measures, and initiate a significant shift to renewable, clean energy sources.

iv. Management Instruments

The KRI will need to develop the necessary instruments for climate change management, including efforts to;

- Develop early warning systems and predictive understanding of landslide and flood processes and triggering mechanisms.
- Make Data Validation and Metadata development an essential part of all the outcomes from consultancies and research projects funded by the government.
- Coordinate the efforts amongst various relevant ministries and agencies concerned with climate change-related events.
- Develop effective programs for public awareness, education, and information diffusion.
- Adopt a public education drive in schools and through the media to inform the public of "incorrect" practices, amplifying climate change-related hazards and the consequences for the community and the country.
- Examine and develop effective Insurance mechanisms as an instrument for managing geohazards and loss reduction measures.

v. Management Scenarios

The KRI will need to develop plausible management scenarios to account for the effects of climate change on the economy and society.

vi. Seeking International Collaboration

The KRI will need to be tempting to persuade international funding agencies to fund quality research and capacity building in the KRI, specifically by providing up-to-date satellite imagery and developing management scenarios to account for the effects of climate change on the economy and society. In addition to identifying and supporting the most vulnerable groups and people in society.

Practical Solutions as Case Studies

Teaching and learning regarding climate change can best be implemented through relevant case studies that can illuminate causes, effects, and solutions as pedagogical tools (Nosir, 2023).

The following presents several relevant and published research outcomes that can serve as case studies aimed at presenting practical solutions and advancing sustainable practices for managing climate change challenges associated challenges in the KRI.

Smart Agriculture: Strategic Agricultural Production

During 2016, Baban identified the major parameters that affect productivity in the KRI. These included: nutrition represented by soil types and climatic needs represented by rainfall and temperature. Then, a GIS-based approach was developed to create the necessary datasets and to develop specific agro-climatic zone maps for growing 16 strategic crops in the KRI (Table 1). These included a map locating the most suitable locations for producing Wheat in the KRI (Figure 2) (Baban, 2016).

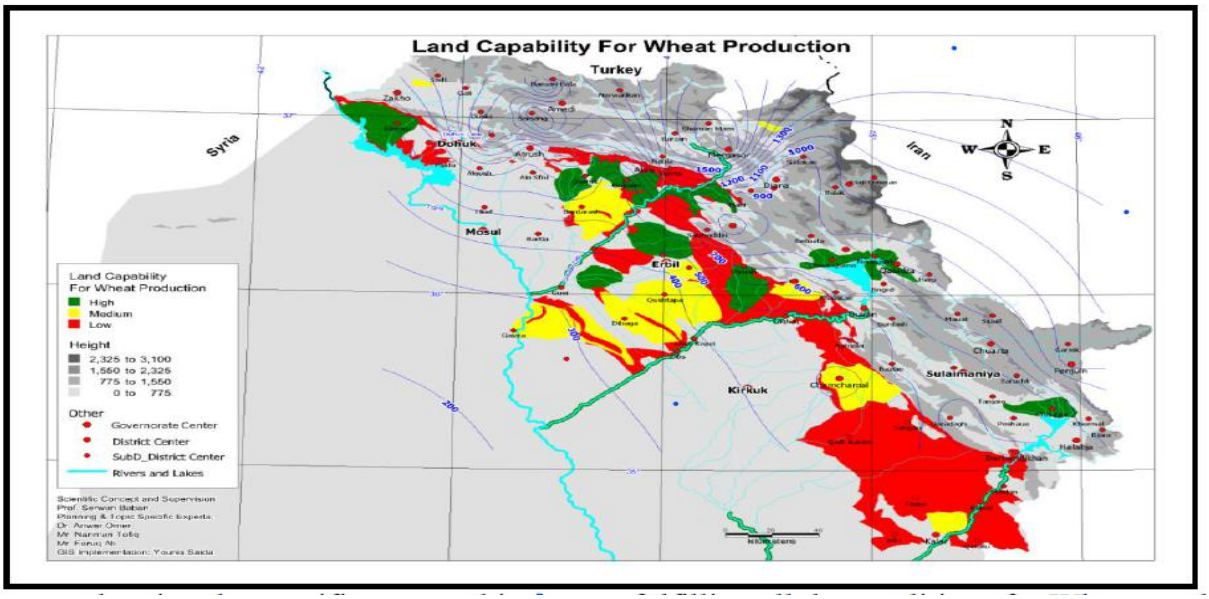
Table 1

The Parameters Affecting the Productivity of 16 Strategic Products in the KRI (Baban, 2016)

No	Production	Soil Type (Reconnaissance Soil Legend)	Temperatures (Centigrade)			CWR (mm)
			Min.	Max.	Optimal	
1	Wheat	Loam-Sand-Clay	5	38	20-25	350
2	Barley	Loam-Sand-Clay	5	38	20-25	250
3	Corn	Loam	20	32-34	22-25	817.41
4	Tomato	Loam	12	28-34	15-20	758.3
5	Potato	Loam	12	28-34	15-20	875.13
6	Sunflower	Sand-Clay	20	25	25	837.37
7	Apple	Clay- Loam	-5	32	30	567.53
8	Courgette	Loam	15	45	25-30	400.41
9	Grape	Clay-Loam-Sand	0	35	5-25	567.53
10	Peach	Sand-Loam	15	45	25-30	567.53
11	Cucumber	Loam-Sand-Clay	25	30	25-30	400.41
12	Pomegranate	Clay-Loam-Sand	15	45	25-30	567.53
13	Rice	Clay	18-22	37-40	30-33	1408
14	Soybean	Sand-Clay	10-14	37-40	25-28	959.75
15	Onion	Sand	15	45	25-30	400.41
16	Eggplant	Sand-Clay	16	45	25-30	400.41

Figure 2

Most Suitable Locations for Wheat Production in the KRI (Baban, 2016)

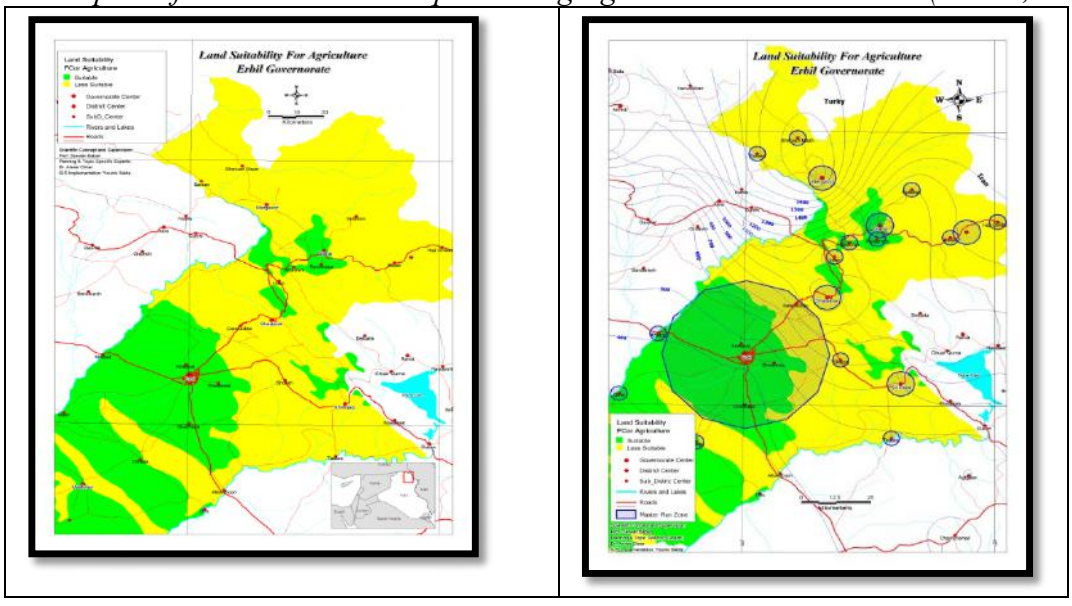


Nature-Based Solutions: Saving Prime Agricultural Land

Baban, during 2015, researched the Impact of Master Plans on Squandering Agricultural Land in the KRI. In this study, he identified suitable land for agriculture based on climate, slope and soil depth (determining rooting volume and water storage), and texture of soil (determining water availability and land drainage) Figure 3). Then, the proposed boundaries for the KRI master plans were overlaid on the map to determine, under current practice (Figure 3), the impacts of urban expansion on wasting prime agricultural land within the KRI. The results showed a significant estimated loss in all the governorates, and the overall loss is about 27% of the prime land for agriculture in the KRI (Baban, 2015).

Figure 3

The Impact of Master Plans on Squandering Agricultural Land in Erbil (Baban, 2015)

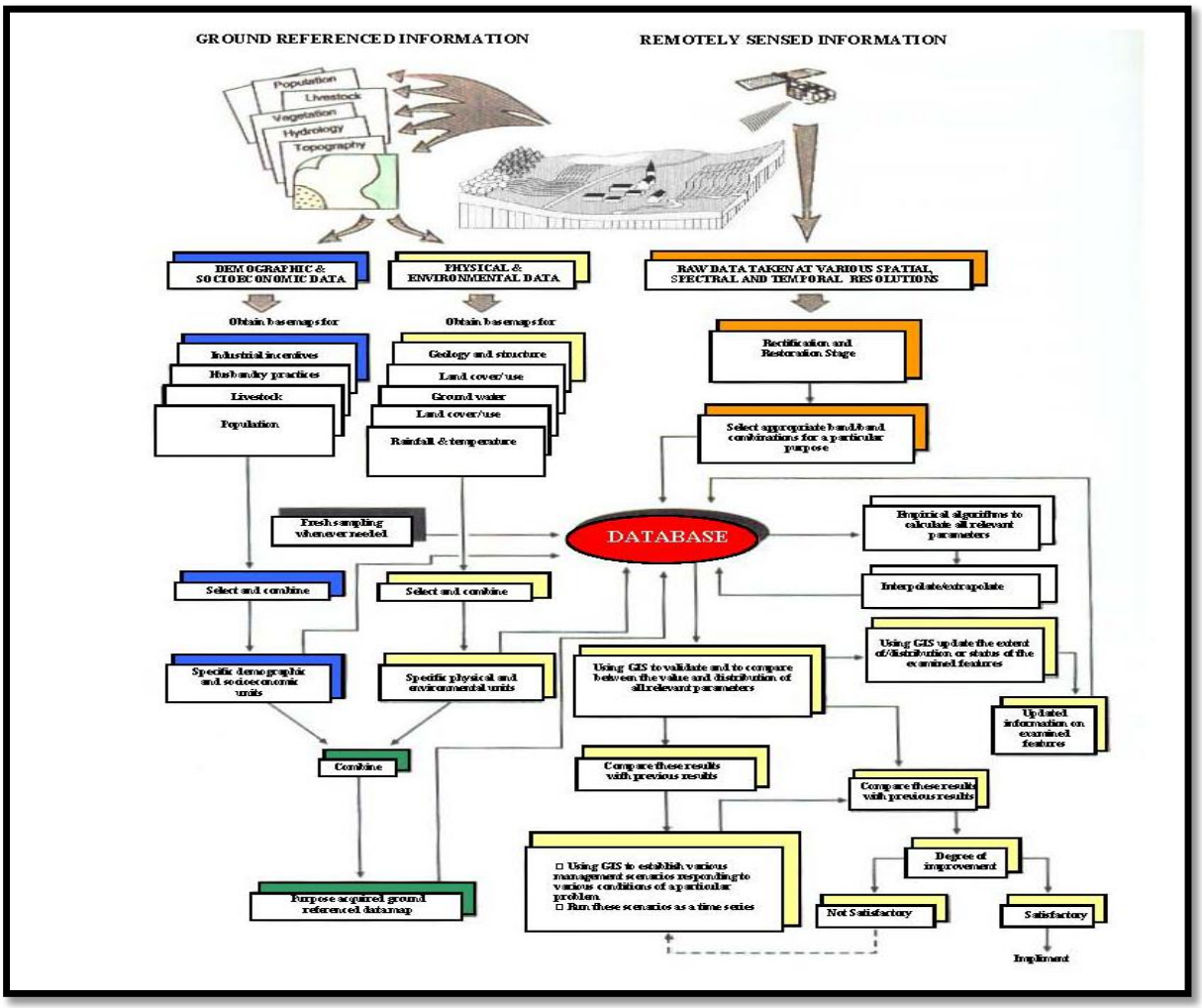


Water Resources Management: Managing Water Resources in the KRG

Baban, during 2006, developed a Geoinformatics-based system for managing water resources in the KRI (Figure 4). The proposed system has a geo-based holistic approach that can be updated as required. Furthermore, through the GIS component, the system allows for examining the suitability of various management options, and identifying the best option to effectively manage these resources under specific conditions (Baban, 2006).

Figure 4

A Geoinformatics-Based System for Managing Water Resources in the KRI. (Baban, 2006)



Conclusions

Climate change is an urgent challenge facing humanity and the future of the planet. KRI higher education is presently encountering the impacts of climate change, which are manifesting as increasing temperatures, reduced precipitation levels, changes in distribution patterns, degradation of arable land due to desertification, frequent droughts and sandstorms, and a decrease in agricultural productivity. These factors are likely to result in increased hardship for the populace and heightened social instability in the years to come, if appropriate protective planning and solutions are not implemented.

This work indicated that a way forward is through the KRI, higher education helping to build a sustainable and climate-resilient future. This ambition can be realized through using the lens of climate change to develop educational and training programs to upskill current and future leaders and professionals to introduce and manage the much-needed systemic change and transformations. Also, through research and innovation to build local knowledge and create science-based, data-driven, and innovative solutions to effectively handle the impacts of climate change on various sectors, and regions with the view to developing adaptation scenarios, planning for the human and economic costs, and strengthening government policies for mitigation, crisis avoidance, and protection of the vulnerable population.

The paper also identified the essential elements that should be integrated into education, training, and research efforts in KRI higher education institutions. It also presented several relevant research outcomes that can serve as case studies, aimed at providing practical local solutions and advancing sustainable practices for managing challenges associated with smart agriculture and water resource management in the KRI.

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Data-Driven Analysis of Learning Behaviors Among At-Risk Students Across Disciplines Using Data Mining Techniques

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Abstract

In recent years, the proliferation of e-learning systems has provided an unprecedented opportunity to collect and analyze vast amounts of data concerning student learning behaviors. This research aims to use data mining techniques to identify common learning patterns of at-risk students across various disciplines. Unlike previous studies that have predominantly focused on individual disciplines or subject areas, this study integrates data from multiple disciplines to offer a comprehensive analysis. We utilized big data sourced from log files of an online e-learning system called Blackboard, supplemented by performance data from individual assessment components. The dataset included all students from 240 subjects across four academic divisions, resulting in a total of 1.7 million rows of records. Our findings show that at-risk students often exhibit low click rates on the e-learning system, delay starting assignments until close to deadlines, and consistently low participation in online activities. Additionally, the study found a high correlation between students' performances in in-class exercises and tests with their overall subject performance. This suggests that regular engagement and participation in formative assessments are strong indicators of academic success. These insights are critical as they will enable educators to develop targeted interventions aimed at improving student performance and retention rates. By understanding the distinctive learning behaviors of at-risk students, educators can provide timely support and resources to help these students succeed. This research not only highlights the importance of using data-driven approaches in education but also underscores the potential of interdisciplinary analysis in enhancing educational outcomes.

Keywords: cross-disciplinary analysis, data mining, at-risk students, e-learning systems, learning analytics

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Introduction

The proliferation of digital technologies and the accelerated adoption of e-learning systems in higher education have fundamentally transformed teaching, learning, and the assessment of student performance (Siemens & Long, 2011). In the wake of the COVID-19 pandemic, institutions worldwide rapidly transitioned to online and blended modalities, resulting in a dramatic increase in the generation of rich educational data (Dhawan, 2020). Learning management systems (LMS) now underpin much of the student learning experience, capturing detailed activity logs that chronicle patterns of engagement, resource access, and participation (Romero & Ventura, 2020). These digital footprints present an unprecedented opportunity for educational researchers and practitioners to apply advanced data analytics and artificial intelligence (AI) to support students more effectively, particularly those at risk of academic failure (Baker & Inventado, 2014).

The advent of learning analytics holds significant promise for both educators and learners by enabling the analysis of LMS activity logs in conjunction with assessment records. Such analytical approaches empower educational institutions to transcend generic interventions, facilitating the development of individualized support mechanisms, real-time feedback systems, and targeted mentorship initiatives (Siemens & Long, 2011). Through detailed examination of activity logs within e-learning environments, it becomes possible to identify a range of critical issues, including curriculum planning, monitoring students' learning progress, analyzing learning behavioral patterns, and early identification of at-risk students.

Traditional approaches to identifying at-risk students have relied primarily on lagging indicators, such as grades, attendance records, or subjective educator observations, that often fail to capture the complex, dynamic, and multifaceted nature of student engagement and risk (Arnold & Pistilli, 2012). Such methods may miss subtle early warning signs, resulting in delayed intervention and missed opportunities to prevent academic struggles or attrition (Jayaprakash et al., 2014). Recognizing these limitations, there has been a growing movement toward leveraging educational data mining, machine learning, and predictive analytics to enable early, proactive, and data-driven identification of students who may be at risk across diverse academic contexts (Slater et al., 2017). For example, machine learning can be used to discover patterns from massive student activity data to create a recommendation system for development of generic competencies (So et al., 2023; Wong et al., 2024).

However, the deployment of such systems is not without its challenges. Data quality and integration, ethical and privacy concerns, the imbalance of at-risk versus non-at-risk cases in real-world datasets, and the generalizability of predictive models across subjects and disciplines all pose significant hurdles to the effective and equitable use of AI in education (Baker & Inventado, 2014; Slater et al., 2017). Prior research in the field has often been limited in scope, focusing on single disciplines or individual courses, and utilizing narrowly defined datasets (Jayaprakash et al., 2014). These subject-specific models, while sometimes highly accurate in their own right, frequently lack the capacity to generalize to different contexts where instructional design, assessment structure, and student demographics may vary widely (Romero & Ventura, 2020). As such, there is a pressing need to develop robust, scalable, and interpretable models that can operate effectively across the diversity of modern higher education (Dhawan, 2020).

This research responds to that need by presenting a comprehensive, cross-disciplinary analysis of learning behaviors among at-risk students, utilizing extensive data from the LMS

and assessment records at a higher education institution. By analyzing activity logs and assessment records spanning 240 subjects across four academic divisions, we aim to uncover both universal and context-specific indicators of risk to improve comparability and predictive accuracy across heterogeneous subjects. Critically, the methodology is designed to respect student privacy by excluding sensitive demographic data, focusing solely on behavioral and academic performance metrics available to instructors.

Literature Review

The application of data mining and learning analytics in educational contexts has grown rapidly over the past decade, offering innovative pathways to identify, support, and retain at-risk students (Baker & Inventado, 2014; Romero & Ventura, 2020). Data mining, a subfield of AI, encompasses a broad array of supervised and unsupervised learning algorithms designed to extract meaningful patterns from large, complex datasets (Baker & Inventado, 2014). In educational settings, these methods are increasingly harnessed to analyze students' digital footprints within LMS, digital assessments, and other online platforms (Siemens & Long, 2011). Historically, efforts to identify at-risk students have relied primarily on discipline-specific or course-level models that leverage easily accessible indicators such as prior grades, attendance, assignment submission patterns, and participation in discussion forums (Arnold & Pistilli, 2012; Jayaprakash et al., 2014). These studies often employ classification algorithms to predict student risk based on features tailored to the unique structure of a given course or subject (Arnold & Pistilli, 2012).

Abu-Naser et al. (2015) developed an artificial neural network (ANN) model to predict first-year engineering students' cumulative grade point average (CGPA). Their approach incorporated variables such as academic background, high school characteristics and location, gender, and other demographic data, achieving a prediction accuracy of 84.60%. Similarly, Adekitan and Salau (2019) utilized an ANN model to forecast the academic achievement of engineering students by using the GPA from the first three years to predict the graduation GPA after completing a five-year curriculum, resulting in an accuracy of 89.15%. A recent study demonstrated that utilizing only LMS log data and assessment results can effectively enable the early identification of at-risk students in a computer programming course (Chiu et al., 2023). This approach achieved an accuracy rate of around 85% to 91% in detecting at-risk students in different stages in a semester, as early as the availability of the first assignment's results.

Beyond academic history and prior GPA, additional research has examined the influence of family factors and living environment on student success. For instance, Rivas et al. (2021) considered students' living regions and neighborhood crime rates as predictive variables, while Xu and Chen (2018) included birth dates, number of books borrowed, and internet usage within their models. Hamoud and Humadi (2019) collected data encompassing students' health and sports participation, family and household status, parental circumstances, and social life. Likewise, Rodríguez-Hernández et al. (2021) integrated academic records with socioeconomic status, home characteristics, household information, and employment status to predict student performance. The resulting model accuracies ranging from 78.20% to 87%.

Focusing on learning-specific factors, Saputra et al. (2020) developed a prediction model that achieved a notably high accuracy of 98.20%. Their study aimed to predict student success in an e-learning course, relying primarily on system activity log files for input variables, such as

training sessions, forum participation, chat interactions, discussion contributions, upload assistance, messaging, quiz attempts, and total logins, using gender as the only personal demographic variable.

The literature mentioned above, while effective in producing high accuracy within a constrained context, is inherently limited in generalizability (Jayaprakash et al., 2014). Models trained on data from a single course or discipline may fail to transfer their predictive power to other academic domains with different pedagogical styles, assessment formats, or student populations (Romero & Ventura, 2020). Furthermore, the feature sets selected for these models are often closely tied to the instructional design of specific courses, rendering them less suitable for broader, institution-wide identification of at-risk students (Dhawan, 2020).

There is a pressing need for research that not only integrates diverse sources of behavioral and performance data but also rigorously addresses privacy and ethical considerations, ensuring interpretability and fairness in model deployment (Baker & Inventado, 2014; Dhawan, 2020). This study addresses this gap by employing a comprehensive, cross-disciplinary data mining approach to uncover universal factors among at-risk students. By applying advanced data-driven techniques to a heterogeneous dataset spanning hundreds of subjects and multiple academic divisions, the research advances the field toward scalable, generalizable, and actionable early warning systems in higher education.

Methodology

This research is conducted within the School of Professional Education and Executive Development (SPEED) at The Hong Kong Polytechnic University (PolyU), an institution that provides professional education. PolyU SPEED offers various top-up degree and taught postgraduate programmes across four academic divisions: the Division of Business and Hospitality Management (BHM), the Division of Languages and Communication (LC), the Division of Science, Engineering and Health Studies (SEHS), and the Division of Social Sciences, Humanities and Design (SSHD). There are two main semesters per academic year, each has 13 weeks for teaching and learning activities.

PolyU SPEED uses Blackboard as its LMS for course administration, content distribution, and student engagement. Blackboard allows instructors to develop course sites where students have access to educational resources such as lecture materials and assignments. The system also provides tools for online discussions, assignment submissions, and real-time quizzes to support various teaching practices.

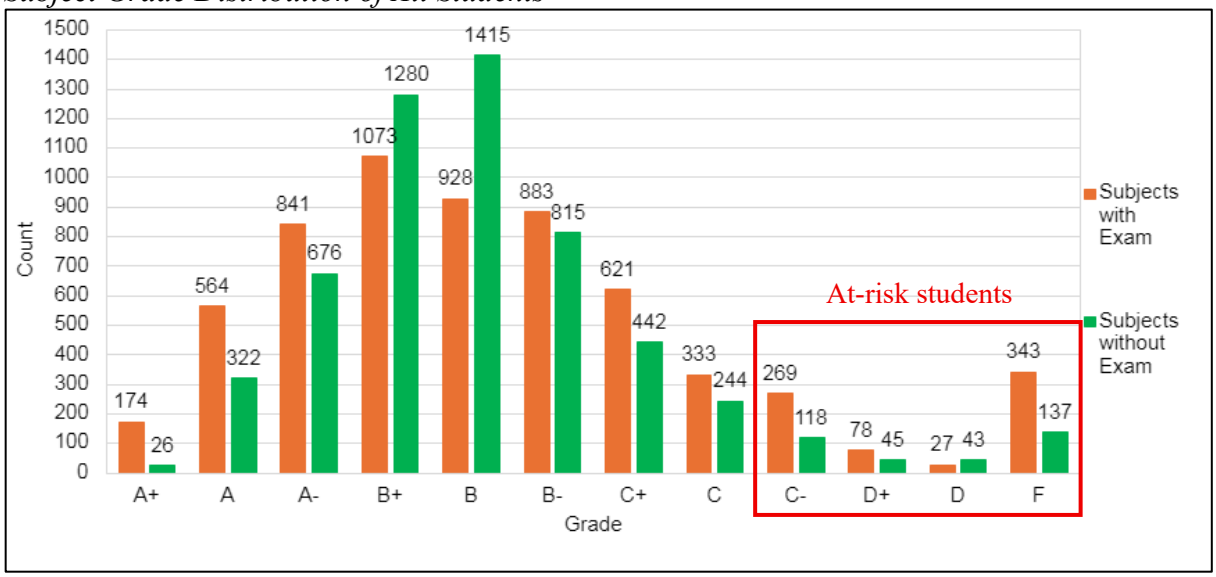
Data Collection

A comprehensive data collection initiative was conducted during the second semester of the 2023–2024 academic year, involving 240 top-up degree subjects across four divisions. This coordinated effort ensured robust representation of the institute's diverse academic programs. Student behavioral data related to learning activities were extracted from the Blackboard, resulting in the compilation of student activity log files, teacher activity log files, and learning component log files. Collectively, these files contained over 1.7 million rows of records documenting various aspects of students' learning behaviors.

Furthermore, comprehensive assessment records for all students were collected and organized by subject within marksheets to support performance analysis. The marksheets contain scores from continuous assessment components and final subject grades for each subject, resulting in over 20,000 assessment records. Figure 1 illustrates the distribution of students across various grades. In this study, at-risk students are defined as those with grades of C- or lower, comprising approximately 5% of the dataset.

Figure 1

Subject Grade Distribution of All Students



The Blackboard log files were systematically summarized, with student activities organized on a weekly basis to accurately reflect learning behaviors over the 13 teaching weeks. Data filtering procedures were applied to ensure reliability. Specifically, subjects with comparable assessment components were selected for detailed analysis. These components included individual assignments, group projects, and tests. Selected subjects encompassed both those with and without final examinations.

This large volume of data not only underscores the scale of the study, but also provides a rich foundation for conducting nuanced analyses that span disciplinary boundaries. The integration of behavioral and assessment datasets supports the development of scalable models for identifying at-risk students, while also enabling the exploration of generalizable factors influencing academic success within a heterogeneous educational environment.

Findings and Discussion

Analysis of the comprehensive dataset revealed a nuanced relationship between student assessment outcomes and their patterns of engagement on the Blackboard e-learning platform. We first analyzed the correlation between assessment components and overall subject grades across the four divisions. Then, the log files extracted from Blackboard are analyzed with the overall subject grades, evaluating the relationship between engagement pattern and academic performance.

Influence of Assessment Components on Academic Performance

Figures 2-7 demonstrate the results of the correlation analysis, where IA and GP stand for individual assignment and group project, respectively. Due to the practical nature of the LC and SSHD, these subjects in Figure 6 and Figure 7 usually do not have examinations.

The correlation results reveal that, as expected, the examination component consistently demonstrates the strongest correlation with overall subject grades among all subjects that incorporate an examination across the four divisions. When the examination component is excluded, which may not be suitable for early detection since it is typically administered at the conclusion of the semester, the test component emerges as the most predictive assessment element, with correlation coefficients frequently surpassing 0.7. Notably, the lowest correlation between the test component and the overall subject grade is observed in BHM subjects that include an examination, as illustrated in Figure 2, where the value registers at 0.59. Nevertheless, this value still represents the highest correlation among all non-examination assessment components under consideration in Figure 2, emphasizing the central role of tests in determining final academic outcomes.

Figure 2

Correlation Analysis of BHM Subjects With Examination

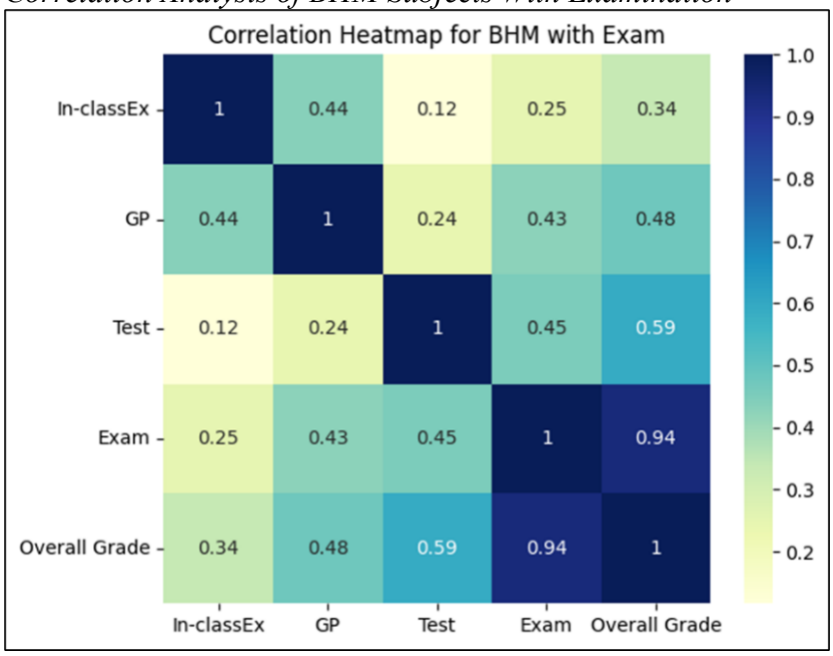


Figure 3

Correlation Analysis of BHM Subjects Without Examination

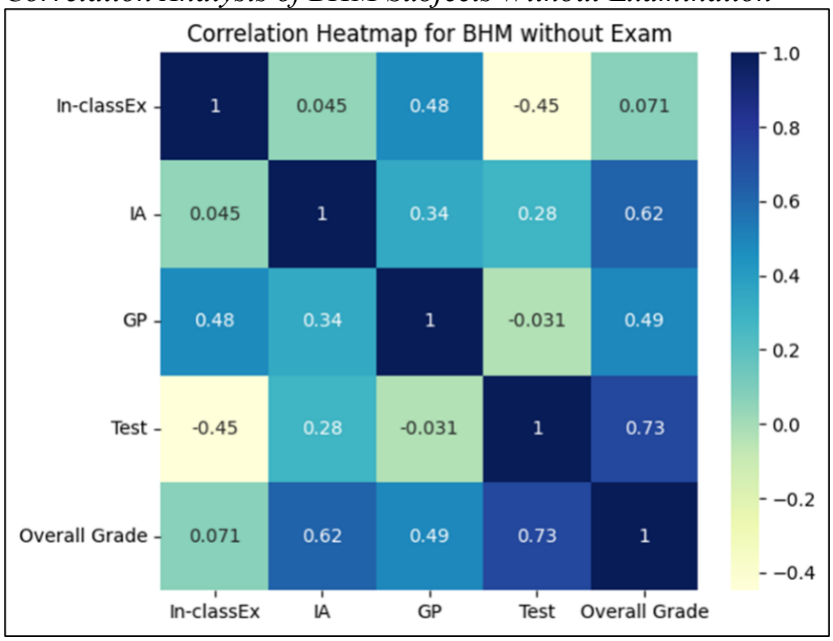


Figure 4

Correlation Analysis of SEHS Subjects With Examination

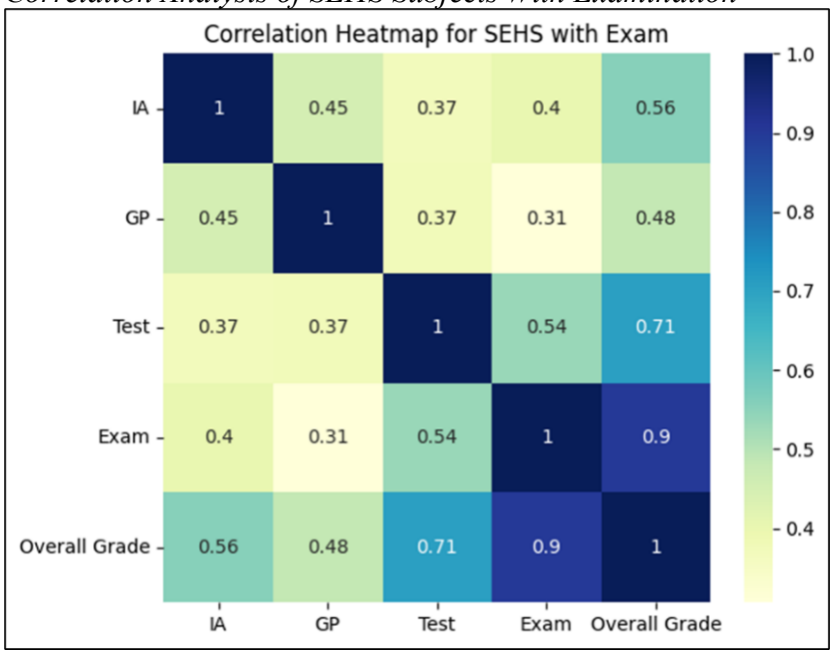


Figure 5

Correlation Analysis of SEHS Subjects Without Examination

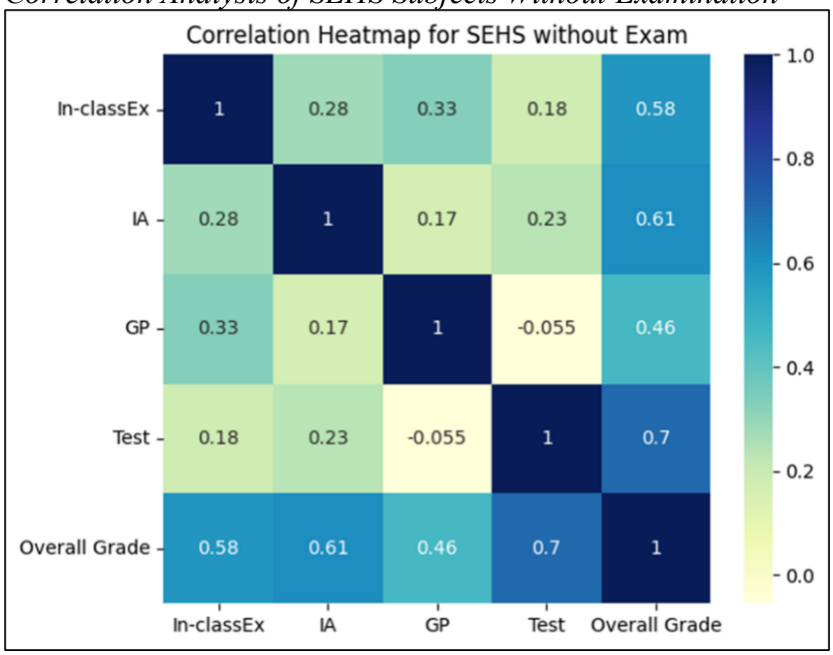


Figure 6

Correlation Analysis of LC Subjects Without Examination

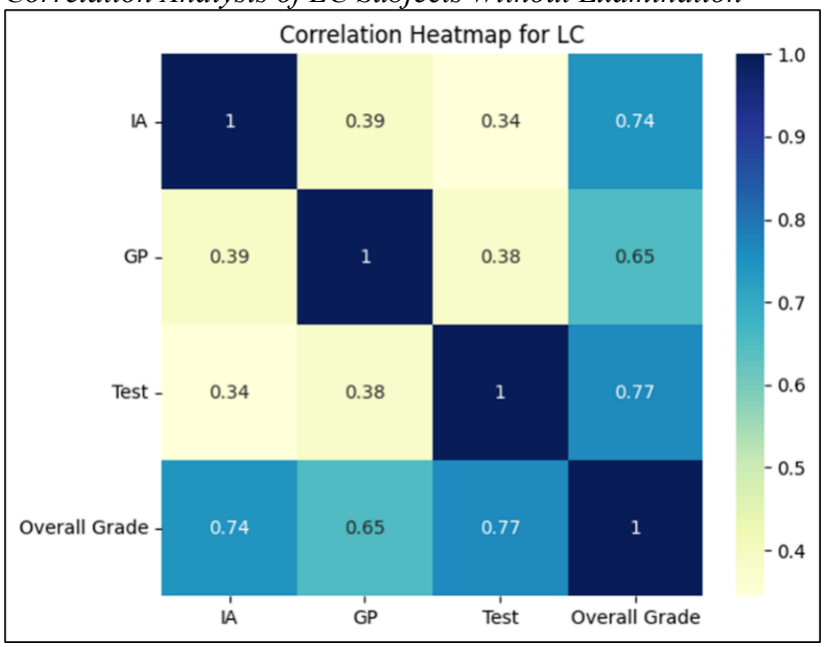
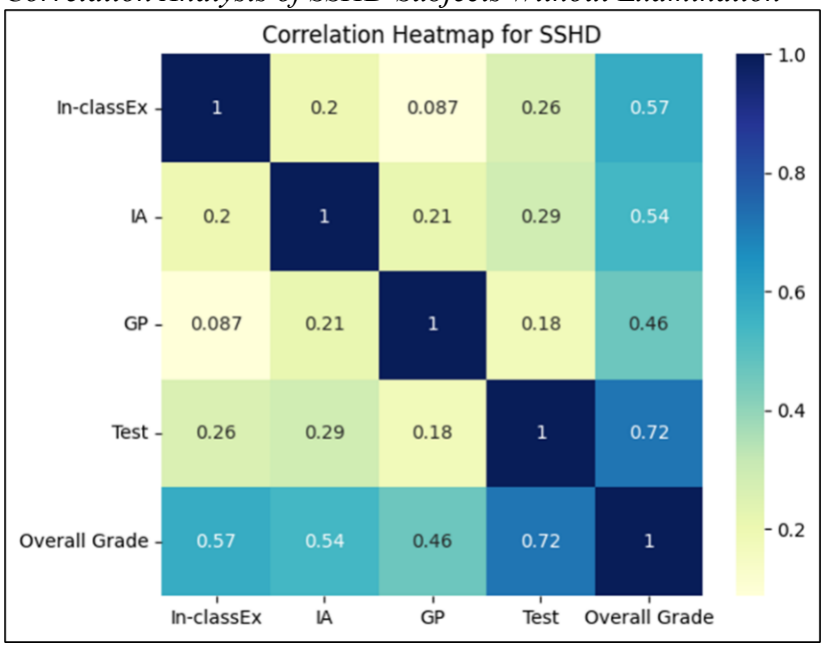


Figure 7

Correlation Analysis of SSHD Subjects Without Examination



Comparable in nature to tests, typically administered during class time under controlled conditions, in-class exercises similarly require students to complete specific tasks within a predetermined period. To provide a comprehensive analysis, the correlation between in-class exercise performance and overall subject grades was examined wherever such data were available. The findings, however, varied considerably across divisions.

For BHM subjects, as depicted in Figure 2 and Figure 3, the correlation coefficients are notably low, with values of 0.34 and 0.071 for subjects with and without examinations, respectively. These represent the lowest correlations among all assessed components within this division. In contrast, for SEHS subjects, in-class exercises are only present in subjects that do not include an examination. The correlation observed is relatively strong, with a coefficient of 0.58 as shown in Figure 5, a value on par with those for individual assignments and group projects. LC subjects do not incorporate in-class exercises within their assessment frameworks. For SSHD subjects in Figure 7, the correlation between in-class exercise performance and overall grade is measured at 0.57, surpassing the corresponding values for both individual assignments and group projects.

These results carry significant implications for both instructional design and student support mechanisms within multi-disciplinary educational environments. Foremost, the analysis underscores the pivotal role of tests as the strongest predictors of overall academic performance, particularly in subjects where examinations are either central or absent. Consistently high correlation coefficients between test results and final grades highlight that well-constructed tests are not merely evaluative tools but also crucial indicators of student understanding and mastery. The findings also suggest the strategic importance of administering early tests in the semester. Early testing provides instructors with timely and actionable data, enabling them to quickly identify students who may be struggling. This early detection facilitates targeted interventions, tailored support, and adaptive teaching strategies, increasing the likelihood of improved outcomes for at-risk students. By leveraging test results early in the learning cycle, educators can shift from reactive to proactive support, fostering a more equitable and effective academic environment.

In-class exercises, while not universally predictive of final grades, present a more nuanced impact depending on the subject division. For some divisions such as SEHS and SSHD, in-class exercises display moderately strong correlations with academic performance, suggesting these activities can reinforce learning and provide ongoing feedback. However, in other divisions like BHM, the correlation is notably weaker, indicating that the design and integration of in-class tasks may need to be more closely aligned with learning objectives to maximize their impact. The findings also emphasize the importance of context-sensitive use of in-class exercises, which, when effectively incorporated, can supplement formal assessments and enhance the learning process.

Relationship Between LMS Engagement and Academic Performance

While assessment results serve as valuable performance indicators, students' interactions within the LMS can also yield important insights. Through data mining of Blackboard log files, key engagement indicators have been identified, including login frequency and duration, session count, number of clicks, as well as the mean and standard deviation of these metrics. These features demonstrate correlation with academic performance and may facilitate early identification of at-risk students.

Table 1 presents the correlation between key engagement indicators and overall subject grades across the four academic divisions. In contrast to the earlier analysis of assessment components, the examination of Blackboard interaction metrics does not reveal a strong, consistent correlation when all subjects and students are considered collectively. The aggregate relationship between students' assessment outcomes and their digital engagement within the Blackboard platform remains generally weak. This attenuated correlation is largely attributable to the considerable heterogeneity inherent in the pedagogical frameworks and course designs encompassed by the study. Each discipline imposes its own unique expectations regarding online engagement, assignment configuration, and the integration of technology into the learning experience. Such variability substantially diminishes the predictive value of any singular behavioral indicator when generalized across a broad and diverse educational landscape.

Table 1

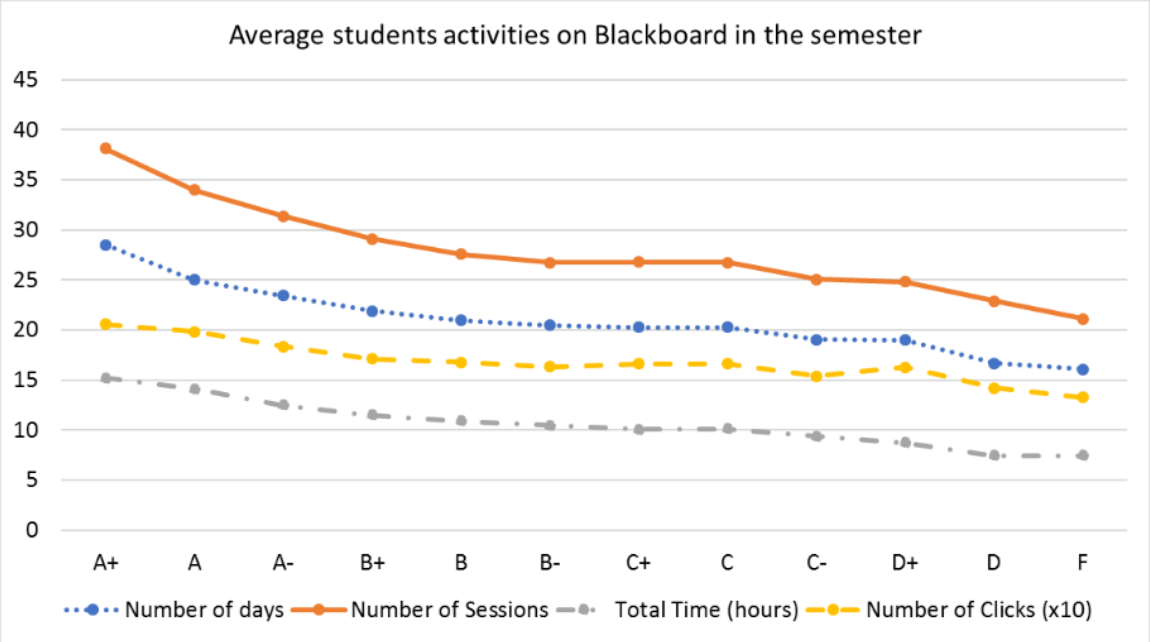
Correlation Between Engagement Indicators and Overall Subject Grade

	BHM	SEHS	LC	SSHD
Days	0.203	0.185	0.142	0.175
Sessions	0.169	0.160	0.116	0.158
Total_Time	0.075	0.123	0.189	0.114
Avg_Total_Time	0.090	0.089	0.154	0.122
Std_Total_Time	0.100	0.118	0.200	0.114
Total_Clicks	-0.064	0.077	0.088	0.030
Avg_Total_Clicks	-0.075	0.036	-0.076	0.077
Std_Total_Clicks	-0.071	0.052	-0.042	0.055
Avg_Time_Per_Day	0.008	0.020	0.108	0.034
Avg_Clicks_Per_Day	-0.213	-0.125	-0.056	-0.192
Avg_Time_Per_Session	-0.008	0.003	0.099	0.018
Avg_Clicks_Per_Session	-0.231	-0.151	-0.081	-0.221

It is particularly noteworthy that the correlation coefficients observed between digital engagement metrics and academic performance in this study are markedly lower than those frequently reported in the existing literature. Previous research, which often focuses on individual courses or homogeneous subject cohorts, has tended to demonstrate moderate to strong associations. The discrepancy observed here is primarily attributable to the unprecedented scale and diversity of the present analysis, which spans 240 distinct subjects, each characterized by individualized instructional approaches, assessment schemes, and activity requirements. The expectations surrounding student engagement with Blackboard vary significantly from one subject to another. For example, dedicating ten hours to activities on the platform may be excessive for a course that emphasizes in-person interaction, yet it might be insufficient for a fully online subject that demands sustained digital participation. Consequently, aggregated measures of engagement lose much of their interpretive power when applied indiscriminately across a highly heterogeneous set of subjects.

Figure 8

Average Students' Engagement on Blackboard With Grades



Despite this overarching limitation, a closer examination of student subgroups reveals a consistent trend. Students with high academic performance, regardless of subject area, tend to exhibit more robust engagement with Blackboard. Figure 8 presents the average students' engagement measures on Blackboard with their overall subject grades. Specifically, good students are characterized by higher click rates on course resources, longer total durations of platform access, and greater login frequency across the teaching weeks under study. These patterns suggest that, while absolute metrics of technology use may not universally predict achievement, proactive and sustained engagement with available digital resources remains a hallmark of successful learners.

Figure 9

Weekly Number of Login Days per Subject

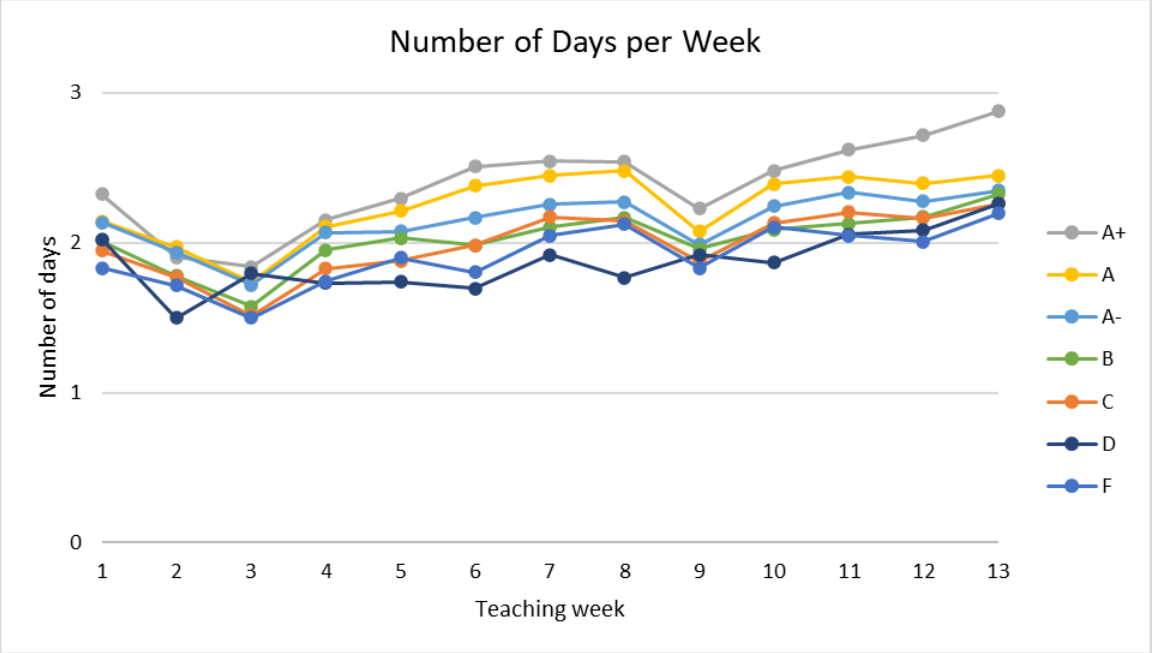


Figure 10

Weekly Number of Login Sessions per Subject

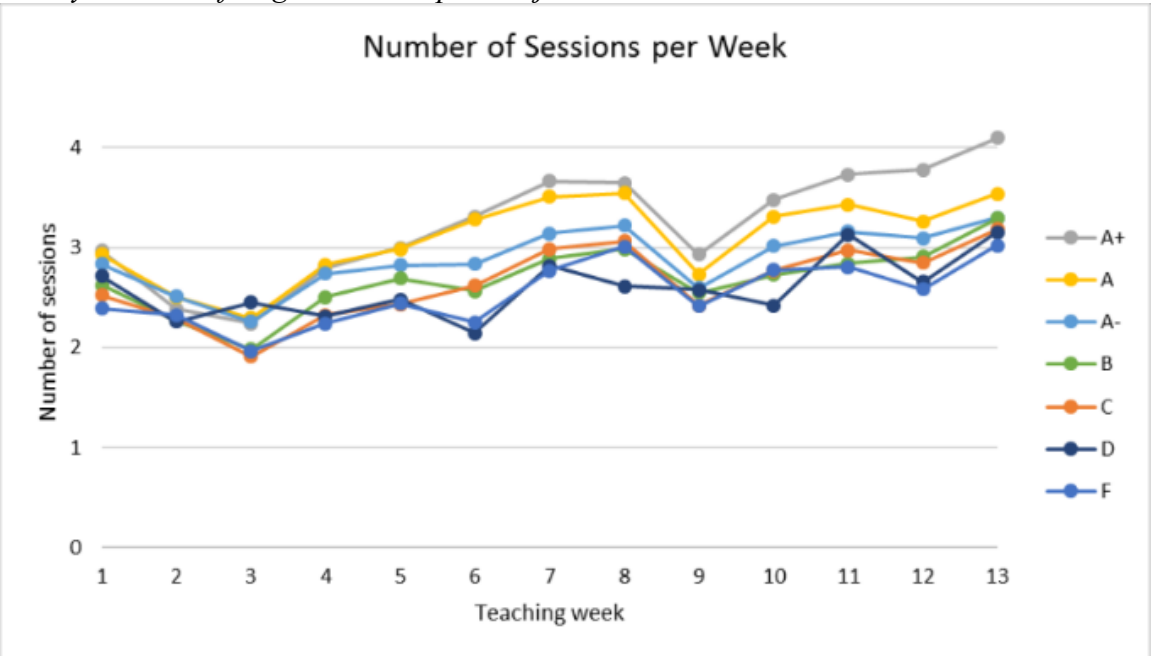


Figure 11
Weekly Login Duration (in Hours) per Subject

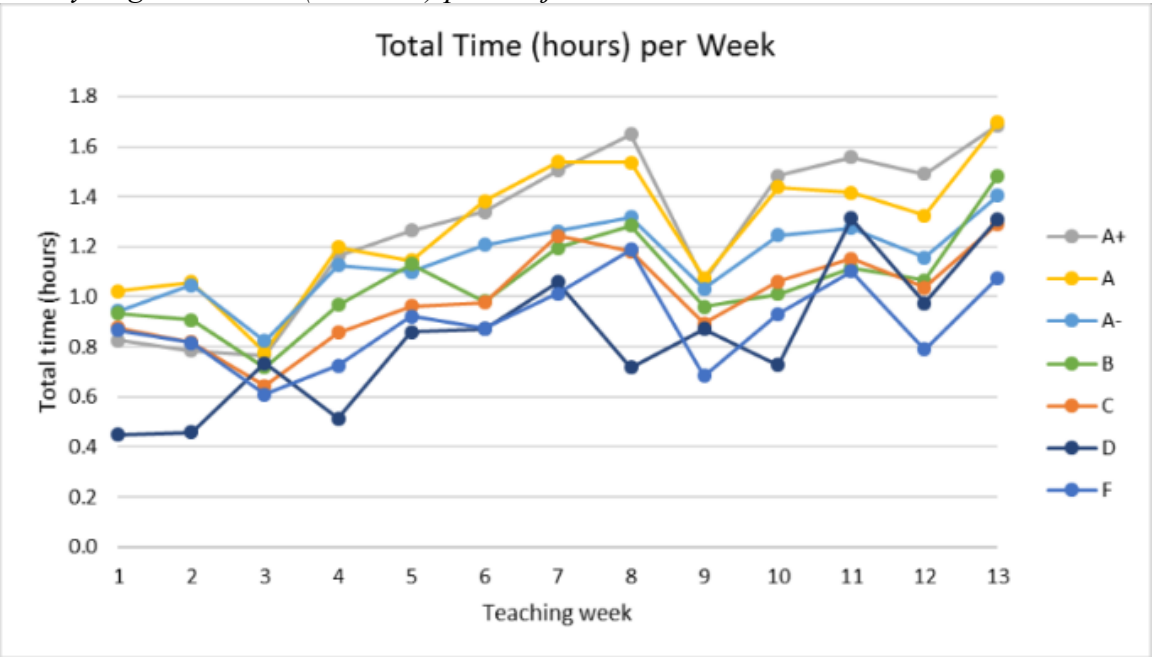
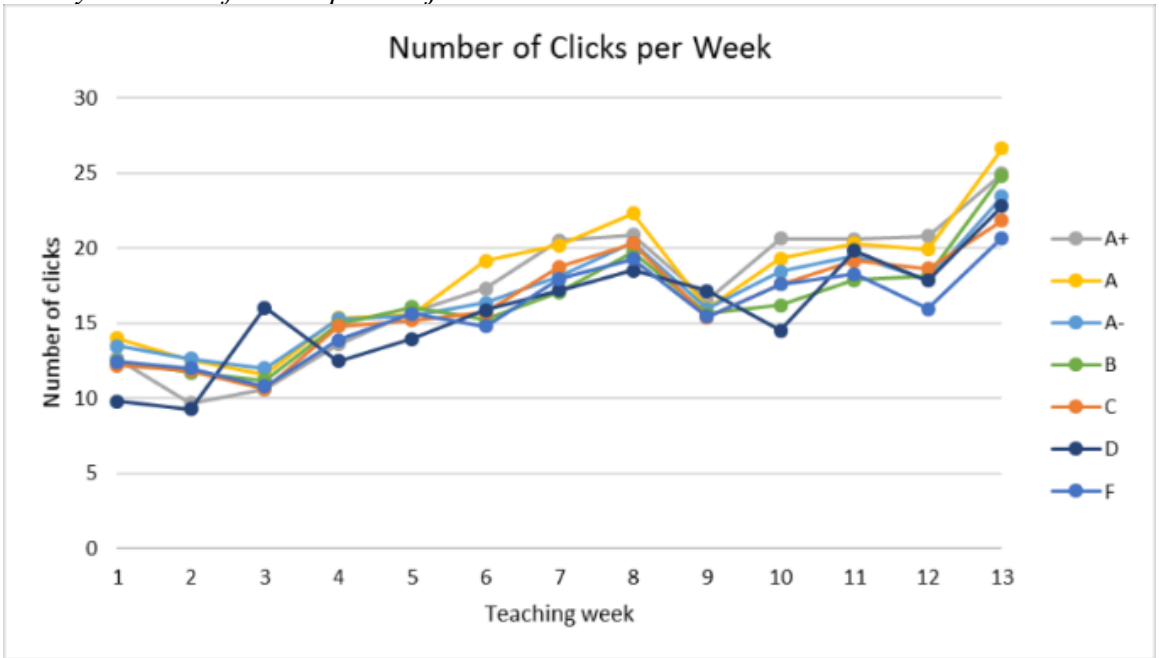


Figure 12
Weekly Number of Clicks per Subject



A more detailed examination of student learning behavior was conducted by analyzing weekly engagement patterns across each subject throughout the 13-week teaching period. As illustrated in Figures 9-12, these patterns were evaluated based on several key metrics: number of days logged in (Figure 9), frequency of login sessions (Figure 10), total login duration per week (Figure 11), and the number of clicks (Figure 12) registered within the subject on a weekly basis.

The findings reveal a general upward trajectory in all engagement metrics among students of varying achievement levels as the academic term progresses. Notably, a consistent and discernible trend emerges: students who attain higher overall grades demonstrate substantially greater engagement with Blackboard. This is evident through their more frequent and sustained interactions, reflected in higher login rates, increased session counts, extended periods of platform access, and a greater number of resources accesses or clicks.

These observations reinforce the notion that, despite the variability in instructional modes and course design, proactive and sustained digital engagement is a characteristic feature of academically successful learners. Such pattern suggests that, while absolute metrics of platform activity may not serve as universal predictors of performance across all contexts, they nonetheless offer valuable insight into the behavioral attributes that distinguish high-achieving students.

Limitations and Future Directions

While the present study draws on a comprehensive and rigorously processed set of digital engagement and assessment data, several limitations must be acknowledged that may shape the interpretation of its findings and inform avenues for future investigation.

First, a fundamental constraint lies in the study's exclusive reliance on data generated within the Blackboard e-learning environment. Although digital behavioral metrics such as login frequency, access duration, and click rates provide valuable windows into patterns of engagement, they inherently omit the substantive domain of students' offline learning behaviors. For instance, after a student opens a file on Blackboard, the dataset cannot discern whether they are actively reading, taking notes, or simply leaving the document open while disengaged. This ambiguity complicates the interpretation of online activity as a direct proxy for cognitive engagement or learning effort. Consequently, some students may appear highly active based on clickstream data, while in reality their true learning may unfold predominantly offline and unobserved by the platform's analytics.

Second, the study does not account for the granularity of assessment design across subjects and instructors. In particular, variations exist in how educators structure and distribute evaluative tasks: some may divide a major assessment into a sequence of smaller quizzes to facilitate continuous monitoring and formative feedback, while others may concentrate evaluation in a single summative exercise. The marksheets collected for this study reflect only the aggregated assessment outcomes and lack visibility into these underlying pedagogical choices and the frequency or sequence of testing events. This omission may obscure nuanced relationships between engagement patterns and achievement, especially where on-going, low-stakes assessments foster more regular student interaction.

These limitations highlight the need for future research to incorporate complementary data sources and methodological innovations. Integrating observational data, self-reported study logs, or in-person classroom analytics could help capture the fuller spectrum of student learning, bridging the gap between online traces and offline effort. Moreover, access to detailed assessment blueprints, including item-level breakdowns and temporal patterns of assignment release, would enable a more precise mapping between instructional design, engagement rhythms, and academic outcomes.

Looking ahead, refining early warning systems and risk identification models will require context-aware analytics that synthesize both digital and offline domains, as well as a deeper appreciation of pedagogical diversity. Expanding partnerships between educators, learning scientists, and data analysts may yield richer, multidimensional datasets, ultimately supporting more equitable and effective interventions for at-risk learners across diverse educational landscapes.

Conclusion

This study underscores the transformative potential of a multidisciplinary, data-driven approach to understanding student learning in contemporary educational environments. By integrating methodologies and insights from educational data mining and learning analytics, the research offers a nuanced examination of how digital engagement and assessment structures collectively shape academic outcomes.

Two principal findings emerge from this analysis. First, the composition and sequencing of assessment components exerts a significant influence on subject performance. Courses that incorporate early-stage tests and well-structured in-class exercises are better positioned to identify students who may be at risk, thereby enabling timely and targeted interventions. Such formative assessment strategies not only provide valuable feedback for learners but also foster more continuous and meaningful engagement with course material. Second, the study reveals a robust and consistent relationship between students' engagement with the Learning Management System (LMS) and their overall academic success. High-achieving students exhibit markedly greater frequency and depth of interaction with the LMS, as reflected in higher login rates, longer access durations, and more resource interactions. This pattern highlights the importance of promoting regular and active use of digital learning platforms as a vehicle for reinforcing academic habits and supporting sustained achievement.

The implications of these findings are multifaceted. Educational practitioners are encouraged to embed early diagnostic assessments and scaffolded in-class activities within their curricula, not only to enhance learning outcomes but also to create mechanisms for early risk detection. Simultaneously, fostering a culture of frequent and purposeful engagement with the LMS can serve as a catalyst for improved student performance. Future initiatives should continue to bridge disciplinary boundaries, leveraging the combined strengths of technology, pedagogy, and analytics to support more personalized, equitable, and effective learning experiences for all students.

Acknowledgement

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Designing Immersive Language Learning Experiences: An Augmented Reality Approach for Young EFL Learners in Greece

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Abstract

Augmented Reality (AR) is becoming more and more popular among educators due to its potential to create immersive and engaging learning experiences. This paper explores the design of an AR-supported language learning activity tailored for young Greek learners of English as a Foreign Language (EFL). Based on Communicative Language Teaching (CLT) principles and Bloom's Taxonomy, the activity exploits AR affordances to address cognitive and affective factors critical to language acquisition, such as age-appropriate engagement, socioemotional learning, and the challenges of mixed-ability classrooms within the Greek socioeconomic context. During the AR activity learners are immersed in a narrative driven scenario so as to engage themselves with an AI-powered 3D friendly alien, who has visited Earth. Through this interaction, learners practice recently acquired vocabulary and they are given opportunities to develop receptive and productive English language skills. The design focuses on the promotion of learner autonomy, creativity and motivation, while also incorporating elements that cater for diverse learning needs. This study not only demonstrates the practical application of AR in EFL settings but also highlights its potential to bridge gaps in traditional language teaching methodologies. The paper discusses both the challenges encountered during the design process and proposes innovative follow-up tasks to extend the learning experience while offering actionable recommendations for educators seeking to adopt AR technologies in language learning contexts.

Keywords: augmented reality, English as a foreign language, young learners

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Introduction

In recent years, learning processes have been largely supported by the use of educational technology. Series of top-notch tools have been introduced to classrooms paving the way to more stimuli rich learning experiences. One of these technologies that is gaining momentum worldwide and reaches users in all levels of education, is Augmented Reality (AR), which enriches the real world with digital elements like images, texts or videos and makes the users believe that they actually exist. A definition that is commonly accepted, describes AR as an emerging technology that allows virtual objects to be superimposed to the real world (Azuma, 1997). When using AR, the users are fully aware of the place and the time they interact with the virtual elements. There is no need for clicking a mouse since the majority of AR applications run on mobile devices that allow flexibility and can be at hand wherever the user goes (Khoshnevisan & Le, 2018; Panagiotidis, 2021). AR has increased its popularity in the research community because it provides unique opportunities for interactivity and improved visualizations that other technologies fail to do so (Avila-Garzon et al., 2021). Research has also shown that AR has positive effects on students' motivation (Bacca et al., 2018), involvement in the learning process and learning outcomes (Akçayır & Akçayır, 2017). AR has also been proved an invaluable ally in foreign language teaching despite the fact that pertinent research is still in its infancy. Some frequently mentioned AR affordances focus on students' increased interest and participation (Akçayır & Akçayır, 2017; Binhomran & Altalhab, 2021; Tsai, 2020; Wen, 2021; Valero-Franco & Berns, 2024) and on the fact that AR enhances the authenticity of learning experiences and meaningful communication (Panagiotidis, 2021; Parmaxi & Demetriou, 2020; Punar ÖzçelİK et al., 2022) while promoting cultural awareness (Boboc et al., 2022; Chen et al., 2023; Liu et al., 2023; Papanastasiou et al., 2019). Additionally, there have been several studies highlighting its positive effects on learners' confidence and reduction of anxiety levels (Lin & Yu, 2023; Panagiotidis, 2021; Pegrum, 2021). Similarly, others have reported improved learning performance in a variety of language skills (Liao et al., 2024; Rintaningrum et al., 2024; Rozi et al., 2021; Shadiev, R.,2023; Tobar-Muñoz et al., 2017; Wedyan et al., 2022;), grammar and vocabulary acquisition (Husna et al., 2025; Idul & Syaiful, 2024; Schorr et al., 2024; Tran et al., 2024) as well as improved learning outcomes (Panagiotidis, 2021; Parmaxi & Demetriou, 2020; Punar ÖzçelİK et al., 2022). A smaller number of studies have successfully explored how AR supports embodied and active learning (Pegrum, 2021), caters for diverse learning styles (Alshumaimeri & Mazher, 2023) and contributes to the development of 21st century skills (Akçayır & Akçayır, 2017; Arpan & Nasution, 2024; Rafiq & Hashim, 2018).

An AR Learning Experience for Young Greek Learners of English at State Primary Schools

Educational Purpose

The objectives of this AR language learning experience are consistent with the present curricula of A1 CEFR level, while blending the sterile classroom environment with the digital content and immersing learners into an AR experience that motivates and stimulates them to practice language. In particular, by the end of the activity learners will be able to:

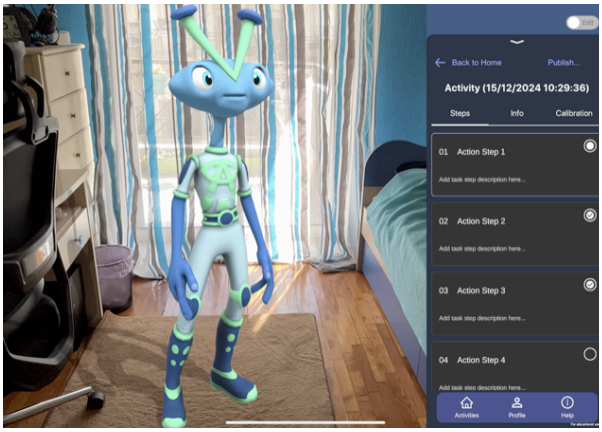
a) successfully identify and recall bedroom objects in English using pre-taught vocabulary,
b) develop listening and speaking skills by following audio instructions and interacting with the AI-powered 3D character,

c) make comparisons of rooms and objects using target vocabulary and simple structures in English,
d) work in pairs or in small groups and collaborate effectively for task completion,
e) familiarise themselves with AR tools and practice specific interaction methods like Tap and/or Pick and Match,
f) reflect on their learning through a series follow up activities that focus on creative writing or role-playing scenarios.

Design and Description of the AR Language Learning Experience

"There is an Alien in my bedroom" is an AR-supported language learning activity designed to last approximately 20' with the students either working in pairs or in small groups in class. During the AR language learning experience learners interact with the AI-powered 3D alien character, who has just arrived on Earth. They can ask him questions and receive answers thus improving understanding and participation. There is also a 3D object of a bedroom, audio messages and a picture with depictions of key vocabulary items in the form of a mini "picture dictionary." MirageXR was chosen among other AR authoring tools because it supports a variety of multimedia elements and due to its versatility in creating immersive learning experiences that enhance engagement, creativity and collaboration.

Figure 1
The AI-Powered 3D Alien Character



The AR language learning experience is designed to take place in class and it is divided into three stages:

Before the AR activity: Learners are briefly introduced to the storyline of the AR activity and to the main hero, the friendly alien, called Alfa. Next, learners form pairs or small groups and work together in order to make questions about the things they would like to ask Alfa, the AI-powered 3D alien character.

During the AR activity: Learners use the MirageXR app to navigate themselves through five task stations. Initially, they are assisted with the calibration and then they meet the AI-powered 3D alien character, who is ready to answer the questions learners have prepared for him. The second step includes the augmentation of a 3D bedroom from Sketchfab. There is also an audio message that informs learners that this is the alien's bedroom, while he stays on Earth and that they have to observe it closely and to write down on their notebooks as many bedroom objects as they know in English. There is no time limit and students can work at their own pace. In the next step, there is an audio recording that asks students to compare the

list of bedroom items they have just created to the picture they see. This picture provides immediate feedback to the students, as it acts as a mini "picture dictionary." It other words, it presents the vocabulary items in question along with an image to enhance the much-needed visual stimuli of objects required by young learners. Students can compare their notes to the mini "picture dictionary." Then they can correct any mistakes they might have made and add new items in their lists, if necessary. During the fourth step, learners are encouraged to help the little alien familiarize himself with the objects in his new bedroom as he does not know anything about them. This step involves the augmentation of the alien's 3D bedroom again, 3D arrows for the Pick and Match activity and audio messages with instructions as to where the learners should place the arrows in order to help the alien spot different bedroom objects. The structure of the instructions is very simple and straightforward to suit the proficiency level of the learners (A1 CEFR). For instance, "There is a bed near the desk" etc. Students practice their listening skills along with vocabulary related to bedroom objects and prepositions of place. At the same time, they get acquainted with AR specific interaction methods and they have to act relatively fast. In the final step, there is the augmentation of the alien character and an audio message asking students to compare orally their own bedroom to the Sketchfab 3D bedroom. The AI-powered 3D Alien character will be students' audience and assistant. This activity also serves as an exit/ evaluation activity, because students should use everything they have learnt/ revised so far.

After the AR language learning experience: This AR learning experience could only be the starting point of many other activities that can lead to further practice of all four skills in English. For instance, learners can write the diary of Alfa, the alien and describe how he spends his time in his new bedroom, thus practicing daily routines. Additionally, learners could swap roles with the Alien and become the visitors to his house. Then they could imagine, draw and finally talk about the Alien's bedroom in his planet. They can also be engaged in role-play scenarios so as to practice asking and answering about all the different objects in the alien's place. Moreover, new AR learning experiences can be organized having the Alien character as a main persona in different settings, in order to explore a variety of thematic vocabulary units. For example, the Alfa in a farm, in a forest or in a classroom can only be some ideas of future scenarios suitable for the interests of this age group.

Figure 2

The 3D Bedroom and the Mini "Picture Dictionary" of Step 3



Conceptual Framework

This AR-supported language learning experience follows the basic principles of Communicative Language Teaching (CLT) as defined by Doughty and Long (2008). Initially,

the activities are linked logically under a thematic unit based on a simple story line. There is a focus on meaning by supplying learners with a purpose to use grammar and vocabulary. Also, learning is promoted by doing. There are no lectures that would lead to abstract ideas as young learners are not able to focus on them. On the contrary, there are concrete examples, pictures and controlled practice activities (Steps 2, 3 and 4) that are followed by a freer task (Step 5), thus leaving more space for creativity, personal relevance, and experimentation with the language. The error corrective feedback, which is also crucial for the learners, is provided in a way that respects the affective filter of the learners and at the same time it follows the principles of CLT. The learners have to compare their own list to the one provided in a form of a mini "picture dictionary" and proceed to self-correction, a method that promotes learner autonomy and has additional value to vocabulary retention. Similarly, when the learners compare and contrast the two bedrooms in Step 5 there is no immediate feedback since at that stage there is emphasis on improving learners' fluency and not so much on their accuracy. Increasing a learner's self-esteem and reaching a level of self-efficacy boosts the levels of intrinsic motivation and the sense of self-fulfilment.

"There is an Alien in my bedroom" also aligns with the cognitive processes suggested by the revised Bloom's Taxonomy (Armstrong, 2022). At the beginning of the AR learning experience learners have to *Remember* useful vocabulary and retrieve all the previously related words they know. *Understanding* is achieved by comparing their vocabulary lists to the mini "picture dictionary" presented to them in Step 3. They *Apply* everything they have learnt so far by attempting the Pick and Match activity during which they have to listen carefully to the instructions given to them. Step 5, which is the most demanding of all, requires learners to *Analyse* and *Evaluate* the information they have about the two bedrooms (the alien's 3D bedroom and their own) in order to *Produce* (*Create*) a valid comparison and talk about it to the AI-powered 3D alien character.

The Implementation Process

For the implementation process the Analyse, Design, Develop, Implement and Evaluate (ADDIE) model was chosen as it has been favourably commented in recent literature related to designing AR interventions in the EFL context (Lazou & Tsinakos, 2022). More specifically, the analysis was directed towards the learners' background knowledge on the topic as well as on their needs for skills' development. Additionally, the affordances of MirageXR authoring tool along with the potentials of the learning environment to host an AR-supported language learning activity were also analysed extensively. The design involved the storyline conception of the AR-supported activity and the steps that learners would follow so as to achieved optimal learning outcomes. The multimedia elements were chosen and / or designed exclusively for the activity. Also, new prompts were written for the AI-powered 3D alien character. Additionally, alignment with the current school curricula and the learning outcomes was ensured. The development entailed the creation and / or curation of AR content, including audio messages with instructions, supplementary materials like the mini "picture dictionary" and the interactive tasks. The implementation involved a small-scale piloting by volunteers both students and teachers to identify potential challenges and points for improvement. The evaluation comprised of delving deeper into collecting feedback and drawing upon insight to further refine the activity for future implementations.

Moreover, further considerations were taken into account for the implementation process related to the specific context young Greek learners of English live and study. The Greek educational system seems to be giving great attention to English language learning. Although

English is taught from pre-primary level up to 3rd year of Senior High School, rarely do students achieve the same level of language proficiency. A question often asked and researched is about the reasons why some people learn a second or a foreign language more easily than others given the same opportunities (Gardner & Lambert, 1972). Undeniably all people can learn a foreign language. However, the rate, the ease and the proficiency level reached varies from learner to learner and this is due to a large number of factors divided into two broad categories: cognitive and affective (Mattheoudakis & Alexiou, 2009). The first category includes variables such as age, language aptitude, intelligence, socioeconomic status (SES), learning strategies, and learning or cognitive styles and the second one is related to personality factors. For instance, anxiety levels, risk-taking, motivation, self-esteem, empathy, inhibition (Brown, 1994). Therefore, the design of our AR learning experience was mainly influenced by the following factors:

a) The age factor: Young children, tend to acquire foreign languages differently than teenagers or adult learners. First of all, they have limited attention span and they lose interest very quickly unless the activity is very engaging. Secondly, young learners prefer concrete activities as their understanding derives mainly from what they see, touch, hear and interact with. Moreover, they are very curious and they show great enthusiasm when discovering things by themselves. In other words, their motivation is stronger when there is an element of surprise and they can physically move around in order to achieve their goals. Additionally, young learners are egocentric creatures, who thrive in activities that are related to themselves and to their daily habits. They are also meaning oriented, which makes them able to respond to meaning even if they do not understand every single word of what they read or listen to. Finally, they are not inhibited to imitate their teacher or their peers while learning and they are quite imaginative, which makes them exceptional story tellers. Above all, they need constant encouragement and approval from their teacher (Harmer, 2001).
b) Socio-economic status (SES) factors: research has shown that Greek young learners' social and economic background affects their progress in English language learning (Frangoudaki, 1985; Katsikas & Kavvadias, 2000; Mattheoudakis & Alexiou, 2009). It seems that learners of a higher SES have some more advantages than students of lower SES. The former group receives extra tuition either in the form of private lessons at home or in afternoon specialized schools of foreign languages. As a result, they progress faster in their language learning process and outperform students of the same age who do not have access to such privileges. The same research also indicates that due to their cultural capital learners of higher SES are more motivated and more positively disposed towards English language learning than students of lower SES. Students coming from a more affluent family background have realized that learning English is closely related to having better job opportunities and making more money. Therefore, providing in class a rich immersive language learning experience would be beneficial and equally motivational for all learners despite their socio-economic background.
c) Mixed-Ability Classes and Constraints: teaching English in Greek state primary schools is characterized by large mixed-ability classes and outdated materials. Classes often include learners with different learning styles, whose proficiency level ranges from A1 to B1 CEFR, making it difficult for a teacher to address all needs. Teachers in Greece, much likely to their colleagues worldwide, often strive to supplement their textbooks and limited resources with activities and online tools in order to meet inclusion and equity (Eloff, 2024). The vision of achieving Sustainable Development Goal 4: Quality Education (Kushnir & Nunes, 2022). requires materials and instructions that can be easily adapted to cater for the students' diverse needs, skills,

preferences and backgrounds (Tomlinson, 2022). Recent research (Ngo & Vo, 2025; Parmaxi et al., 2024) has shown that the variety of AR's multi-modal features can successfully accommodate different learning styles and provide opportunities for enhanced engagement and personalized learning thus promoting inclusivity.

Considerations / Limitations

There are certain anticipated problems mainly deriving from the age of the target group. Young learners might need more time to familiarize themselves with the application before being able to fully explore its potential. However, spending time in class and training students how to use the application could be a solution to the problem. Also, the availability of compatible devices could pose problems at the smooth running of the activity. Although MirageXR is compatible to a long list of devices, it is quite probable that schools might not have the suitable equipment. It is therefore, at the educators' disposal to check compatibility and/or provide other possible solutions for the AR activity. Additionally, strong and stable wi-fi connection is required as it can seriously affect the outcomes and the smooth running of any AR learning experiences. Unfortunately, not all classroom areas have access to reliable internet connection and for this reason alternative connectivity solutions should be available when introducing AR immersive experiences. Last but not least, educators should make sure that their classrooms are suitable for AR activities. Noisy, classrooms with limited light and space to move around are not ideal. For this reason, it is advisable to rearrange the desks and create more space, opt for quieter, less crowded rooms when possible. Another solution would be to consider using AR outdoors or in larger shared spaces like the school library or a multipurpose room.

Conclusion

Designing and developing AR learning experiences for young English language learners requires to take into account a range of cognitive and affective factors before making the final choices. Also, the principles of CLT and Bloom's taxonomy can provide a safe framework for all the educators who are interested in creating AR learning experiences that allow the learners to take control of their learning, to become autonomous, while practicing and revising vocabulary, skills and structures in English language. MirageXR is a free, powerful tool that can support the design of such AR learning experiences and it can also be integrated with many course materials.

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Efficacy of Modelling and Contingency Management Techniques on Daily Living Skills Improvement of Pupils With Intellectual Disabilities in Ibadan, Nigeria

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Abstract

This study examined the efficacy of the two techniques-modelling and contingency management in the enhancement of daily living skills of pupils with moderate intellectual disability in Ibadan, Nigeria. A pretest, posttest, quasi-experimental research design was used in the study, 276 Basic 2-5 pupils of six special schools were purposively selected as sample based on their peculiar intellectual deficit and maladaptive behaviour. Two validated research instruments viz: Weschsler Intelligence Scale-Revised (Wisc-R) and Daily Living Skills Checklist (DLSC) were used to collected data from the respondents. The three hypotheses were tested at 0.05 level of significance. The results obtained indicated that there is a significant main effect on the variation in the respondents scores in daily living skills, ($F(1:266) = 653.64$; $P < 0.05$), intellectual ability of the participants has significant main effect on the results obtained from testing hypothesis 2. ($F(1:266) = 2.64$; $P > .05$). Also, Gender was found not to have any significant main effect in daily living skills improvement of the participant Pupils. Modelling and Contingency management techniques were effective in enhancing daily living skills of pupils with moderate intellectual disability. Special education teachers, curriculum planners, researchers and pupils would find the two techniques useful in the enhancement of daily living skills of pupils with moderate intellectual disability.

Keywords: daily living skill, moderate intellectual disability, modeling technique, contingency management techniques

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Introduction

Daily living skills are some of the important skills expected to be learnt and developed as behavior by pupils in the society. They are all in the areas of development that are integrated to everyday living. These include tasks such as feeding, sleeping, dressing, taking care of hygiene, washing, toileting, personal health and safety, grooming and other adaptive skills. All these may pose challenges for pupils with moderate intellectual disabilities.

It is rather worthwhile to note that if pupils with moderate intellectual disabilities must integrate properly in the society, it becomes necessary and mandatory to develop skills in daily living and other areas mentioned above. Several methods had been employed and useful results obtained in the training of daily living skills to the pupils with mental retardation; for example Eni-Olorunda (1998), Obani (2006) Ohiaeri (2006) and Adediran (2018) have investigated various physical and behavioural characteristics of pupils with intellectual disability which make daily living skills very difficult for them to acquire, so as to attain possible degree of self-management and independence.

The pupils with moderate intellectual disability, by comparison, because of their developmental delay, learn more slowly, less perfectly than their non-disabled peers. They therefore, require sound behaviour change strategies such as modeling to improve their daily living skills. Pupils with moderate intellectual disability are deficient in acquiring adaptive skills. In this context, they contend with the ability to effectively manage daily life tasks and social situations which are crucial for them to live independently and actively participate in their communities. These skills such as self-care (dressing, eating, hygiene) home living (cooking, cleaning) and occupational skills (work-related tasks).

Deficit in all these adaptive skills can hinder a pupil's ability to meet the demands of daily life and can lead to social isolation or reliance on others. Other adaptive daily living skills include practical skills like using money or credit card for transactions, identifying and resolving everyday challenges, task – all these are crucial for pupils with moderate intellectual disability.

Thus, Bandura (1997), the proponent of modeling technique posited that, the requirement for learning through modeling is the observation of a model. In the same vein, Adediran (2018) explained that much of our understanding of the world around us, including our language, dressing and customs come to us through our observation of the behaviours of others around us.

Modelling as viewed by Adediran (2018) is meant to bring about desirable or pleasant behaviours, but if it is not well handled, it can adversely affect the pupil. According to him, peer modeling can also prove effective as pupils learn appropriate behaviours by observing and imitating others. When a student observes one of his peers being rewarded for desirable behaviours, he tends to follow the example of the model, also unacceptable behaviours may be discouraged when students watch another receiving punishment for unpleasant behaviour.

Contingency Management theory was development by an Austrian Psychologist Fred Fiedler, in the 1960s. He studied leaders' personalities and characteristics, and came to the conclusion that leadership style, since it is formed through one's life experiences, is incredibly difficult, if not impossible to change.

Contingency management revolves around the description of the relationship between individual's behaviour (responses) and environmental events (stimuli). The term "Contingent" means that, there is a relationship between what individual does and the consequence (Slocum, 2017). In contingency management, there is a clearly specified agreement between a teacher (sometimes, parents) and students. In the contract are bonuses for outstanding performance and penalties for failing to meet the terms of the contract, the contract may be negotiated as well as having the expiration date.

For instance, Umoh (2018) explained that preferred leisure or recreational activities can be made contingent upon the performance of academic assignment; such rewards need to be immediate and frequent, particularly when stating this approach, little but often should be the guideline.

Contingency Management may be used as part of a treatment technique for pupils with moderate intellectual disability, this involves rewarding or reinforcing desired behavior in these pupils in a supportive manner, this would encourage positive behavior change. The dynamic and rewarding nature of contingency management therapy makes it a pivotal element of treatment for moderate intellectually disabled pupils. It is not just about making changes, it is about making changes that last, at least for a sustainable success.

Contingency management had been found to be widely used in educational practices with individuals at all levels of intellectual disability. Slocum (2017) discovered that if a teacher wishes to change or modify behaviours of pupils with intellectual disabilities through contingency management, he/she should reward the new desirable behavior. The new desirable behavior is thus strengthened while the old inappropriate behavior would be extinguished. The two behaviour change strategies-modelling and contingency management are part of the behaviour building techniques that are meant to increase the manifestation of weak and deficit behavior in individuals without cohesion (Adediran, 2018).

On the efficacy of modeling as a powerful tool in behavior modification strategy, Malhauser (2008) conducted a research on whether gender has significant effect on children's ability to remember and imitate a computer-recorded story they were exposed to, the result obtained indicated no significant gender effect in their disposition to imitate character in the story.

Eni-Olorunda (1998) used modeling technique on children with moderate mental retardation reading achievement and attitude towards reading, the results indicated a significant effect, but in the study, females were found with higher reading achievement ability than their male counterparts.

In another study, Athorp et al. (2022) used video-modelling via portable technology to improve daily living skill for a student with an intellectual disability in a University Campus-based transition programme. The results showed increased independence across four daily living skills. This study suggests that video modeling can be an appropriate intervention for more complex tasks as well.

In a study, contingency management treatment for substance use disorder on patients was reported by Petry et al. (2017) the results obtained indicated an efficacy in treating a variety of substance use disorder including stimulant, opioid, marijuana, and nicotine and polydrug use disorders.

In another study, Igborgbor (2014) had earlier used contingency management in a research carried out in old Bendel State, Nigeria effectively in the treatment of school truancy of 47 identified truants. Equally, Okoli (2019) had used contingency management effectively in the treatment of stealing among selected Nigeria youths. Okwori and Abekhale (2022) also discovered no significant main effect of gender on moral correctness using contingency management as counseling approach.

Purpose of Study

The study sought to investigate the efficacy of modeling and contingency management techniques in the enhancement of daily living skills of pupils with moderate mental retardation. It further examined gender implication on the acquisition of the skills.

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

HO_1: There is no significant difference between pupils exposed to modeling techniques and those exposed to contingency management in the improvement of their daily living skills.

HO_2: There is no significant difference between the intellectual ability of the two groups in the improvement of daily living skills.

HO_3: There is no significant difference between the gender of the two groups in the improvement of daily living skills.

Research Methodology

A pretest, posttest, quasi-experimental research design was employed in this study.

The population of this study consists of all pupils with moderate intellectual disability in Ibadan. The samples selected were 276 primaries two to five pupils (four arms of classrooms per school) from six special schools out of eleven special schools that are concerned with offering services for the pupils with intellectual disability in Ibadan, Nigeria. They were all purposively selected because of their peculiar intellectual deficits and adaptive behavioural problems.

The experimental schools are broken into two groups; each group was exposed to modelling and contingency management techniques respectively;

Group 1: Cheshire Home School, Ibadan, Ijokodo School for the Handicapped, Ibadan and C.A.C. School for the Handicapped, Oniyanrin, Ibadan.

Group 2: H. L. A. School for the handicapped, Agodi, Ibadan, Omoyeni School for the Handicapped, Aperin Ibadan and I.M.G School for the Handicapped, Oke-Bola, Ibadan.

The instrument used in this study were Wechsler Intelligence Scale-Revised (WISC-R) for intelligence classification screening and a validated checklists tagged “Daily Living Skills Checklists” (DLSC) to measure the acquisition of the chosen daily living skills of the pupils. Daily living skills checklist (DLSC) was validated using back translation method (translating items from source language) and committee approach method (translators, intellectual disability unit specialists of the University of Ibadan, Nigeria and researchers to decide the best version of the items in the checklist). This gave face and content validation. Further, split

half method was used for scoring the checklist items and Spearman-Brown formular was applied as a reliability factor. The correlation coefficient of 0.76 was however obtained.

Two experimental groups were involved in the study that is, the modeling group and contingency management group. The researcher was assisted by class teachers in administering these two instruments on the pupils. The treatment involved using modeling techniques to enhance daily living skills of a group and using contingency management to enhance daily living skills of the second group. The teachers had earlier received training on the use of these two strategies from the researchers prior to the commencement of the treatment. After 6 weeks of treatment for the experimental groups, they were exposed to post-test.

Data Analyses

All the data collected in the study were analysed, using inferential statistics. The difference arising from the various treatment conditions in the post treatment were analysed. A 2 x 3 x 2 analysis of covariance was used along with Multiple classification analysis (MCA) for each dependent variable in the experimental groups where appropriate. All the hypotheses formulated were tested at 0.05 level of significance.

Results

The table below contained the results of the analysed data.

Table 1

Summary of Analysis of Covariance on the Post-test Pupils' Attainment Scores of Subjects According to Instruction Ability and Gender on Daily Living Skills

S/N	*Variable + Category*	*N*	*Unadjusted*	*Eta*	*Adjusted for Independent Deviation*	*Beta*
	Instruction					
1	Modeling	151	6.58		6.00	
2	Contingency Management	125	7.26		-7.18	
				.81		71.70
	Ability					
1	High	78	6.01		4.01	
2	Medium	140	-1.02		-19	
3	Low	58	-5.34		-4.91	
				.45		.34
	Gender					
1	Male	142	-1.18			
2	Female	134	1.29			
				.14		.03
	Multiple R Squared					.794
	Multiple R					.891

Table 1 shows the adjustment attainment mean score of the pupils. The experimental group, (modelling) had an adjusted mean score of 6.00 while the experimental group (contingency management) obtained -7.18. The results show that pupils in the contingency management group obtained a higher mean score of 31.09 and the modeling group obtained a lower mean score of 18.06.

The summary of ANCOVA as contained in Table 1 shows that ($F_{(1;266)}$ = 653.64. P < 0.05) the treatment was found to have significant main effect on the variations in respondents scores in daily living skills. Based on this result, one can suggest that there is a significant difference in the mean post-test scores of the groups; hence hypothesis 1 is not accepted.

Table 2

Multiple Classification Analysis of the Post-test Mean Scores of Pupils Attainment in Daily Living Skills According to Instruction, Ability and Gender

Source of Variation	***Sum of Squares***	***Df***	***Mean Square***	***F***	***Sig.F***
Pre-test	3282.161	1	3282.161	196.322	.000
Main effects	14548.149	4	3637.037	217.549	.0.00
Instruction	10927.68	1	10927.68	653.637	.000
Ability	2584.501	2	1292.25	77.296	.000
Gender	44.130	1	44.130	2.640	.105
2-way interaction	64.788	5	12.958	.775	.568
Instruction & Ability	35.400	2	17.700	1.059	.348
Instruction & Gender	4.543	1	4.543	.272	.603
Ability & Gender	21.982	1	21.982	.657	.519
3-way interaction	36.817	2	18.408	1.101	.334
Instruction x Ability x Gender	17929.715	10	1792.972	88.954	.000
Residual	4445.924	266	16.714		
Total	**22375.320**	**276**	**81.07**		

***** Significant P < 0.05

Grand mean = 24.68

Testing hypothesis two, the data collected with their corresponding analyzed result as presented in Table 1 were re-visited. Intellectual Ability is found to have significant main effect on the variations in pupils attainment scores ($F_{(2; 266)}$ = 77.29 P < .05).

Based on this result, hypothesis 2 is also not accepted.

The MCA Table (Table 2) shows that high ability group pupils obtained the highest mean scores of 29.39, the medium ability group obtained 25.16 and low ability group obtained the lowest mean score of 20.45.

Testing hypothesis 3 that “there is no significant difference between the gender of the two groups in the improvement of daily living skills”.

The data collected with their corresponding analyzed results as presented in Table 1 were revisited. Gender was found not to have any significant main effect, given that ($F_{(1;266)}$ = 2.64; P > 0.05). The null hypothesis is therefore not accepted.

The MCA Table (Table 2) shows that the female pupils obtained higher mean score of 25.71 while the male pupils obtained lower mean scores of 24.89.

Discussion of Findings

The major issue addressed in this study was the determination of the efficacy of modeling and contingency management strategies in the development of daily living skills of pupils with moderate intellectual disability. The findings indicated significant differences between the modeling groups and contingency management group, and among the intellectual ability grouping of the pupils. The contingency management was found to be more effective in enhancing daily living skills. The finding gives further empirical support on the usefulness of the strategy as it brought the desired improvement. (Adediran, 2018; Igborgbor, 2014, Okoli, 2019; Slocum, 2017).

However, the study shows that gender as a single factor has no significant main effect. This may be explained with the fact that the development of boys and girls proceeds more or less at an even pace as noted by Okwori and Abekhale (2022).

Also, the research result corroborated the findings of Malhauser (2008) where no significant main effect was confirmed on gender basis for pupils with intellectual disabilities in terms of learning by imitation and viewing a model as having powerful influence on him/her.

Conclusion

This study has been able to establish the efficacy of modeling and contingency management techniques in enhancing daily living skills of pupils with moderate intellectual disability. However, it was observed that, modeling technique by itself may not be sufficient enough to achieve desired performance in every situation. This is because, in teaching and learning new skills, verbal instruction may complement modeling thus increasing the likelihood that pupils would attend to relevant, rather than irrelevant features of model's performances.

In respect of the above assertion, it was observed that human and life models seen on television screen work effectively in teaching behavior modification than the use of non-human figure (puppets). This is because; the learner could and will always identify with living model than non-living model.

Second, contingency management technique, although, widely used in educational practices, could be effective in improving daily living skills of pupils with moderate intellectual disability. In this study contingency management proved to be more effective than modeling technique in the results, it was in the opinion of the researcher that the combination of the two techniques would be more effective and beneficial to pupils with moderate intellectual disability in improving their daily living skills.

Recommendations

In view of the various behavior characteristics of pupils with moderate intellectual disability, it is important that a suitable curriculum be provided and made use of. Such curriculum should address their level of cognition and task to be accomplished in improving their living skills within a given period of time.

Parents, teachers, care-givers and educationists counsellors should note that positive attitude is very important in motivating pupils to learn these basic skills, and no pupils should be abandoned or written off as being unable to learn. Modelling and contingency management proved effective with the researcher's findings, as such; the pupils with moderate intellectual disability are capable of learning and improving their daily living skills just like other non-retarded pupils.

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Transnational Communication Competence in (Virtual) Higher Education: The Potential of Short-Term Learning Experiences

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Abstract

Transnational communication competence is increasingly recognized as essential in higher education and professional life, particularly in virtual and hybrid working environments. As institutions respond to global demands, learners are expected to develop flexible communication skills that transcend national, linguistic, and cultural boundaries (Kovalainen, 2022). While intercultural competence has been a central focus in curriculum design, transnational communication—especially in the context of digital learning—remains less explored. Short-term language and communication learning experiences—such as virtual exchanges, workshops, and micro-courses—are gaining popularity as accessible alternatives to long-term mobility programs. However, their potential to foster deeper transnational competencies is still insufficiently understood. This paper is based on interviews with higher education students studying in Finnish institutions (N = 30) from various countries and with different first languages. This paper examines how virtual short-term experiences might support the development of transnational communication competence, drawing on Kovalainen's (2022) conceptualization of transnational competence as a multi-dimensional construct. In particular, the focus is on how learners in virtual contexts engage in linguistic flexibility, exercise agency in multilingual digital spaces, develop contextual sensitivity, and a sense of belonging across cultural boundaries. The results so far indicate that elements related to transnational communication competence may also be supported through virtual short-term learning experiences that allow students to collaborate in terms of language and communication skills to practise their intercultural communication. The effectiveness of such activities may ultimately depend on how learners navigate linguistic, cultural, and technological complexity in real-time, digitally mediated interactions.

Keywords: intercultural communication, transnational communication, communication competences, virtual communication, higher education

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Introduction

Just as in trade, commerce, entertainment and leisure, the global shift toward hybrid and virtual communication environments has redefined higher education (hereafter HE) and what it means to work and communicate effectively across borders. As international mobility becomes increasingly digital, short-term, and modular, the communicative competencies required of learners must also evolve. While intercultural communicative competence (hereafter ICC) has received considerable attention in higher education curricula for decades, transnational communication competence (hereafter TCC) calls for pedagogical innovation that goes beyond traditional cultural binaries. This is especially true in virtual communication contexts.

TCC, as conceptualized by Kovalainen (2022), emphasizes the dynamic and context-sensitive nature of communication in transnational environments. It involves the ability to create reciprocal and meaningful dialogue across sociocultural contexts, relying on both transferable intercultural skills and emergent, shared communicative practices. Rather than anchoring communication in fixed cultural categories, TCC recognizes the fluidity of identity, the agency of learners in digital environments, and the power asymmetries often present in English-dominant virtual spaces (Kovalainen, 2022, pp. 36–39).

This shift reflects broader transformations in the global knowledge economy, where professional and educational interactions increasingly occur across linguistic, cultural, and temporal boundaries. Kovalainen (2022) argues that in these spaces, learners are required to negotiate meaning not only across languages, but also across technological platforms and communicative norms. Digital learning environments—such as virtual exchanges, collaborative online international learning (COIL), and micro-courses—are emerging as significant arenas for developing such competence, especially when designed to foster reciprocity, agency, and cultural reflexivity.

Furthermore, Kovalainen's (2022, p. 39) research highlights the growing importance of *third culture formation*—the process by which individuals co-construct shared communicative practices that transcend any single cultural background. This co-created third culture space enables learners to build connections and make sense of diversity through interaction, rather than through predefined cultural scripts. Within digitally mediated settings, this process is often facilitated through informal rituals, visual and multimodal cues, and a shared willingness to navigate ambiguity.

Given these factors and their development, this study explores the extent to which short-term virtual learning experiences can serve as fertile grounds for fostering TCC. Drawing on interviews with higher education students from various linguistic and cultural backgrounds, it examines how learners engage in linguistic flexibility, exercise agency in multilingual digital environments, and develop a sense of belonging through the formation of third-culture communicative spaces. In doing so, it contributes to the emerging discourse on transnational education by positioning virtual short-term learning not as a substitute for long-term mobility, but as a legitimate and impactful mode of intercultural and transnational learning.

Theoretical Background

Kovalainen (2022) defines TCC as the ability to create reciprocal, meaningful dialogue across sociocultural contexts by using and transferring intercultural skills. It draws on and extends

intercultural communication theory by focusing on identity negotiation, third-culture formation, and virtual communicative agency. In this chapter, the key dimensions of the proposed model of transnational communication competence (Kovalainen, 2022) are explained in more detail.

There are several dimensions of TCC that can either occur or not, be emphasized or not, and mastered or not. Regardless of the weight of importance they are given, they will be a part of the communicative context of TCC. These dimensions are interconnected and bear different degrees of importance to individuals.

1. *Linguistic flexibility:* Operating effectively across multiple languages or varieties, often using English as a lingua franca (Kovalainen, 2022, pp. 33–36).
2. *Digital agency:* The capacity to participate actively and shape communication in virtual spaces (Kovalainen, 2022, pp. 89–90).
3. *Contextual sensitivity:* Awareness of interactional and cultural cues like politeness strategies, silence, or turn-taking across digital platforms (Kovalainen, 2022, pp. 85–87).
4. *Sense of belonging:* Identity co-construction and affiliation in hybrid, intercultural, international or transnational communities (Kovalainen, 2022, pp. 96–98).

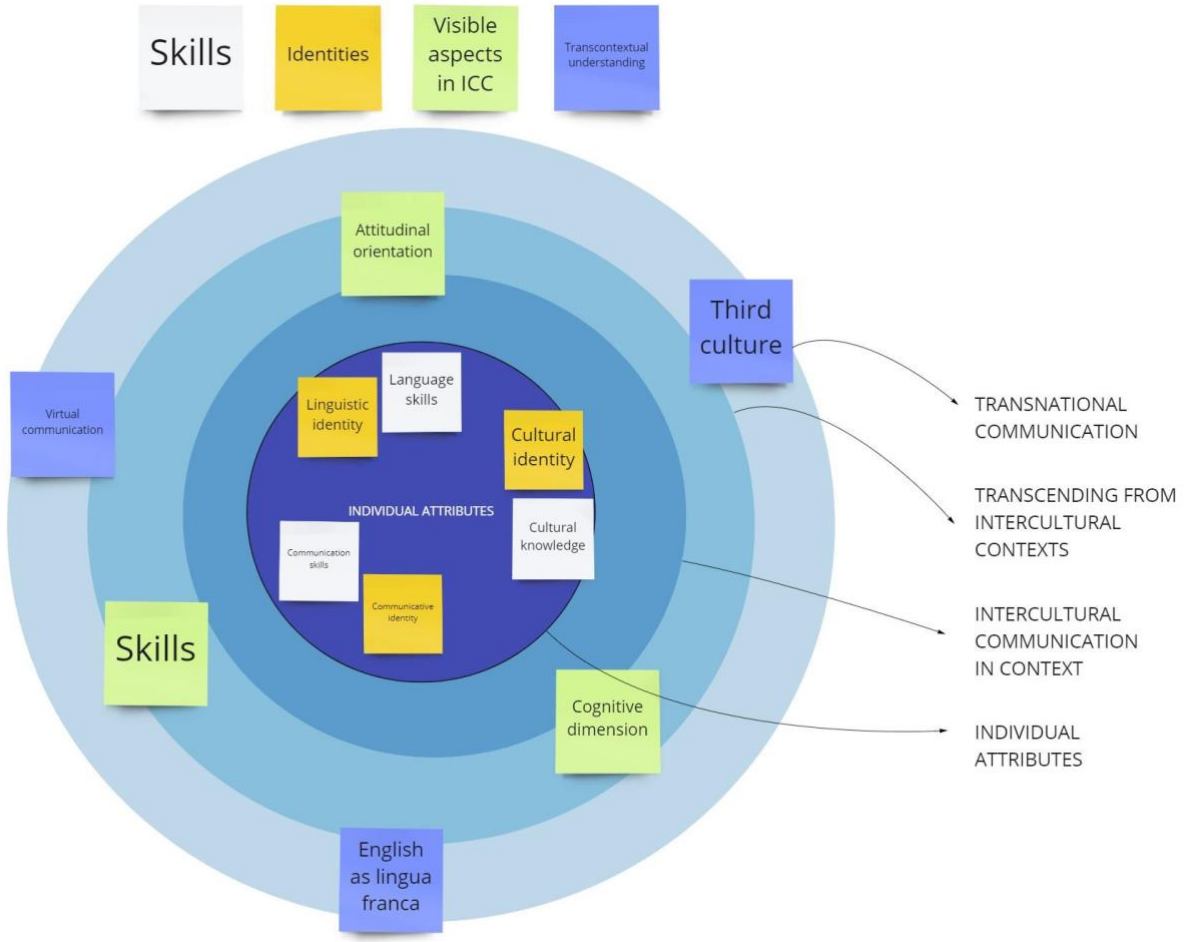
These interconnected dimensions of TCC are a part of third culture formation. Kovalainen (2022, p. 39) conceptualizes the formation of a "third culture" as a central element in achieving TCC. This co-created cultural layer emerges when interlocutors negotiate shared practices across differing linguistic and cultural backgrounds. It allows for effective, inclusive communication in spaces where no single cultural norm dominates. This concept builds on Kramsch's (2013) notion of intercultural third spaces and is particularly relevant in digitally mediated education.

Whereas Kovalainen (2022) argues that intercultural communication competence is not necessarily centred on third culture formation, transnational communication competence, however, is. Koehn & Rosenau's (2002) model on communicative transnational competence emphasizes proficiency in a shared or foreign language; effective use and interpretation of nonverbal communication; listening; reciprocal and appropriate self-disclosure; and commitment to reciprocal dialogue and managing cross-cultural misunderstandings. These competencies appear to mirror key challenges in virtual learning, where time zones, varied digital literacies, and dissimilar communication expectations intersect (Kovalainen, 2022, pp. 90–92). Koehn and Rosenau (2016) argue that intercultural communication alone cannot prepare students for the multicultural challenges that contemporary working life will offer.

Our communicative contexts are shaped by our perceptions of ourselves, others and the surrounding world, for instance, our views on cultures and cultural backgrounds, language skills in various possible languages, and individual preferences on available or possible communication methods. TCC also involves an evolving understanding of one's linguistic identity. In today's educational contexts, students must often negotiate between native, learned, and situational language roles, particularly in English-dominant environments (Kovalainen, 2022, pp. 36–39). Kovalainen (2022) notes that while English serves as a shared medium, its dominance can obscure underlying power dynamics and affect students' sense of voice and belonging.

Figure 1

Components of Intercultural and Transnational Communication Competences



Note. Adapted from Kovalainen (2022, p.101)

As the picture illustrates, all the previously mentioned dimensions of TCC can be seen to form layers of intercultural communication understanding, finally leading up to transnational communication competence. The innermost layer is individual attributes: different identities related to communication, language and culture. The middle layer is intercultural communication, a layer where those individual attributes come together to form three concepts underlying all the individual components: cognitive dimension, attitudinal orientation and skills. Utilising these concepts in action is always contextual. These same three concepts are the dimensions that can transcend onto the next, outermost layer - transnational communication competence. On the final layer, individual communicators have an understanding of how their individual skills, attitudes and knowledge can be transferred from one communication context onto another, hence creating transnational communication competence.

Data & Methodology

This research utilises data that were collected through semi-structured interviews with 31 higher education students of Finnish or international origin, who wished to share their views on intercultural learning experiences in Finnish HEIs. The data was collected as part of a project called "*Recognition of Cultural Diversity in Everyday Life in Finland: Case Studies in Intercultural Interaction Arenas*" at Tampere University in 2008-2010 (cf. Pitkänen, 2011).

The interviewed students were all degree students, to gain a better understanding of long-term oriented communication skills development. The students were a stratified purposive sample (Creswell & Poth, 2018). These students came from diverse linguistic and cultural backgrounds (12 first languages, 12 countries) and were studying for either a Bachelor's, Master's or Doctoral degrees. The thematic analysis of the data focused on learners' reflections about communication, identity, languages, cultures, and inclusion in (digital) working contexts (Kovalainen, 2022).

For this article, this data was revisited and analysed in relation to intercultural and transnational communication competences with the analysis scheme below.

Table 1

Analysis of Data

Analysis Category	Derived From	Focus of Analysis
Communication Competence	Spitzberg & Cupach (2011); Spitzberg (2000)	Nonverbal competence, clarity, conversational turn-taking, listening
Intercultural Communicative Competence	Deardorff (2006); Bennett (1993); Byram (1997); Guilherme (2002); Kramsch (2013)	Cultural knowledge, attitudes, empathy, adaptation to cultural norms
(Foreign) Language Skills	Kohn (2015); Jenkins (2015); Seidlhofer (2011); House (2003)	English as lingua franca, multilingual practices, accommodation strategies
Transnational Communication Competence	Koehn & Rosenau (2002); Appadurai (1996); Dervin (2015)	Virtual interaction, skill transfer across contexts, third-culture negotiation

Findings

Students were able to see differences in communication skills, language skills and cultural know-how, but their reasoning towards challenges or difficulties was not, most of the time, justified. Most of the respondents understood and saw the importance of linguistic flexibility, but credited all success in intercultural communication to their own -or their counterpart's- English skills. This lack of understanding of intercultural communication dimensions created a lot of challenges, especially with international students who were eager to belong to Finnish working life communities. There was a similar dissonance in their views concerning digital agency, as they used English as a foreign language not as a means to ensure a common understanding but as an emotional buffer. Some respondents felt that it was easier to speak more freely in English than in their own first language, as making mistakes and expressing feelings was aloof, not as close to the head or heart. In virtual communication contexts, the respondents mainly felt that writing in a foreign language was easier than talking, as reading and answering messages could be done with more caution. However, they disliked it if they did not get a response to their written message right away, as making a person wait was considered to be rude. Yet again, personal communication preferences coincided with language skills as well as virtual skills.

The findings suggest that students are linguistically flexible and able to adjust to diverse proficiencies if those proficiencies are known to them. They assume digital agency quite easily by managing multimodal tools in conversations and work and are accustomed to using English as lingua franca. HE students appear to have some level of contextual sensitivity but face various challenges in digital etiquette awareness as well as managing silences. Some respondents state that their feeling of belonging does not necessarily come from belonging to a certain group, but more of the informal aspects outside group work, such as informal chats

and the use of emojis in messaging others. According to this data, success factors for HE students are interactivity, being able to reflect on actions taken as well as responding relatively positively to being facilitated in times of need. Some respondents stated that there is a will to know more about intercultural communication and to gain those essential skills for international, transnational working life contexts, but there is either no time or money to go abroad to gain those skills.

It would seem that short-term experiences of transnational communication would be beneficial in building HEI students' transnational communication competencies as the premise is already there: being able to use technological tools, being able to use different common languages, being aware of otherness, and taking an active role in one's own feeling of belonging. As only some students are able to travel to study abroad for a longer period of time, offering them short-term experiences within their studies at home appears to be beneficial for their future working life competencies. In order for these activities to develop transnational communication skills, leading up to competencies, the activities must remain reciprocal and interactive, embracing multilingual realities. Cultural expression must be supported and technological literacy needs to be integrated into communication skills. As it is evident that transnational communication skills are a multidisciplinary entity, HEIs should make a conscious effort to add transnational communication experiences into their curricula - short-term virtual experiences need not merely be a crisis solution.

Finally, it must be noted that there was a sense of contextual sensitivity underlying the respondents' communication. Most respondents appeared to understand different forms of digital etiquette in both study and work environments and were making a conscious effort in learning to navigate challenging communication contexts. Reciprocal politeness was seen as a necessity; however, its real origin and the manner in which it could be achieved were not clear to any of the respondents. The respondents truly felt an urge to learn more about intercultural communication, but were unaware of what it truly consists of, and were neither realistic nor very polite in expressing their wishes concerning future communication situations. The respondents placed far too much value on English language skills as a sole provider of ICC, and nowhere near enough value on creating a third culture based on mutual and shared understanding. Some respondents stated they did not have a sense of belonging to their studying environment because of a lack of (Finnish) language skills. Therefore, it can be argued that in order for HE students to graduate better equipped with a predisposition towards TCC in modern international, intercultural and largely transnational working environments, they must be able to practise TCC much more than they currently do.

Discussion

Short-term virtual learning experiences offer significant potential for fostering transnational communication competence (TCC) in higher education. As Kovalainen (2022) argues, these experiences make international engagement more accessible and inclusive by removing common barriers associated with traditional mobility, such as financial costs, travel limitations, and visa restrictions. Virtual exchanges, collaborative online international learning (COIL), and micro-courses allow a wider range of students to participate in intercultural learning, regardless of their personal or institutional circumstances. Given the current financial challenges of Finnish higher education institutions' funding systems, all possibilities to foster future skills with low costs are in high demand.

Beyond accessibility, short-term virtual experiences actively support the development of multidimensional transnational competencies. Kovalainen (2022) defines TCC as a dynamic combination of linguistic flexibility, digital agency, contextual sensitivity, and communicative identity negotiation beyond contextual intercultural communication competencies. These competencies can be cultivated through reciprocal, real-time engagement with culturally diverse peers in digital learning spaces, and through real challenges in communication, institutional practices, time zone differences, as well as virtual and technological skills. Students reported gaining confidence in navigating intercultural dialogue in unfamiliar virtual environments, highlighting the formative nature of these experiences (Kovalainen, 2022, pp. 36–40).

The relevance of short-term virtual learning is further underscored by its alignment with the communicative demands of hybrid and global workplaces. Kovalainen (2022, p. 43) notes that these experiences mirror the project-based, multilingual, and intercultural settings that define many contemporary work environments. As such, virtual learning acts as a preparatory space where students can hone the flexible communication skills needed in transnational professional contexts. Moreover, these experiences encourage the formation of third culture spaces where students collaboratively negotiate shared communicative norms that transcend any single cultural background. In such spaces, learners shift perspectives and co-construct new ways of interacting, which deepens their transnational competence (Kovalainen, 2022, pp. 38–39). This makes short-term virtual learning not only pedagogically meaningful but also transformative on a personal and social level.

Finally, the relative ease of integrating short-term virtual formats into existing curricula makes them a practical choice for institutions seeking to internationalize education. Kovalainen (2022, pp. 41–42) observes that virtual exchanges and related activities can be embedded within communication or language modules without significant structural changes, making them a feasible addition to many academic programs. In conclusion, short-term virtual learning experiences represent an accessible, future-oriented, and educationally robust approach to developing transnational communication competence. They offer a valuable alternative to long-term mobility, while fostering the communicative agility and intercultural insight necessary in globalized learning and working environments.

How can we then organise these short-term virtual learning experiences so that they truly offer a flexible and inclusive way to build transnational communication competence? These experiences, often embedded in real-world collaboration with companies and international peers, enable students to practise authentic communication in low-threshold environments. Digital badges and micro-credentials allow for the recognition of specific micro-skills, making learning visible and up-to-date. Teachers report improved integration of language and content teaching and note that such formats support internationalisation without requiring full-scale mobility or courses. Crucially, these experiences help operationalise abstract competencies—such as tone awareness and reflection—by situating them in meaningful, practice-based contexts. Moving forward, co-creation of learning units with students and work-life partners, expansion to additional languages, and visual alignment with transnational competence frameworks are essential steps to ensure the relevance and scalability of these practices.

Table 2

Initial Suggestions for Transnational Communication Competence: Developing Micro-credentials

Micro-Credential Focus	Skill Emphasis	Suggested Implementation	Transnational Communication Competencies
Initiating, Pitching Your Project	Persuasive Oral Communication,Idea articulation, audience adaptation, intercultural rhetoric	Micro-credential in Project Communication linked to COIL pitch presentation or peer-reviewed idea proposal	Virtual communication, Skills, English as lingua franca
Developing, Professional Email Communication	Formal Writing & Intercultural Awareness; Digital tone, genre conventions, intercultural pragmatics	Digital Badge for Professional Intercultural Writing, awarded after asynchronous email simulation tasks	Skills, English as lingua franca, Transcontextual understanding
Piloting, Feedback That Builds Trust	Giving/Receiving Feedback Respectfully, Constructive feedback, empathy, cross-cultural response styles	Short module on Constructive Feedback Across Cultures integrated into COIL peer review assignments	Third culture, Transcontextual understanding
Assessing, Language for Reflective Writing	Metacognitive Communication Skills, Critical reflection, self-awareness, communication strategy analysis	Micro -credential in Reflective Practice in Global Teams includes journaling and peer-commented submissions	Transcontextual understanding, Skills
Implementing, Sharing Project Outcomes	Public-Oriented, Accessible English, Clarity, plain language, accessibility, knowledge dissemination	Badge in Public Engagement & Accessible English tied to project dissemination blog/video in transnational setting	Virtual communication, Third culture, English as lingua franca

After analysing the data from the viewpoint of transnational communication competence for future working life skills, particularly with short-term learning possibilities in HE in mind, one possibility appears to be to approach the topics by segmenting the learning process into project plan stages. These initial proposals for micro-credentials in an interdisciplinary course related to TCC offer possibilities for individual, reciprocal, and public ICC, while allowing students to work with other HE students and/ or degree-relevant company representatives in various lengths of time. These proposed activities also allow students to practise reading, writing and speaking in various formats and for various audiences, and offer possibilities for self-reflection, peer and teacher feedback and feedforward. These tasks will be tested in the autumn term of 2025 at Laurea University of Applied Sciences (UAS), Finland. Laurea UAS uses LbD, *Learning by Developing* (Laurea, 2025), as their learning and teaching pedagogy, which enables collaboration with real degree-related companies with their respective projects as well as any university, whether national or international, whose learning goals and plans fit Laurea's degree-specific curricula. In a society such as Finland, where foreign languages, multinational companies, as well as technological tools and skills are present everywhere, it seems vital that strides towards teaching and learning skills that are relevant -and even vital- in future occupations are taken frequently and by many.

The findings of this study suggest that short-term virtual learning experiences can indeed be seen as a possible manner to foster transnational communication competence (TCC), particularly when they are designed to be reciprocal, interactive, and inclusive of multilingual and multicultural realities. Students can benefit from low-threshold opportunities to engage in authentic communication tasks with peers and professionals from diverse backgrounds, building both confidence and practical skills. These results align with Kovalainen's (2022) conceptualization of TCC as a dynamic and co-constructed process, emphasizing mutuality over standardization.

Importantly, the results revealed that virtual communication skills emerged not only as a technical skill but as an integrated aspect of communication competence in virtual spaces. It can be argued that language and content integration do improve intercultural communication skills significantly, but that is not sufficient to construct TCC. The use of digital badges and micro-credentials provides a meaningful way to recognize progress in communication skills, even outside traditional course structures. Overall, the results advocate for higher education

institutions to embed short-term, digitally mediated international exchanges into their curricula, not as emergency solutions, but as sustainable, scalable tools for preparing students for transnational professional life.

This study suggests that even brief virtual exchanges can, however, allow HE students to practise in meaningful transnational communication contexts and gain competence, provided the learning situations are:

- Encourage active, reciprocal communication
- Acknowledge and support multilingual realities
- Create safe spaces for cultural identity expression
- Integrate virtual skills as a part of communicative skills

Such findings align with Kovalainen's (2022) conclusions that competence is best fostered through real-world, communicative tasks that blend personal and contextual awareness. The third culture model and linguistic identity theory both emphasize the importance of creating space for mutuality and adaptation rather than standardization (Kovalainen, 2022).

Experiences such as international virtual workshops, micro-credentials, learning badges, project-based COIL modules, and collaborative micro-courses allow students to engage in authentic, goal-oriented communication with peers and professionals from around the world. These learning opportunities are particularly significant for students with limited access to physical mobility, offering inclusive and scalable pathways to develop global competencies that are increasingly critical in digitally connected societies.

Conclusion

Transnational communication competence is not limited to long-term mobility programs. Carefully designed short-term virtual experiences offer flexible, scalable, and equitable opportunities for learners to build critical communication skills for global professional life. Higher education institutions must embrace these tools not only as convenient tools during crises but as sustainable components of a transnational curriculum.

This study suggests that short-term virtual learning experiences—while limited in duration—can create meaningful conditions for developing transnational communication competence, particularly when designed with intentionality and interaction at their core. While their depth is limited by time and platform constraints, structured facilitation, shared goals, and informal social interaction (e.g., chats, humour, small talk) can support the co-construction of temporary third cultures. These moments—though transient—can have lasting developmental value, particularly when students are prompted to reflect on their role in intercultural meaning-making.

Students reported having experienced moments of linguistic negotiation, virtual agency, and the gradual formation of shared communicative norms that reflect the third-culture processes described by Kovalainen (2022). These findings support the idea that transnational competence is not tied to prolonged mobility but can emerge from reciprocal and situated communication, even in short timeframes. Micro-credentials can scaffold a HE learner's progression across multiple short-term interactions, gradually deepening their TCC profile and enhancing employability in globalized labour markets.

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

This article has been language-checked and formatted with the help of ChatGPT. All interpretations, analyses, and argumentation are the author's own.

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The Discursive Normalization of AI in Pedagogical Mediation and the Risks of Uncritical Acceptance of Its Interlocutions

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Abstract

With the increasing presence of Generative AI in professional and educational environments, this research examines the ability to distinguish between human and AI mediation in higher education, analyzing epistemological, emotional, and pedagogical impacts. Through the lens of reflexive modernity, it explores challenges to knowledge reliability, self-continuity, and emotional responsibilities displaced by simulated empathy. It also examines the erosion of epistemic trust due to plausible but imprecise AI-generated content, affecting critical knowledge construction and academic discourse. This study assesses whether the normalization of AI in pedagogical mediation fosters uncritical acceptance of its interlocutions, aligning with the "colonization of the future," where algorithmic predictions shape behaviors in opaque ways, challenging authorship, accountability, and academic integrity. Empirical research analyzed a discussion forum in a distance learning Portuguese Language course, comparing student interactions with human and AI mediators (ChatGPT-3.5). A textual corpus was evaluated by 13 human mediators based on relevance, empathy, and clarity, alongside an Adapted Reverse Turing test where AI assessed authorship. This exploratory study, using Likert-scale and open-ended questionnaires, provides insights into the ethical and pedagogical implications of AI in higher education. By addressing risks and opportunities, the findings contribute to strategies for preserving epistemic trust, fostering human-centered education, and ensuring AI enhances rather than replaces critical thinking, student engagement, and inclusive pedagogy.

Keywords: artificial intelligence, pedagogical mediation, discursive authorship, reliability, AI invisibility

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Introduction

Pedagogical mediation involves more than content transmission: it builds trust, establishes interpersonal connections, and fosters critical thinking. However, the growing presence of Generative Artificial Intelligence (GAI) in education, especially as a mediator in digital environments, introduces new challenges. One of these is the difficulty in recognizing whether mediation is conducted by humans or machines, which can undermine epistemic trust (Vallor, 2016; Zuboff, 2019) and alter the notion of academic authorship.

This study discusses the concept of simulated empathy, understood as the GAI's ability to deliver emotionally charged responses without subjective experience. Such simulation can lead students to perceive genuine empathy where there is only programming, making it harder to distinguish between human and automated support. According to Elish (2019), these interactions place users in a "moral crumple zone," shifting responsibility for GAI failures to human operators. Crawford (2021) notes that this false empathy can create affective bonds with AI, compromising students' intellectual autonomy and weakening critical capacity (Danaher, 2019; Duah & McGivern, 2023).

The study investigates the normalization of GAI in pedagogical mediation, understood as the process by which its use becomes routine and unquestioned. This naturalization promotes the invisibility of AI, obscuring authorship and making it difficult to distinguish between human and machine. This invisibility relates to Ulrich Beck's (2010) concept of "colonization of the future," in which educational decisions become shaped by invisible and decontextualized algorithmic predictions (Eubanks, 2018; Pasquale, 2020).

The research is framed within the theoretical context of Risk Society, as outlined by Beck (2010) and Giddens (1991). Both highlight how trust in abstract technological systems, increasingly ubiquitous, can mask structural risks. The reliance on invisible AI mediators in virtual learning environments is a clear example of reflexive modernity. As Giddens (1991) states, specialized systems are used without full understanding by individuals, transferring trust from users to specialists and programmers.

Zuboff (2016, 2019) reinforces this analysis with the concept of Surveillance Capitalism, in which behavioral data extracted from digital interactions are turned into predictive products. In education, AI mediators in distance learning forums silently collect data, influencing the behavior of both students and teachers. Thus, AI mediation is not neutral: it structures interactions in ways that feed prediction models and algorithmic learning, creating an opaque surveillance environment.

These dynamics are also expressed discursively. The simulated empathy of GAI is not merely functional—it shapes the content and pedagogical meaning of the interaction. These machines employ strategies of active listening and emotional support that reinforce the illusion of affective interlocution (Crawford, 2021). Discursively, these strategies replicate internalized social norms, increasing uncritical acceptance of AI as a legitimate agent in educational spaces.

Elish (2019) warns of the ethical risk of responsibility transfer: when AI fails in mediation, the blame may fall on the human teacher, who does not control the algorithms. The construction of an artificial ethos—i.e., a discursive image of competence and empathy—sustains this illusion. As Danaher (2019) and Zuboff (2019) show, this trust is often

unjustified, since generative models can produce imprecise or misleading content with high plausibility.

To mitigate the negative impacts of simulated empathy, authors such as Pasquale (2020) and Eubanks (2018) advocate for transparency policies and AI regulation in education. Clear signaling of AI presence, restrictions on its use in contexts requiring real emotional support, and digital literacy for students are essential strategies.

GAI-generated discourse can also be examined through enunciation theory and discourse analysis as proposed by Maingueneau (2008, 2013, 2015). The author introduces the concepts of scenography and ethos, showing how GAI language simulates a legitimate speaker, shaping perceptions of trustworthiness. This discursive construction is especially relevant in educational contexts, where mediation presupposes authenticity and active listening. AI projects an ethos of support and competence, even without subjectivity, which favors its acceptance as a mediator.

The increasing sophistication of AI-generated language makes authorship identification more difficult. Researchers at the University of Maryland (2023) found that AI text detectors can be easily deceived by paraphrasing. OpenAI itself states that its tool is only 26% accurate, with a 9% false-positive rate (McCrosky, 2024). Reeves and Nass (1996) also demonstrate that these algorithms are biased against non-native speakers, compounding issues of epistemic justice.

Authorship is a central issue. Gunkel (2023) asserts that writing in AI-mediated environments is characterized by distributed authorship, shared between humans and machines. Fernandes (2023) refers to a "simulacrum of author function," while Gallo (2023) questions whether AI textual production constitutes genuine authorship or mere statistical reproduction. Simulated empathy, by intensifying the illusion of authenticity, deepens this dilemma and reinforces the attribution of subjectivity to systems that, in fact, lack it.

In the field of genre analysis, Bakhtin (1997) and Marcuschi (2008) emphasize that educational forum interactions follow relatively stable structures. Even in this context, AI adapts its discourse to prevailing genres, establishing itself as a legitimate part of the environment. By adhering to these conventions, GAI not only imitates but participates in the construction of pedagogical and collaborative meaning.

Statement of the Problem

The growing presence of Generative Artificial Intelligence (GAI) in educational settings, especially in pedagogical mediation within distance learning courses, raises complex challenges related to the identification of authorship and its epistemological and emotional implications. The difficulty in distinguishing whether mediation is conducted by human agents or artificially intelligent agents threatens epistemic trust, a fundamental element for knowledge construction and the development of students' intellectual autonomy.

Furthermore, GAI's simulation of empathy—an emotionally charged but programmed response without true subjectivity—can create a false impression of genuine emotional support, compromising students' critical capacity. This phenomenon, coupled with the invisibility of artificial intelligence in educational environments, hinders clear authorship identification and contributes to the naturalization of AI use in pedagogical contexts. This

process can be understood as a “colonization of the future,” in which decisions and behaviors are shaped by opaque algorithmic predictions.

In this scenario, there is also an ethical risk related to responsibility transfer, where failures in AI-mediated mediation are unfairly attributed to human instructors or operators, reinforcing an artificial ethos that legitimizes AI as a competent and empathetic interlocutor. Additionally, the production of content that is plausible but imprecise or erroneous challenges the construction of reliable knowledge, demanding reflection on transparency, regulation, and digital literacy.

Therefore, the central problem of this research is to investigate how the invisible presence of GAI in pedagogical mediation impacts perceptions of discursive authorship, epistemic trust, and emotional dynamics in higher education environments—particularly analyzing the risks of uncritical acceptance and the consequences for ethics and educational quality mediated by intelligent technologies.

Study Objectives

This study aims to investigate the growing presence and normalization of Generative Artificial Intelligence (GAI) as a mediator in higher education, focusing on its epistemological and emotional impacts. The specific objectives are:

1. To examine the ability of students and educators to distinguish between mediation conducted by humans and by artificially intelligent agents in digital learning environments.
2. To assess how the invisibility and normalization of AI in pedagogical mediation influence perceptions of authorship and trustworthiness.
3. To empirically analyze the discourse of a distance learning forum, contrasting human and AI-mediated interactions through qualitative and quantitative methods, including evaluations by human evaluators and AI authorship detection tests.

Research Questions

How effectively can students and educators identify whether pedagogical mediation is conducted by humans or by Generative Artificial Intelligence in digital higher education environments?

1. What are the epistemological and emotional consequences of AI-simulated empathy on students' learning experiences and critical thinking skills?
2. How do the invisibility and normalization of AI mediators affect epistemic trust and perceptions of authorship?
3. How do human evaluators and AI authorship detection tools perform in distinguishing between AI-generated and human-generated mediation texts?

Research Hypotheses

H1: Students and educators have significant difficulty distinguishing between human-led and generative AI-driven mediation in digital learning forums.

H2: Empathy simulation by AI mediators creates affective engagement that can compromise students' intellectual autonomy and critical thinking skills.

H3: The normalization and invisibility of AI in pedagogical mediation leads to reduced epistemic trust and obscured authorship attribution.

H4: Responsibility for failures in AI-mediated pedagogical interactions is implicitly transferred to human educators, despite their lack of control over the AI.
H5: Generative AI adapts its discourse according to prevailing educational genres, thus reinforcing its acceptance and legitimacy as a pedagogical mediator.

Methodology

This exploratory research focuses on the difficulty of distinguishing human from artificial authorship in the context of pedagogical mediation in distance education environments. Based on the use of Generative Artificial Intelligence (GAI), especially the ChatGPT 3.5 model, the study questions the growing presence of AI as a mediator in educational forums, using a theoretical framework including Turing (1950), Gunkel (2023), Beck (2010), Giddens (1991), Zuboff (2019), Elish (2019), and others. The research investigates the limits of human and algorithmic perception regarding authorship of AI-mediated discourse, analyzing its epistemic, emotional, and ethical impacts.

The methodology, structured in eight stages, involved collecting real excerpts from forums in language courses and creating two distinct corpora: one consisting of interactions between students and human mediators and the other between students and GAI. A third mixed corpus was created from these. The data were evaluated by thirteen human mediators who assessed the quality and assumed authorship of the interactions. Simultaneously, GAI was tasked with performing the same evaluation using what was called the Adapted Reverse Turing Test. A third verification tool, GPTZero, was also employed to detect authorship based on linguistic and stylistic patterns.

In each evaluated interaction, humans were asked to assess mediation in terms of relevance, empathy, and clarity. The AI was given the same task before being asked to infer the nature of the responding agent. The results showed that in most analyzed interactions, both humans and AI classified GAI responses as being authored by humans. For example, in Interaction 1, about 70% of experts rated the mediation as “good” or “excellent,” and 80% believed it was human. GAI, in turn, rated the quality as “good,” likely of human authorship. Similar results were found in subsequent interactions, including those with more affective mediation or controversial content, such as Interaction 4, where AI responded empathetically to a harsh critique from a student.

Analysis of Results

These results demonstrate a concerning pattern of misattributed authorship, supported by two central phenomena: the “normalization” of GAI and its “invisibility” in educational environments. Statistical analysis of the results revealed that in both the traditional and Adapted Reverse Turing Tests, the correct detection rate was only 20%. That is, in 80% of cases, GAI was mistaken for a human. This finding supports Floridi and Chiriatti’s (2020) argument about the obsolescence of the Turing Test as a reliable measure of artificial intelligence in contemporary contexts. Moreover, it shows that even trained human interlocutors face significant limitations in detecting the nature of responses in digitally mediated environments.

The results also highlight that GAIs, by simulating empathy with discursive fluency, can deceive both human evaluators and themselves. This supports concerns raised by authors like Madeleine Clare Elish (2019), who warns about the “moral crumple zone,” in which

algorithmic simulation shifts emotional and moral responsibility to human operators. AI thus appears not merely as a neutral tool but as a discursive agent constructing its own ethos—a term that, according to Maingueneau (2008), refers to the image of trustworthiness projected in discourse. AI formulates responses with politeness, active listening, and motivational suggestions that mimic the actions of a caring and attentive educator, despite lacking subjectivity.

This simulation capacity becomes even more evident when AI is evaluated in terms of empathy. As Crawford (2021) and Danaher (2019) demonstrate, empathy simulated by algorithms reinforces uncritical acceptance of their responses, especially in educational settings where emotional support is expected. The difficulty in distinguishing between human and artificial empathy weakens epistemic trust, as programmed responses are perceived as authentic interactions. This reflects Ulrich Beck's (2010) notion of "colonization of the future," which warns of technologies shaping human behaviors through algorithmic predictions without transparency or critical debate.

In this scenario, the sophistication of language models emerges as a significant challenge for contemporary pedagogy. The fact that GAIs can respond with coherence, fluency, and artificial empathy means that the "humanity" of discourse can no longer be assessed intuitively. Recent studies from the University of Maryland and OpenAI (2023) point out high error rates in detecting artificial authorship, with false positive and negative rates compromising trust in automated detectors. GPTZero, for instance, failed to correctly analyze part of the samples tested in this research.

Furthermore, the analysis shows that educational forums constitute their own discursive genres, with rules and conventions internalized by participants, as noted by Bakhtin (1997) and Marcuschi (2008). Within this context, AI learns to model its utterances according to these rules, reinforcing its discursive camouflage. David Gunkel's (2023) notion of "distributed authorship" gains strength, as it demonstrates that discourse produced in digital environments is no longer the result of a single subjectivity, but a blending of human and machine.

Conclusion

The results indicate that the trust attributed to AI is anchored in its discursive performance. Giddens (1991) observes that in late modernity, individuals place trust in abstract systems they do not understand, granting them authority based on the credibility of their developers. GAI, by adopting a polite tone and presenting organized information, builds its ethos as a legitimate mediator, even without clearly disclosing that it is not human. This uncritical acceptance is amplified by daily familiarity with AI tools and the lack of explicit authorship markers in educational interfaces, as discussed by Selwyn (2019).

The research thus demonstrates that the presence of GAI as an invisible and indistinguishable pedagogical mediator poses ethical, pedagogical, and epistemological challenges. The successful simulation of empathetic mediation masks the absence of subjectivity and shifts responsibility, demanding better preparation from human mediators and the development of protocols that clearly indicate the authorship of interactions. As Pasquale (2020) and Eubanks (2018) point out, it is necessary to establish regulations to ensure that AI is used transparently and not in contexts that require genuine human mediation.

Given the evidence that both humans and GAIs achieve only 20% accuracy in identifying authorship, it is urgent to promote algorithmic literacy among students and teachers, enabling them to recognize signs of AI presence and critically question the discourses it produces. The absence of such literacy can compromise the quality of pedagogical mediation and learners' autonomy, while reinforcing AI's “invisibility” in the educational ecosystem.

Finally, the research confirms that pedagogical mediation cannot be reduced to the production of plausible responses; it requires genuine empathy, subjective responsibility, and the collective construction of knowledge. However advanced GAI may be, it still operates in the realm of simulation, without lived experience or emotional commitment. Therefore, its presence in education must be carefully regulated to preserve authentic human interaction as the foundation of epistemic trust and critical formation.

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Exploring the Role of Social and Emotional Learning and Personal Resilience Interventions in Saudi Higher Education Curricula

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Abstract

This study examines the integration of Social and Emotional Learning (SEL) and personal resilience into the curricula of higher education institutions in Saudi Arabia. Despite the growing empirical evidence highlighting the positive impact of SEL on academic achievement, emotional well-being, and resilience, there is a gap in research regarding its specific implementation within Saudi colleges. The study highlights that while SEL is increasingly recognised as essential for fostering emotional intelligence and resilience, its incorporation across various academic disciplines remains inconsistent. Through qualitative interviews with students and faculty, the research identifies several themes: a growing emphasis on emotional regulation and personal development, variability in SEL integration across departments, and the emergence of resilience-building in psychology and leadership programmes. The study also finds that SEL activities are often relegated to extracurricular programmes rather than integrated into core curricula, limiting their effectiveness. Faculty members acknowledge the importance of SEL and resilience, but face challenges related to time constraints, insufficient training, and competing academic priorities. Students, on the other hand, express a desire for broader SEL integration across all subjects, emphasising the need for resilience training to help them cope with academic pressures and personal challenges. The study concludes with recommendations for more structured SEL and resilience initiatives to enhance student outcomes in Saudi higher education.

Keywords: social and emotional learning, resilience, curriculum, higher education institutions

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Background

Social and Emotional Learning (SEL) is a transformative educational approach that helps students explore and embrace their unique identities, develop meaningful relationships, and gain a deeper understanding of their emotions (Corcoran et al., 2018; Durlak et al., 2011; Min et al., 2024). At its core, SEL empowers students to set and achieve personal goals. Essentially, students learn how to be proper goal-setters and achieve personal goals while being aware of the importance of compassion and empathy (Silke et al., 2024). This targeted approach aims to assess the essential skills required for success while minimising distractions or failures that could hinder emotional regulation or social development in the classroom (Collaborative for Academic, Social, and Emotional Learning [CASEL], 2023).

Resilience building is a key component of SEL interventions. Resilience refers to a person's capacity to achieve positive outcomes in the face of challenging situations (Noltemeyer & Bush, 2013). It is a socially and contextually driven process that allows students to overcome adversity and attain success (Ang et al., 2021). Students who develop resilience can maintain stable levels of achievement, motivation, and functionality even under stressful circumstances (Carsone et al., 2024; Khedr et al., 2023). Resilience can be enhanced by addressing protective factors and minimising risk factors across multiple levels, including individual, family, school, and community (Noltemeyer, 2014). For example, academic resilience-related factors can heighten resilience levels in college students (Carsone et al., 2024). Resilience training, which helps students develop inner strengths and social competency, should be integrated into all higher education curricula to support college students both during their studies and beyond (Ang et al., 2021).

While there is a lack of sufficient research on the direct link between resilience and SEL, studies have shown that both resilience and SEL are critical to students' academic performance, well-being, and future success (Varela et al., 2013). Integrating SEL strategies in higher education can promote stress resilience, self-management, social awareness, and student motivation to learn (Elmi, 2020). A study conducted in Saudi Arabia found that a significant proportion of students transitioning to distance learning during the pandemic experienced high levels of anxiety, depression, insomnia, and low resilience (Alyoubi et al., 2021). Another study suggests that resilience serves as a protective factor against emotional exhaustion, while stress is a risk factor for emotional exhaustion (Alsharif, 2020). These findings emphasise the need for targeted intervention and instructional strategies that instil resilience and stress reduction in order to mitigate the adverse effect of the pandemic on students' mental well-being (Alyoubi et al., 2021). However, in the context of Saudi higher education, there is a lack of social and emotional support for students due to poor educational content that does not meet their learning needs (Alenezi, 2020; Almoslamani, 2022).

Social and Emotional Learning (SEL) in Education

At all levels of education, including professional and continuing education programmes, there is an increasing focus on SEL (Conley, 2015; Keefer et al., 2018). SEL is not only a trend; it is an efficient strategy that can enhance classroom relationships, academic growth, students' motivation, and engagement (Reicher, 2010; Srinivasan, 2019; Tantillo Philibert, 2018). SEL has attracted growing interest in international educational reforms because it can equip students not only with academic achievement but also with the emotional and social difficulties they will face throughout their lives (Durlak et al., 2011; Jones-Schenk, 2019; Lisciandro et al., 2016; Schonert-Reichl, 2017; Strahan & Poteat, 2022; Taylor et al., 2017).

SEL is increasingly recognised as an integral part of education, having a positive effect on both academic performance and personal resilience (Almakky, 2025; Khasawneh, 2023).

Extensive research also attests that SEL skills can be instructed and assessed effectively. Not only do these skills foster positive growth but also decrease problem behaviour. They lead to academic success, improved citizenship, and healthier lifestyles (Durlak & Weissberg, 2015; Durlak et al., 2011; Schonert-Reichl & Weissberg, 2014). In addition, studies have demonstrated that SEL is a predictor of long-term life success, including high school graduation, college graduation, and stable employment (Hawkins et al., 2008; D. E. Jones et al., 2015).

The growing body of evidence demonstrating that SEL promotes academic, personal, and professional success has led to supportive policies at federal, state, and local levels. These policies aim to integrate social, emotional, and academic development in young people (Schonert-Reichl, 2017; Taylor et al., 2017). Various SEL frameworks have been proposed, each outlining the different elements affecting SEL, including school culture, climate, and pedagogical competence of teachers. These models target student outcomes like academic success and social-emotional competence (Schonert-Reichl, 2017).

Literature Review

Students' and Teachers' SEL Competencies

SEL involves processes through which students acquire and apply knowledge, attitudes, and skills to understand and manage their emotions. It also helps them feel empathy for others, set and achieve positive goals, develop positive relationships, and make responsible decisions (Schonert-Reichl, 2017; Silke et al., 2024). CASEL has identified five interrelated competencies central to SEL: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making (CASEL, 2023; Elmi, 2020; Silke et al., 2024; Weissberg et al., 2015).

Teachers' social-emotional competence plays a significant role in shaping the learning context and fostering SEL within classrooms and schools. Their ability to manage social and emotional demands in the classroom directly influences student outcomes, including academic performance and SEL development (S.M. Jones et al., 2013). Warm teacher-student relationships promote deeper learning, as students who feel comfortable with their teachers are more likely to engage with challenging material and persist through difficult tasks (Merritt et al., 2012). On the contrary, when teachers struggle with managing social and emotional demands, students may show lower performance and reduced engagement (Schonert-Reichl, 2017). Therefore, improving teachers' ability to foster SEL in their students requires enhancing their own social-emotional competence (Jennings & Frank, 2015).

Research indicates that classroom environments, characterised by positive teacher-student relationships, promote both academic learning and SEL (Durlak et al., 2011; Durlak & Weissberg, 2015; Lisciandro et al., 2016; Schonert-Reichl & Weissberg, 2014; Silke et al., 2024). Teachers need more than just the knowledge to teach SEL; they must also possess the dispositions and skills necessary to create a safe, caring, and responsive classroom community. Teachers' own emotional well-being and competence significantly affect their ability to promote SEL effectively (Schonert-Reichl, 2017).

Any conversation about teachers and SEL should begin by examining whether teachers accept the idea that education should explicitly promote students' SEL. Recent research shows that the answer is overwhelmingly yes. However, teachers have expressed a need for stronger support from district and school leaders to effectively implement and promote SEL in their classrooms (Bridgeland et al., 2013).

The Role of SEL and Personal Resilience in Higher Education Curricula

In recent years, Saudi Arabia has increasingly integrated SEL into its educational curricula, driven by a growing awareness of its importance in fostering resilience among students (Almakky, 2025; Khasawneh, 2023). SEL has been recognised for its role in promoting emotional intelligence, critical thinking, and problem-solving, skills essential for navigating the complexities of modern educational environments (Al-Asmari, 2014; Al-Ghamdi, 2014; Al-Shakifi, 2015; Pham, 2024; Saud, 2019). As part of this process, resilience enables students to overcome academic and personal challenges, enhancing their ability to manage stress and regulate emotions.

A study conducted in Saudi Arabia by Rayani et al. (2024) explored factors influencing well-being and resilience among nursing students. The study found that nursing students exhibited higher levels of resilience, positively correlating with more favourable perceptions of their well-being. This highlights the potential of SEL in improving students' emotional and academic outcomes.

Further emphasising the connection between resilience and academic achievement, Almulla (2024) assessed academic resilience among college students in Saudi Arabia and explored its correlation with academic performance. The study revealed a significant positive relationship between academic resilience and academic success. Additionally, resilience was particularly high in the sub-dimensions of perseverance, followed by adaptive help-seeking, underscoring the importance of these traits in students' academic journeys.

The studies from Saudi Arabia are consistent with Pham (2024) who emphasises that culturally responsive SEL frameworks are crucial for addressing the socio-cultural context of Saudi students. By implementing SEL in a way that aligns with the cultural and societal values of Saudi Arabia, its effectiveness in promoting resilience can be significantly enhanced (Almakky, 2025). Thus, SEL programmes in Saudi higher education should not only aim to improve academic performance but also foster an emotionally supportive and inclusive environment for students.

The primary role of SEL and personal resilience in higher education curricula is to nurture emotional regulation, self-awareness, relationship building, and decision-making skills (Lubit, 2019). Research has shown that developing social and emotional competencies in these areas is essential for students' overall development, adjustment, and success in higher education (Conley, 2015). Elmi (2020) found that instructional practices supporting SEL are well-suited for engaging learners' multiple intelligences, contributing to better student engagement and resilience. In particular, integrating SEL may be a valuable strategy for promoting interest in subjects like science, building resilience to stress, and enhancing student engagement.

According to Dahleb et al. (2024), integrating SEL in classrooms has been shown to improve both students' emotional well-being and academic outcomes. This is achieved by fostering

essential life skills such as stress management and conflict resolution, which are critical for students navigating the pressures of university life. These skills contribute to their overall resilience, making SEL an essential part of the Saudi educational context.

Moreover, Brill et al. (2025) emphasise the direct relationship between SEL programmes and improved resilience. Their research suggests that SEL helps students develop the capacity to recover from setbacks and maintain effective functioning across various life situations. This focus on resilience is particularly important in Saudi higher education, where societal expectations and academic pressures can be overwhelming (Rayani et al., 2024; Dahleb et al., 2024).

Educators' Perceptions of Incorporating SEL and Personal Resilience

Teachers have a central role to play in successfully implementing SEL and personal resilience in curricula because they are also required to proactively address both students' academic and social and emotional needs (e.g., Jennings & Greenberg, 2009). A study conducted by Min et al. (2024) indicates that teachers are increasingly identifying the significance of SEL in building students' emotional resilience. However, their perceptions of SEL's effectiveness are influenced by their level of training and understanding of emotional intelligence and resilience (Al-Asmari, 2014; Al-Ghamdi, 2014; Al-Shakifi, 2015; Saud, 2019).

In the context of Saudi higher education, incorporation of SEL programmes has been well received, especially among academic staff who view the possibility of such programmes establishing a more balanced approach to student development. Dahleb et al.'s (2024) study found that several teachers recognised the benefit of SEL in enabling students to better face challenges of real life. However, views on its adoption in Saudi colleges are not uniformly positive. On one hand, some educators are enthusiastic about fostering an emotionally supportive learning environment that promotes resilience, viewing it as essential for student development. On the other hand, there are concerns regarding the practical application of SEL within the traditional educational structure, which often prioritises academic results over emotional and social development. Dahleb et al. (2024) recommend that in order for SEL to be successfully incorporated, teachers should receive proper training and resources so that they can establish a conducive and engaging environment for learning. The SEL approach should also entail strategies that explicitly teach social-emotional skills. This involves building self-awareness and empathy, encouraging collaboration through group work, and dealing with the emotional needs of students. These practices in turn build resilience (Silke et al., 2024).

Despite the enthusiasm, challenges remain, especially in the area of educator preparedness. Although beginning teacher education mainly addresses academic knowledge, it sometimes neglects social and emotional ability. Teachers have little to no direct training in emotional self-regulation, regulation of their own emotions and actions, or tracking their progress towards personal and professional objectives (Pham, 2024; Schonert-Reichl, 2017). This gap in preparation not only impacts their own health but also influences student achievement and behaviour (Jones-Schenk, 2019; Lisciandro et al., 2016). In order to overcome these difficulties, effective training initiatives must be implemented and sufficient resources made available to support educators in incorporating SEL in their instruction.

Students' Perceptions of Incorporating SEL and Personal Resilience

The perception of SEL among students is often shaped by their personal experiences and their awareness of emotional challenges in both academic and personal aspects of their lives (Lubit, 2019). According to Durlak et al. (2011), students exposed to SEL programmes in school tend to perform better than their peers on various indicators, such as demonstrating positive social behaviours, empathy, teamwork skills, and improved academic outcomes.

Research also shows that students' ability to understand and manage their emotions and relationships is closely linked to academic and career success (Jones-Schenk, 2019; Strahan & Poteat, 2022). Pham (2024) found that students participating in SEL programmes report enhanced emotional well-being, improved stress management, and stronger resilience, all of which are essential for navigating the challenges of higher education. Moreover, SEL programmes help students develop a sense of belonging, fostering positive social interactions and emotional stability.

Several studies have demonstrated that learning SEL skills and building resilience help students manage stress, improve relationships, and boost their academic perseverance (Ang et al., 2021; Maunder et al., 2023; McGillivray & Pidgeon, 2015). Students, particularly those involved in specific SEL initiatives, for instance the “HEROES” programme, have demonstrated improved resilience, suggesting that SEL interventions can significantly contribute to both personal growth and academic success (Brill et al., 2025). However, some students view SEL as an additional burden on their already demanding academic workload. These students may not fully understand the long-term benefits of SEL, focusing more on immediate academic pressures (Brill et al., 2025; Dahleb et al., 2024).

Furthermore, SEL interventions that focus on practical strategies, such as mindfulness, role-playing, self-evaluation, reflective thinking, and reflective journaling, have been shown to foster a deeper connection with oneself. Studies have found that these activities help students improve emotional regulation and develop a better understanding of their own behaviours (Hammad Al-Rashidi & Aberash, 2024; Kim et al., 2024; Schonert-Reichl & Lawlor, 2010; Taylor et al., 2017). Despite this, the level of integration and student engagement with SEL varies, often depending on the support and motivation provided by faculty members (Brill et al., 2025; Dahleb et al., 2024).

Nevertheless, integrating SEL into the curriculum presents several challenges. As Lisciandro et al. (2016) point out, students often resist SEL programmes due to their novelty and the difficulty in reconciling emotional development with academic priorities. This resistance underscores the need for educational institutions to clearly communicate the benefits of SEL and to integrate it in a way that does not overwhelm students with additional burdens.

Research Gap

Despite mounting empirical evidence indicating that SEL interventions have positive effects on academic performance, resilience, and stress reduction (Alyoubi et al., 2021), there is a substantial gap in the literature from Saudi Arabia on the subject. Although SEL and resilience are known for their capability to promote academic achievement and emotional well-being, few studies have focused on their particular embedding in Saudi higher education courses.

This study seeks to close this gap by examining the role of SEL and personal resilience in Saudi higher education. In particular, the study examines how SEL and resilience are integrated into curricula and assess the perceptions of both teachers and students with regard to these interventions. Through these perceptions, this study offers significant insights into how SEL and resilience can be improved so that they address the changing demands of Saudi higher education students.

Knowledge of how university students and teachers perceive the integration of SEL interventions like resilience into the curriculum is central to an improved understanding of this phenomenon. The study seeks to fill this gap by addressing the following research questions:

1) What is the role of SEL and personal resilience in the curricula of Saudi colleges?
2) How do educators perceive the incorporation of SEL and personal resilience into the curriculum?
3) How do students perceive the incorporation of SEL and personal resilience into the curriculum?

Methodology

A qualitative research design was adopted for its small-scale study. Semi-structured interviews were used to collect data from faculty and students. Participants were selected using criterion sampling to ensure "selection of cases that meet some predetermined criterion of importance" (Patton, 2001, p. 23). Since this is a small-scale study, the sample consisted of 6 students and 4 faculty members from one HEI in Jeddah. An interview protocol was used to collect data pertaining to SEL and resilience and perceptions of the presence of these concepts in the curricula of the higher education institutions. The collected data were analysed using a thematic analysis framework suggested by Braun and Clarke (2006).

Results and Discussion

The thematic analysis of the interview transcripts yielded 12 overarching themes.

Table 1
Overarching Themes

Research Question	Themes
How are SEL and personal resilience addressed in the curricula of Saudi colleges?	1. Emphasis on personal development and emotional regulation 2. Variability in SEL integration across courses and departments 3. Growing recognition of resilience and coping strategies 4. SEL and resilience as emerging educational priorities
How do educators perceive the incorporation of SEL into the curriculum to build students' personal resilience?	5. Challenges in integrating SEL into the curriculum 6. The need for resilience training in higher education 7. Emphasis on both personal and social aspects of resilience 8. Need for ongoing support and institutional commitment

How do students perceive the incorporation of SEL into the curriculum to build personal resilience?	9. Desire for broader integration of SEL across the curriculum 10. Perceived inadequacy of SEL in addressing holistic student needs 11. Need for integrating resilience training into the curriculum 12. Emphasis on developing social competency

The Role of SEL and Personal Resilience in Saudi Higher Education Curricula

The qualitative data from both students and faculty indicate that SEL and personal resilience are increasingly recognised in Saudi higher education, but their integration into the curriculum is still inconsistent. Several themes emerged from the responses:

Both students and faculty highlighted the focus on self-awareness, emotional regulation, and stress management as part of personal development in the curriculum. However, as noted by Student 1 and Faculty 1, these SEL elements are often framed as personal development rather than core academic subjects.

> In our courses, we focus a lot on self-awareness and emotional regulation. …. It's mostly seen as a personal development aspect, rather than a core subject. (S6)

> Incorporating SEL into the curriculum has been a relatively recent development. We primarily focus on academic excellence, but in my courses, we try to integrate resilience-building exercises, like group discussions on stress management and personal reflection. (F1)

This aligns with the findings in the literature, where SEL is viewed as a way to improve emotional well-being, social awareness, and stress management but is not always integrated into academic curricula (Elmi, 2020; Reicher, 2010).

The integration of SEL is not uniform across all disciplines. Some courses incorporate SEL activities like teamwork and empathy, but others lack such initiatives.

> I believe that the curriculum has begun to recognise the significance of emotional intelligence. For instance, in some of my courses, we participate in activities that teach teamwork, empathy, and communication skills. However, honestly, I do not believe that it is a regular part of all courses. (S3)

> The integration of SEL into the curriculum remains limited to certain courses and is often seen as an extra component rather than a core educational focus. (F2)

This variability is consistent with research indicating that while there is increasing awareness of SEL's importance, its application remains uneven, particularly in institutions where the focus is more on academic excellence than on holistic student development (Schonert-Reichl, 2017).

There is a noticeable shift toward resilience-building, particularly in psychology and education programmes.

> In some of the education and psychology courses, there is emphasis on building resilience skills. We are taught how to recover from failure, set realistic goals, and cope with academic pressure. (S3)

> We focus on equipping students with the skills to regulate their stress and emotions. (F4)

Students and instructors alike emphasised the value of educating students on how to manage academic stresses and personal struggles, in concordance with the literature highlighting the value of resilience training on campus (Almulla, 2024; Pham, 2024). The findings resonate with research indicating that resilience is needed to overcome academic and personal adversities (Carsone et al., 2024).

SEL activities are frequently offered through workshops and seminars, but they are not always integrated into core courses. As Faculty 4 mentioned, while there is a growing recognition of SEL's importance, it remains largely "supplemental". This echoes the broader trend in higher education where SEL is often relegated to extracurricular programmes rather than being systematically integrated into the curriculum (Bridgeland et al., 2013).

Both students and faculty noted the increasing incorporation of SEL and resilience, especially in leadership and personal development programmes.

> In our leadership courses, self-management and coping are a given priority. I believe that resilience is getting more ingrained in some areas, particularly as students struggle academically and move into the workplace. (S3)

> In my courses, I emphasise the development of strong relationships and cultivating resilience in adversity. (F4)

The increasing recognition of such competencies also aligns with the research of Rayani et al. (2024), which reveals that resilience programmes positively affect students' academic and emotional performance. Full institutionalisation of these practices across all departments, however, remains a work in progress.

Educators' Perceptions of the Incorporation of SEL into the Curriculum to Build Students' Personal Resilience

Educators' responses reflect both recognition of the importance of SEL and the challenges in its implementation:

Faculty acknowledged the importance of SEL but pointed out several challenges, including time constraints, lack of structured training, and competing academic priorities.

> I believe integrating SEL is crucial, but we have time and resource issues. We require more training for teachers to be able to teach these ideas effectively. It's usually left as an optional section of the curriculum, but I feel it should be a mandatory component for all students. (F2)

This is consistent with the literature that highlights the need for faculty training and institutional support to successfully integrate SEL into the curriculum (Durlak & Weissberg, 2015; Min et al., 2024).

Faculty members expressed strong support for the inclusion of resilience training, highlighting its benefits for managing academic pressures and enhancing students' overall well-being.

> I strongly believe that resilience training should be part of the curriculum. It is necessary to equip students with coping mechanisms for failure, stress management, and cooperation. (F2)

This perspective is supported by research suggesting that resilience training can significantly improve students' ability to cope with stress, thus enhancing their academic experience and success (Alsharif, 2020; Dahleb et al., 2024).

Educators highlighted the importance of addressing both emotional resilience and social competency, noting that students need to develop not only emotional strength but also the skills necessary for positive interpersonal interactions.

> Resilience-based programmes need to extend beyond stress management. It should enable students to become emotionally resilient and socially competent, which are the keys to their overall success. Inner strength enables students to cope with pressure, and social competency enables collaboration and effective communication in academic and interpersonal environments. (F1)

This is consistent with evidence in the literature that highlights the dual role of resilience programmes in developing both inner strength and social competence (Brill et al., 2025; Jennings & Greenberg, 2009).

Faculty also expressed the need for ongoing institutional support to effectively deliver SEL.

> I think incorporating SEL is essential, but we face challenges in terms of time and resources, besides continuous training. (F3)

This finding echoes the research by Dahleb et al. (2024), which emphasises that the successful implementation of SEL programmes requires continuous support, training, and resources from the institution.

Students' Perceptions of the Incorporation of SEL into the Curriculum to Build Personal Resilience

Students' perceptions align with many of the findings from the faculty interviews but also highlight unique challenges and desires:

Students expressed a desire for SEL to be integrated into all subjects, rather than just being addressed in isolated workshops or seminars.

> I think it's good that they are trying to teach us emotional intelligence, but I'm not sure if it's enough. It would help if SEL topics were more incorporated into every subject, rather than just in occasional workshops or seminars. (S1)

> In my experience, it's not something that's well embedded in the curriculum. I'd like to see more emphasis on practical emotional management techniques that we could apply in day-to-day situations. (S2)

This reflects the literature's call for SEL to be incorporated throughout the curriculum, as it can significantly impact students' academic performance and personal resilience (Conley, 2015; Durlak et al., 2011).

Students acknowledged the value of SEL but felt that its scope was limited.

> I like the occasional resilience workshops, but overall, I believe the focus is on grades. It seems like SEL is reserved for students who are struggling emotionally or academically, as opposed to something that might benefit everyone. (S2)

> I believe in the value of personal resilience courses, particularly when we are working with pressure, but there is still a stigma in talking about feelings openly. (S6)

Students believed that although resilience training was useful in coping with academic stress, it did not cater to overall mental health needs. This is consistent with research that suggests SEL programmes must cover both academic stress and overall emotional well-being to be effective (Alyoubi et al., 2021; Kim et al., 2024).

Many students expressed support for resilience training as a consistent part of their education.

> I believe including resilience training in the curriculum would be very beneficial. It would equip us with the skills to handle academic stress and failures as well. (S5)

> Resilience is certainly relevant in college. Having it part of the curriculum would allow us to develop coping skills early on, and I believe it could really alter the way we respond to challenges. (S4)

The students argued that resilience training would enable them to better cope with the pressures of university life. This argument is consistent with research findings indicating that resilience training enhances students' academic outcomes and emotional regulation (McGillivray & Pidgeon, 2015; Dahleb et al., 2024).

Students also highlighted the significance of emotional resilience and social skills, including communication and teamwork skills.

> Resilience programmes must equip us to have self-confidence and emotional resilience so that we can also overcome personal setbacks. Learning to manage relationships, develop empathy, and manage setbacks positively is essential. (S4)

He is consistent with literature suggesting that effective resilience programmes should build both personal and social skills to support students in navigating academic and personal challenges (Strahan & Poteat, 2022; Varela et al., 2013).

Conclusion

The incorporation of SEL and resilience at Saudi higher education is ongoing but continues to face challenges in terms of consistency across departments and institutional support. Students and educators alike appreciate the value of these skills in supporting academic success and well-being, but greater institutional commitment, structured training, and more consistent curriculum incorporation are urged. The results affirm the increasing body of research highlighting the importance of SEL programmes in addressing personal as well as social dimensions of resilience in order to make students flourish academically and personally. More work is required to completely integrate SEL in Saudi colleges' educational system in a way that all students can enjoy access to these essential life skills.

Results of this study can be utilised to design initiatives that aim at SEL and individual resilience in order to enhance academic performance, student well-being and long-term success prospects. Outcomes of this study can provide valuable information on how Saudi university instructors can facilitate the cultivation of effective learning strategies among students.

Implications for Educational Practice

The results of this research highlight the increasing awareness of SEL and personal resilience in Saudi higher education. These findings are significant for educators and policymakers seeking to promote comprehensive student development. The implications of the study indicate that universities need to more systematically integrate SEL and resilience-building practices in all academic fields. Although some of these programmes, especially in leadership and psychology, have begun incorporating these skills, an even more standard and holistic application is imperative. Teachers need to be well-trained to implement SEL programmes consistently and thoroughly, thus ensuring depth and consistency of application. In addition, the development of resilience through formal curricula can do much to improve students' capacity to manage academic stress as well as personal adversity, enhancing both emotional well-being and academic performance. Institutions must incorporate SEL as an integral part of their curriculum, apart from voluntary workshops and extracurricular activities, so that students can acquire essential life skills, including emotional control, social understanding, and stress management.

Limitations

While the study provides valuable insights into the integration of SEL and resilience in Saudi higher education, there are certain limitations that have to be noted. To start with, the research is built on a limited sample of 6 students and 4 faculty members at a single higher education institution within Jeddah. This smaller scope could limit the generalisation of the research to other institutions or even geographical areas within Saudi Arabia. Furthermore, the research utilises qualitative approaches, which, although rich in detail, are prone to researcher bias and cannot advance absolute conclusions on the extent or efficacy of SEL programmes in the larger educational community. Moreover, the use of interview data from participants in the study implies that SEL and resilience perceptions may not have captured actual practices or results completely. Future research can be based on larger, more representative samples, with a combination of qualitative and quantitative methodology to gain more complete insights into the effect of SEL on pupils' achievement and well-being within various settings.

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

Generative AI or AI-assistive technology such as Grammarly and ChatGPT 4.5 with advanced reasoning were used in writing, improving, or proofreading this manuscript. Include information such as the name of the software, the intended use, and the extent of use.

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Can AI Generative Tools Cripple Literary Analysis / Critical Thinking Skills? A Case Study

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Abstract

While teaching a Novel course for EFL undergraduates, the researcher observed that a student was liberally using AI generative tools to study the course. She used ChatGPT as a substitute for reading the novel. Since the exams tackled higher critical thinking skills, she opted to memorize the answers generated by AI tools and simply paste them! This paper aims at employing action research as "a form of enquiry that enables practitioners to develop their own living theories of practice." (Whitehead & McNiff, 2006) This case study juxtaposes the literary critical essays written by two EFL- undergraduate students studying a Novel course. One student was too liberal in her use of AI Generative tools as a learning tool. The other student was commited to the recommended method of studying, i.e., starting with a close reading of the text to ensure well-informed analysis. The method of this study is a qualitative case study assessing all the critical essays the subjects submitted in midterm and final exams then to conduct an open-ended interview to explore their perspectives. The results illustrate the effects of overusing AI tools on critical thinking skills; They provide a overview of the effects of overusing AI on EFL students and suggest solutions.

Keywords: AI critique, critical thinking, literary analysis, misusing AI generative tools, writing, undergraduate EFL student

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Introduction

Teaching literature in general revolves around reading and summarizing certain literary texts, understanding the events and themes within these works, then fostering students attempts at original analysis. Moreover, it is a common practice to encourage students to read external articles about a literary text to analyse, prove or disprove them. Indeed, some advance literary courses for EFL undergraduate students would list in their course learning outcomes CLOs the skill of examining different articles written about the texts under study. The course at hand is such an advanced course taught in an undergraduate program of English Language and Literature. It is a Modern Novel course catered to EFL students in Saudi Arabia. The skills learning outcomes of this course include:

- Interpret specific passages, characters, themes, settings, and events of the prescribed modern novels from various critical perspectives.
- Examine different critical articles written about the modern novels at hand.
- Defend and disprove different theses and opinions about the major ideas and features introduced in the assigned fiction.

They include the following values learning outcomes:

- Show responsibility for self-learning to continue personal and academic development.
- Demonstrate ethical behavior in all personal and academic practices (for e.g., being honest, ethical testing practices, writing original assignments, and research papers...etc.).

However, the fair assessment of students was shifted after the introduction of AI generative tools for the public in November 2022. Instructors were obliged to explore the new technology for themselves and examine its effects on students' fulfillment to the required learning outcomes. In this case study the researcher observed that a student used ChatGPT as a substitute for reading the required literary text. A use that may undermine the development of her analytical skills. Since the exams tackled higher critical thinking skills, the student opted to put her trust in ChatGPT to memorize answers generated by it and simply paste them in the midterm exam! Another student was commited to the recommended method of studying, i.e., starting with a close reading of the text to ensure well-informed analysis. The two students regrettably received the same grade due to the fact the regulations for the fair use of AI were not officially implemented. This study tackles this educational issue using action research that is characterized by "combining diagnosis, action and reflection" (McNiff 2002).

Action Research: Identifying an Educational Problem, Interveining, and Reflecting With Stakeholders

The research problem presented itself while correcting the midterm papers in this course. A 22-years-old undergraduate student submitted a midterm paper that has passed all the rubrics put to assess the CLOs. From the outset the student got the full mark on her essay. It was a fairly written essay, presenting an argument in an appropriate grammar and style, corresponding to her undergraduate level; the issue was in the argument itself. The student argues that the leading character in the assigned novel (*Mrs. Dalloway*) is oppressed by society and that had she freed herself from the "oppressive" rules of society she would have chosen to be with her true love; her female friend over her husband. Her conclusion was not validated by supporting details from the text. It is not in alignment with the values she was expressing in class (participation/ in-class discussion). Starting from the observed

phennomina reported by EFL undergraduates that they occasionally rely on literary articles written by native speakers without critically reviewing their core arguments; The instructor assumed this statement was quoted, not the student's genuine opinion. The student's passive acceptance of this blatant homosexual remark without supporting details is also evident; This initial observation was highly alarming, especially for a student who demonstrated good language proficiency, thus good reading comprehension skills.

The instructor assumed this passive acceptance of the remark implied a degree of analytical illiteracy. If so, a special study of this case is needed. It may also be an endorsement of this inclination, which will lead to terminating the study because then she is expressing her original opinion. Navigating this situation was tricky. First the student was contacted to inquire about how she prepared for the midterm, and if there are specific articles that she drew her conclusions from. She replied that she used ChatGPT. She also confirmed that she was not able to read the whole novel; she reported she only read 20 pages from the ebook. Her consent was obtained to study her essay as a case study to understand the educational challenges of using AI generative tools in literary courses.

The Intervention

To study this case thoroughly the student who replaced reading with using AI tools (Student A) was instructed to watch the film adaptation of the novel to ensure that she understand the literary text it is based on, and to reflect on her answers in the midterm. Student A only received the intervention of watching the film adaptation as a supporting educational tool. The decision to use it as an educational tool is informed by a recent study about the effectiveness of incorporating film adaptations in EFL literature courses. That study concluded that "incorporating film adaptation as a tool in teaching literature courses enhances EFL students' understanding of the assigned literary texts" (Azhar, 2024). Another student (Student B) is added to the case study. Student B has the full experience of the novel. Her answers are informed by a close reading of the novel. This case study, therefore, opted to explore two cases to gain depth. The research used open-ended questions and interviews.

Research Gap and Mythodology

Most recent papers on this topic (Almanea, 2024; Werdiningsih et al., 2024) explore using ChatGPT by employing students' subjective feedback (perspective) as a primary tool. They do not examine student's performance objectively to juxtapose it with their self-reported observations. In their paper "Revolutionizing EFL writing: unveiling the strategic use of ChatGPT by Indonesian master's students" the authors have established students' positive reception of ChatGPT. It states that master students utilize a range of strategies in their interactions with ChatGPT, including critical evaluation, peer consultation, and the use of primary research sources, which demonstrates its adaptability as an educational resource. The research honestly "acknowledges limitations, including the potential biases of self-reported data" (Werdiningsih et al., 2024). They recommend addressing these limitations in future research through "[…] mixed-methods approach that includes real-time interaction tracking, [that] would offer a clearer view of ChatGPT's role in EFL learning contexts and its influence on academic writing capabilities" (Werdiningsih et al., 2024). The case study on the effects of using AI generative tools in literary courses took the following consecutive steps: (1) analyzing the original essays written by the students, (from now on will be called subject A and B, (2) properly familiarizing student A with the literary text through directing her to watch the film adaptation. (3) giving both subject a written form with open-ended questions,

(4) a face-to-face interviews are held to discuss the subjects' answers to the written questions, and the essays.

Research Questions

This study explores the following research questions:

- Q1: Does ChatGPT arrest the subject's critical thinking skills when used without reading the text?
- Q2: How is critical thinking affected by reading the novel only?

Analysis

Student A (overused AI tools)

Midterm Analysis

In this essay the contrast between the relatively well-phrased sentences and the misspelling of many words has drawn the researcher's attention to discrepancies between the form and the content of the essay. They indicate that the writing is not an original analysis by the student. The style of writing seems to be elevated, yet the mechanics of writing are not as elevated. The misplaced apostrophe for the plural possessive is one example (See Appendix A for the full transcript). Moreover, the essay is deprived of textual evidence. It glosses over details and generalises rather than elaborate to prove a point. This is one of the observable characteristics of texts generated by AI and ChatGPT especially. "Some indicators of AI-generated content include an impersonal tone and a lack of valid sources and citations" (Almanea, 2024). The essay is too short to illustrate its main idea. It lacks emotional engagement with the characters. For instance, she puts on equal footing the internal struggles of a privileged woman like Clarissa Dalloway with the intense turmoil of a shellshocked war veteran like Septimus Smith. She attributes their struggle to "society failure to understand those who *do not fit it's norms*" which is arguably not applicable to Mrs. Dalloway who is not stigmatised or mistreated by society in the typical sense. Student A is not aware that her statement could be contested and needs further explanation and textual evidence to prove it.

Lastly, her ideas contain an implicit endorsement of homosexuality that are not compatible with what is already expressed in class. Initially the researcher proposed the hypothesis that the student does not have the level of advanced linguistic competency to detect the queer tone to the sentence: "Woolf reveals her internal dissatisfaction, especially when reflecting *on her past love* for Sally Seton. This tension shows the limitation placed on women in *patriarchal* society." The hypothesis changed after conducting the intervention which aimed at enabling student A to engage with the literary text. The most efficient and scientifically packed route was advising her to watch the film adaptation of *Mrs. Dalloway*. After watching the film, an open-ended interview with guided questions was conducted. These have revealed that before the midterm exam she was not able to critically evaluate the text generated by Open AI because she has used it as a substitute for reading the novel itself. Moreover, she stated that she was practically taught by previous Literature professors to not express subjective views about a specific text even if the analysis is based on textual evidence and an authentic engagement with the literary text. This reveals another layer to this multilayered problem; teachers who teach literary works to EFL students are not keen on promoting critical thinking skills but rather teach students the criticism already put forward by well-established literary

critics. Such a hidden curriculum impedes the development of critical thinking skills and encourages reiterating critics' opinions without much challenge.

Not Fulfilling the Course Learning Outcomes (CLOs)

The determining factor in this study is achieving the course's learning outcomes. The learning outcomes of this course (CLOs) state critical thinking to be one of the central skill outcomes. Student A's failure to provide an original essay is a clear defect that should be reflected in her overall grade. The CLOs also state: "Demonstrate ethical behavior in all personal and academic practices (for e.g., being honest, ethical testing practices, writing original assignments, and research papers...etc.)" These outcomes are not achieved in the case of student A because the official guidelines for ethical use of AI are not explicitly announced; they are not yet part of the course specification or the course syllabus. A fair official measurement to address misusing AI is not yet devised. This means that in all fairness her mark cannot be cut without changing the rubrics used for evaluating students' fulfilment of the CLOs. Teachers are prone to continue using written articles and research papers as the ultimate proof of achieving the learning outcomes. Written exams are regrettably becoming a false witness in the age of AI. Active discussions, presentations, and debates are more reliable; they need to be allocated more marks. Students are susceptible to over relying on AI generated texts instead of developing their own essays in exams. But as many studies suggested some measures are recommended to deter potential ChatGPT misuse such as incorporating personal elements into assignments that AI cannot replicate (Almanea, 2024).

The student also stated that she used ChatGPT in the process of reading summaries about the novel, in brainstorming ideas, and in editing the essay to study from it. This means that she used it to do all the major writing steps: reading, arriving at an informed opinion, and editing. This made her essay a thorough AI product that does not contain authentic cultural point of view (which is one of the essential reasons for reading foreign literary works).

The final exam for student A was conducted after the intervention and the interview, yet it does not show an improvement. The researcher speculates that she developed a mistrust of ChatGPT knowing that its liberal use is discouraged. She was not able to finish reading the whole novel and was deprived of her secret weapon. All these factors resulted in an essay that was evidently less convincing than her midterm paper.

Student B (read the novel only)

Midterm Analysis

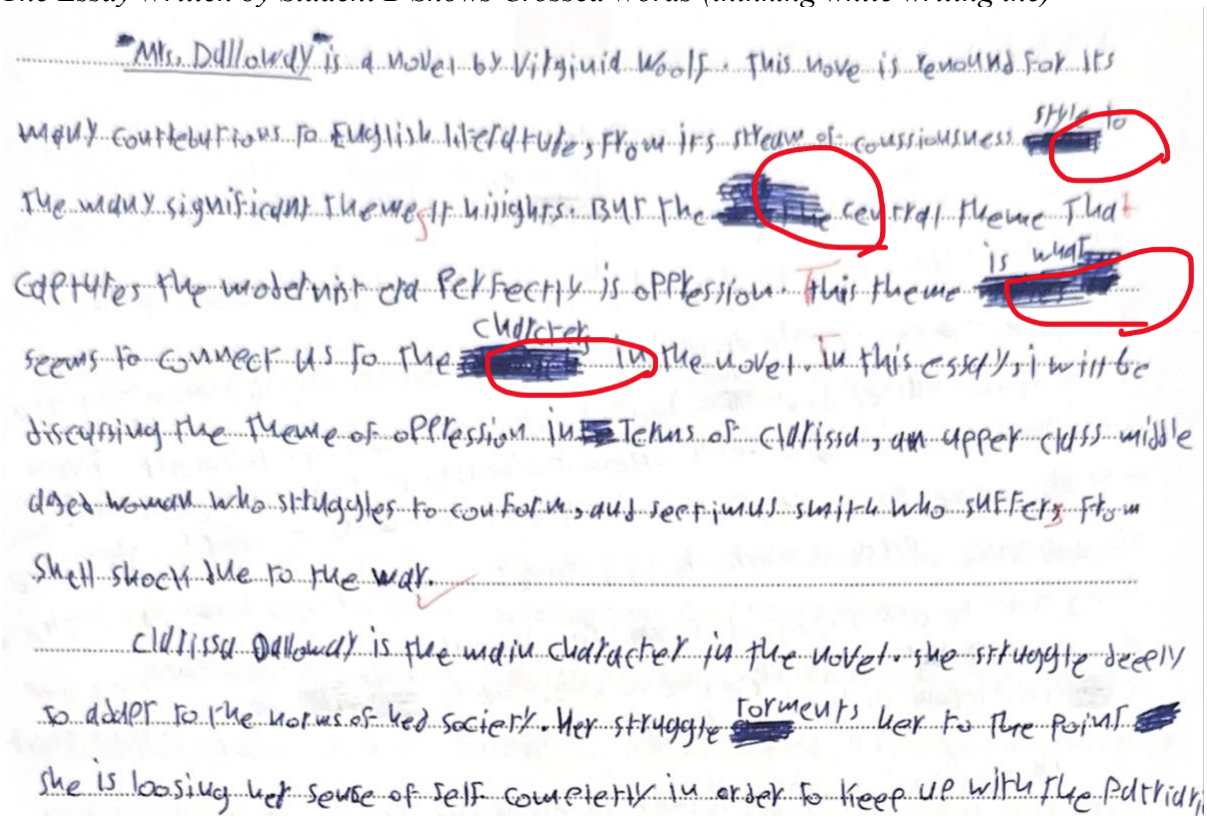
Although the student's essay contains many spelling mistakes and errors in mechanics, it is evident that it is original. (1) There is a clear point of view and a central argument backed by textual evidence. For instance, she writes: "Her happy place is her bedroom, when wher [*sic*] she can lie in bed and read her books." Providing supporting details from the text to prove Clarissa's isolation. The central argument can be seen in her thesis statement: "In this essay, I will be discussing the theme of oppression in terms of Clarissa, an upper class middle aged woman who struggles to conform, and septimus smith who suffer from shell shock due to the war" [*sic*]. She is careful to show that even though both characters suffer from oppression, Smith's suffering comes from participating in war. The thesis is elaborated on in the body paragraphs; She writes: in body paragraph 1: "Her struggle torments her to the point she is

loosing sense of self completely in order to keep up with the patriarchal society she is living in" [*sic*].

(2) The essay itself was written spontaneously not memorized before the exam; This is evident in its misspelling of words that are spelled correctly in other lines; perhaps due to exam stress. The passages contain crossed words sometimes multiple times showing that the student is thinking while writing. See the picture below:

Figure 1

The Essay Written by Student B Shows Crossed Words (thinking while writing the)



The essay organization and length are appropriate. The ideas are expressed not in a constraint generalise/ borrowed way but in a detailed original way. For instance, the student is careful to point out the paradoxical nature of Clarissa's plight: "But this very desire of wanting others approval is also the reason she loses her desire to express herself as an individual."

She uses simple style of writing that is admittedly ineloquent. Yet, it reflects her undergraduate level contributing to the overall assessment that this essay is a raw spontaneous product of an undergraduate student illustrating her blooming critical thinking skills. It shows human engagement with fictional characters. For instance, she states: "Even saying his struggles outloud [*sic*] doesn't seem to matter to his wife, or his doctor […]. this feeling […] where he can never escape drives him into the only thing that he can think of to free him and ends up jumping out of a window where is free [*sic*], he no longer has to conform with a society that is indifferent to his suffering." The analysis shows deep empathy with Septimus Smith, it describes his state of mind that sought solace in suicide due to the immense pressure he had endured.

Her final exam essay (see Appendix B) is very insightful, she displays a good background in psychology that may not be backed very well by an eloquent language and diverse vocabulary. A very illustrative line is her line: “He represents the good. A man that risked his life for his country and leaving his wife and his comfertable [*sic*] life behind to Fight for his country. His biggest worry isn’t a party that he can choose not to thow [*sic*] it’s his desire to leave his troubles behind” This line shows a perspective that reflects a cultural Arabian/ Muslim believe that defending your country is the highest form of honor. This perspective is a genuine interaction between a 24 years-old student from Saudi Arabia with a character who may be viewed as a victim in the English culture that is charged by the cultural impact of WWII. There are no Western echoes in her analysis, the known position of War Poetry that attacks the ideal of dying for your own country as a lie. She is thinking independently from the English view in memorable poems like: “*Dolce Et Decorum Est.”* AI Generative tools may have edited this statement that express the culturally different view about how honourable to participate in war for your country due to ChatGPT established cultural bias towards “white, Western” perspective (Almanea, 2024). The affectation that only a human can have and the literary view that is informed by her own values may have been obliterated had she decided to proofread the essay using Open AI in preparation for the exam.

In her line: “the novel is critisized for having no story, but how can someone overlooks this brilliance only because there is no ‘action’.” The use of quotation marks is conspicuously reflecting her age and emotional engagement with the critical output about the novel fulfilling one of the CLOs in skills. It reflects her fluency accurately making written essays a valid assessment method for her case. Students’ emotional engagement is a valuable attribute that can resist the misuse of AI tools. Thus, it is feasible to relax the rules about informal expressions in undergraduate academic writing in this age of AI tools because these informal expressions are genuine and cannot be forged yet by AI tools.

Insights From Students’ Reflections

Student A

Q: What if the work endorses approves and accepts slavery adultery infidelity sexual exploitation of children should we accept these ideas without commenting on their unethical nature when writing?
Answer: “I think we need to comment on them and linking them to our culture but some doctors don't like to do that and want us to write only about the ideas.”
“my first novel yes. [The teacher] didn't ask us to write about our opinion so I stick on that with you.”

Q: What was special about watching the movie?
Answer: “My person I don't like to read. I like to see things and the picture of the characters so it's really good option to see the movie first then.The movie so when I read the novel, I can picture the characters”

Q: Do you think that group reading in class would encourage students to speak their opinion more?
Answer: “Yes, they would understand that their opinion is valued because it's not an exam and t's not graded with grades. So we can speak more.”

Q: Do you think that Clarissa is harboring (hiding) homosexual feelings for Sally?
Answer: "I think when she was young yes, but when she grow up and saw her in the party she over come her feelins."

Student B

Q: Some students say that watching the film adaptation is going to help them if they are audiovisual. Comment please.
Answer: "Personally when I read books, I love that I can imagine instead of seeing. So to me, I imagine characters look a certain way […] If I'm struggling with the book I listen to it. I don't have to watch."

Q: Why are many students arguing for opinions that can be refuted with textual evidences?
Answer: "I think most of the students decided not to finish the novel. It was really hard for me, the stream of consciousness was so confusing. It took me so long to finish it so maybe I think that's why I think not reading enough means that they didn't get to know the character […] I really think that you have to read to be able to understand."

Findings

The two students received the same grade, even though one has evidently read the novel and engaged with it in the optimal manner while the other used ChatGPT as a shortcut undermining the development of her critical thinking skills. Further discussion with student A and B validated this conclusion. Student A's written answer shows that the film demistified some aspects about the AI generated answer she used in the exam. Now she is able to see that AI tools were giving her feeble arguments not solid provable facts. The open discussion with the student further proved this point. She also pointed out she is a visual learner which makes her value the added benefit of watching the film adaptation of the novel. This suggests that watching the film adaptation as a replacement of reading the work does not affect critical thinking skills the way using AI tools as a subsitute does. It may also suggest that students whose learning style is auditory have the advantage of listening to audiobooks and hence can finish reading the whole novel. This is later confirmed by Student B's reflections.

Moreover, this study found that writing skills (which require critical thinking) for EFL undergraduate students are clearly undermined by the overuse of AI tools such as ChatGPT because it bypasses the typical 5 step writing process: Prewriting, drafting, revising, editing, and publishing. It enables students to simply take a topic and then generate an essay about it without the need to get thoroughly acquainted with the topic. See figure 2 below:

Figure 2
Writing Process (misusing AI tools)



With AI generative tools students are able to bypass all the writing steps in the figure above. They start with the topic suggested by the instructor and with few prompts they produce a

paragraph/ essay that they do not properly understand. Such a practice undermine the validity of written assignments, exams either in-class or at home. The suggested writing process steps after the introduction of AI tools is as follows:

Figure 3
Suggested Writing Process if AI Generative Tools Are Used



Needed Revision of Assessment Methods

The current pedagogy implemented now focusses on knowledge & understanding (K), and skills (S) far more than its focus on values (V). The introduction of AI tools evidently shifted the evaluation of (K) & (S) but values (V) are original to students and cannot be forged by AI tools. These are a complex net of cultural, religious, and disciplinary values that AI tools are not advanced enough to mimic. This study proposes changing the marks allocation to include more tasks that engage CLOs in (V) such as in-class debates on undisclosed topics which will show the true critical competence of the students. Oral presentations during the trimester under study were very important to show students' values, genuine thoughts and reflections about the text. Student A answers in the midterm were not compatible with what is expressed in class which made it possible to detect the effects of using AI on critical thinking skills. Unlike skills, values in the CLOs are not easily emulated by NLP software.

The rapid breakthrough in technology that is happening nowadays entices undergraduates to over-rely on AI tools. Academic institutions and educators are advised to train students on the fair use of AI tools. A healthy dose of scepticism of AI tools output is needed. Students can overcome these issues by inspecting AI generated output for machine errors and compatibility with their own cultural, religious, and political views (to avoid obliterating them). Finally, the study suggests that EFL learners who are not fluent are more susceptible to supressing critical thinking skills while using AI tools. If they lack confidence in their own grasp of the content generated by AI tools, they are prone to accept the generated content without discerning errors. Teachers are advised to instruct them against using AI tools in the brainstorming phase.

Limitations and Recommendations for Future Research

The duration of the case study is short. A longitudnal research that studies EFL undergraduates critical thinking in the age of AI is needed.

Conclusion

Firstly, overusing and misusing AI tools in EFL undergraduate Literary courses can hamper the development of students' critical thinking skills. Student A initially reported positive reception of ChatGPT as an educational tool yet when a reliable educational tools such as using film adaptation was implemented, the student perspective has shifted. She was able to critically evaluate the AI generated content and find its faults. The study, hence, indicates that watching the film adaptation as a replacement of reading the work does not affect critical thinking skills the way using AI tools as a subsitute does. Secondly, writing skills are

undermined by the overuse of AI tools such as ChatGPT because it bypasses the typical 5 step writing process that also requires critical thinking: Prewriting, drafting, revising, editing, and publishing. Such a practice undermine the validity of written assignments, exams either in-class or at home. Written essays, once the trusted assessment method is becoming a false witness due to overusing AI generative tools. The suggested writing process steps after the introduction of AI tools is as follows: Human knowledge, prewriting, drafting, revising, editing, and publishing.

Finally, Learning style plays a role in some non-performative literary forms like novel; auditory students can finish reading the text by listening to audiobooks which they find a very helpful educational tool, while visual or kinesthetic learners may not.

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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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Appendices

Appendix A

Midterm transcript of a student A:

In Mrs. Dalloway's Virginia Woolf explores the theme of oppression through her characters' struggles with societal and personal constraints. The novel shows how gender roles, societal expectations, and mental health issues, limit personal freedom and happiness.

Clarrissa Dalloway, for instance, faces gender passed oppression. As an upper class woman, she is expected to fulfil her values as a wife and hostess. Although she appears to emrace these roles, Woolf reveals her internal dissatisfaction, especially when reflecting on her past love for Sally Seton. This tension shows the limitation placed on women in patriarchal society.

Siptimus Warren Smith, A war veteran, represent another form of oppression society disregard for mental illness. His doctor dismis his trauma and force him to conform, leading to his tragic suicide. Woolf critiques society failure to understand those who do not fit it's norms, highlighting the harsh impact of such indifference.

Overall, Mrs. Dalloway shows how societal and internal pressures Oppress individuals, calling for greater empathy and understanding to improve both personal and social wellbeing.

Final transcript of subject A:

In Mrs. Dalloway Virginia Woolf avoids the traditional story telling and uses the modern techniques in writing. In the novel, the plot doesn't follow a straight forward story telling, instead it's unrganized plot.

The plot in the novel doesn't follow a straightforward storytelling. Instead it's moving back and forth between past and present. The Novel is about one dayin mrs. Dalloway life. The plot shows the inner struggles of the characters. For example, clarissa thinking about her past and the choices she has made, She is stuck in her past, rather than focusing on her present. Woolf uses this plot to critique the society and its expectations. Also, how personal conflicts can be harsh on individuals.

Overall, Woolf uses modernplot instead of traditional one to show the inner struggles of the characters. The novel starts with Mrs. Dalloway preparing for her party, and end with her party. The plot move back and forth between past and present to reflect the personal conflicts of the characters.

Appendix B

Midterm transcript of a student B:

Mrs. Dalloway is a novel by Virginia Woolf. This novel is renound for its many courteburious to English Literature, from its stream of conssiousness style to the many significant theme it hilights. By the central theme tha captures the modernist era perfectly is oppression. this theme is what seems to connect us to the characters in the novel. In this essay, i will be discussing the theme of oppression in terms of Clarissa, an upper class middle aged woman who struggles to conform, and septimus smith who suffer from shell shock due to the war.

Clarissa Dalloway is the main character in the novel. she struggle deeply to adapt to the norms of her society. Her struggle torments her to the point she is loosing sense of self completely in order to keep up with the patriarchal society she is living in. Her happy place is her bedroom, when wher she can lie in bed and read her books. this isolated style is the result of her trying to keep up her appearance as a lady and a hostess. But this very desire of wanting others approval is also the reason she loses her desire to express herself as an individual. She is both the opressed in the opressor of some sorts, after all the novel is about her throwing a party. she is also guilty of septimus's death by accepting the norms her society set for her. that is how the theme comes in full circle.

septimus smith is a solider who suffers from shell shock after world war I. despite being with the woman he loves and being at home he feels as though he is stuck in this hellish reality. With everyone around him dismissing his struggles, he is driven more and more into this tortured confienment. His doctor, sir bradshaw is treating his condition as though it is a simple matter, by recomending that he only needs to be mor open and pich up a sport. He is pushing him towards the same inviorement that caused him to be this way. His wife is unwilling to accept his struggle and isolates herself out of helplessness. the people around him are aggravating his mental state and pushing him further down and deeper into this mental torment. Even saying his struggles outloud doesn't seem to matter to his wife, or his doctor who are suposed to be the people who give him the most comfort. this feeling of ommence oppression where he can never escape drives him into the only thing that he can think of to free him and ends up jumping out of a window where is free, he no longer has to conform with a society that is indifferent to his suffering.

In conclusion, Mrs. Dalloway delves in the theme of oppression in ways that are relatable to many. by showing us the struggle that are very much realistic to the entire world, no matter your gender you will find yourself lost in this masterpiece. By Bringing the modernist era back to life we can feel the struggle of her characters. the theme of oppression was the soul of the novel from the main character, down to the smaller ones. Whether we see it in Clarissa's efforts to please her society or in septimus and his desire to leave this world where his troubles are, the theme of oppression is indeed the guiding theme in the novel.

Final transcription Student B:

Mrs. Dalloway is a novel by Virginia Wolfe. It's about Clarissa Dalloway, hence the title of the novel. She is a woman living in a post-war society who struggles with her identity and role. Although the novel is renouned for its tecnique it has gained alot of crtisis being one of the greatest novels ever written. Critics argue that there is no actual story in the novel and that it has no plot. In this essay I will be arguing that theplot of the novel doesn't rvolve around the action, but around what the character represent and the wassclge you get through them.

First, you have life and death. This complex theme is center of the novel. at first glance you might wonder what septimus's character mean to the the plot, since the story is about

clarissa. As clarissa walks through London, we are taken with her to memories of her life. And some might argue that she is longing for freedom. From her memories with her friend Sally as she admits her unconventional and wild personality and how she chose a different life than the one they imagined together. As she talks to her friend peter, he is offended by the description of her as a trophy wife, for she want her life to be moremeaningful. But when clarissa hears about septmus's death at the party she is torn between her envy and her greatfullness. This is where septimus ties in the story. throgh him we can see clarissa clearly for the First time. part of her want to do what he did, and another part thinks he is a fool who threw away his life, leaving the rest of them living. Meaning she also finally sees that life is worth living and pushes her to go enjoy The party with her Friends.

Secondly, we have the idea of good and evil. clarissa, the main character represents evil. As a woman living as an upper class lady, she is blind to her privildge and The possibilities she has. The novel is about her planing a party afterall. She feels sad as she remembers parts of her life because she wonder if she had made the right decisions in her life. Even thog she is living a comfortable life, she choses this life style and encourages it, not only causing her own sadness but also the sadness of others. This brings us to septimus. A veteran who doesn't have many luxuries in life and who is suffering From the terrible Effects of the war. He represents the good. A man that risked his life for his country and leaving his wife and his comfertable life behind to Fight for his country. His biggest worry isn't a party that he can choose not to thow it's his desire to leave his troubles behind. A man so depressed that he Finds death easier than living.

A man who suffers from the expectations of society. The same society that is affected by the people in it. People like clarissa who are blind to what they encourage. He has no say in his fate wants to leave, but has to deal with what they caused.

In conclusion, the novel is critisized for having no story, but how can someone overlooks this brilliance only because there is no "action". The novel is experimental afterall, you have to read it expecting to see the unusual. Althogh the story has little to no action, you are left with so many emotions after reading it, why? Because even thogh it has no clear plot or stor, that is not the purpose of it, it does not strive to satisfy the traditional norms of story telling. Virginia Woolf wants to leave you with a masterpiece. The way she does that is by writing a novel that does not center around aa story, but around The layers of meaning that someone can be fortunate enogh to understand. which is life as we know it. sometimes, you have to take a second to look at the details to see what really matters, not just in art but in life.

Postdoctoral Fellowship in the Diaspora: Postgraduate Students' Perspectives in the Education Sector

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Abstract

Postdoctoral fellowships are essential for academic advancement, particularly among the African diasporas scholars of African heritage have profoundly impacted research and teaching across the continent. However, in Nigeria, the rigorous nature of doctoral studies often deters PhD graduates from pursuing postdoctoral opportunities, limiting their global research engagement and interdisciplinary collaborations. International postdoctoral studies offer networking, interdisciplinary experience, and academic growth, enriching scholars' perspectives and fostering innovation. Despite these benefits, Nigerian postgraduate students' perceptions of postdoctoral studies remain underexplored. This qualitative study examines postgraduate students' views on pursuing postdoctoral fellowships abroad. Ten students from public universities in Oyo State, Nigeria, were purposively selected. Findings show that while students recognize the benefits, enhanced research skills, funding, and collaborations, barriers such as limited information, financial constraints, institutional restrictions, and job security concerns hinder participation. The study calls for policy support and awareness campaigns to facilitate postdoctoral transitions.

Keywords: postdoctoral fellowship, African diaspora, postgraduate students, higher education

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Introduction

Many researchers have documented postdoctoral fellowship's positive impacts on diaspora academia (Echono, 2023; Kahn & MacGarvie, 2024; Mwampanba et al., 2022; Teferra, 2021). Academics in the African diaspora have contributed immensely to academic development at the continental level. Because of the arduous and strenuous challenges of doctoral studies, most PhD holders in Africa, especially in Nigeria hardly venture into the postdoctoral programmes in Diaspora. Acquiring skills and international experiences during postdoctoral studies break new ground and provides room for research Doctoral specialization. Doctoral graduates must venture into postdoctoral studies in the diaspora as this will avail the opportunity for international experiences such as collaborative work, enhanced research ability in international perspectives in another field and provide an opportunity for international influence.

However, acquiring advanced research skills and international exposure during postdoctoral studies presents invaluable opportunities for academic and professional growth. Engaging in postdoctoral training abroad allows doctoral graduates to specialize further in their fields, gain cutting-edge research experience and develop expertise in emerging areas of study. Furthermore, participation in international postdoctoral programs fosters cross-border collaborations, enhances research capacity, and broadens scholars' perspectives by exposing them to diverse methodologies, academic cultures, and multidisciplinary approaches.

African doctoral graduates must proactively pursue opportunities to participate in global research networks to optimize the advantages of postdoctoral study. Pursuing postdoctoral studies abroad offers scholars a distinctive opportunity to engage in international collaborations, enhance their research output, and elevate their academic prominence. Furthermore, international experience and exposure gained during PDF training, to other academic settings improves their teaching, mentoring, and leadership abilities, thereby equipping them for significant contributions upon returning to their home institutions (Karakaş, 2020; Rotstein, 2025).

Statement of the Problem

Many doctorate holders in Nigeria are hardly interested in furthering their research careers by entering into postdoctoral fellowships. Evidence revealed that many doctoral students felt depleted by the rigours of their doctoral studies and were not inclined to pursue further studies. This denies them the many opportunities within postdoctoral studies. Therefore, there is an urgent need to bridge the gap between factors that limit interest in doing postdoctoral studies and the benefits to be gained from a fellowship programme. This research work thus investigates Nigeria postgraduate students' perspectives on postdoctoral fellowships in diaspora.

Purpose of the Study

Therefore, the main objective of this study is to examine the attitude of Nigeria postgraduate students on doing postdoctoral fellowships in diaspora and the specific objectives are to:

Objectives of the Study

The main purpose of the study was to investigate postgraduate students' perspectives on postdoctoral fellowship in the diaspora, in Oyo State. The specific objectives of the study were to:

1) Examine postgraduate student understanding of the meaning of doing postdoctoral research in Oyo State, Nigeria.
2) Assess postgraduate students' intentions to obtain postdoctoral fellowships in the diaspora.
3) Illuminate the benefits attached to postdoctoral fellowships in the diaspora for the postgraduate students of Oyo State, Nigeria.
4) Evaluate postgraduate students' perceived challenges of doing postgraduate studies in diaspora.
5) Ascertain the strategies to encourage postgraduate students in Oyo State, Nigeria to pursue PDFs in the diaspora.

Research Questions

The following research questions were answered at the end of the study.

1) Do the postgraduate students in Oyo State, Nigeria, understand the meaning of doing postdoctoral research in the diaspora?
2) Do postgraduate students wish to obtain PDFs in the diaspora?
3) What are the perceived benefits attached to PDFs in the diaspora?
4) What are the postgraduate students' perceived challenges in pursuing postgraduate studies in diaspora?
5) How can postgraduate students be encouraged to pursue postgraduate studies in diaspora?

The rest of the study is organised as follows: literature review as well as the conceptual and theoretical framework adopted to frame the study, the research methodology, outlining the process and steps undertaken to collect and analyse the data. Also, the presentation of the results as well as discussion of the findings. Lastly, the conclusion of the study, summarising the key insights and implications drawn from the research:

Literature Review

Many universities globally, interested in impacting PDFs, are designing programmes to support early career scholars (Lambert, et al., 2025; Sherry, 2013; Teelken et al., 2024). A postdoctoral research associate is responsible for assisting the educational institution's research department, writing research reports, publishing at least 2 units per annum as required by the host institutional in a highly reputable accredited journal both nationally and internationally – as prescribed in the letter of award and contract within the fellowship period. The minimum of the 2 publications will accrue to the relevant institution as their intellectual property, which will belong to the particular institution. Other events such as co-supervision, seminars and involvement in departmental activities will be required.

Postdoctoral Fellow Perceptions

Globally, and especially in the African diaspora academics have contributed immensely to academic development at the continental level (Kaba, 2024; Grinin & Korotayev, 2023; Oanda, & Obonyo, 2021; Ogachi, 2015). Postdoctoral fellowships are regarded as training and retraining of young emerging scholars in research in the skills of their chosen field of specialization. Many researchers have documented the positive impacts of postdoctoral fellowships on academic development in the diaspora (Abdulrahman & Gabriel, 2023; Huynh, 2021; Ogachi, 2015; Ortiga et al., 2018). After the vigorous challenges of doctoral studies, the majority of PhD holders in Nigeria hardly venture into postdoctoral studies.

It is essential that new researchers venture into postdoctoral studies in the diaspora as this will avail them of opportunities for international experiences such as collaborative work, enhanced research abilities, international perspectives in other fields and an opportunity to have an international influence (Biao, 2006). Acquiring such skills and international experiences in postdoctoral programmes break new ground and provide room for research beyond the scope of one person's specialization. There is, therefore, an urgent need to create awareness among postgraduate students about the benefits and availability of postdoctoral fellowships in the diaspora. Despite the positive influence of diaspora networks and exposure, little empirical research is available on the positive effects of postdoctoral research.

Conditions Attached to Post-doctoral Fellowships (PDFs)

- The prospective candidate will follow the advert procedures – read the guideline carefully. If you do not meet the essential requirements, do not apply.
- Get advice from your PhD supervisor and other mentor on how to become PDF (they know better than you at this stage).
- Build your networks early – there is a lot of research available to help build networks. You might not find a formal postdoc position, but there might be an opportunity for collaborative work, i.e., (game collaboration) – identify the research area as well as the academics in that field.
- Look for compatibility with your own area of specialization and expertise.
- Have the mind of team player – be ready to work as part of a team, demonstrate respect towards the contribution and achievements of other colleagues. As a postdoc fellow, you must be ready to take on sometimes difficult and tiring fieldwork and be ready for different and demanding situations.
- Your boss – you have to be very comfortable with your host institution and your host supervisor, they will surely help you get what you want to get out of the postdoc.

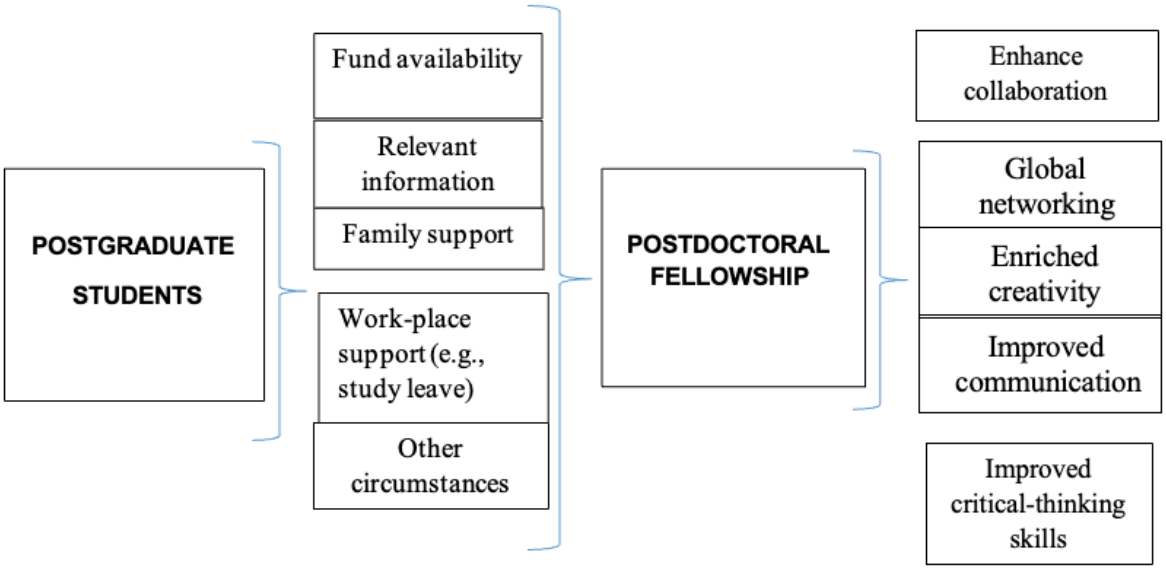
Research Support for PDFs

- Emerging research grants and other available financial support
- Payment for all the research publications
- Sponsorship for both local and international conferences
- Support in training and retraining for relevant skills needed for the tasks
- Support and mentoring from Postgraduate Research office on a PDF progress report
- Active group platform for relevant information to all the postdoctoral fellows

Conceptual Framework

Figure 1

Conceptual Framework for Circumstances and Factors Influencing Postgraduate Students' Perceptions About the Benefits of Doing a Postdoctoral Fellowship



Source: The Authors (2025)

From Figure 1, it can be seen that postgraduate students with adequate funds for postgraduate studies and access to relevant information, as well as sufficient family and work-place support are likely to proceed from their doctoral to post-doctoral studies. Circumstances that are inimical such as – non-availability of fund, paucity of relevant information, inadequate family and work-place support, along with poor psychosocial circumstances can prevent them from transiting to postdoctoral fellowships. When a PhD holder with supporting circumstance proceeds to a PDF, they will encounter opportunities to enhance their relevant collaborations, their global connectivity, improve communication and empower critical thinking. These skills are all needed and expedient skills for the 21st century; as well as being precursors to sustainable quality education (SGDs No. 4).

Theoretical Review

Theory of Reason Action (TRA)

The Theory of Reasoned Action (TRA) of Al-Suqri and Al-Kharusi (2015), explains behaviour and the reasons for differences in behaviour. The TRA states that behaviour is immediately determined by the behavioural intention, circumstances and perceived behavioural control. Relevant to this present study is the perceived behavioural control that postgraduate students have of postdoctoral fellowships in the diaspora. The circumstances that surround postgraduate students during their doctoral studies are the factors influencing their behavioural intentions (whether negative of positive) towards postdoctoral studies in the diaspora.

The Rational Emotive Behaviour Therapy (REBT)

Rational Emotive Behaviour Therapy (REBT) was created and developed by the American psychotherapist and psychologist Albert Ellis, who was inspired by many of the teachings of Asian, Greek, Roman and modern philosophers (Ellis, 2004; McMahon & Vernon, 2010). REBT is a type of cognitive behavioural therapy (CBT) which is an action-oriented approach focused on helping people deal with irrational beliefs and learn how to manage their emotions, thoughts and behaviours in a healthier, more realistic way.

When people hold irrational beliefs about themselves or the world, problems can result. The goal of REBT is to help people recognize and alter those beliefs and negative thinking patterns in order to overcome psychological problems and mental distress. According to REBT, our cognition, emotions and behaviour are connected. In order to understand the impact of events and situations that people encounter throughout life, it is essential to look at the beliefs people hold about these experiences and the emotions that arise as a result of those beliefs.

A core concept of REBT is the ABC model. This model explains how, while we may blame external events for our unhappiness, it is our interpretation of these events that truly lies at the heart of our psychological distress. ABC is an acronym for: A: Activating event, which is when something happens in the environment around you; B: Belief, which describes your thoughts about the event or situation; C: Consequence, which is your emotional response to your belief. This theory has a bearing in the context of postgraduate students' perspectives on postdoctoral fellowships in Oyo State. The postgraduate students have access to postdoctoral fellowships, but their irrational thinking can limit their access to such wonderful academic exposure. It is the role of the postgraduate programme officer to raise awareness about and to create interest in postdoctoral fellowships among these students.

Empirical Review

Felisberti and Sear (2014) studied postdoctoral researchers in the UK to gain a snapshot of factors affecting their research outputs. The study used an online survey to explore the research questions. The findings showed reliable links between research outputs and research institutions, time spent on PDR and parental education. No clear links were observed between PDR outputs and research area, nationality, gender, number of siblings or work environment.

Chen et al. (2015) studied postdoctoral positions as preparation for desired careers as a narrative approach to understanding the postdoctoral experience. The findings revealed that the postdocs were beneficial in three ways; namely, intellectual, networking and institutional. It was found that these factors were all agentive in preparing for the future; yet, agency was exercised differently due to different institutional and personal contexts.

Scholars investigated the improving of the postdoctoral experience in an empirical approach (Patt et al., 2022). While the population of postdoctoral researchers in science and engineering has undergone a large expansion, the results found that a handful of straightforward and relatively inexpensive measures appear to make a large difference in postdoc productivity and in the overall quality of the postdoctoral experience.

Hayter and Parker (2018), in an exploratory study, inductively investigated factors that may influence a postdoc's transition to a non-academic career. They found that following influencing factors: individual factors; organizational and policy factors; the lack of relevant

skills; the absence of support and, in some cases, even opposition from their principal investigators; and poor availability of non-academic career preparation opportunities derived.

Methodology

Research Design

The descriptive survey design was adopted for the study. The qualitative data collection and analysis methods were adopted to answer the research questions.

Population and Sampling

All postgraduate students from public universities in Oyo State, Nigeria, i.e., University of Ibadan (UI) and Ladoke Akintola University of Technology (LAUTECH) constituted the population of the study. An accidental non-probabilistic sampling technique was used to interview the participants, based on their willingness to participate in the interviews.

Data Collection Instrument and Procedure

A five-item scale interview schedule was used entitled: Postgraduate Students Perspectives on Postdoctoral Fellowships in the Diaspora Interview (PSPPFDI). PSPPFDI was trial tested on 6 individuals and their responses were subjected to inter-rater reliability which yielded a value of 0.64. The interview was conducted on 10 respondents (5 from University of Ibadan and 5 from LAUTEC, Ogbomoso) and their responses subjected to thematic analysis.

Qualitative Data Collection

Moises (2020) agrees that an online data collection method appropriate for the collection of data from participants is through the use of questions to prompt discussion among the participants. Researchers constructed guided questions and kept records. Following these virtual conversations, the researcher formulated 5 items to be used either online, cell phone or WhatsApp calls for the individual interviews. The following open-ended questions were posed during the interviews and were thematically analysed to generate results for the study.

Question 1: What is a postgraduate fellowship? The question was intended to find out the understanding of postgraduate students about the meaning of PDFs, which helped to determine if the participants really understood what a PDF refers to.

Question 2 : Will you do PDF after your PhD? If not, Why? The reason for this question was to ascertain the interest of participants as to whether they have the desire to enter into PDFs after their doctoral degree.

Question 3: Will a PDF benefit to your career? This question is intended to find out if postgraduate students are aware of the advantages of doing a PDF.

Question 4: Why don't many PhD holders go on to do their PDFs? This question is intended to find out the possible problems and challenges confronting postgraduate students; and which prevent them from doing their postdoctoral fellowships after their doctoral degree.

Question 5: How can PDF holders be encouraged to go for their PDFs? The purpose of this question was to find out which factors encourage or discourage postgraduate students from pursuing postdoctoral studies in the diaspora.

Ethical/Concept Letter

A concept letter was written and sent to all participant's emails and WhatsApp. Those who participated in the research agreed with the study questions. The researcher guarantees all participants that the study will set up the optimised advantages for both participants and the community, and the study will be carried out honestly, openly and without any deceit or disinformation.

Results and Discussion

Theme 1: Meaning of Postdoctoral Fellowship in the Diaspora

Statements from the postgraduate students and doctoral degree students coded from this interview show that most respondents understood the meaning of PDF in the diaspora, which is supported by the literature (Segun et al., 2006).

Some of the responses from the respondents expressed the following views to support their understanding of postdoctoral fellowships in the diaspora:

> "Thank you for the question, Postdoctoral fellowship is an extension of PhD programme, and it very useful for postgraduate student for exposure."
>
> "PDF is an advanced form of knowledge after you must acquire your PhD degree, whereby you learn from another person in order to be lean tutelage from another mentor in another institutional entered. Seeing your discipline outside your university."
>
> "Obviously, that is a fellowship that comes after your PhD degree, it offers to person as follow up with grants award to research."
>
> "I think it is a research activity after being a PhD holder."

The researchers observed that most postgraduate students understood the meaning of postdoctoral fellowships in the diaspora.

Theme 2: Reasons for Doing Postdoctoral Fellowships Immediately After Doctoral Degrees

The following were some of the responses from participants on the reasons for doing their PDF after their doctoral degree:

> "With all intentions, I am get reading to do it and I am preparing for it, it will boost my research in international."
>
> "Exactly, as postgraduate student, it will extend what I have been researching for, it boosts my research, it will open way for my international connection and affiliation."

"Yes, if I have the opportunity, I will surely do it."

"Definitely, if I have the opportunity to do to, I will because it will broaden my research and new pedagogy."

"Yes, I will because basically, most people do not do their research after their doctoral degree, I think it will be very good to continue the research immediately."

"Yes, I will like to go for it, if there will be opportunity."

Theme 3: Benefits of Postdoctoral Fellowships to Individual Careers

"Exactly, as postgraduate student, it will extend what I have been researching for, it boosts my research, it will open way for my international connection and affiliation."

"Yes, it will have benefit because I get learning other outside of my institution, that is how I will be opened more to many opportunities which I didn't have before and collaborate to increase my network skill in other perspectives."

"Yes, it will enable me to involve in international scholarship and even keep me more on research and to determine the career in research and publication and anything about academia."

"Yes, it would, it will give me a bigger scope and more enlightenment as a researcher with collaboration in publishing paper."

"It will improve excellently in academic performance for the rapid development of my career."

"One of the benefits, to increase the knowledge as a researcher and have focus on particular area of interest and increase the knowledge in particular area."

"Yes. because PDF will give you opportunity to relocate to an international community and build international experiences with the collaboration and networking with other researchers in diaspora."

Theme 4: Why Many Postgraduates Do Not Go for Postdoctoral Fellowships

"It is unfortunately, because not all PhDs are allowed to do that and not all given opportunity to do especially when you are an academic, the person will not release in place of work for that and this is unfair for doctoral student to enlarge his/her connection."

"That is an important question, some PhD they didn't go because to get funds for the fellowship and the requirements are very rigorous and you must work in many areas that may not be in your area. There are some I got that they don't want me to research in my area. And also, to get host to mentor in your area. Funding, host supervisor sometime difficult and the criteria are very difficult."

> "In this part of the world, Nigeria particularly, we have lack of information about this, lack of mentorship inline of PDF to guide to participate more in the PDF."

> "The first things, is that they are not aware, because they can start the PDF and another is fund."

> "Because most PhD holder do not have adequate orientation on the programme."

> "One of the major, many people are not motivated along the area, most of the research, if one didn't have grants mine not be possible. Also, request for the PDF programme in many institutions were not mandatory. People see PhD degree and compulsory especially, when you work in academic environment."

Theme 5: How to Motivate or Encourage Doctoral Degree Holders to Go for Their PDFs

> "Actually, this programme of PDF is what PhD holder should attempt to do immediately after their doctoral degree. There should be policy from ministry of education to encourage PhD holder to assist them to go them, there should be support from government level to institutional level. Policy should be laid down to support this program."

> "Those people who have gone can share their experiences, and if they can be link up. The government or each institutional should make funds and host institution and mentor for the Postdoctoral fellow."

> "I think, when there is an exchange programme with outside university, that is collaboration between different university, it should be an avenue to encourage PhD student to boost their interest to go for the PDF immediately."

> "There should be awareness and training about the PDF and what it takes in the processing."

> "Postgraduate students and Doctoral degree holder should have proper orientation from government in the process to go for PDF programme."

The results of the responses show that the majority of participants understand the meaning of postdoctoral fellowships. From the available qualitative data, the responses reveal that the majority, up to 90%, of the respondents understand the construct of postdoctoral research.

Discussion

From the qualitative data, thematically analysed, it was realized that the majority of the postgraduate students were aware of the demands and advantages of postdoctoral fellowships. Only very few among those interviewed were unaware of PDFs. This might be due to lexical or morphological mis-interpretation of the construct"postdoctoral." These results are supported by an empirical study by Davis (2017) who found that the population of postdoctoral researchers in science and engineering has undergone a large expansion.

Equally, from the results of the study, many of the interviewed participants expressed a desire to proceed to postdoctoral fellowships if there was fund availability, relevant information, family supports, work-place support and positive goodwill to encourage their intentions. These results are corroborated by the findings of Davis (2017) that postdoctoral researchers in science and engineering have undergone a large expansion and many postgraduate students now wish to pursue fellowships. Also, the findings of Chen et al. (2015), show that postdocs assist in three ways; namely, intellectual, networking and institutional. It was found that these all contributed to preparing for the future.

Furthermore, the results indicate that postgraduates perceived immense benefits in PDFs thus enticing many of the respondents to intend to proceed to PDFs after their doctoral studies. This finding is also supported by Chen et al. (2015), who state that postdoctoral positions serve as preparation for desired careers and many PhD holders plan to embark on PDFs for career enhancement.

Additionally, the results of the study revealed that many PhD holders did not enter PDFs due to many factors ranging from paucity of information, lack of funds, inadequate support from family and many other extenuating factors precluding them from PDFs in the diaspora. These results are supported by the findings of Felisberti and Sear (2014) who studied postdoctoral researchers in the UK. They found that factors promoting their research output included a reliable nexus between research output and research institutions, time spent in PDR, parental education and support for PDF.

Moreover, the findings of this study indicate that postgraduate students can be encouraged to proceed to their PDF. Timeous awareness programmes and political will, as reflected in policy statements, as well as adequate information from the postgraduate schools can provide an impetus for postgraduate students to embark on their PDF.

From the study, it can be concluded that many of the postgraduate students in Oyo state are aware of postdoctoral fellowships (PDFs) and that many of them are willing to proceed on to a PDF after their PhD studies. Additionally, there are enormous benefits inherent in doing a PDF SUCH AS WHAT; and that governmental policy and postgraduate schools should support awareness campaigns and the diffusion of relevant information in order to facilitate the transition for postgraduate students to postdoctoral fellowships.

Conclusion

There should be an inclusive policy in the Ministry of Education in Nigeria to encourage postgraduate students to apply to do their postdoctoral fellowship immediately after their doctoral degree. There should be regular seminars and symposia for postgraduate students (Masters and PhD) on the need for postdoctoral fellowships. Postgraduate schools at institutions in Nigeria should run awareness programmes in the form of posters, conferences, workshops and symposia on the benefits of doing a postdoctoral fellowship.

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Adapting the Student Attitudes Toward Artificial Intelligence (SATAI) Scale for Higher Education Contexts

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Abstract

The growing integration of artificial intelligence into educational environments underscores the need for valid and reliable tools to assess students' attitudes toward AI across different educational levels. The purpose of this study is to adapt the Students' Attitudes towards Artificial Intelligence (SATAI) Scale, developed by Suh and Ahn (2022) for primary and secondary education, for higher education contexts. The participants in the study were 535 undergraduate students from English Language Teaching departments at two different universities in Türkiye. Data were collected through Google Forms in two rounds: the first round for exploratory factor analysis ($n_1 = 325$) and the second round for confirmatory factor analysis ($n_2 = 210$). The exploratory factor analysis confirmed the original three-factor structure of the scale, which includes cognitive, affective, and behavioral components. Following this analysis, nine items were removed for the confirmatory factor analysis. The results of the confirmatory factor analysis showed a good fit, supporting the three-factor structure. Therefore, the SATAI Scale for higher education contexts (SATAI-HE) is validated as a reliable tool for measuring the attitudes of higher education students toward artificial intelligence. This study contributes to the field by offering a relevant assessment tool that can guide AI-related educational practices, policy decisions, and curriculum development in higher education.

Keywords: AI, higher education, scale adaptation, validity, reliability

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Introduction

AI technology dates back to the 1940s and 1950s, and its definition was initially coined by McCarthy in 1956, emphasizing its component of intelligence. Especially after COVID-19, technology became an indispensable part of education. ICT tools have had many applications in teaching and learning for many years, and it has also been transformed on a big scale with the rise of AI in education, including its rapid integration in higher education (Zawacki-Richter et al., 2019).

AI in education has a long history, and it has a controversial one for educators (Konecki et al., 2024). Its use is becoming increasingly popular and widespread. While AI has the potential to significantly enhance teaching and learning, its growing presence in higher education also raises new dangers and ethical concerns (Zawacki-Richter et al., 2019). In their study, Almaraz-López et al. (2023) found that most students employed AI technologies for learning purposes and, while their opinions on its use, limitations, and possible hazards were clear due to lack of training in AI. Therefore, understanding student attitudes regarding the use of AI is crucial since it has become very popular and has promising functions for universities to guarantee successful adoption and alignment with their educational objectives. Also, the educational landscape is changing, especially in higher education, thanks to the use of AI (Holmes, 2019).

AI is not always welcome by researchers or educators (Chrisinger, 2019), and it has dual facets that can present both benefits and drawbacks for the educational process (Humble & Mozelius, 2022; K. Zhang & Aslan, 2021). On the other hand, the study conducted by Johnson et al. (2024), revealed that university students use AI for various purposes and they suggest, instead of prohibiting students from using AI technologies, HE institutions must find ways to integrate it in their educational system and to teach their students how to use it effectively and ethically, as it presents a great number of advantages.

Nevertheless, how AI affects education is still a grey area, and that needs further investigation from different perspectives, specifically from teacher candidates' perspectives, so as to get deeper and more detailed ideas about their attitudes and even tendencies towards it. In addition, it holds significance to identify young people's attitudes towards the use of AI in education as they are engaged with it more than others (Luckin, 2018) due to their complex skills and exploring desires (Turgut & Kunuroğlu, 2025). Therefore, preservice teachers are important figures, and their attitudes can influence the use of AI for pedagogical purposes (Gao et al., 2025). Therefore, the current study aims to provide researchers, educators, curriculum developers, and policymakers with a reliable instrument to reveal teacher candidates' perceptions towards the use of AI in higher education. It will also contribute to the growing body of literature on AI in higher education and offer evidence and insights from the higher education context by focusing on the perceptions of English Language Teaching (ELT) undergraduate students in Türkiye.

Literature Review

AI has been widely used in various fields today. It is used in practically every aspect of education, for various educational purposes such as tutoring, mentoring, personalizing learning, testing, translation, gaming, etc. (Alam, 2022; Chen et al., 2020; Fitria, 2021). Technology advancements have made it feasible to modify AI systems to do nearly anything, from simple to complex tasks. The way students study and reach information has changed as

a result of the widespread use of AI technologies in higher education. The use of AI in education is increasing, and it is changing tertiary education through various applications of AI in education, such as virtual assistants, grading, researching, etc. (Zawacki-Richter et al., 2019).

The reason why AI has widespread applications in many fields, and its use in education is increasing and catching the spotlight every year (Chen et al., 2020) in today's world might be that people's opinions towards AI have changed significantly over time, and the topic remains debatable. Especially, teachers' ideas about AI tools and their applications play a crucial role in determining whether they are approved or not (Gao et al., 2025; Ghimire et al., 2024) because this might increase the potential of their acceptance by individuals.

The concept of attitude is important in education, and it has been of interest for many years even though attitudes towards the use of AI in education are a relatively new topic on the agenda. One of the early definitions of attitude was made by Allport (1967) focusing on its being a mental state and an individual response to different things. It also refers to specific inclination (Ajzen & Fishbein, 2000). It has been touched upon from various perspectives and technology use is one of the popular topics that have been addressed by researchers (e.g. Ardies et al., 2015; Kemp et al., 2019; Svenningsson et al., 2022).

Attitudes towards the use of AI, other than education, have been interestingly influenced by the term "AI" itself (Cojean et al., 2023). However, it should be borne in mind that teachers have a lot to learn and do while using AI in the classroom because it offers many advantages, but also difficulties.

Even if AI has the potential to greatly enhance teaching and learning, the growth of AI applications in HE also brings with it possible hazards and ethical issues (Zawacki-Richter et al., 2019). In order to ensure successful alignment, it is crucial to comprehend students' attitudes toward AI as institutions use these tools more and more. Students' desire to use AI tools is influenced by their attitudes, and they include cognitive, affective, and behavioral aspects. These attitudes also affect how they view the ethical and pedagogical consequences of AI (Teo, 2011; B. Zhang & Dafoe, 2019), and their attitudes are likely to impact the adoption and implementation (Suh & Ahn, 2022).

With a coherent purpose, the development and validation of SATAI-HE scale in a higher education context targets to investigate tertiary-level students' attitudes towards AI from multidimensionally significant aspects, since AI has been pervasively adopted by university students for various educational purposes. Also, it aims to contribute to the gap in HE context with a practical implication to integrate AI successfully by assessing their perceptions.

Method

Quantitative in nature, this research is structured as a cross-sectional survey. Data were collected from undergraduate students studying English Language Teaching in Türkiye during January-March 2025 after the ethical board approval from the ethics committee of Bartın University Decision no: 2024-SBB-0960. Those students who agreed to voluntarily participate in the survey filled in the online questionnaire without including any identifiable information.

Original Scale

Originally developed by Suh and Ahn (2022), SATAI is developed for primary and secondary school students. SATAI is a 5-point Likert scale and has a three-factor structure, with cognitive, affective, and behavioral factors, and consists of 26 items. The items range from 1 (strongly disagree) to 5 (strongly agree). The cognitive factor includes 4 questions, while the affective factor includes 10 questions, and the behavioral factor includes 12 questions. Specifically designed for AI education, SATAI allows educators to assess and quantify students' attitudes toward artificial intelligence.

Participants

Comrey and Lee (2013) indicate that the reliability of factor analysis results is significantly affected by sample size, with larger samples yielding more reliable correlations, and a sample size of 200 is considered fair. In our study, the sample size was decided according to the items being analyzed. In the first round, we surveyed 325 undergraduate students, and in the second round, we included 210 students. Before data collection, we obtained informed consent from the participants in both rounds.

In the first round, the participants consisted of 325 freshmen, sophomores, juniors, and seniors studying English Language Teaching at two different universities in Türkiye. Among these participants, 225 (69.2%) were female, 89 (27.4%) were male, and 11 (3.4%) preferred not to disclose their gender. Additionally, the distribution of participants by class year was as follows: 127 (39.1%) were freshmen, 108 (33.2%) were sophomores, 43 (13.2%) were juniors, and 47 (14.5%) were seniors. Table 1 shows the frequencies of gender and class year in the first round.

Table 1
Frequencies of Gender and Class Year in the First Round

Gender	**Counts**	**% of Total**
Female	225	69.2%
Male	89	27.4%
Preferred not to disclose	11	3.4%
Class year	**Counts**	**% of Total**
Freshman	127	39.1%
Sophomore	108	33.2%
Junior	43	13.2%
Senior	47	14.5%

In the second round, participants were 210 undergraduate students. The participants included 129 (61,4%) females, 75 (35.7%) males, 9 males and 6 (2.9%) who preferred not to disclose their gender. Additionally, the distribution of participants by class year was as follows: 11 (5.2 %) were freshmen, 111 (52.9 %) were sophomores, 58 (27.6 %) were juniors, and 30 (14.3%) were seniors. Table 2 shows the frequencies of gender and class year in the second round.

Table 2
Frequencies of Gender and Class Year in the Second Round

Gender	Counts	% of Total
Female	129	61.4%
Male	75	35.7%
Preferred not to disclose	6	2.9%
Class year	**Counts**	**% of Total**
Freshman	11	5.2%
Sophomore	111	52.9%
Junior	58	27.6%
Senior	30	14.3%

Data Analysis

The initial 325 students' data were used to run EFA. Initially, the data collected through Google forms were transferred to Jamovi 2.4.12 (The Jamovi Project, 2024) for descriptive statistics, and then EFA was conducted on Jamovi with initial 26 items from 325 participants for construct validity and factor structure. After conducting EFA, the factor loadings were checked, and the number of items was reduced to 17.

In the second round, CFA was conducted again using Jamovi version 2.4.12 with the remaining 17 items and with the data collected from a sample of 210 students. The model's fit was evaluated by various fit indices. The chi-square/degrees of freedom ratio (df), comparative fit index (CFI) and Tucker-Lewis Index (TLI) were C) were used to evaluate the model data fit. The results of EFA and CFA are presented under the "Results" section of the paper.

Results

Results From EFA

We conducted EFA to see whether the adaptation of the SATAI Scale keeps the original three-construct structure and to identify the specific items associated with each construct. Before proceeding, we assessed the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity for assumption checks and both assumptions were met to continue with EFA. Overall KMO value was found as 0.916, which indicates "marvelous" sampling adequacy for conducting EFA (Kaiser, 1974). Also, Bartlett's Test of Sphericity [$\chi 2(2922) = 136$, $p < 0.001$], was significant.

First of all, descriptive statistics of the items were checked out and they are given in Table 3 below.

Table 3
Descriptive Statistics

Items	Mean	Median	SD	Skewness	Kurtosis
Item 1	4.25	4	0.736	-0.670	-0.0808
Item 2	3.91	4	0.849	-0.535	0.0767
Item 3	4.07	4	0.794	-0.605	0.182
Item 4	3.94	4	0.848	-0.536	-0.0953
Item 5	3.63	4	1.04	-0.557	-0.183
Item 6	3.90	4	0.848	-0.777	0.652
Item 7	3.49	4	0.915	-0.345	-0.177
Item 8	3.54	4	1.04	-0.570	-0.273
Item 9	3.46	4	1.09	-0.445	-0.567
Item 10	3.96	4	0.929	-1.09	1.42
Item 11	3.28	3	1.09	-0.307	-0.575
Item 12	3.41	3	0.940	-0.362	0.102
Item 13	4.00	4	0.747	-0.853	1.59
Item 14	4.14	4	0.758	-0.847	1.07
Item 15	2.79	3	1.11	0.225	-0.644
Item 16	2.51	2	0.977	0.341	-0.099
Item 17	2.88	3	1.12	0.138	-0.768
Item 18	3.42	4	0.977	-0.576	0.049
Item 19	3.83	4	0.832	-0.800	1.270
Item 20	3.81	4	0.837	-0.736	1.103
Item 21	3.09	3	1.106	-0.205	-0.751
Item 22	3.28	3	1.039	-0.256	-0.444
Item 23	3.46	4	1.028	-0.564	-0.153
Item 24	4.02	4	0.782	-0.969	1.966
Item 25	3.58	4	0.939	-0.614	0.371
Item 26	3.67	4	0.886	-0.370	-0.167

Principal Axis Factoring in combination with oblimin rotation was employed as the extraction method to identify the underlying factor structure. The analysis extracted a three-factor structure (Table 4). As can be seen in Table 4, 16 items had high factor loadings. Factors 1-3 cumulatively explained 54,8 % of the total variance. Specifically, Factor 1 explained 23.6%, Factor 2 explained 16.9%, and Factor 3 explained 14.3% of the variance, respectively.

Table 4
Factor Loadings

	Factor			
	1	2	3	Uniqueness
1		0.763		0.419
2		0.744		0.418
3		0.872		0.280
4		0.695		0.391
7			0.542	0.533
8			0.871	0.324
9			0.734	0.385
10			0.559	0.588
11				0.653
16	0.703			0.537
17	0.853			0.394
18	0.518			0.446
19	0.569			0.510
20	0.558			0.388
21	0.671			0.506
22	0.709			0.416
23	0.699			0.497

Note. "Principal axis factoring" extraction method was used in combination with a "oblimin" rotation

Results From CFA

In the second round, we ran CFA to test the factor structure results from EFA. Descriptive statistics of each item were calculated and presented in Table 5.

Table 5
Descriptive Statistics

Items	Mean	Median	SD	Skewness	Kurtosis
Item 1	4.24	4.00	0.843	-1.452	2.982
Item 2	4.02	4.00	0.904	-0.949	1.053
Item 3	4.08	4.00	0.832	-1.049	1.749
Item 4	4.07	4.00	0.891	-1.042	1.186
Item 7	3.69	4.00	1.010	-0.714	0.352
Item 8	3.80	4.00	1.066	-0.860	0.355
Item 9	3.79	4.00	1.032	-0.887	0.404
Item 10	4.12	4.00	0.849	-0.902	0.861
Item 11	3.48	3.00	1.374	4.428	43.898
Item 16	2.60	2.00	1.032	0.574	-0.044
Item 17	2.89	3.00	1.152	0.169	-0.809
Item 18	4.00	4.00	1.050	-0.476	-0.208
Item 19	4.00	4.00	0.833	-0.865	1.268
Item 20	4.00	4.00	0.884	-0.843	1.136
Item 21	3.21	3.00	1.108	-0.232	-0.692
Item 22	3.36	3.00	1.045	-0.174	-0.649
Item 23	3.54	4.00	1.049	-0.503	-0.231

We ran CFA to look into the factor structure of SATAI-HE. All factor loadings were statistically significant ($p < 0.001$). This shows that the items strongly indicate the structure. The results of CFA, including standardized estimates, are presented in Table 6.

Table 6
Results From CFA

Factor	Indicator	Estimate	SE	Z	p	Stand. Estimate
Cognitive	**1**	0.692	0.0484	14.32	< .001	0.823
	2	0.751	0.0516	14.55	< .001	0.832
	3	0.748	0.0452	16.56	< .001	0.901
	4	0.805	0.0482	16.70	< .001	0.905
Affective	**7**	0.641	0.0637	10.06	< .001	0.636
	8	1.016	0.0556	18.27	< .001	0.955
	9	0.936	0.0556	16.83	< .001	0.909
	10	0.567	0.0527	10.76	< .001	0.669
	11	0.425	0.0953	4.46	< .001	0.310
Behavioral	**16**	0.606	0.0676	8.97	< .001	0.589
	17	0.750	0.0734	10.21	< .001	0.653
	18	0.818	0.0627	13.04	< .001	0.781
	19	0.623	0.0506	12.30	< .001	0.750

20	0.714	0.0519	13.76	< .001	0.810
21	0.771	0.0692	11.14	< .001	0.697
22	0.769	0.0639	12.04	< .001	0.738
23	0.705	0.0664	10.62	< .001	0.673

The chi-square/degrees of freedom ratio ($\chi 2/df$), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) were used to test model fit. Table 7 shows the criteria for good and acceptable model data fit.

Table 7
Fit Values of the CFA Model

Fit values	Good fit	Acceptable fit	SATAI-HE Scale Fit Values	Reference
$X^{2/}df$	$0 \leq \chi 2/df \leq 2$	$2 \leq \chi 2/df \leq 3$	2.06	Kline (2011)
CFI	$.95 \leq CFI \leq 1.00$	$90 \leq CFI \leq .95$	.942	Baumgartner & Homburg (1996)
TLI	$.95 \leq TLI \leq 1.00$	$90 \leq TLI \leq .95$	.932	Baumgartner & Homburg (1996)

The three-factor model provided an acceptable fit for the data with the following indices: $\chi 2 = 240$ ($df = 116$, $p < .01$) CFI = .942; and TLI = .932. The CFI and the TLI were CFI = 0.942, TLI = 0.932, both exceeding the acceptable threshold of 0.90, indicating good fit. Additionally, the Root Mean Square Error of Approximation (RMSEA) was 0.0714, and the Standardized Root Mean Square Residual (SRMR) was 0.0738, both within acceptable limits. All factor loadings in the final model were statistically significant ($p < .001$). These results support the construct validity of the scale with a three-factor structure: Cognitive, Affective, and Behavioral.

Reliability

Cronbach's alpha (α) was used to test the reliability of the SATAI-HE scale in both rounds. In the first round, Cronbach's α for the overall scale was .938; .866 for the first factor; .851 for the second factor and .913 for the third factor, respectively.

The Cronbach alpha (α) reliability coefficients was used to analyze the reliability of the final version of the scale. Cronbach's α for the final scale was .920 for the overall scale; .922 for the first factor; .853 for the second factor and .883 for the third factor. Table 8 shows the overall and factor reliabilities.

Table 8
Reliability Coefficients in the Final Version of SATAI-HE Scale

Factor Name	Reliability coefficients
Overall	.938
Cognitive	.866
Affective	.851
Behavioral	.913
Factor Name	Reliability coefficients
Overall	.920
Cognitive	.922
Affective	.853
Behavioral	.883

Discussion and Conclusion

Our study aimed to adapt the SATAI scale for use in higher education environments and to assess its psychometric characteristics. The results from both EFA and CFA demonstrate strong evidence that the original three-factor structure of the SATAI scale- comprising cognitive, affective, and behavioral dimensions- was maintained in the adapted version. This outcome underscores the continued relevance and theoretical soundness of the original scale when applied to university-level populations, reinforcing its conceptual applicability across diverse educational contexts.

Furthermore, the reliability analysis demonstrated consistently high internal consistency across both study rounds. In the first round, Cronbach's alpha values for the total scale and its subscales ranged from .851 to .938, while in the second round, they ranged from .853 to .922. These findings confirm that the items within each dimension are closely aligned and that the scale provides a stable measurement of students' attitudes toward artificial intelligence across cognitive, emotional, and behavioral aspects. Additionally, factor loadings between .518 and .872 further validate the construct integrity of the adapted instrument.

The current study contributes to the growing body of literature on AI in education by offering a reliable and valid instrument tailored for the higher education context. As Almaraz-López et al. (2023) found that tertiary-level students have mostly positive attitudes towards the use of AI and are eager to learn more. Still, they are also aware of its potential risks, which were also found in our study. Similarly, Katsantonis and Katsantonis (2024) identified positive attitudes among university students from the social sciences towards the use of AI, using SATAI in a Greek context. This finding aligns with our study in terms of research motivation, higher education context, and results. Turgut and Kunuroğlu (2025), in their study, adapted SATAI into Turkish. The findings showed high consistency, reliability and validity of the scale to be used in HE context, which shows accordance with our study. Derinalp and Özyurt (2024), from a similar perspective, used and adapted SATAI in Turkish K12 context (middle and high school). They found the scale was reliable and valid to be used to find out secondary and high school students' attitudes towards AI. In addition, it showed significant resemblance to the original study.

As AI tools are increasingly incorporated into university teaching, learning, and administrative functions, it is essential to grasp students' perceptions and interactions with these technologies. The SATAI-HE can be an important resource for researchers and

educators looking to evaluate students' readiness, concerns, and expectations about AI, which can help shape the development of AI-integrated curricula and support structures.

The study offers a strong multidimensional tool (SATAI-HE) for future research, institutional planning, and curriculum development in AI integration in education by confirming the scale's structure and reliability using both exploratory and confirmatory factor analyses with a sample of ELT undergraduates in Türkiye. Additionally, university students typically might possess more developed viewpoints about AI than younger students. As a result, the scale used in this study takes into account the unique characteristics of these learners in educational environments.

The study is not without limitations. Our sample was limited to undergraduate students from a specific context - country and department- which may affect the generalizability of the findings. Cultural, institutional, or disciplinary differences could influence students' attitudes toward AI, and future research could test the SATAI-HE in more diverse populations, including students from different faculties and departments, graduate students, or students from different countries. In addition, further research could focus on the potential risks or negative attitudes towards AI as it possesses a blurry area in people's minds and needs further and deeper investigation.

In conclusion, the SATAI-HE is a valid and reliable scale for measuring students' cognitive, affective, and behavioral attitudes toward AI in higher education. Its strong psychometric properties make it a useful instrument for both research and practical applications in educational settings where AI continues to gain prominence.

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Bringing Real-World Topics Into Language Classrooms Through Content-Based Language Teaching: An EFL Teacher's Perspective

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Abstract

This contribution presents an exploratory case study focused on the initial implementation of the Content-Based Language Teaching (CBLT) approach in a lower secondary foreign language classroom in the Czech Republic. The aim is to examine the lived experience of a novice English as a Foreign Language (EFL) teacher as they incorporate real-world topics – specifically media literacy – into their lessons, aiming to create an engaging classroom environment through authentic materials and content relevant to students' lives. The study employs qualitative methodology, with data collected over a five-week period through classroom observations, reflective journaling, and semi-structured interviews with the teacher. Thematic analysis revealed key aspects of their experience, including evolving instructional practices, perceived challenges, and the development of content-based strategies. Findings suggest that authentic content increased student engagement and fostered critical thinking, though the teacher struggled to balance linguistic and cognitive demands, particularly with unadapted materials. Notably, the experience prompted a shift in the teacher's pedagogical mindset toward more purposeful and relevant instruction. While exploratory in nature, the study offers insights into the challenges and opportunities of adopting CBLT, emphasizing the importance of teacher support, targeted preparation, and reflective practice in enabling effective implementation and instructional change.

Keywords: content-based language teaching, CBLT, language teaching, foreign language teachers

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Introduction

Content-Based Language Teaching (CBLT), also known as Content-Based Instruction (CBI), is an instructional approach that integrates meaningful and relevant subject matter into foreign language education. Its main goal is to create an authentic learning environment that simultaneously develops students' foreign language proficiency and deepens their understanding of various content areas. CBLT has its roots in Canadian immersion education programs that emerged in the 1960s, in which students learned school subjects such as science or history through their second language (Lambert & Tucker, 1972). These programs emphasized the importance of meaningful content in language acquisition and contributed to the growth of CBLT in North America during the 1980s and 1990s, amid a broader shift toward communicative language teaching (Genesee, 1987). The model has been further developed into English for Specific and Academic Purposes (ESP/EAP) contexts, which aim to equip learners with language skills essential for academic success. Over time, CBLT became closely associated with other integrative approaches, such as CLIL (Content and Language Integrated Learning) in Europe and sheltered instruction in the United States, all of which share the same goal –integrating content learning with language development.

The CBLT approach allows for a flexible definition of "content". It can be derived from academic disciplines like science and history, or from cross-curricular subjects such as media literacy, environmental education and global citizenship. However, it is essential that the content be cognitively stimulating, engaging, and relevant to learners' interests and needs (Genesee, 1994; Met, 1999). Another characteristic of CBLT is that it can be implemented across a variety of educational settings. In early childhood and elementary education, it may take the form of theme- and play-based instruction. In the secondary school context, it aligns well with project-based or interdisciplinary learning. At the university level, it is most implemented through English for Academic or Specific Purposes (EAP/ESP), engaging students with discipline-specific academic content and language.

The flexible nature of CBLT is best described as a continuum proposed by Met (1999). At the content-driven end are full immersion programs where subject learning is at the forefront of instruction and language is acquired implicitly. Toward the center are models such as sheltered instruction and partial immersion, which balance content and language focus. At the language-driven end are theme-based or ESP/EAP programs, in which language acquisition remains the primary goal and content is used to achieve that objective. Educators can thus tailor this approach to suit the needs of diverse age groups, educational contexts and objectives.

A successful implementation of CBLT depends on several factors, such as institutional support or availability of materials and resources, but most importantly, teachers' preparedness to integrate both language and content instruction (Horn, 2011), as well as their beliefs and attitudes toward teaching and learning (Markee, 1993). The interplay of these factors shapes how CBLT is implemented in real-world educational contexts, however, the perspective of the teacher and their experience with the practical realities of using CBLT are the central focus of the following case study.

Case Study

This exploratory case study investigates the early implementation of Content-Based Language Teaching (CBLT) by a novice English as a Foreign Language (EFL) teacher in a

lower secondary school in the Czech Republic. The purpose of the study was to gain an in-depth understanding of the teacher's initial experience with this instructional approach, including perceived benefits, encountered challenges, and the strategies employed to manage both content and language objectives in the classroom.

Theoretical Background

The experiences of teachers who have implemented CBLT in their classrooms have been examined in detail by Cammarata (2009, 2010) in order to identify the challenges faced during this process. The author observed that despite the challenges, teachers found the process rewarding as it forced them to reflect more deeply on their practice and learn new ways of teaching. Cammarata stressed that with the right training and support, the process could be less challenging for teachers (Cammarata, 2009). Pessoa et al. (2007) explored attitudes towards the use of CBLT among two teachers and found that their personal beliefs had the most significant influence on its implementation. Although they perceived the challenges associated with the process positively, their experiences of using CBLT in practice had different characteristics. While the first teacher found the matching of content and language too challenging and preferred explicit grammar instruction, the second teacher reported that he viewed CBLT as a much more beneficial and enjoyable way of teaching because it created an authentic context for language learning. Although the teachers followed the same curriculum, materials, and resources, their experiences and perceptions differed considerably. This study shows that more than context and environment, the factors that determine the success of CBLT are largely dependent on teachers' attitudes and preferences, which highlights their crucial role in the process of implementing CBLT.

In his studies, Martel (2018) points to the need to examine teachers' identity construction processes to provide them with adequate support and environment for their development. He also highlights the need to provide ongoing support in the form of mentoring so that teachers adopt new teaching practices and transform their practice. More specific aspects of CBLT implementation include, for example, efforts to balance language- and content-focused instructional goals, which have been shown to be the most crucial and common in a number of studies (Baecher et al., 2013; Bigelow & Ranney, 2005; Spenader et al., 2018). These have shown that although teachers initially tended to lean toward language-focused goals, they gradually learned to formulate goals with both aspects of integration in mind. Collaboration with content-specialist colleagues played an important role in this process, highlighting the importance of institutional support and collaboration for the successful implementation of CBLT.

Kong (2009) identified effective forms of CBLT instruction, including cyclical lesson structuring, use of content-related language, and support for student interaction. Pessoa et al. (2007) argue that a balanced focus on content and language can be achieved through conversational practices that support learners' use and development of language, including, for example, fostering metalinguistic awareness, providing opportunities for co-construction of forms, and teacher feedback. The above studies highlight the challenges teachers face in integrating content and language, the complex interplay between teachers' beliefs and their teaching practices, and the importance of professional development and the provision of support in applying this method.

Case Context and Participant Background

The case study was conducted during April and May 2024 at an elementary school in the Czech Republic. The research was carried out in collaboration with one English teacher (a novice teacher with two years of teaching experience) in a Grade 7 EFL class consisting of eight students, whose proficiency levels ranged from A2 to B1 on the CEFR scale.

An initial preparatory meeting with the teacher was held prior to the implementation phase. This meeting served to gather contextual information about the class, including established routines, textbooks and materials in use, and methods of assessment. It also allowed for the collaborative planning of a thematic unit based on the cross-curricular subject of media education, which was selected for its relevance and potential to engage learners while supporting the goals of CBLT.

Research Aim and Guiding Question

The study aimed to explore the practical realities of adopting CBLT by a teacher without prior experience in this method. The investigation was guided by the following research question: *What benefits and challenges does a novice EFL teacher reflect upon when implementing the CBLT approach?* To address this central question, the study also considered several related aspects, such as the process of material selection, language- and content-related goals, teacher's preferred activity types and instructional strategies.

Teacher Preparation for CBLT Implementation

The collaboration began with a teacher training workshop designed to introduce the theoretical underpinnings of CBLT. This session also included hands-on tasks to familiarize the teacher with the method's practical application, such as setting dual-focused language and content objectives for a thematic unit. Together, we outlined the learning goals for the five-week implementation, aligning them with the selected topic of media education. Through this collaborative process, the teacher gained experience in identifying and articulating content objectives alongside language objectives. This planning phase laid the groundwork for a CBLT-based thematic unit that integrated all four language skills through meaningful and cognitively challenging tasks.

Implementation Phase

The core content was derived from the cross-curricular subject of media education, with lesson topics focusing on identifying misinformation, fact-checking techniques and critical analysis of various media formats. In the Czech Republic, cross-curricular subjects are intended to be integrated across a variety of subjects, making English lessons an ideal context for this integration, as they naturally provide opportunities for discussing authentic media and fostering critical thinking in a foreign language.

To adhere to the key principles of CBLT, the thematic unit and individual lessons were built around clearly defined language and content objectives.

By the end of the unit, students will be able to:

- Use media-related vocabulary in both spoken and written context.
- Read and analyze short authentic news texts.

- Practice modal verbs and opinion expressions in discussion and writing.
- Engage actively in pair and group discussions.
- Write an opinion essay on a media-related topic.

Corresponding content goals were:

- Understand the concept of fake news and recognize its examples in media.
- Evaluate online sources based on given criteria (source, author, evidence, bias).
- Discuss the impact of the media on society.
- Express informed personal opinions about the media.

As regards materials and activities, authentic resources such as news articles, infographics, videos, and podcast excerpts were used by the teacher to provide learners with rich input and expose them to real-world language. To support both content and language learning, the teacher also created tailor-made worksheets, guided reading tasks, and discussion prompts to supplement the various authentic resources. The aim of using these supporting materials was to provide scaffolding and guide learners throughout the activities that were different from the traditional textbook-based exercises. Some examples of activities include evaluation of media sources based on given criteria, academic debate, role plays, and opinion essays. These were designed to allow students to synthesize the information they had learnt in both written and spoken forms, with the goal of consolidating their knowledge and using language with a clear purpose.

Data Collection and Analysis

Data for this exploratory case study were collected from three primary sources: classroom observations, the teacher's reflective journal (submitted in both written and audio-recorded formats), and two rounds of semi-structured interviews. The triangulation of data sources was employed to ensure credibility and comprehensiveness of the findings while capturing multiple perspectives on the implementation process (Merriam & Tisdell, 2016).

Classroom data were collected through observations of three lessons, using a structured observation protocol crafted to record the utilization of CBLT-specific principles (Appendix A). The protocol categories included lesson preparation and delivery (setting clear content and language goals, using authentic materials and meaningful activities, providing learners with comprehensible input), scaffolding strategies, interaction patterns, review and assessment.

Moreover, one of the lessons was video recorded and later examined in detail to add to the observation protocol records and contribute to the interpretation of the data. The teacher kept a reflective journal (Appendix B) during the five-week period, submitting entries in both written and audio-recorded formats. The audio format of the teacher's reflections was regarded as particularly effective, as it allowed for an immediate post-lesson reflection and proved to be less time-consuming. The analysis of these reflections offered rich insight into the evolving thinking of the teacher, challenges encountered, and decisions made in lesson planning and delivery. In addition, two semi-structured interviews were conducted to gain a deeper understanding of the teacher's experience (Appendix C). The first took place midway through the implementation and served to review preliminary observations, discuss the recorded lesson, and explore the teacher's early impressions of the approach. The second interview was conducted after the conclusion of the unit and focused on the teacher's holistic

reflections, including perceived benefits and difficulties and their evolving pedagogical mindset regarding integrated content and language instruction.

In the final step, all data were analysed using thematic analysis, following Braun and Clarke's (2006) six-phase framework. This involved becoming familiar with the data, generating initial codes, identifying patterns, reviewing and refining themes, and interpreting the findings in relation to the main research question. The aim of the analysis was to identify key themes that best characterize the teachers' experience with implementing CBLT, its benefits and challenges, and draw insights to inform future practice.

Results

The analysis revealed five key themes capturing the teacher's experience of implementing CBLT:

1. **Positive impact of integrating authentic content:** The teacher observed that using authentic materials such as articles, YouTube videos and podcasts within the selected topic of media education increased students' motivation and engagement. It was highlighted that selecting topics directly connected to learners' lives outside the school, such as the topic of Fake News, proved to be highly engaging. Compared to the traditional English textbook content, the teacher appreciated that learners could relate to these themes, acquire new information and skills while being exposed to real-life language and resources.
2. **The challenge of balancing the cognitive and linguistic demands of the content:** The teacher occasionally found it challenging to balance students' linguistic proficiency with the cognitive demands of the content. This difficulty stemmed from the use of authentic online materials intended for native speakers, which often contained unfamiliar vocabulary and complex grammatical structures, as well as tasks requiring higher-order thinking skills (e.g., identifying an author's intent in an article). Although most students managed to complete the tasks successfully, some struggled when lower language proficiency was paired with cognitively demanding activities. The teacher concluded that greater attention should be given to connecting ESL lesson content with knowledge students had acquired in other subjects, thus providing the necessary context to support learning in the CBLT-based lesson.
3. **Lesson planning and selection of appropriate content/materials:** Even though the teacher moved away from using the standard textbook and sought to find materials from other sources, they had no difficulty finding what they needed, as a wealth of resources was available online on relevant websites. The only issue was selecting materials that matched students' level of proficiency. In case the teacher found a resource that was suitable content-wise but linguistically more challenging, they compensated for this by providing thorough scaffolding and supplementary materials. As the teacher was already accustomed to working with resources beyond the textbook, planning and implementing CBLT lessons did not require significantly more time than usual.
4. **Effective teaching strategies and activities:** The teacher noted that some of the most effective ways of integrating language and content were through discussions, pair-work, the use of ICT tools, and working with authentic resources. Collaborative activities gave students opportunities to support one another and deepen their understanding through interacting with peers. For example, academic debates proved to be particularly effective, with students being actively engaged, expressing and defending their opinions, practicing their speaking skills, and critical thinking

simultaneously. The teacher also pointed out that combining formal and informal assessment, such as portfolios and written tasks in the form of brief self-reflections and essays, was an effective way for students to demonstrate their understanding of the content while offering a valuable and meaningful way to monitor progress.

5. **Teacher motivation and mindset transformation:** The initial workshop motivated the teacher to implement CBLT, and the insights gained transformed their approach to instruction. Integrating relevant content provided a clear instructional focus and prompted experimentation with new teaching strategies. Positive student feedback further reinforced the value of the approach, shifting the teacher's perspective and inspiring the systematic integration of content into lessons across different grade levels, even after the case study concluded.

Conclusion

This case study offers valuable insights into the early implementation of Content-Based Language Teaching (CBLT) from the perspective of a novice EFL teacher in a lower secondary classroom. While the study involved only one teacher, one group of learners, and a five-week implementation period, the findings provide valuable insights for both pedagogical practice and future research.

The results indicate that, with adequate preparation and support, CBLT can be implemented effectively even by teachers new to the approach. Besides noticing increased student engagement, the participating teacher described the experience as professionally enriching and pedagogically transformative, stating that it encouraged a more thoughtful and purposeful approach to lesson planning. Importantly, the teacher emphasized the need for training not only in the theoretical underpinnings of CBLT, but also in its practical applications, such as setting balanced language and content objectives, adapting authentic materials, and managing the cognitive demands of tasks. The teacher's decision to continue using CBLT even after the case study has been completed shows just how valuable and impactful they found it in their own practice.

The insights may inform larger-scale and longitudinal studies examining teachers' evolving experiences with CBLT and student learning outcomes across diverse contexts. By integrating meaningful, real-world content, CBLT can not only make the process of learning a language more engaging for the students but also invite teachers to reflect on the purpose and relevance of language education. While challenges remain, particularly in balancing cognitive complexity with linguistic accessibility, they can be addressed through scaffolded instruction, teacher agency, and ongoing reflective practice.

Ultimately, this study illustrates the transformative potential of CBLT when implemented thoughtfully. It is not simply a language teaching method, but a curricular model for designing intellectually stimulating and socially relevant learning experiences. As Martel (2021) reminds us:

> If we want foreign languages to be as relevant, engaging, and significant as other school subjects, we must do something different. We must choose content that is thought-provoking.

CBLT, I believe, offers a compelling framework for realizing this vision.

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Appendices

Appendix A
Sample of the Lesson Observation Protocol

Teacher & School : M.; Labyrinth Brno
Date: April 10

Observation Protocol

Recognising Fake News; 7th grade; A2/B1 level

	Highly Evident 4	3	Somewhat Evident 2	1	Not Evident 0	Comments
Lesson Preparation & Delivery						
1. **Content objectives** clearly defined and reviewed with students	☑	☐	☐	☐	☐	*1. + 2.) Both content and language objectives have been clearly stated and discussed on the board (interactive panel) in the introduction of the lesson. Content goal: Recognizing fake news. Language goal: Learn the vocabulary connected to the topic. Identify types of texts.*
2. **Language objectives** clearly defined and reviewed with students	☑	☐	☐	☐	☐	
3. **Content concepts** appropriate for age and educational background of learners	☑	☐	☐	☐	☐	*3. Concepts to be learnt: C.R.A.P. method used to check the validity of a piece of news and determine whether itś. not fake news.*
4. **Supplementary materials** used to a high degree, making content clear and comprehensible (e.g. visuals)	☑	☐	☐	☐	☐	*4. Supplementary materials: Worksheet, screen-sharing on the panel,*
5. **Adaptation of content** to appropriate level of proficiency	☐	☐	☑	☐	☐	*5. Adaptation: Materials used were highly authentic, and therefore cognitively challenging for some pupils.*
6. **Meaningful activities** that integrate lesson concepts with language practice opportunities	☑	☐	☐	☐	☐	*6. Meaningful activities: Reading comprehension with analysis of the purpose of text.*
Comprehensible Input						**Comments**
7. **Key vocabulary** emphasized (introduced, written, repeated, highlighted)	☐	☑	☐	☐	☐	*7. Key vocabulary introduced in the preparation worksheet activity - introduced, written. However, when working individually, students needed to work with the vocabulary themselves - they either asked the teacher or used a translation.*
8. **Clear explanation of tasks**	☑	☐	☐	☐	☐	*8. Comprehension-checking, individually helping each learner.*
9. **Variety of techniques used** to make content concepts clear (e.g. modeling, visuals, hands-on activities, body language, demonstrations)	☑	☐	☐	☐	☐	*9. Modeling, visuals, hand-on activities.*

	Highly Evident 4	3	Somewhat Evident 2	1	Not Evident 0	Comments
Strategies						
10. **Scaffolding techniques** consistently used assisting and supporting student understanding	☑	☐	☐	☐	☐	*10. Variety of scaffolding techniques used, constantly checking student understanding, providing meaning-making activities*
11. **Variety of questions and tasks** that promote higher-order thinking skills	☑	☐	☐	☐	☐	*11. Lower- to higher-order thinking skills necessary: e.g. connecting keywords (simple task); analysing texts to assess purpose of the article, audience, author information etc. (connection to other subjects), perhaps too difficult for some pupils, would require more instruction or perhaps a model example using modified texts.*
Interaction						**Comments**
12. **Frequent opportunities for interaction** and discussion between teacher and students and among students	☐	☐	☑	☐	☐	*12. Pair-work configuration, opportunities for peer-help - e.g. when answering worksheet questions, asking for help with translating vocabulary*
13. **Grouping configurations** support objectives of the lesson	☑	☐	☐	☐	☐	
Review & Assessment						**Comments**
14. **Review of key vocabulary**	☐	☐	☐	☐	☑	*14. Key vocabulary revised throughout the lesson*
15. **Review of key concepts**	☐	☐	☑	☐	☐	*15. Some of the concepts were perhaps too cognitively challenging, would require deeper focus*
16. **Regular feedback provided to learners on their output (e.g. language, content, work)**	☑	☐	☐	☐	☐	

Appendix B

Description of the Teacher's Lived Experience of Implementing CBLT for the Reflective Journal (adapted from the protocol created by van Manen, 2003 and later adapted by Cammarata, 2010)

Task description**:**

The purpose of this short record to be written by you is to recall a selected episode of your experience of CBLT-based teaching. Choose one that is still vivid in your memory and try to describe it as specifically as possible. To this end, avoid rationalisations, causal explanations, generalisations or interpretations as far as possible. There is no limit to the length of the text. Here are some guidelines to follow in describing the particular learning experience you have chosen:

- Try to think of a specific event or situation in which you have used CBLT principles in your teaching. Try to recall a moment that has stayed vividly in your mind.

- Try to describe what you were thinking about, the mood, feelings, emotions you were experiencing. You can even try writing the text in the present tense, as this can help you create an even more vivid description.

- You can also discuss how you experienced the situation in your interaction with your pupils.

Appendix C

Questions for Semi-structured Interviews

A. Semi-structured interview (during implementation, based on description)

- Can you describe a specific case where you think you have successfully integrated content into language teaching? What was the topic and what activities did you use?
- Why did you choose this particular episode? Why do you consider it a key moment to share?
- Are there any anecdotes or stories that you could share with me that would best describe your CBI learning experience?
- What was it like for you to implement the CBLT method? Is this experience similar or different from others you have experienced in previous teaching practice? If so, how is it similar or different?
- Is there anything that would have helped you to implement in the coming weeks (e.g., support from a researcher, colleagues, help with creating materials...)

B. Interview at the end of the implementation

- Can you describe specific situations where you have successfully integrated content into language instruction and achieved positive results?
- What do you think are the challenges and opportunities of integrating CBLT into foreign language teaching?
- What criteria did you use to select the content on which CBLT instruction was based?
- From where did you draw materials for teaching?

- What specific advantages or disadvantages have you observed in relation to learner motivation when teaching using the CBLT method?
- Which types of activities do you think were most effective in integrating content and language?
- What strategies do you find most appropriate (e.g. group work, discussions, project-based learning...)?
- What advice would you give to other teachers in implementing the CBLT method in their own teaching?

Study Abroad and Scholarships: Are Student Preferences Affected by Performance Related and Determined Financial Incentives?

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Abstract

This paper looks at the differences in study abroad preferences of two cohorts of Japanese university first year students (2024: n99, 2025: n113). The reasoning for the research was to determine whether study abroad preferences were affected by the changes in underlying principles for scholarship awards, i.e. pre 2024: destination and time-period and 2024 onwards: destination, time-period and internationally or domestically recognised tests that assessed foreign language proficiency or the number of foreign language credits attained. The research shows three main areas; first, the 'weak yen' in 2024 led to a drop in a number of students going abroad; second, destination choice (English speaking countries of Australia, Canada, New Zealand, the USA, the UK) as well as South Korea and China remain popular as do some European countries and consequently, the language choice follows suit (English, Korean, Chinese and French); third, students are more likely to go on short-term or medium-term programmes on either of their first two years at university but there is also a greater interest in exchange programmes due to the possibility of gaining greater funding. This consolidates findings in earlier research but there is a need for more longitudinal studies over a three-to-four-year period that investigates not only actual students who went abroad but also those didn't as well also incorporating other influencing factors such as self-perceived language ability, recruitment and employment prospects and familial ties.

Keywords: Japanese university students, international education, study aboard, scholarships

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Introduction

International education (IE) can be said to be seen as important and integral part of tertiary education in Japan on both a national and institutional scale. In 2023, the Government of Japan (GOJ) announced as part of the J-Mirai initiative, one of the main aims was to increase the number of "outbound students" i.e. students who study aboard, to 500,000 by 2033 (Cabinet Secretariat, 2023). This figure was targeted for several reasons which included: to match the levels of students going abroad from countries such as France and Germany. Furthermore, to develop "highly skilled professionals…support regional growth and development" and build "a diverse, inclusive, and sustainable society…boost(ing) Japan's growth and international competitiveness and contributing to world peace and stability" (ibid). In terms of concrete numbers for university students studying abroad, the 2023 target for long-term i.e. earning a degree overseas, was 150,000 and short-term or medium-term programmes was 230,000 with the 120,000 remainder being made up of high-school students. The overall figure of 500,000 represents a doubling of the level of pre-COVID 19 levels. This figure has been called both "ambitious" by some critics (Nash, 2023) and it is debatable whether it is appropriate to base future targets on historical achievements as the post COVID-19 state of IE is markedly different. A full discussion on the efficacy of this target goes beyond the remit of this paper, however, it will be touched upon again in the Conclusion on both the national and institutional level. It is to this institutional level that is paper now turns i.e. a description of the institution in question and the reasoning behind the scholarship system changes.

Main Body

This is the second in a series of papers that looks at to what extent the study aboard preferences of students attending a medium sized private Japanese are affected by a performance or credit determined scholarship system. James (2024) covered the three main areas:

1. The reasoning behind the scholarship change system change not only in terms of the potential benefits itself but also considering the GOJ's plans to double the number of "outbound students"
2. The changes in the number of the students who went on outbound programmes over a 10-year period and the factors that likely affected that
3. The results and consequent analysis of questionnaires to give to two cohorts of first-year students in 2023 and 2024 that described their preferences about studying aboard. Those preferences included:
    a. Destination (country and region)
    b. Languages interested in
    c. Timing (which year or grade to study aboard in)
    d. Length of preferred ideal programme
    e. Kind of programme i.e. exchange programme or shorter term (less than 6 months)

As a continuation from that paper, this report will look at two main areas:

1. The numbers of students who went aboard on the first year (2024) of the new scholarship programme and the factors that may have affected those numbers
2. The results and analysis of questionnaires on study abroad preferences to a cohort of first-year students in 2025. As in James (2024) this set of results will be compared to

the previous year's (2024) set of results with accompanying analysis and interpretation

Institution in Question and Scholarship Systems: Old, New and Reasoning Behind Change

Institution in Question

The data was collected from two cohorts of first year students at a medium sized private university in the west of Japan. The total student enrolment averages between 6,300 and 6,500 students over four-year cohorts with each year group comprising approximately a quarter of the student body in total. At the moment of writing the university has 37 partner universities in 17 countries and regions with Taiwan being considered as a region rather than a country following the GOJ's maintenance of non-governmental, working level relations with Taiwan (Wikipedia, 2024). The study aboard programmes (SAPs) are sub-divided into two main types of "outbound" SAPs: university offered exchange programmes for either 6 or 12 months with 14 countries and programmes called 'seminars' offered at time-lengths: short-term of 2-10 weeks and medium-of term 3-6 months. Exchange and the seminar programmes differ according to the following distinctions:

1. On exchange programmes there is usually one or two places available each academic year with each partner institution
2. Exchange programme participants are required to attain a predetermined officially mandated level of the target language to be able to apply for the process (e.g. TOEFL or IELTS for English or TOPIK for Korean) and in some cases a certain level of GPA from their home institution is also required
3. Once sent aboard exchange programme participants register and take classes in the main language of the host institution but can also choose to study 'regular' subject classes with other students from the host institution
4. Exchange programme participants are not required to pay host institution tuition as they have paid the home institution tuition
5. For most but not all 'seminar' programmes, students do not have to achieve a pre-determined level of the target language, however according to specifications of the host institution a recommended level of ability maybe occasionally required
6. Seminar programme participants classes are mainly language oriented although several seminars run hand in hand with such volunteer work in local primary schools, local parks and or as free tourist guides
7. Also, seminar participants are required to pay two sets of tuition fees both for the home and for the host institution.

From the above points it can be seen that exchange programme participants may have the advantage of being required of only paying tuition once to the home institution, however, being accepted onto the programme is perceived to be much more difficult as the limited number of spaces on each programme makes the rate of competition much higher as does the necessity to achieve the required level of language ability. By comparison, in most cases seminar participants do not have to fulfil a language expectation, yet these students or their family pay two sets of tuition. At the university in question, students who take part in seminar SAPs are required to pay tuition fees to maintain their registered place and ensure their status as a student. As far as students who take part in SAPs of over 3 months or more are concerned, the financial burden can be substantial i.e. an additional ¥500,000 or more per semester and therefore deters students from studying abroad.

Institution in Question and Scholarship Systems: Old, New and Reasoning Behind Change

Prior to 2024 the university under discussion operated a grant type scholarship system for participants in SAPs and had calculated the size of the grant based upon the destination and length of time with fixed weekly, monthly, half-year and yearly amounts. In the light of increased total programme costs particularly in several the core countries to study English i.e. the USA, the UK and New Zealand because of rises to additional medical insurance and/or increased accommodations fees, it was felt that this was a deterrent to students applying for exchange and long-term seminar programs. Additionally, post COVID-19 there was a marked a reluctance to travel or study aboard which appeared to be having a longer-lasting effect than expected. As a result of this, the decision was made to fundamentally remake the scholarship system with the aim to increase the number of students going abroad. However, this decision was made bearing in mind that the long-lasting after-effects of the COVID-19 pandemic were unlikely to cede rapidly and that achieving the levels of pre-pandemic participation rates was unlikely to be reached soon and it was better to perceived as a long-term goal of 4-5 years.

The post 2024 scholarship system was based on a principle in that the higher the level of the individual student's language ability (based on an officially recognised test score or number of foreign language credits earned at university) then the greater the weekly amount of awarded to them. This total programme amount was also determined by geographical area that the programme went to and the length of the programme in weeks.

The two scholarship systems are shown below in Table 1.

Table 1

Old and New Scholarship Systems (all figures are in Japanese yen)

Old ~2023		Exchange programme			6 months		12 months	
					100,000		200,000	
	Seminars	3 months+ All areas 30,000 per month						
		≤ 3 months			Asia 50,000		Aus / NZ / USA / Europe 100,000	
New 2024~		Stage	1	2	3	4	5	6
	All seminars & exchange programs	USA/UK/CAN/ GER/FRA/SPA	10,000	12,000	14,000	16,000	18,000	20,000
		AUS/NZ/CZE/ KOR/VTN/PHI	6,000	8,000	10,000	12,000	14,000	16,000
		MEX/CHI/ TWN	4,000	6,000	8,000	10,000	12,000	14,000
	Seminars	All areas ≤ 3 Months	All 1st years 50,000 (or more if their 'stage' is higher)					

The move away from fixed amounts based on area and length of programme to a system of weekly amounts varying between individual students was seen to potentially work against first-year students as they would not have had as long as older students to increase their level or achieve better scores on internationally recognised language qualifications. Furthermore, they would have comparably fewer foreign language credits due to their shorter time at university. To off-set for this and to simultaneously broaden the appeal and increase the SAP participation rate, a one-time only fixed amount of ¥50,000 was to open all first-year participants in programmes of 3 months or less.

The new system was also based on incentivising students to carry on studying foreign languages post SAP return. The bottom half of Table 1 shows it is technically possible for students to increase their "stage" from 1 to 6 over their time at university and consequently increase the weekly amount that they could be awarded on an SAP. It was hoped that this would not only encourage students to continue studying on their return from their first SAP but might also potentially incentivise them to participate in more than one programme over four years. It was also made feasible for students to take part in the same programme more than once and be awarded a larger amount per week (should their level increase), however, credits attached to the programme would only be recognised by the university once.

It can be seen that the new system represented a profoundly different way of financial support compared to the previous system and as such it was possible to expect that this would have two effects:

1. Increase the number of students taking part in SAPs in general
2. Affect the students' study abroad preferences in terms of destinations, languages, length and type of programme and which year or grade they choose study in

As can be seen form Table 2 below, in the period from 2014 to 2019 here was an average of 2-3.5% of the student body taking part in SAPs. Naturally during the COVID-19 pandemic in 2020 no students were sent abroad. Between 2021-2023, i.e. after the SAP system reopened, the number of student participants in SAPs was at between 0.7-1.5% the total student body. These low figures were a concern for the university in question. Furthermore, as the level of SAP participation fell from 2023, it would seem that the introduction of the new scholarship system had not had its desired effect.

Table 2

Total Number of Participants in Study Aboard Programmes

Academic Year[1]	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total number of students	229	133	205	200	212	199	0	46	97	84	66

The surprising and disappointing drop in SAP participation can largely be attributed to the weak yen especially in relation to the US dollar which forced up the overall costs to studying abroad. This is borne out by examples of other universities. The Asahi Shinbun (2024) highlights the examples of students from Kwansei Gakuin University who either switched the SAP destination from Europe to Asia or gave up on the idea altogether. The Japan Times (2024) cites the experiences of Nagoya University students who "gave up on the idea of gaining overseas experience" in "significant" and "considerable" numbers.

It was noted above that it was not an immediate expectation for SAP numbers to return to pre-COVID-19 levels and a long-term view was taken to the SAP participation slowly returning to around 2-3% of the total student body. However, it was hoped that student preferences would be favourably affected in the coming years. This brings this paper to its second aim, a consideration of the results and analysis of questionnaires on study abroad

[1] The Japanese academic year runs from April to end of March the following year. i.e. Academic year 2025 is from April 1st, 2025 to March 31st, 2026.

preferences to a cohort of first-year students in 2024 and 2025 which will be preceded by a description of the methodology.

Methodology

The data was obtained from two online Google Forms based questionnaires (See Appendix A) in two consecutive years, 2024 and 2025. The questionnaires were given to and answered by to those first-year students who voluntarily attended one of four pre-entry orientation sessions. Access to the questionnaire was given by QR code after each session finished the same room as the explanation session and the students completed and submitted them on their smart phone or tablets. The questionnaire was answered by 99 students in 2024 and 113 students in 2025.

The questionnaires were taken as a part of the pre-entry orientation in the period before classes had started and before any country or programme specific explanation sessions, therefore their answers should only be interpreted as indications rather than definitive choices. As can be seen in Appendix A, information on the students' faculty and department was collected, however, as students' names and student number were not, students' identity was and is unidentifiable. Questions concerning about language choice, destination choice, timing choice and programme type and length, allowed students to make multiple choices. Each of these five parameters will be covered in the discussion below.

Discussion

Language Choice Indication

Table 3 shows below there was no change in the top two (English and Korean) and bottom three (German, Czech and Vietnamese) languages in terms of popularity. This follows expectations as English is the usually the first foreign language that Japanese students encounter in formal education as well as being the language that is still widely used outside of education and the language that most students tend to study to gain the necessary number of credits at university to graduate. Korean is consistently the second most popular language due to the closeness of the South Korea to Japan as well as the wide appeal of Korean culture with young people. The 10-percentage point increase in interest in Spanish can be interpreted as showing that it is increasingly seen as a language option for university students due to the establishment of exchange partners in Spain and Mexico as well as a relatively low-cost short-term programme in Spain. The 16-point increase in interest in China shows that concern about studying in China post COVID-19 is lessening and the geographical proximity and intertwined history of the Japan and China means that students see the latter as a legitimate SAP option. The interest in French did not increase as much as for Spanish or Chinese, however, the relatively high level of interest can be attributed to the establishment of an exchange programme and short-term study programme in 2023. The doubling of the figures for both German and Czech can be seen as part of an overall interest in studying multiple languages especially those in Europe. The drop in interest in Vietnamese can be seen to be disappointing however it must be noted that it is not offered as a foreign language to study at the university in question. Given that there are multiple countries that languages e.g. English and Chinese, can be studied in, the discussion will move to preferences for countries and regions.

Table 3
Language Choice Indication

Language	English	Korean	French	Chinese	Spanish	German	Czech	Vietnamese
2024	95	34	26	14	21	10	2	1
2025	102	55	29	30	31	20	4	0

Country/Region Choice Indication

The figures displayed below in Table 4a, 4b and 4c show three trends:

1. 4a. Countries which can be typified as traditional places to study aboard remain popular with students. The 19-point increase in the UK may be attributed to establishment of a new reputable university partner in London. However, these results must be qualified that these students are first years and that their interests are likely to be in keeping with more traditional destinations and that at this point they are unaware of the high cost of the programmes in these countries.
2. 4b. South Korea and China remained the two most popular countries in both cohorts although the doubling of interest in Taiwan may be attributed to the fact that it is seen as a viable alternative to China. The small drop in interest in the Philippines is hard to quantify as significant or not and might go against the trend on increasing interest in Asian countries (British Council, 2024) although any one single figure needs to be seen against a longitudinal backdrop. There appears to be a steady interest in Mexico which can be attributed to the sister partnership between a state in Mexico and a prefecture in Japan, visits by various organisations to the university in question from the same Mexican state as well as the acceptance of the first inbound exchange student from Mexico.
3. 4c. Interest in all four European countries grew from 2024 to 2025 which shows a widening of preferences outside of the traditional English and Asian areas. The establishment of partners in France and Spain may have helped pique interest in short-term and exchange programmes. Also, while the USA and other core English speaking countries remain popular (see Table 4a.) the relatively high level of English needed for exchange programmes can be inhibitive, thus, Germany and the Czech Republic become attractive as viable options due their comparatively low level of required English.

Despite the overall increase in interest across all languages and most destinations, it cannot be said that the change to the scholarship system had marked influence on the students' preferences. Contrastingly, as the following discussion will highlight, timing, programme type and length of programme preferences might have been affected by the changes to the financial support system.

Table 4a
Country/Region Choice Indication: Asia & Mexico

Country	USA	Australia	Canada	UK	New Zealand
2024	116	45	40	26	27
2025	105	47	41	45	29

Table 4b
Country/Region Choice Indication: English L1 Countries

Country / Region	South Korea	China	Taiwan	Philippines	Mexico
2024	22	6	5	4	2
2025	42	11	10	3	3

Table 4c
Country/Region Choice Indication: Europe

Country	France	Spain	Germany	Czech Republic
2024	14	13	9	4
2025	31	22	19	9

Timing Indication (1st ~ 4th Choice)

Table 5 below, shows three patterns which will be described in turn. First, there is a 9-point increase in students who showed interest in taking part in an SAP in their first year. This can be attributed to the fixed amount payment offered to all first years who take part on SAPs of less than 3 month and an increased awareness of that. Second, the second year in still the most popular time that students consider participating in an SAP although this was 5 points less than 2024 which also might be attributed to increased interest in the fixed payment for first year students. The 10-percentage point drop in going in the third year might be an indication of students' preference for finding a job as early as possible however, this seems to be in contradiction to the increase in students who would consider studying abroad in their fourth year. When seen as a total over the third and fourth years, there was 5-point drop from 2024 (n46) to 2025 (n41) which seems to be in indicate that students are looking to take part in SAP earlier than before so that there is little conflict with looking for a job and employment prospects. Third, there is a marked rise of 8-points between 2024 and 2025 in the students who chose 'I don't know'. This can possible be seen as a part of general increase in options that students consider or as first years, they are still relatively undecided as to when is the most suitable time for them to take a part in an SAP. This can also be seen by their choices in the programme types and programmes length.

Table 5
Timing Indication (1st ~ 4th Choice)

Timing 'Year'	1st	2nd	3rd	4th	I don't know
2024	40	77	43	3	3
2025	49	72	33	8	11

Programme Type

Table 6 shows that there is an increase in all options from 2024 to 2025. As with the previous parameter this could be interpreted as showing that students are more likely to show an interest in both exchange programmes and shorter SAPs. As the student group under investigation are first years then the increase in seminar programmes might be attributed to the one-off payment as well as the possibility of being to increase the amount of the scholarship over time and as result of increasing their level i.e. they are incentivised to improve. This latter reason could also be attributed to the increase in the number of students

interested in exchange programmes. As noted in the introduction, participation in exchange programmes necessitates achieving a pre-required level of language ability. If the nature of the scholarship programme is that the higher the level that the students achieve, the greater the amount of scholarship can be attained, then students are more likely to consider an exchange programme even with high participation barriers. With the current system being clearly delineated in terms of what level earns what amount and what level indicates which programme can be applied for then students have a clear target to aim for. Additionally, as exchange programme participants only have to pay one set of tuition then an increased number of students might have considered exchange programmes as possible options. As highlighted above, it should be noted that exchange programme participation necessitates achieving a pre-determined level or score on an internationally ratified language test and therefore could be beyond some students' language ability who as result select shorter SAPs which mostly do not have a pre-required minimum level of language ability. It is to these seminars that the discussion now turns.

Table 6
Programme Type

Type	Seminar	Exchange	I don't know
2024	74	46	11
2025	80	52	15

Programme Length

Table 7 shows that there appears to be an overall increase in interest in types of programmes according to length. Also, there seems to a pattern of the shorter the programme, the more people are likely to consider it as an option for a SAP. This could be reasoned to be based upon: first, the one-off payment offered to all first years and second the longer the programme, the more expensive it becomes not only for the programme itself but also for other costs as well e.g. the host institution tuition which also must be paid for the student to maintain their registered place at the university. Post COVID-19 SAP costs have increased especially due to rises in tuition and accommodation costs and naturally the longer the programme, the greater the burden of these becomes. Additionally, SAPs over six months would incur two sets of host tuition payment which is approximately ¥1,000,000. Combined with a similar or even greater amount for the SAP itself, students will tend to select short- and medium-term seminar programmes and exchange programmes which can both optimise the scholarship amount and lessen the burden of the costs in general.

Table 7
Programme Length

Length	Short (2 weeks~ 3 months)	Medium (3~6 months)	Long (6 months+)	I don't know
2024	55	51	33	5
2025	66	56	35	11

From the results of the questionnaires and the consequent discussion above it appears there were some were some changes in students' preferences and that those differences can be partly attributed to the scholarship system introduced in 2024. Importantly, it should be noted that the change to the system itself was not only the "financial" factor that affected the SAP patters. In 2024, the weakness of the yen seemed to have deterred many students from

studying abroad and hence the total number of students went down from 84 in 2023 to 66 in 2024. This has forced has other universities to consider "IE" to longer just mean "International Education" but also "Intercultural Education" and to increase the opportunities for classes that that have both international and domestic students (Yamamoto Rosenbaum & Iwaki, 2025).

In terms of potential future participants, it would seem that some parameters are likely to be more affected by the nature of the scholarship system than others. Destination choices do not seem to be overly affected and that the core English countries as well as South Korea and China remain popular with some growing interest in European countries. Similar patterns can be found language choices in the continued popularity of English, Korean, Chinese but with European languages, especially French, growing in its appeal. There was some noticeable growth in interest in short-term and medium-term programmes and exchange programmes which can be arguably attributed to increased funding for first year students and the potential for increased scholarship amounts for exchange programmes. Yet, as James (2024) pointed "the data is limited in that it only focusses on the preferences of first year students from one university and at the very start of their time at university". In order to better determine the degree to which changes to the scholarship system continues to have a similar effect over time then prolonged and widened investigation is required. This should incorporate:

1. an analysis of the number of students on SAPs from 2025~2027
2. post-return interviews and questionnaires for students who went abroad and those who did not to determine what, if anything, deterred them
3. carrying out the same questionnaires for first year cohorts in 2026 and 2027

While this paper has focussed on the financial influences on the decision to go study abroad or not, critics have highlighted other factors shown that Japanese students' decisions to participate in SAPs. Porter and Porter (2020) argued that other factors such as low confidence in lingual abilities, a desire and feeling of responsibility to take part in university sport or club activities, the comparatively inflexible nature of the recruitment system where periods studying abroad might be deleterious to finding job and finally, a reticence to spend prolonged time away from their family. Any further research and investigation should also consider these parameters when discussing the decision to study abroad.

Conclusion

This paper has consolidated the findings of the first paper in this series in that when considering the decision to study abroad or not some parameters are more greatly influenced by the scholarship system. Destination choice and language studied are unlikely to be influenced whereas timing, programme type and length of programme are. Despite the shortcomings of the data and its analysis i.e. one university, the findings remain relevant as indications of potential future study abroad patterns. A wider and more holistic approach to consider other factors such as language ability, recruitment anxieties, university club and familial concerns should also be incorporated to gain a more a more comprehensive and accurate appraisal of the students' decision to study abroad.

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Appendix

Appendix A

Questionnaire 2024 and 2025

1. Student Number
2. Cohort (Year)
3. Faculty / Department
4. Gender
5. Which languages are you interested in? (Choose up to 5)
6. Which countries/areas are you interested in going to? (Choose up to 9)
7. When do you want to study abroad? (1st/2nd/3rd/4th Year) (Choose up to 4)
8. For how long do you want to go for? (Choose up to 3)
9. What kind of programme are you interested in-seminar or exchange or I don't know? (Choose up to 3)
10. Please share your impressions of the explanation session today

From Text to Structure: Towards an Intelligent Framework for Evaluating Course Syllabus Completeness Leveraging NLP-Based Approach

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Abstract

A syllabus is a roadmap for instructors and students to successfully navigate and complete a course. A well-developed intelligent system for checking syllabus coherence and completeness can significantly enhance curriculum design and overall educational quality. Numerous educational research emphasize that a proper syllabus should contain several key components, including instructor contacts, course information, course description, course objectives, course outline or schedule, course requirements, alignment with program outcomes, course evaluation methods, prerequisites, required materials, grading scale, institutional policies, and additional course materials. However, despite the importance of these elements, many syllabi in practice suffer from inconsistencies, incompleteness, or a lack of alignment with institutional and accreditation standards. These shortcomings can diminish the overall quality of education and lead to disengagement among students. Based on our literature review and to the best of our knowledge, there is currently no standardized automated tool available to evaluate whether a specific course syllabus meets these essential criteria. In this study, we propose a Natural Language Processing (NLP) technique that extracts and interprets the textual content of a course syllabus, identifies key components, and compares them against standardized syllabus templates. The system calculates a completeness score for the syllabus and highlights components that are either incomplete or missing. The system is currently in development and has shown initial success in detecting structural components within sample syllabi. The goal is to establish an automated, intelligent tool that benefits educators and academic institutions by supporting optimized curriculum structuring that aligns with educational standards and learning objectives.

Keywords: course syllabus, completeness, accessibility, natural language processing, sentence embeddings, and document analysis

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Introduction

Academic instruction begins with a course syllabus that specifies learning goals, along with assessment techniques and policy requirements, as well as student expectations. When properly structured, the syllabus serves as a student's curriculum guide and remains compliant with accreditation requirements and educational standards. The strong importance of syllabi is often neglected due to poor completion standards, which also leads to misalignment with academic goals and results in weaker educational effectiveness and student engagement. Assessment of a course syllabus is required in order to have a successful outcome. It implies checking if the course syllabus fulfills all the requirements. Course syllabi are unstructured, diverse in format, and often written in natural language. Manually evaluating their completeness, coherence, and alignment with academic standards is time-consuming and error-prone. The increasing variety of academic programs and student mobility, and the emphasis on outcomes-based education, have compounded the importance of syllabus standardization and transparency. Colleges are compelled to indicate alignment of the content of their courses to program objectives. Students also need more transparency and organization in order to better manage their study tracks. Here, automation represents an efficient and data-based approach to ensuring syllabi are always of a high standard. In addition to that, the push towards digital transformation in education has brought about the need for organized education content. Syllabi, which are usually kept in disjointed forms (PDFs, Word documents, LMS text boxes), are an unrealized source of institutional information. Automation of syllabus data extraction and structuration helps facilitate better curriculum mapping, accreditation reporting, and customized learning.

This work proposes a structured, intelligent framework that evaluates course syllabi based on their content completeness and accessibility. The system leverages Natural Language Processing (NLP) techniques to transition from unstructured syllabus documents to structured evaluations, providing actionable feedback for faculty and administrators. The primary objectives of this research are:

- Evaluating academic syllabi against institutional content and accessibility standards.
- Assessing the presence and completeness of essential syllabus components.
- Identifying common accessibility issues based on best practices for digital document design.

The rest of the paper is designed as follows: description of key components in standardized syllabi, related study in the arena of employing NLP in the evaluation process of academic curriculum, the methodology of our proposed syllabus evaluation approach, results, discussion, and conclusion.

Key Components in Standardized Syllabi

Accreditation bodies and educational guidelines suggest a standardized set of syllabus components, including instructor information, course descriptions, objectives, learning outcomes, evaluation methods, course schedules, prerequisites, and institutional policies. Researchers in various educational fields show consensus in having this particular component in a syllabus in order to make it complete (Collier & Beel, 2018; Rashtian et al., 2020; Wagner et al., 2023; Wotring et al., 2021). A brief description of these components is given below.

Instructor Contact Information: This section includes the instructor's name, email address, office hours, and phone number. It is critical for establishing communication between students and faculty, helping foster a supportive learning environment.

Course Information: A standard syllabus should contain details about the course name and code and semester, and year, along with meeting time. Fundamental course information allows students to understand crucial aspects of their coursework.

Course Overview: The learning program details all important subject matter discussed throughout the curriculum extensively. Students can understand the course material better to assess if it aligns with their academic goals.

Course Objectives: The coursework should outline the achievements of students using the curriculum experience. One of the main advantages of well-stated learning objectives is the possibility of relating the assessment strategies to the learning needs of students.

Course Schedule or Outline: A week-by-week topic outline, reading lists, and due dates of assignments and examinations must also be provided. Having a proper outline will assist students in developing efficient time management systems.

Course Requirements: The document provides not only the requirements in terms of attendance but also the general code of conduct on the part of the students, along with the specifications of various assignments, presentations, tests, and projects. Clarity of requirements definition will enhance understanding of what is expected, besides treating students fairly.

Alignment to Program Outcomes: The course will be linked to its allied programming outcomes through this section, which indicates the course's relevance in attaining broader program objectives. The process also makes it possible to ascertain whether the whole curriculum is meeting and complying with the university standards and the requirements of accreditation, and would make the curriculum easy to trace.

Course Assessment Techniques: Records how the performance of the students will be evaluated. It can include the grading of assignments, assessments, and participation, as well as other marked activities to enhance transparency.

Prerequisites: Describes requirements on prior knowledge or classes that have to be passed to be enrolled. It gives the student a background of the essentials needed to carry out the course.

Required Materials: The course uses a list of required textbooks, articles, and software, among other learning materials, which the students are required to get for the course. The listed course materials ensure that learners possess the required tools to communicate instructions.

Grading Scale: A standard Syllabus should contain the grading system that determines the correspondence between percentage grades and the letter grades in order to determine the academic progress made, as well as the grades that will be attained.

Institutional Guidelines: Transmits academic honesty standards, disability accommodations, attendance policy, and other information required by the university.

Additional Course Materials: These are extra reading, tools, etc. that support students' learning experience and diverse learning approaches.

According to Rashtian et al. (2020), the absence or inconsistency of these components often compromises educational coherence. Automating the identification and verification of these elements is, therefore, a logical step in optimizing curriculum design.

Related Works

Previous assessment systems employed hard-coded templates as well as keyword checks to verify key syllabus elements through their rule-based system (Delialioglu & Yildirim, 2008). Although these systems provided deterministic responses and were comparatively simple to implement, these systems were not flexible to various formats and vocabularies and hence proved to be domain-dependent. Progressing to the next level, ontology-based systems brought structured semantic representations that facilitated mapping of course elements to defined curricular ontologies (Sabri, 2016). Ontologies facilitated interoperability, alignment to accreditation standards, and machine reasoning about the content of the courses. Despite the above developments, the construction and maintenance of domain-specific ontologies are still labor-intensive and need expertise. Knowledge graph-based models have also recently been suggested to model syllabi as nodes connected through semantic relationships. Dietze et al. (2012) showed how linked educational data and semantic graphs can connect syllabus items with broader learning resources. Such models support querying, personalization, and integration with institutional data systems—but demand rigorous preprocessing and a shared semantic backbone across departments. Institutes must perform substantial data standardization and preprocessing before they can use these systems, but few institutions maintain this capacity.

Natural Language Processing (NLP) stands today as a central element for syllabus automation initiatives. Free-text documents (Fiallos, 2018) can yield key syllabus components by employing NLP techniques that include Named Entity Recognition (NER) and topic modeling, as well as dependency parsing and transformer models (e.g., BERT, GPT). Numerous recent studies and pilot systems have explored the use of NLP for automated analysis and evaluation of educational and curriculum documents, including course syllabi. Rashtian et al. (2020) provide an overview of CRAgent, a tool built to demonstrate the possibilities of using NLP to assist in automated curriculum analysis. The computer program CRAgent allows one to quickly search and map course and program text against stated learning objectives, and more systematically and with greater specificity and scope than a manual review. The paper shows that NLP-driven instruments can help automatically identify and confirm or deny the existence of major syllabus items and the alignment with program results. Various articles have put forward the automatic mechanisms of NLP and Optical Character Recognition (OCR) in the process of grading written educational texts, e.g., answer scripts and essays. These systems apply techniques like tokenization, text similarity metrics (cosine similarity, Jaccard, and semantic matching), and machine learning (including neural models such as LSTMs) to automate evaluation and scoring tasks, demonstrating effectiveness in reducing the manual burden of assessment (Deepak et al., 2024). The adoption of structured rubrics and alignment to answer keys or official frameworks—paralleling syllabus analysis—has enabled high levels of automation,

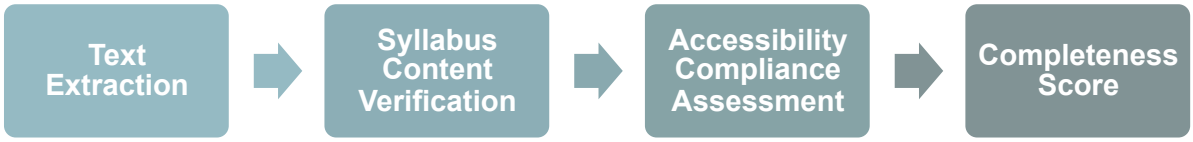
improving both speed and consistency (Gao et al., 2024). Lang et al. (2018) introduced an automatic framework that extracts learning goals and objectives based on their syllabus and uses a hybrid data mining technique that involves the utilization of Latent Dirichlet Allocation (LDA) and neural networks. Based on their system, they were able to process 70 syllabi to identify topic clusters of the syllabi and associate them with Bloom's taxonomy through topic modeling. A neural net was subsequently trained to project the discovered textual patterns to learning objective frameworks and provides a scalable way to create structured learning outcomes out of unstructured text. Parhizkar et al. (2010) presented a novel online course feedback mechanism possessing NLP and text mining capabilities that parse open-ended answers given by students. Although focused on post-course feedback rather than syllabus design, the system illustrates the potential of NLP in structuring educational feedback and documents.

The studies increase the existing body of knowledge, in that they show how NLP and AI methods can extract structured meaning from an unstructured text in education, be it to identify the learning objectives or carry out synthesis evaluation. Our proposed approach builds upon these foundations by combining component verification and accessibility analysis into a unified framework for syllabus evaluation.

Methodology

The proposed framework follows a structured pipeline that converts course syllabus documents into a standardized, machine-interpretable representation and conducts completeness assessment and accessibility compliance checking in an automated fashion. Figure 1 conceptually depicts the workflow, which is divided into four main stages: (1) text extraction and preprocessing, (2) content verification, (3) accessibility compliance assessment, and (4) scoring and report generation.

Figure 1
Workflow of the Syllabus Evaluation System



Text Extraction: Our initial dataset consisted of 36 syllabi from courses in the Information Science (IST) and Computer Science (CS) categories. One of the main input forms we chose is the .docx file format since it is common in schools, colleges, and universities, allows structural metadata to be embedded (such as headings, table components), and is simpler to process compared to PDFs or scanned documents. The syllabi were analyzed with the Python-docx library. Under this methodology, we extract:

- Paragraph Text: Course instructional data, policies, and descriptions.
- Table Content: Table structures are maintained and are often utilized in course schedules and grading distributions.
- Document Metadata: These would consist of heading styles, list markers, as well as inline formatting indicators, which are helpful in accessibility testing.

Verification of Syllabus Content: We developed a required component checklist. To detect the components that we have discussed in the previous sections of this paper, we implemented two detection approaches:

Baseline (Keyword Search): Each component was associated with a set of keywords (e.g., "objectives", "outcomes", "goals" for learning outcomes). A syllabus was marked as containing the component if any keyword was present.

Proposed (Semantic Embedding Matching): Using the all-MiniLM-L6-v2 sentence transformer, each sentence in the syllabus was embedded into a 384-dimensional vector space. Canonical descriptions of every mandatory component were also embedded. Cosine similarity was calculated between syllabus sentences and component vectors to define the presence of a component. Therefore, the detection was possible even in cases when the non-standard phrasing was used.

Accessibility Compliance Assessment: Along with the completeness of the content, we approach the question of accessibility, analyzing compliance with the accessibility requirements, paying attention to the 3 most important aspects:

1. Heading Structure: Confirms that headings are used with the semantic styles of the document and not the visual styles only. This is vital for screen reader navigation.
2. Alternative Text for Images: Checks to ensure that every embedded image has an alternative (alt) text attribute.
3. Table Header Tags: Checks that tables contain marked out header rows, without which users who use assistive technology will not be able to read the table.

These checks were applied directly on the document object model (DOM) parsed from .docx files, and we correctly identified formatting capabilities without using heuristic-based inspection of the text.

Scoring Completeness: We designed a two-tier scoring system:

- Component Score: The required syllabus items will each offer up to 1.0 points as long as they are present. The total number of components is used to bring the score to a standard level. The score is normalized by the total number of components.
- Accessibility Score: A maximum of 1.0 point is awarded for accessibility compliance, depending on accessibility compliance and fractional deductions given to each violation.

The Final Completeness Score is an explainable metric (0–100%) that can be compared across syllabi, which is computed as:

$$\textit{Final Completeness Score} = (\textit{Component Score} + \textit{Accessibility Score}) / 2 \times 100\% \quad (1)$$

The system produces three outputs for each syllabus:

- A dictionary-style report that lists the status of each required component (Present/Missing) as shown in Figure 2.
- A detailed list of accessibility violations and compliance checks, an example is shown in Figure 3.
- The Final Completeness Score.

Figure 2
Syllabus Evaluation System Output (List of Missing/Present Components)

Standard Syllabus Template

	Component	Status
0	Course Information	Present
1	Instructor Info	Present
2	Course Description	Present
3	Learning Objectives	Missing
4	Course Outline	Present
5	Course Requirements	Present
6	Textbooks	Missing
7	Grading Policy	Present
8	Attendance Policy	Missing
9	Academic Integrity	Missing

Figure 3
Syllabus Evaluation System Output (Accessibility Issues)

```
Accessibility Issues:

Course Schedule Table Not Detected.
Heading Styles Found.
No Poor Link Text Found.
Images Found.
Image 1:Has alt text | Text: Illustration of a machine learning concept graph
```

This multi-layer output design ensures that results can be used both for quantitative benchmarking and qualitative improvement.

Evaluation

We tested using a set of original course syllabi to assess the system to determine the accuracy of our proposed framework. The section presents the description of the dataset, the experimental design, performance measures, and the gained results.

Dataset: The evaluation dataset comprised 36 course syllabi, including courses from the Information Science (IST) and Computer Science (CS) subjects. The syllabi had all been converted into a .docx format so they were fully compatible with our text extraction and accessibility checking modules. The collected syllabi contain specific characteristics such as:

- Style of writing: from formal policy-oriented language to informal instructor-prepared notes.
- Structural organization: certain syllabi walked through templates established by an institution, whereas some were free form.

- Terminology: alternative wording of a similar element (e.g., learning goals vs. course outcomes).

Such differences offered a pragmatic testing platform to measure the strength of both the keyword as well as the semantic methods.

Experimental Setup: We compared two content verification methods:

1. Keyword Search (Baseline): A rule-based system where a list of keywords is maintained per component.
2. Sentence Embedding Matching (Proposed): We utilized the all-MiniLM-L6-v2 transformer to calculate semantic similarity between syllabus sentences and reference component descriptions.

We manually highlighted the availability or absence of the mandatory items in each of the syllabuses. The ground truth basis of such evaluation was provided through these annotations. All syllabi were subjected to accessibility checks, and the data were used to form the accessibility value in the final metric of evaluation.

Performance Metrics: We applied the metrics below to test the performance of the system with the ground truth:

- Precision – The proportion of detected components that were correct.
- Recall – The proportion of actual components correctly detected.
- F1 Score – The precision and recall in combined through a harmonic mean.
- RMSE (Root Mean Square Error) – This is to quantify the difference between the scores assigned by the system and the actual score.

Table 1

Comparative Performance of Baseline and Proposed Approaches

Detection Method	Precision	Recall	F1 Score
Keyword Search (Baseline)	0.22	0.20	**0.21**
Sentence Embedding (Proposed)	0.50	0.45	**0.47**

Result: Table 1 shows the performance of the keyword searching model and the NLP-based embedding approach. Semantic embedding method performed better in all the metrics when compared to the keyword search method, with the greatest part being achieved on the recall performance measure, i.e., the method is more robust toward the changes in phrase. Regarding the completeness score prediction, RMSE 1.74 implies a moderate difference between the human scoring and the model.

The comparison shows that the proposed NLP-based semantic matching method is significantly more useful than the keyword search in the detection of components of a syllabus.

Discussion

Evaluation results reaffirm that the semantic embedding technique produces a significant improvement of the traditional keyword-based method when it comes to synthesis-based detection of syllabus completeness. The F1 score is higher when using semantic matching (0.47) as compared to keyword search (0.21), which reflects the usefulness of the contextual understanding aspect of natural language processing. It is especially significant to the

academic environment, as course documents can be immensely different in their languages, manners, and shapes even when describing similar components.

The fact that the embedding model obtained a higher recall rate proves that it can recognize the elements of the syllabus presented in non-standard or subject-specific language. An example is the successful mapping of the embedded approach of associating the skills to be acquired and the learning outcomes component, but which failed in the keyword-based system. Such flexibility is needed to scale the framework to a wide variety of disciplines without exhaustive lists of keywords. An RSME of 1.74 about the completeness scoring indicates that, though the system is, overall, in agreement with human raters, there are some edge cases that the system is unable to work out. These consist of syllabi that partially cover a component but in an unusual format, so that the detection is less precise. The accessibility results also point to a notable gap: even well-designed syllabi commonly do not meet the bare minimum of satisfying digital accessibility requirements.

- More than half of the syllabi did not contain an adequate heading style, which restricts their usage by students who use screen readers.
- Almost 50 percent of them failed to provide alternative text to images, which puts learners with visual impairment at a disadvantage.
- Violation in the table header is less common, but it still applies to almost one-third of the sampled syllabi.

Figure 4

A List of the Syllabus Evaluation System's Output for Selected Syllabi

Filename	Completeness Score	Missing Elements	Accessibility Issues
CGDD422_SL.docx	89.60%	Textbooks	Images Missing Alt Text, Tables Without Headers
CGDD303 Advanced Game Networking.docx	91.70%	Textbooks	None
CGDD271Syllabus.docx	100.00%	None	Tables Without Headers
CGDD214_SL.docx	89.60%	Textbooks	Images Missing Alt Text, Tables Without Headers
CGDD213 Roleplay Realms.docx	91.70%	Textbooks	None
CGDD212_Deal, Dice, and Strategy.docx	91.70%	Textbooks	None
CGDD203 Intro to Networking.docx	91.70%	Textbooks	None
CGDD109jg_SL.docx	89.60%	Textbooks	Images Missing Alt Text, Tables Without Headers
CGDD101jg_SL_v2.docx	89.60%	Textbooks	Images Missing Alt Text, Tables Without Headers
AMUS_383-Syllabus[59].docx	97.90%	None	No Heading Styles, Tables Without Headers
AMUS201_Syllabus.docx	97.90%	None	No Heading Styles, Tables Without Headers
AMUS_382_Syllabus[82].docx	97.90%	None	No Heading Styles, Tables Without Headers
AMUS_381_Syllabus[5].docx	97.90%	None	No Heading Styles, Tables Without Headers
AMUS_337_Syllabus.docx	97.90%	None	No Heading Styles, Tables Without Headers
CGDD100 LevelUp Intro.docx	97.90%	None	No Heading Styles

These certainly provide an outline of how accessibility assessment must be integrated into any syllabus assessment scheme. Although outcomes are encouraging, a number of limitations should be noted in the current version of the proposed system:

1. Disciplinary Scope: The review focused on IST and CS syllabi. Fields that employ more narrowly focused terminology (ex., humanities, fine arts) may need extra adjustment of the system.
2. Format Limitations: The existing implementation accepts only .docx formats of files. The widespread use of PDFs in academic distribution poses problems in the verification of accessibility issues.
3. Fine-tuned Model: The all-MiniLM-L6-v2 embedding is a general-purpose model, which makes it effective. Corpus-level fine-tuning can be used to improve precision and recall on a corpus of syllabus documents.

Despite those limitations, it is evident that the proposed tool can reduce the time to review curriculum committees, assist instructors in adhering to requirements challenged by institutions.

Conclusion

The objective of this work is to propose a framework that uses state-of-the-art NLP methods to automatically determine the quality of completeness and the accessibility of course syllabi. Transforming free-form text into structured evaluations, the system helps identify missing elements and the existing accessibility gaps. Experiments with actual syllabi revealed that the model observes course elements more than a course content keyword search and provides conclusive, demonstrative feedback to educators and administrators. It is also scalable so that institutions can apply it to a large variety of courses without any extensive manual review. The current version has been tested with Syllabi in limited disciplines; however, expanding the database, checking the format support, and utilizing fine-tuned language models have the potential to improve the accuracy. The framework can develop into an effective instrument for enhancing the quality of the syllabus and inclusive practice with these additions.

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

The writers state that the manuscript's language was proofread and improved using AI-assisted writing tools, including Grammarly and QuillBot. The use was restricted to fixing spelling and grammar mistakes and rewording sentences to make them more precise and understandable. The author additionally states that no other AI or AI-assisted technologies were employed to generate material for the paper, except for Grammarly and QuillBot. The original writings of the methodology, findings, analyses, and discussion are the result of meticulous and methodical investigation.

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Enhancing History of Architecture Education in India: Redefining the Curriculum for Competency Development Using Curation as a Teaching Method

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Abstract

The educational curriculum in Indian higher secondary and post-secondary institutions fails to identify and foster competencies in students, based on the constructivist and cognitivist frameworks. While teaching the subject of history or history of architecture, the focus is on transmission of knowledge rooted in traditional instructional methods like rote learning. Previous research shows that, while formulating the curriculum, the main gap is in developing innovative instructional techniques that integrate global and local narratives in teaching history. The syllabus for teaching history often emphasises the evolutionary narrative which revolves around landmark events like nationalism. The scene for teaching the history of architecture is no different than the above mentioned, where the teacher is the medium through which the subject is taught in a sterile environment. Contemporary history education demands a broader perspective from the pupil and the teacher so that historical events are understood both from its centre and periphery agencies of knowledge generation. The revised National Education Policy by the Government of India highlights the need for innovative and multidisciplinary approaches in the development of teaching methods. With the help of case studies, this paper examines how the method of curation can be an effective teaching method that integrates local and global narratives which will help the students to develop curricular competencies like historical reasoning, critical reasoning, spatial literacy and analytical thinking.

Keywords: history of architecture, constructivist and cognitive framework, curation, global to local narratives, meaning making

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Introduction

According to constructivist paradigm, the meaning of an idea or reality is multiple and subjective. Education is a system, where this process of meaning making happens within a prescribed framework. A major challenge in this system is that the rules governing this system restrict the learners to develop multiple meanings. Teachers and their instructional methods focus on maintaining the stability of the system, rather than creating a space for learners to construct their own meanings, exercise their cognitive abilities and develop competencies to address the world around them. In the landscape of India's educational system, History or history of architecture is one such subject which has always been facing this challenge. There is a lack of adequate research on what competencies need to develop when history is taught and consequently, a dearth of innovative teaching methods.

In the article, Architecture Education in India, an overview (Mehta, 2006), Mehta opines that Architecture Education in India has always been perceived as an extension of the profession and hence History and other Art subjects fail to appear in prominent roles during the period of education. They remain at the level of content delivery but struggles to gain momentum during the practice of architecture education. Therefore, critically studying historical materials was not an objective. This paper aims to address this gap by identifying the competencies that need to be developed when the subject of history is taught and propose curation as a teaching method to achieve this.

Meaning of Curation in the Context of Education

The word curation originated in the field of Museum Studies, where the role of the curator is a keeper of art and who mediates the artist and the public. By the 1970s the meaning of curation changed from a process of selecting works of art and mediation to a meaning-making process when the curator creates his own artistic expression (Rubantseva & Hoffmann, 2020). This meaning making is the narrative of the curator and plays an important role in engaging the viewers emotionally and imaginatively. In the context of mythological studies, Levi-Strauss (1966) introduced the concept of "bricolage" where one, combines "heterogenous resources" to create new meanings. It is based on the concept of bricolage, that we redefine the meaning of curation in this research. In an educational context, curation can be defined as the curation of meanings, where the educator facilitates a new learning experience by carefully selecting the resources, combining ideas and helping the learner practice meaning making.

Methodology

The first part of the study analyses selected syllabuses from the different universities in India, to find gaps in competency building. Second part of the study uses a qualitative case-study based method which will be analysed using a framework approach. The framework is constructed based on the curatorial theories and competency based pedagogical frameworks (OECD, Unesco 2030). Six dimensions have been identified and the corresponding competency development for each of these dimensions form the framework. The selected case studies will be coded based on these dimensions and the relevant competencies which are developed will be identified. Data will be collected using interviews and ethnographic methods to document the teaching strategies that were used to curate learning experiences. This includes lesson plans, participation and artifacts of student engagement. Based on this

data, the curatorial dimension and practices that were used for each cases study will be identified.

Concept of Competency and Competency Development in the Field of Education and Learning

Since the revival of competency development learning from the early 2000s, numerous competency development frameworks have been formulated by various organizations across the world. UNESCO's competency frameworks, OECD's transformative frameworks, European Union's Life Comp Framework, 21st century skills are few of the largely known frameworks for successful life and well-functioning of society. In the context of architecture, NAAB (National Architectural Accrediting Board) has established student performance criteria that helps educators and policy makers shape architecture programs that must prepare professionally trained architects. Additionally, educational bodies have also attempted competency-based curriculum development and assessment of learners. A hiatus in the development of curriculum by educational organizations is lack of understanding of the concept of competence.

At a broader level, competency is the ability to do something effectively and efficiently. It is a combination of knowledge, skills, abilities and behaviours (UN Competency based Interviewing Guide). A working definition of competency is "context-specific cognitive dispositions that are acquired by learning and needed to successfully cope with certain situations or tasks in specific domains" (Weinert, 2001, as cited in Klieme et al., 2008, p. 9). The aspect of context-specificity of competency is elaborated by Koeppen et al. (2008), where they argue that the question "competent for doing what is essential to any competence definition" (p. 7). This brings us to the question, what should be the competencies of a student of history who is training to be a creator of design solutions for real-life problems.

At this point it is imperative to understand the differences between key competencies, meta competencies, discipline-based competencies and cross- disciplinary competencies. Largely known frameworks of competencies such as the ones listed above, address the holistic performance of a human being. It is not adequate to shape the competency development of a learning setting. It is observed that curriculum developers lack this understanding of the concept of competency and refer to just cognitive skills while formulating curriculums. Competencies provide a framework based on performance outcomes that determine the development of a curriculum (Kim, 2015). For example, enabling critical thinking alone won't make a learner competent to be a good knowledge creator. It requires the identification of a group of other cognitive skills which together should be presented as meta-competency, discipline-based competency or cross -disciplinary competency that needs to be fostered.

Competency Development in History Education Curriculum

A student of history is not just a student of history alone. The present educational landscape does not restrict learners to be a part of a particular discipline or system. In the case of the discipline of architecture, the student of history can become an architectural journalist, a photographer or a knowledge creator. It brings us to the question what competencies need to be developed by learning history, to train the learner to perform in versatile professional settings in their future. Moreover, defining the competency developed as part of a history course is at times difficult to be projected with lucidity. This often is a result of history being traditionally taught as a description of a landmark event and narratives in the classroom stay

within the realm of knowledge. Understanding the true purpose of learning history and addressing the existing gaps can largely help us identify competencies that need to be cultivated.

Purpose of Learning History

To identify what competencies, need to be fostered in a student of history, this research will now look at the different perspectives of the purpose of learning history. Dan Nutall in his paper "What is the purpose of studying history?" has presented various arguments and perspectives of the purpose of learning history based on the survey of his sixth form students in north-west England. The first purpose is to create *historical literacy* or in simple terms, "to pass on the knowledge of the past" (Nuttall, 2021, p. 91). Pedagogy of historical literacy should help students understand that the past has relevance for the present. It should provide students with a usable historical past, one that is applicable to their own lives today (Downey & Long, 2016, p. 12). He also argues that it leads to the creation of *cultural literacy* which is a tool for *identity building*.

Secondly, learning history develops "identification with the common good" (Nuttall, 2021) and thereby develop the competency of *participation and citizenship* within a democratic society. Thirdly, he points out how learning history can cultivate reasoning, which allows them to question commonly accepted truths and not fall into the trap of confirming their own biases. Most of the historical courses and specifically, history of Architecture focuses on mastery of the material and remembering the historical narratives. It struggles to anchor the competency around reasoning which Romila Thapar argues is one of the objectives for any historical education (Karwaan – The Heritage Exploration Initiative, 2020). This requires the curriculum for history courses to be centered around developing reasoning as the overarching competency which includes skills like critical thinking, Reflective thinking, creative thinking, communication skills, social skills.

Fourthly, Nuttall (2021) argues that the skills that are learned from studying history like *handling evidence, extended writing* and *assessing multiple interpretations* is vital in navigating the modern world. This argument aligns with Thapar's argument that traditional skills of learning history like rote learning doesn't find a bearing since it cannot connect the past to the current world view and its projections on future (Karwaan – The Heritage Exploration Initiative, 2020). Also, assessing multiple interpretations is relevant considering the common practice of historical education being conducted in silos without a window to look out to develop a world view. Nuttall (2021) explains the fifth purpose as *developing metahistorical understanding* like concepts of causation, change and evidence. He identifies the final purpose of learning history as learning lessons like consequentialist lessons about what to do (or not) to achieve an outcome. By learning the purpose of studying history, we have identified some of the competencies that can be developed. These are *cultural literacy, historical literacy, participation and citizenship, critical reasoning and metahistorical understanding*. Next, we will look at the existing gaps in the history education to identify competencies that need to be fostered.

Addressing the Gaps of Existing Curriculum

From our classroom experience, the analysis of existing curriculum and literature reviews, it has been found that these are several gaps in existing history education that does not allow competencies to be fostered. Firstly, it has been observed that history is taught in isolation as

a memory exercise of historical narratives. It's crucial to find the connections between local and global narratives. This exercise makes the learner competent to compare interdisciplinary ideas and generate new ones. Secondly, existing teaching methods of history doesnt leave space for interpreting meanings. Looking at Nuttall's (2021) argument from the previous section, it needs to be emphasized that even though history education is about facts and figures, there should be space for questioning biases and creating new meanings. Thirdly, traditional teaching methods like rote learning is proving to be inefficient and the situation calls for alternative learning methods. Refer Appendix to go through the comparison of history of architecture curriculum that clearly shows this gap.

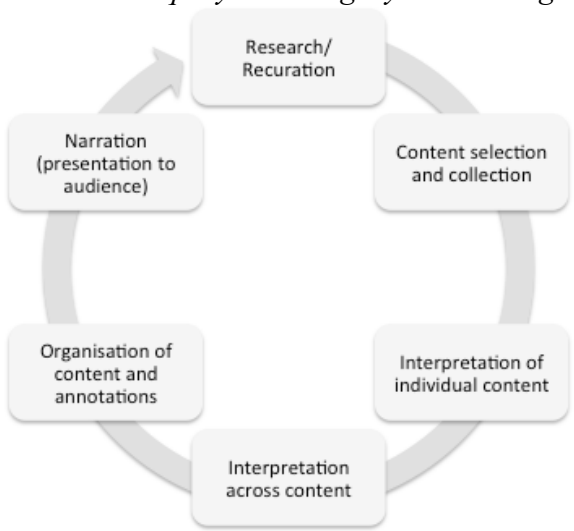
Curation as a Method to Develop Competencies in History Education

In the search for alternative teaching methods, we identified curation as method of learning history when we conducted a Heritage Walk of the historical city of Mysuru, when group of students, educators and heritage enthusiast attend a walk around the city which is curated based on themes like historical narratives, building styles and evolution. The curatorial process of the Heritage Walk revealed ways to narrow the gaps identified in the learning history. This paper proposes curation as a method of learning history. Consequently, this section tries to identify competencies based on the curatorial process of learning history.

Wolff and Mulholland's (2013) analysis of museum practice revealed several stages of the curatorial process and proposes that the same process can be applied in inquiry-based learning settings, particularly historical inquiry.

Figure 1

Curatorial Inquiry Learning Cycle Showing Stages of Curatorial Process



Source: Wolff & Mulholland (2013)

The first step of *research* comprises of definition of goals and objectives, setting of scope and identification of knowledge gaps. The competencies that are nurtured in this process are critical thinking, creative thinking, information literacy, inquiry skills and metacognition. The second step is *content selection and collection*. As students training to be professional designers and architects, it's imperative to develop judgement skills. This will help them develop competencies like visualization, evaluative judgment, digital literacy and knowledge management. Third stage of the process is *interpretation of individual content,* where the learner connects content to a context to create meaning. Analytical skills, critical thinking,

perspective-taking are few competencies that are developed in this stage. Next stage of the curatorial cycle is *interpretation across content* where learners connect multiple narratives and perspectives to create new meaning. In the context of historical inquiry, this stage helps the learner to bridge local and global narratives to have a better understanding. The competencies that are developed includes synthesis, pattern-recognition and story building. The fifth stage is *organization*. The learner develops competencies like systems thinking and logical structuring by compartmentalizing information into different parts of a system. The last stage is *narration* where the learner communicates the interpretations to a third person, thereby cultivating competencies like communication, audience awareness and reflective thinking.

Table 1a
Stages of Curatorial Process and the Competencies Developed

Stage of Curatorial Process	Competencies developed
Research	Critical thinking, creative thinking, information literacy, inquiry skills and metacognition
Content selection and collection	Visualization, evaluative judgement, digital literacy and knowledge management.
Interpretation of individual content	Analytical thinking, critical thinking, perspective - taking
Interpretation across content	Synthesis, pattern-recognition and story building
Organization	Systems thinking and logical structuring
Narration	Communication, audience awareness and reflective thinking.

Framework of Analysis

To understand the effectiveness of curatorial methods in educational contexts that have been identified as case studies, a framework has been developed based on the analysis of existing curatorial theories and educational theories. Six dimensions have been identified, namely agency and voice, plurality, contextuality, collaboration, empowerment and critical consciousness.

Agency and Voice

In the educational context, agency and voice signify the learner's ability to share agency with educators, allowing them to be co-creators and not passive consumers of knowledge. From a deconstructivist point of view, the fixed role of a passive learner is broken down to open space for students to become co-creators of learning and develop alternative narratives. Curator Paul O' Neill, defines the curation as "the very social relations out of which collective cultural manifestations emerge" (O'Neill et al., 2010, p. 24). In the context of education, this would mean that the act of learning and knowledge creation is a process where students are critical agents in the meaning-making process. The importance of learner's agency and voice is bolstered by educational theorist Paulo Freire, where he opines that teaching must not serve as a crafty instrument for the domination of one person by another (Freire, 1968).

Plurality

From curatorial perspective, epistemic plurality recognizes that knowledge transcends boundaries of disciplines and there is no single way of knowing things. Rogoff (2006) explains this idea through the concept of "smuggling" in curatorial practice, where boundaries are blurred in the dissemination of ideas. He explains that ideas cannot be tied to a given structure of knowledge and a legitimating frame or environment but exists in the in-between area (Rogoff, 2006). From an educational theory point of view, Rogoff's "smuggling" of ideas becomes relevant in the existing danger of teaching history in silos. Learning history by connecting local to global narratives is one way of interpreting Rogoff's concept. Therefore, epistemic plurality in the educational context can be explained as the learning experience that is interdisciplinary, and which allows multiple interpretations over dominant educational narratives.

Contextuality

Contextuality in curatorial point of view refers to how meaning of an object not just arises out of it but is constructed by changing social, cultural, spatial and political surroundings. Bourriaud explains contextuality as a relational space where people create meanings within specific context (Bourriaud, 2002). It resists and questions the creation of mass produced, generalized meaning and makes spaces to document personalized experiences. In educational settings, contextuality play a crucial role in learning process. More than a century ago, John Dewey (1916) highlighted the importance of contextualized learning which is connected to real-world experience and relevance. He advices educational systems and settings to stay away from "the danger of material of formal instruction being isolated from subject matter of life-experience" and instead train the students to make meanings with changing social and cultural context.

Collaboration

It is a learning method and competency to be developed in learners, resulting in dialogical learning and collective knowledge construction. Nina Simon's Participatory Museum discusses the relevance of collaboration and dialogical learning from a curatorial point of view. She draws an important connection to museums as sites for collaborative learning- the dialogue between learner and content (Simon, 2010). This idea can be extended to Vygotsky's sociocultural theory which discusses the role of community interaction in the learning process. Combining both the perspectives, we can conclude that, learning is the dialogue between learner, the mentor, the peers and the content so that there is conversation, reflection, debate and interaction.

Empowerment

From both curatorial as well as educational theory, empowerment is about shifting the power from the content or the creator to the learners. It gives power and ownership for the learners to transform the knowledge. In his seminal work, the pedagogy of the oppressed, Frier argues that dialogical learning cannot be limited to depositing of ideas or exchange of ideas (Freire, 1968). It should empower the learner to use the ideas, shape new connections and construct knowledge, without the interference of the system that tend to restrict them. Another important aspect of empowerment is to transform the knowledge to meet personal and communal needs. Simon (2010) and Rogoff (2006) views empowerment as learner's self-

realization about using the knowledge to bring in a larger impact either in their own life or other's.

Critical Consciousness

Critical consciousness is critical in both curatorial as well as educational perspective whereby it creates a space of inquiry. It allows the learner to question interpretations, assumptions and power structures. Rogoff (2006) opines that "criticality is the recognition that we are also living out the very conditions are trying to analyse" (p. 2). This highlights the role of the learner as a subject within power structures rather than a detached observer. This thought is congruous with Freire's philosophy of the learner constant fight against discomfort and oppression that comes with being a part of complex and contradicting power structures (Freire, 1968).

Table 1b below represents the framework of analysis developed based on the above six dimensions. It further describes how each dimension aligns itself in an educational context, followed by competencies that are cultivated by fulfilling each of these dimension.

Table 1b

Framework of Analysis (Based on Curatorial Theories and Pedagogical Theories)

Curatorial Dimension	Description in Educational Context	Competency
Agency and Voice	Learners share agency with the educators, allowing them to be co-creators and not passively accept what the teacher says?	Critically engage, question, create and co-construct knowledge
Plurality	Learning experience is interdisciplinary which allows multiple interpretations over dominant educational narratives (Local to global narratives)	Integrating interdisciplinary knowledge systems
Contextuality	Learning experience allows the students make meanings with changing social and cultural context.	Interpret and integrate changing socio-cultural and environmental context
Collaboration	The learning experience collaborates learners, teachers, materials and other participants so that there is conversation, reflection, debate and interaction.	Engage in collaborative and dialogical practices to co-create knowledge
Empowerment	The learning experience free the students from systems that restrict growth and empower them to see themselves as agents of knowledge instead of forcing them to fit into a system.	Question and reimagine systems that produce knowledge
Critical consciousness	The learning is experiential, active and reflective and creates a critical consciousness and give an opportunity to reflect upon larger questions and act in real world?	Reflect and adapt to real-world scenarios

Case Studies

In their article Moving City: Curating Architecture on site, Jonathan Hale and Holger Schnadelbach investigates the potential for developing a vivid, engaging and meaningful paradigm for architectural exhibitions with the help of curating on site (Chaplin & Stara, 2009). It is demonstrated by effectively bringing the viewer, the building and interpretation together in a "third space" created using mobile and interactive media technology. Traditionally architecture Exhibitions typically consists of photographs, drawings and panels of text displayed within an exhibition space. This often comes from the point of view of the creator of the project in a studio environment. This approach fails to understand the voice of the third person who interacts with the building. Thus, knowledge production remains mostly at the level of design process of the building, but the role of other agencies gets neglected.

In the traditional teaching methods, the classroom environment discusses the idea of the building as a design process but limits itself when understanding the value that a student can add from their own perspective. This process therefore restricts the competencies developed in a history of architecture student.

In the article Curating Contemporary Architecture: Touring the Bilbao Guggenheim and Seattle Central Library, Ari Seligmann discusses the methods of architectural curations through the lens of a building as well as that of the city (Chaplin & Stara, 2009). In the first study of architectural curation of Guggenheim Museum, the curatorial process narrates the process of creating the building thus glorifying the work of the architect. This narration provides limited scope for the viewer to develop their own narratives. They are constrained within the knowledge provided by the curator and the architect. In the case of curation of Seattle Library, there are two guided tours provided. The first one talks about the library in general, its functions and its relevance to the city. And the second one is that of the architectural tour of the building. Depending on the tour opted by the participant, they are presented with the opportunity to debate and discuss about the building its social, economic, communal and architectural relevance. Seligmann concludes by asking how curation should historicize, reframe and critique architecture and how should diversity be incorporated into perceptions of engaging with the building.

Case Study 1: Study of Curation as a Method Adopted in Heritage Walk in Mysuru

In the article, Perceptions of Heritage among students of Early Childhood and Primary education (López-Fernández et al., 2021) heritage is understood not only as a monumental element but as something that is alive and adapting to change. Study of Heritage is being proposed as a way out of studying History which largely focussed on memorising the facts. By letting students engage with heritage at their local level they argue that student can develop self-reflection and critical consciousness that can lead to the understanding of different contexts. However, at the level of primary education there can be challenges faced in adopting this methodology.

At the undergraduate student level, a qualitative survey was done to collect the students feedback to understand how curating and undertaking research as part of Heritage Walk Cell has helped you discover Yourself. The method of deductive coding was used to analyse the data of this qualitative survey. Based on the framework mentioned in the previous section, a set of codes were developed to analyses the survey responses. The table below illustrates the

explanation of codes for each dimension, their explanation and illustration of example responses.

Table 2a

Expansion of the Framework of Analysis- Explanation of Codes, Criteria and Example Responses to Analysis the Qualitative Survey

Curatorial Dimension	Code	Criteria	Example Response
Agency and Voice	Co-Creation	Learning developed through shared activities like sketching together, dialogue, mutual interpretation	"We sketch images and imagine ourselves in that place" and "Mam will allow us to add points on the topic; she will allow us to sketch on floor".
	Personal Relevance	Descriptions of emotional, cultural, or contextual connections	"So many things we learn in history are very important in today's context" and "It helps me bring design better as I understand the topic"
	Participation and Engagement	Statements of feeling involved, enthusiastic, or immersed in the learning process	"Yes, I feel like I'm part of the topic" and "I could really feel that something was getting into my head..."
	Meaning making	Confidence or competence gained in another domain through engagement with history	"…because it taught me about how things came to be the way they are".
Plurality	Local to Global Narrative	Mentions of local influences on large events and lesser dominant narratives	"Every local historical event has a butterfly effect to it."
	Collaborative Interpretation	References to collaborative meaning-making, debates, shared experiences	"Discussions often turned into thoughtful and healthy debates."
	Fluidity of Knowledge Transfer	Ideas that history cannot be studied in isolation, global and local are intertwined	"It's not just about historical facts, it's about how people move through space, what they see, and how they connect"
	Multidisciplinary	Recognition of complexity, simultaneity of interpretations, or multidimensional knowledge layers	"It also involves history, architecture, culture, art, geography, and storytelling."
Contextuality	Local Relevance	Learning that connects students with social, cultural, spatial and political surroundings	"I could relate to it better because we explored Mysuru and Vijayanagara histories."
	Constructivist Learning	Mentions of learning connected to real-world experiences	"It was not just facts; we discussed and interpreted stories together."
	Cultural Identity	Mentions of how history relates to developing personal or community cultural identity	"It helped me understand my roots and heritage better."
Collaboration	Teacher-student connection	Teacher encourages questioning, provides scaffolding, and supports exploration.	Teacher…creates a space where students can explore ideas on their own and with each other.'
	Ownership of	Environment allows open	'Yes…we have to have an

	Learning	dialogue, mistakes, and respectful disagreement	opportunity to tell our own stories and perspectives.'
	Community and Peer Interaction	Learning occurs through conversation and collaboration among peers and interaction with community.	'Most of the learning happens through peer discussions.'
Empowerment	Independent thinking	Mentions thinking for oneself, critical evaluation, forming own conclusions, questioning assumptions.	"We were encouraged to interpret historical events from our own perspective, not just accept what was in the textbook."
	Confidence and Awareness	Expressions of increased self-belief, trust in one's knowledge or growth, belief in one's contribution.	"After this course, I now feel like I can speak up and contribute to discussions about heritage and history."
	Critical Engagement	Mentions questioning authority or canonical sources, assessing reliability, engaging in debate or reflection.	"We didn't just learn facts—we debated and questioned where those facts came from and what they meant."
	Creative Autonomy	References to unconventional thinking, freedom in design, personal interpretation of assignments.	"The heritage walk we created was based on our personal interests, and I chose to focus on forgotten structures."
Critical Consciousness	Design and Creative Exploration	Application of historical or theoretical knowledge to inform design and practice today	"Yes. These processes of research, analysis, conclusion and presentation go beyond just the course…"
	Reflective thinking	Developing independent thought, opinions, and design voice through reflective practice	"I believe I have learnt to form my own opinions and stand by them…"
	Design thinking	Development of analytical, research, and conceptual design skills through historical exploration	"Learning to analyze architecture deeply… applying the logic used in traditional architecture to innovate new ideas."

Source: Author

Table 2b
Incidence of Codes, Identified Within Students' Responses

Curatorial dimension	Codes	Number of students referencing	Percentage (N = 28)
Agency and Voice	Co-Creation	9	32
	Personal Relevance	10	35
	Participation and Engagement	4	14
	Meaning making	8	28
Plurality	Local to Global Narrative	15	53
	Collaborative Interpretation	8	28
	Fluidity of knowledge	8	28
	Multidisciplinary	10	35
Contextuality	Local Relevance	8	28
	Constructivist Learning	15	53
	Personal and Cultural Identity	7	25
Collaboration	Teacher- student connection	27	96
	Ownership of learning	19	67
	Community and Peer Interaction	3	10
Empowerment	Independent thinking	23	82
	Confidence and Awareness	17	60
	Critical Engagement	5	17
	Creative Autonomy	4	14
Critical Consciousness	Design and Creative Exploration	21	75
	Reflective thinking	10	35
	Design thinking	16	57

Source: Author

Case Study 2: Study of Curation as a Method Adopted in Classroom Learning Environment

Table 3
Quantitative Survey of History of Architecture (Studio Course) Undertaken in Academic Year 2024- 2025, Even Semester

Curatorial Dimension	Question	Statistics			Inferences
		Mean	Mode	S.D	
Agency and Voice	I felt that I was a part of the learning process.	4.42	4	0.60	Values, indicates a strong level of agreement, which is consistently positive about being a part of the learning process.
	I had space to express my thoughts	4.47	5	0.60	Values, indicates a strong level of agreement, which is consistently positive about having space to express thoughts.

Plurality	I learned how to include ideas and information that are not part of the textbook.	4.33	4	0.67	Values indicate that most of the participants agreed to the opinion.
	I learnt that the role of other disciplines is crucial in learning architectural history	4.13	4	0.70	Most of the participants agreed to the opinion but high S.D weakens the agreeability of the opinion.
Contextuality	I learned that there are patterns in historical narrative that I can compare and replicate in my personal exploration	4.16	4	0.71	Most of the participants agreed to the opinion but high S.D weakens the agreeability of the opinion.
Collaboration	I was given an opportunity to narrate my reasoning and observations about different contexts	4.22	4	0.57	Values, indicates a strong level of agreement, which is consistently positive about being able to collaborate
	I enjoyed learning through prompts provided by my teacher and peers	4.42	4	0.60	Values, indicates a strong level of agreement, which is consistently positive about being able to collaborate
	I worked in a group and was able to collaborate with the teacher and peers in the decision-making process	3.82	4	0.82	Values indicate lesser agreeability and high S.D indicates variability in the opinion of the participants about being the part of the decision-making process
Empowerment	I feel more confident in expressing my ideas.	4.07	4	0.86	Values indicate high agreeability but high S.D indicates variability in the opinion of the participants about being able to express ideas.
	I felt that I am capable of being the part of knowledge making process	4.11	4	0.79	Values indicate high agreeability but high S.D indicates variability in the opinion of the participants being part of the knowledge making process.
Critical Consciousness	I believe that I can have multiple ways of interpreting an problem	4.35	4	0.64	Values, indicates a strong level of agreement, which is consistently positive about development of critical consciousness
	I understand that a single narrative cannot be the only reasoning in learning about a problem	4.48	5	0.57	Values, indicates a strong level of agreement, which is consistently positive about development of critical consciousness

Source: Authors

Findings

Based on the findings from the qualitative survey, it was observed that, under the dimension of agency and voice, only 14 percent of students expressed positive statements of feeling involved, enthusiastic, or immersed in the learning process showing that majority of the students couldn't express their participation and engagement in the heritage walk. While observing the dimension of collaboration, only 10 percent of the students expressed their support that learning occurred through conversation and collaboration among peers and interaction with community. The remaining students didn't attribute their leaning to interaction and communication. Under the dimension of empowerment, only 17 percent supported that through this method of learning history, they were able to critically engage in assessing reliability of sources and engaging in debate or reflection. Moreover, only 14 percent of students expressed that they could exercise their creative autonomy by personal interpretation of assignments. Based on these findings, it can be inferred that, students' responses were relatively unsatisfactory in terms of their ability to participate and engage, ability to interact and collaborate with peers, ability to critically engage in reflection and creatively interpret design problems.

Based on the findings of the quantitative survey, its observed that under the dimension of Agency and Voice, the first survey question "I felt that I was a part of the learning process" had a high mean value (4.42) and S.D (O.60) indicating an average level of agreement among the participants, with low variability in their opinion about being a part of the learning process. The second question "I had space to express my thoughts", indicates a strong level of agreement (Mean value 4.47) about having space to express thoughts. These findings indicate that the students developed competencies to critically engage, question, create and co-construct knowledge. However, 1% expressed their disagreement that they were unable to express their thoughts.

Under the dimension of plurality, the first question, "I learned how to include ideas and information that are not part of the textbook", had a high mean value of 4.33 indicating a strong level of agreement among the participants (90 % of participants agreed on the opinion) .However, the higher S.D value of 0.67 shows a variability in the opinion (5.5% of the students took a neutral position and almost 1.8% expressed their disagreement expressing their inability to include information outside textbook). The second question, "I learnt that the role of other disciplines are crucial in learning architectural history" also indicated similar values with a mean value of 4.13 and S.D of 0.70 indicating high variability (18.2 % submitted a neutral response). These findings indicate that the students show consistent agreement on being competent to construct knowledge through non-linear, multidisciplinary and local to global narratives, and integrate interdisciplinary knowledge systems.

Looking at the dimension of contextuality, the first question "I learned that there are patterns in historical narrative that I can compare and replicate in my personal exploration" gathered a mean value of 4.16 (81.3 % of participants agreed on the opinion). But the relatively high S.D value of 0.71 indicates variability in opinion (18.2 % expressed neutral response). The second question, "I was given an opportunity to narrate my reasoning and observations about different contexts", gave a high mean value of 4.22 and a low S.D value of 0.57 indicating strong agreement without any variability. Even though the values indicate that generally students are competent to interpret and integrate changing socio-cultural and environmental context (81.8 %), 18.2 % indicate a neutral response.

When it comes to the dimension of collaboration, the first question, “I enjoyed learning through prompts provided by my teacher and peers” indicate a mean value of 4.42 with a S.D of 0.6. An interesting observation is that, the second question “worked in a group and was able to collaborate with the teacher and peers in the decision making process” only gave a mean value of 3. 82 and relatively high S.D of 0.82 indicating high variability in opinion. We can observe that 27.3 % of the students disagree and 5.5 % disagree. This makes us question whether, students are competent to engage in collaborative and dialogical practices to co-create knowledge. Even though they are competent to work collaboratively, the values indicate their uncertainty as decision- makers.

Assessing the dimension of empowerment, we can see that, the first question “I feel more confident in expressing my ideas” indicate an average level of agreement (mean = 4.07) but the relatively high S.D of 0.86 shows inconsistency (16.4 % expressed a neutral response and 5.5.% disagreed). Similarly, the second question “I felt that I am capable of being the part of knowledge making process”, shows general agreeability with high variance (S.D = 0.79). This indicates the gap in their competency to question and reimagine systems that produce knowledge.

Finally under the dimension of critical consciousness, the first question “ I believe that I can have multiple ways of interpreting an problem” and the second question “ I understand that a single narrative cannot be the only reasoning in learning about a problem” , indicate values that shows a strong level of agreement, which is consistently positive , establishing the fact that students are competent to reflect and adapt to real-world scenarios.

Discussion

The findings indicate that students at large agreed and realised that the method of curation allowed them to achieve competencies that were being proposed. But not all parameters were achieved by all students. In the case of Heritage Walk conducted in the city of Mysore by students it was observed that students identified well with the idea of Co- creation, personal relevance, meaning making, relating global and local narrative, collaborative interpretation, contextuality, independent thinking. A significant number of students also stated that the method promoted confidence and awareness. Students opined that the method enhanced the connection between the teacher and the student and imbibed a sense of ownership and accountability in the process thus promoting design and creative exploration, reflective thinking and design thinking. At the same time a significant number of students also showed disagreement and argued that the method did not aid in creating a sense of participation and engagement and hence did not help in enhancing their interaction and communication skills. The values also indicate that this method was not successful in promoting critical engagement and creative autonomy. This informs us that the method could successfully aid in promoting dimensions of agency and voice, plurality, contextuality, collaboration and critical consciousness in students while the method needs to be adapted to help students to develop a sense of empowerment in them.

In the case of curation adopted within the classroom environment, students felt that the method helped them to be a co-producer of knowledge and provided them with a space to express their thoughts thus enabling a critical engagement within the classroom. The curatorial dimension of plurality helped them to appreciate nonlinear form of learning and multidisciplinary approach. This method also helped them to understand the relation between local to global narratives. While a significant number of students agreed that the curatorial

dimension of contextuality helped them to appreciate the settings in which architecture functions some students could not appreciate socio cultural and environmental attributes of the topics while it was curated within the classroom. Students also opined that while they could work collaboratively within a classroom, they could not be efficient decision makers in the setting. In both the curatorial setting students felt that they were not being empowered with communication skills that promoted better interaction while they felt that overall, this method helped them to develop critical consciousness in them.

The data indicates that the competencies developed in student vary when curation is adopted as a learning method in different environment. Within a classroom environment, a significant number of students felt that contextuality could not be enhanced while this was achievable when exploring the context itself. While the classroom environment provided them a space to express their thoughts freely, conducting a heritage walk allowed them to integrate world view and accommodate multiple narratives. The result can also vary based on the interest of the student and their inclination. Hence among the multiple competencies that are being proposed as part of historical thinking, curation as a teaching method can help students in achieving them considering the environment for learning and personal interests of the students. As a teaching and learning technique it helps the student and teacher move away from the traditional method of memorising the facts and enables the student to question how historical literacy can be used to enhance the life of the student in the future.

Conclusion

With the roles of the architect varying in the current educational and economic systems, history of architecture education needs to revisit its curriculum with respect to the competencies that needs to be developed in the student. This should be aided by innovative teaching methods that can move from the traditional teaching methods like memorisation. Curation, as a technique both within the classroom and outside, can aid students to develop historical literacy in students. With the help of the case studies identified for the study it can be understood that curation enables a student to critically engage with a topic and therefore allowing them to construct knowledge integrating the contributions of different disciplines and socio-cultural contexts. It helps them to collaborate with different agencies in the process of knowledge production and allows the students to practice reflecting on the “self”.

The findings indicate that students will respond to the method of instruction based on their personal interests and conditioning. It is therefore important that a learning environment should cater to multiple competencies that can be picked up by the student in the process of learning. Curation can be emphasised as one of the learning methods that can develop a worldview approach in students while recognising the that they hold a significant role in defining their historical narratives as part of the larger global narratives.

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Appendix

Table 4

Comparison of course Outcomes in History of Architecture Curriculum to identify the gaps in curriculum

	University 1	University 2	University 3	University 4
Semester 1	Provide an insight to the architecture of the prehistoric period, ancient civilizations across the world, and Buddhist and Hindu architecture in India. introduce them to the cultural and contextual determinants that influenced the built form and settlement patterns. Help them to understand the development of architecture with reference to character, style, materials, technology, climate, geography, religion, and culture.		Upon completion of the course, the student should: Be able to relate and identify built forms through socio cultural, climatic, political, economic influences on them in respective geography and timeline. Possess the skill to formally (visually and theoretically) analyse and appreciate architectural works.	To provide an insight into the architecture of prehistoric period and early civilizations. Social, religious and political character, construction methods, building materials and how they influenced their built form and settlement pattern shall be explained with suitable examples. Combined influence of geology, geography, climate, beliefs, religion and culture on the architecture must be highlighted to appreciate how architecture embedded in place specific context. The study must enable students to do a comparative evaluation of various civilizations, appreciate chronological developments along the timeline and across geographies.
Semester 2				
Semester 3				To provide an insight into the architecture of Classical antiquity & early Medieval period.

Social, religious, political and architectural character, construction methods, building materials and settlement planning shall be explained with suitable examples.
To provide an understanding of the evolution of Classical architecture in the west, Indian Architecture in its various stylistic modes characterized by technology, ornamentation and planning practices.

Combined influence of geology, geography, climate, beliefs, religion and culture on the architecture must be highlighted so as to appreciate how architecture is embedded in place-specific context.
The study must enable students to do a comparative evaluation of developments in a chronological manner along the timeline and across different geographies. Also, students must be enabled to appreciate tangible and intangible aspects of heritage associated with history.

Semester 4	Help to provide awareness about the development of architecture in the Ancient Western World and the cultural and contextual determinants that produced that architecture. To study the influences of events which have led to the outcome of styles such as Romanesque, Gothic & Renaissance and their architects in Italy, France and Britain comprehending the rich vocabulary of forms & shapes and structural systems.	An understanding of the built environment as a process and knowledge of its determinants. Ability to analyse built environment through the knowledge of approaches to its study. Knowledge of settlement morphologies and regional/ vernacular architecture in specific regions of India	Upon completion of the course, the student should: Be able to relate and identify built forms through socio cultural, climatic, political, economic influences in respective geography and timeline Possess skill to formally (visually and theoretically) analyse and appreciate architectural works Be able to use a theoretical base developed from architectural history in their design process Be exposed to plethora of contemporary architecture practices in India	To provide an insight into the architecture of high and late Medieval period. Social, religious and political character, building materials, construction methods, landscape and how they influenced their built form and settlement pattern shall be explained with examples. To provide an understanding of the Architecture in its various stylistic modes, characterized by technology, ornamentation and settlement planning practices. Combined influence of geology, geography, climate, beliefs, religion and culture on the architecture must be highlighted to appreciate how architecture embedded in place specific context. The study must enable students to do a comparative evaluation of developments in chronological manner along the timeline and across different geographies. Also, students must be enabled to appreciate tangible and intangible aspects of heritage
Semester 5	To provide the student an in-depth knowledge of modern design philosophies in the evolution of innovative architectural forms and designs.	An understanding of modernity as a fundamental transformation in Western society that spread across the world and the resultant architectural production. An insight into the development of various strands of modernism and modern architecture. An understanding of architecture of colonialism, nationalism and modernity in India		

		associated with history.
Semester 6	Introducing the students to various Design philosophies of colonial, post independent and contemporary architecture in Indian context.	To impart an understanding of the evolution in architecture and urbanism from the medieval to industrial times; Understanding about European Renaissance and its contemporary Mughal architecture in India. Understanding about Industrial Revolution and its influence on the built form and settlement patterns; Colonial mercantile capitalism and spread of Western influences in India. Synthesis of architectural styles as modes of political accommodation. Also, students must be enabled to appreciate tangible and intangible aspects of heritage associated with history.

Source: Curriculums of School of Planning and Architecture, Vijayawada, M.G University, Anna University, Calicut University.

Embracing Large Language Models in Higher Education: A Case Study on Hong Kong's Students' Perceptions

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Abstract

A key feature of large language models (LLMs) is the ability to comprehend and generate human-like texts, and this feature undoubtedly endows LLMs with the capacity to revolutionize the education sector, particularly higher education. Although ChatGPT, the most well-known LLM, is still not available in Hong Kong to the public, universities in Hong Kong are no exception to this global race of embracing LLMs into teaching and learning. Although students' perceptions of LLMs are not typically an under-studied topic, such perceptions may constantly shift because of new developments in LLMs. In particular, LLMs have become more advanced, and there have been a growing number of LLMs. This study aims to understand the perceptions of Hong Kong university students on the adoption of LLMs in higher education. Thirty university students or recent graduates (within two years) constitute the sample of this study, who were asked to fill in a survey mostly consisting of qualitative questions that explore their perceptions of LLMs in regard to their usage, reliability/accuracy, negative impacts, and trade-offs. This study concludes that Hong Kong university students are generally aware of the known concerns of LLMs in education, and while most of them have used LLMs for educational purposes, the majority of those who have used them have not used them to directly write academic essays. At the same time, some students acknowledge that they are personally suffering from related adverse impacts from the use of LLMs, but most that acknowledge so would continue to use LLMs.

Keywords: large language models, higher education, students' perceptions, Hong Kong

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Introduction

The rise of large language models (LLMs) has brought both opportunities and concerns in higher education. A key and unique feature of LLMs, including ChatGPT or DeepSeek, is the ability to comprehend and generate human-like texts (Xing et al., 2025). It is undeniable that LLMs have the potential and capacity to revolutionise higher education. Some may even compare the birth of LLMs to the popularisation of computers in universities in the late 20th or early 21st century, when desktop computers were made available to students, and students no longer needed to hand-write their theses. LLMs are perceived with a mix of enthusiasm and criticism: some institutions recognise the transformative potential of these technologies and hence embrace them with support; others believe that the learning process of students would be compromised. This leads to the importance of understanding the perspectives of different stakeholders to seek the right balance between embracing such potential and addressing such concerns.

Universities in Hong Kong are early in the game in embracing LLMs into teaching and learning. In particular, the Hong Kong University of Science and Technology (HKUST) is the first to adopt LLMs into its pedagogy, providing students with access to ChatGPT (via cloud) and free token quotas. Other universities soon followed, and access was also expanded to other LLMs (notably, DeepSeek). Through qualitative surveying, this paper aims to gain in-depth insights into students' experiences, opinions, and concerns regarding the integration of LLMs into their education journey.

Methodology

As in most studies that attempt to gain in-depth perspectives from the relevant group of the population, this study is based on qualitative data collection.

2.1 Participants

This study sampled students pursuing a degree (bachelor's, master's, or doctorate) or recent graduates (within two years) who obtained a degree from a university in Hong Kong. The rationale for including recent graduates is to gather their perspectives at the later stages of their studies when LLMs emerged in education, as they might be able to draw comparisons from their earlier stages of studies. To potentially make this study comparable to other studies (both domestically or internationally), students who are enrolled in certificate programs, diplomas, higher diplomas, associate degrees, and postgraduate diplomas, as well as students from non-university self-financing post-secondary institutions and overseas institutions, who are not also enrolled in a university in Hong Kong as a degree-reading student are excluded from this study.

2.2 Sampling

A convenience sampling method was used. A total sample size of 30 was collected.

2.3 Instrument

A questionnaire is distributed to participants electronically (see Appendix A). It consists of multiple-choice questions to gather information from participants on their levels of study, home institutions, fields of study, and purposes for using LLMs; one Likert-type question for

them to rate the reliability of LLMS; open-ended questions to gather in-depth perspectives on participants' perceptions on the usage, accuracy, impact (on both learning process and academic integrity) on LLMs; and a text-box in the end for the participants to express any closing thoughts. All questions aside from the closing thought text box are compulsory.

2.4 Make-Up of Participants

Participants were required to answer background-related questions based on their latest educational status. For example, if a participant recently read for both a bachelor's and master's in Hong Kong, he/she should refer to his/her master's degree to answer such questions.

In total, 63.3% of respondents are reading for/ have received a bachelor's degree, 26.7% are reading for/ have received a master's degree, and 10% are reading for/ have received a doctorate (see Figure 1). 46.7% of participants chose HKU as their institution, 13.3% chose HKUST, 10% chose CityU, the remaining 30% chose other institutions, and no participants chose HKSYU, HSUHK, and HKSFU (see Figure 2). 66.7% of participants chose "humanities, social science, and law" as their field of study, 23.3% chose "science, engineering, and medicine," 10% chose "creative arts, music, and performing arts," and no participants chose "business and economics" (see Figure 3).

Figure 1

Levels of Study

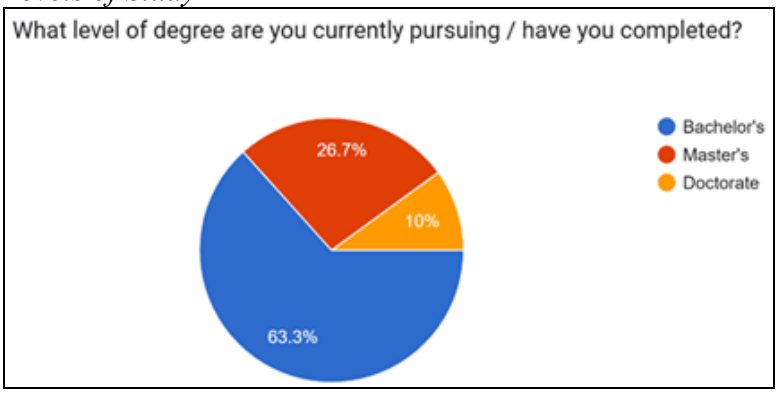


Figure 2

Instituional Make-Up

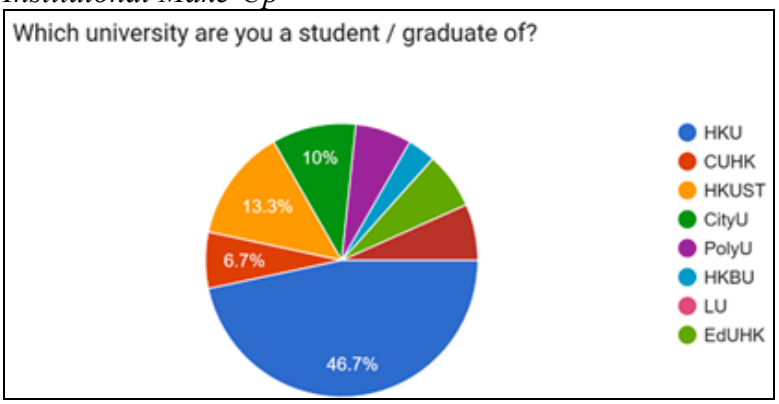
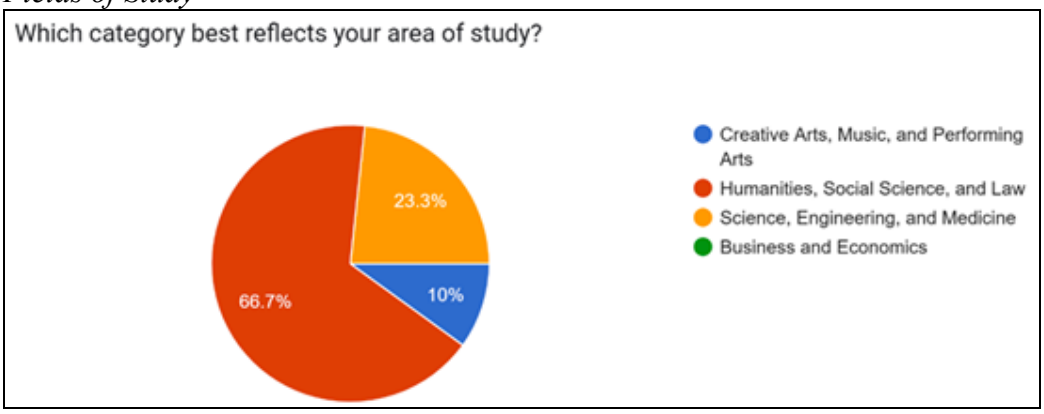


Figure 3

Fields of Study



Results and Discussion

3.1 Usage of LLMs

LLMs can be used to generate content, edit texts, generate ideas, search for information (although the database of some models is outdated), and seek solutions (e.g., generating codes for R or Python) [Bernabei et al., 2023]. Most participants (70%) claimed that they had used LLMs in their learning journey (see Figure 4). Figures from similar research are diverging, from ~30% to ~80% (see Paustian & Slinger, 2024; Renna, 2024; Zhu et al., 2024). When asked about their purpose for using LLMs, 53.3% of participants have used it for idea generation, 50% have used it for text editing, 36.7% have used it for information gathering/solution seeking, and only 23.3% have used it for content generation (see Figure 5).

Figure 4

Usage of LLMs

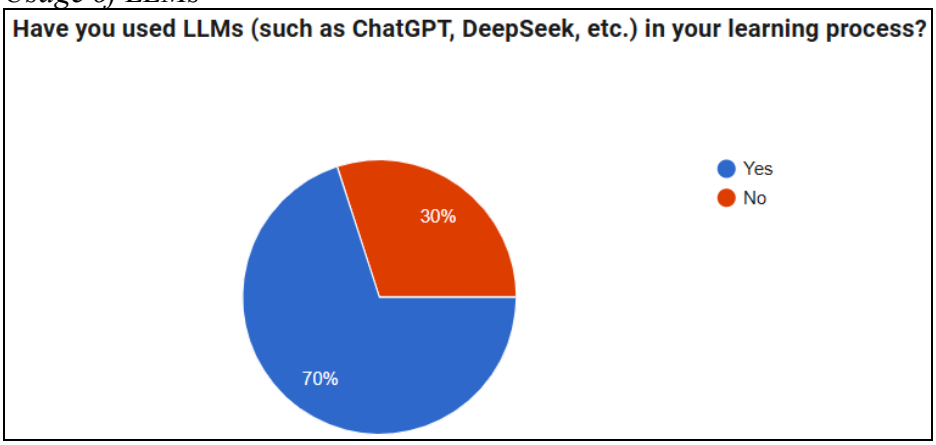
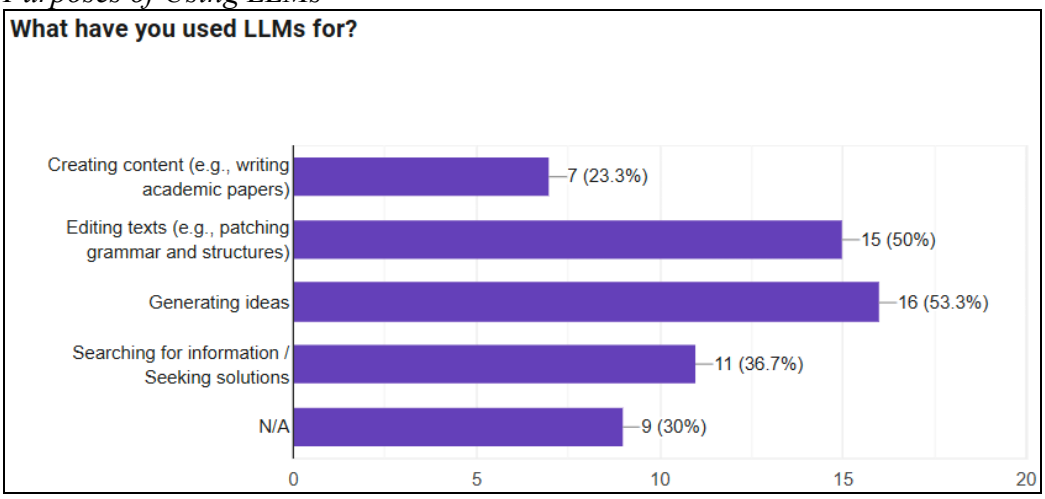


Figure 5

Purposes of Using LLMs



Many of the participants claimed that they are using LLMs for polishing their texts (including fixing their grammar), translating texts, and changing the tone of the writing:

"I used LLMs for grammar checks and transcribing historical texts in foreign language"

"Paraphrasing grammar because you no longer need effort in learning new vocab with LLM."

Others have used it to generate ideas for class, research ideas, and research methodologies:

"Help brainstorm some preliminary ideas for tutorial discussions and direction to approach essay questions."

"Using LLMs as a research assistant to generate research/methodological ideas, consolidate key points, and change writing style to scientific."

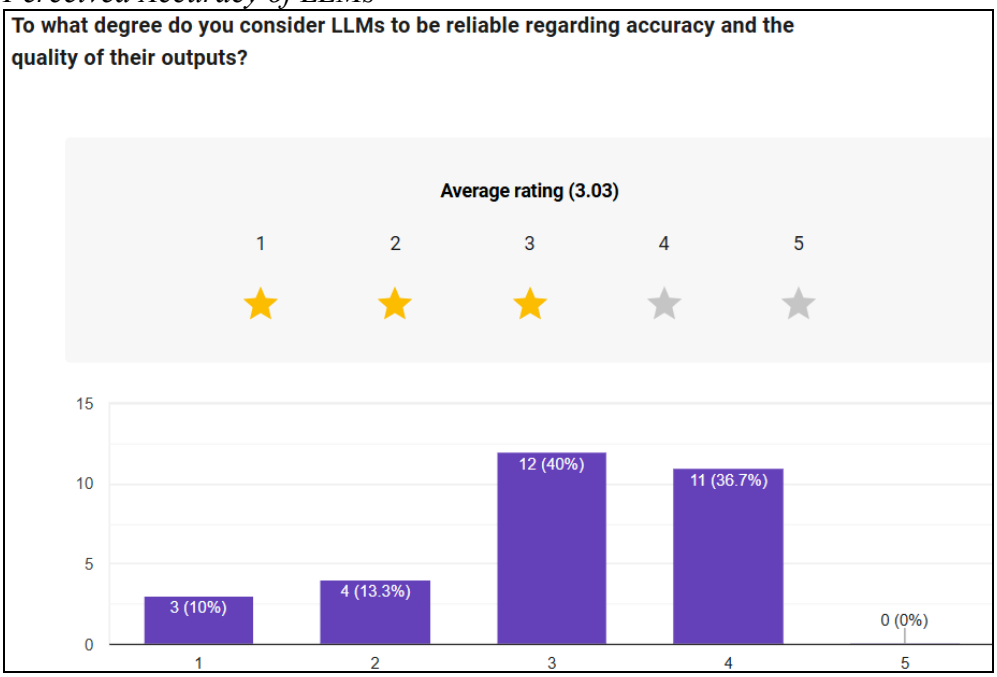
While most participants have used LLMs in their learning process, interpreting what the participants have mentioned, most treat LLMs as advanced translators or search engines. No participants explicitly mentioned that they had used LLMs to write academic papers. Most participants know that their assignments or other writing tasks are integral to their learning process. Among our participants, usage of LLMs is largely limited to "everyday" tasks in their learning or research journey that reduce their time costs, rather than using LLMs for a purpose that replaces them as agents of learning. Depending on the purpose of usage, LLMs can potentially be used as a tool to facilitate students' learning process and enhance productivity. However, as some of our participants showed, LLMs may discourage them from thinking originally or critically, but educators may still want to be aware of such a phenomenon (see 3.3 & 3.4).

3.2 Reliability and Accuracy of Output

Existing studies have established that LLMs can contain unverified or even, at times, factually incorrect content (Bélisle-Pipon, 2024; Qin, 2024; Schiller, 2024; Wang et al., 2024). Participants were asked to rate the reliability of LLMs, and an average score of 3.03 out of 5 was given. Most participants rated "3" or "4," with no participants rating "5."

Figure 6

Perceived Accuracy of LLMs



Most participants seem to be aware (and have experienced) the potential inaccuracies of LLMs:

"Sometimes, LLMs hallucinate information, and without own knowledge, it is hard to find out."

Some participants pointed out that LLMs are better at general tasks rather than specialized tasks in their field:

> When I am looking for something very general (common senses), I think the models are quite reliable. However, if I ask them to do some analysis, I will fact check by myself, since most responses are likely make[made] up, or not that accurate.
>
> It is convenient, but there are still many errors (e.g.: Grammatical mistakes and lack of content coherence). From my experience as a language learner at university, other languages (exclude English) still have a long way to improve its grammatical accuracy and content coherence (e.g. wrong sentence structure, wrong verb conjugation or wrong use of verbs etc.).

Some participants shared their personal experiences dealing with inaccurate output from LLMs with reference to their field of study. Such experience persists across all fields of study:

"For subjects on literary reviews that depends heavily on personal preference, the times we tried to seek inspiration from these models resulted in very vague and useless responses." – presumably a literature student

"Lack of details in case law." – presumably a law student

Contrary to some popular beliefs that the accuracy of LLMs might "perform" better in certain fields or can even "replace" students of humanities or social sciences, our participants largely disagree. Our participants find them, at times, unreliable in such fields. Other participants also recognize that content generated from LLMs can be inaccurate, unreliable, and even, at times, "*terrible.*" Contrary to some concerns of educators, students are largely aware of the potential problems of inaccuracies on LLMs.

3.3 Self-Perceived or Peer-Perceived Negative Impacts on Learning Process

Many participants believe that the potential inaccuracy from LLMs (also see 3.2) constitutes a negative impact on their peer's learning process:

"Some people don[']t check the LLM results."

"Some students may overuse LLMs and their works may not be original."

Some others expressed concerns about how LLMs may jeopardize the learning process:

> Most of the learning task in the curriculum is designed in a way that facilitate learning by doing. If one were to substitute conscious effort at thinking and writing with output generated from AI, the effectiveness of learning through doing this task is practically moot.

> At times, it makes me stop thinking originally on my own, even though I believe I have a solid foundation already. It's almost like taking a shortcut to get to faster and more outcomes, which from a utilitarian perspective is not a bad thing, but I'm genuinely afraid my brain might shrink because of this.

Many participants admit that using LLMs may discourage them from thinking critically and originally and admit that the effectiveness of learning might be compromised. These responses align with what some literature argues (Duenas & Ruiz, 2024; Jošt et al., 2024). Some others also believe that using LLMs has decreased their capability to write coherently, with one participant suggesting that his/her "*English become[s] worse.*" As discussed in 3.2, while students are aware of the potential inaccuracies of LLMs and potential adverse effects on their psychology of learning, many students may still opt to use LLMs in order to save time and effort. Educators must be aware of such a trend and potentially design learning tasks that encourage critical and original thinking.

3.4 Perceived Impact on Academic Integrity

The way LLMs obtain data and generate responses according without attributing to the original source may bring concerns regarding academic integrity (Pudasaini et al., 2024). Some popular sources even criticize LLMs as "plagiarism machines" (Keegin, 2023; Novak, 2023). Based on the responses that the participants have given, there are two dimensions to such concerns: 1) students committing plagiarism from the use of LLMs, and 2) teachers wrongly accusing students of using LLMs when they are forbidden.

One participant listed four major reasons how LLMs may compromise academic integrity: 1) accuracy, in terms of both the citation and the content being cited; 2) transparency, the process of response generation is not known to the user, such that the user cannot identify

potential bias or problematic information in a dataset, 3) credit, whether attributions are probably given, and 4) infringement of institutional policies, if the coursework requirements forbid the use of LLMs.

However, an under-investigated perspective by similar studies would be the other way around: how instructors may have misunderstood their students for using LLMs without permission when they have not:

“The teachers would often misunderstand students using LLMs when the so-called ‘ai detector’ detected 100% ai but they didn't use it.”

Despite the dependency of AI-generated detectors on some faculty members, it is well-known that they are largely unreliable and inconsistent (Elkhatat et al., 2023; Weber-Wulff et al., 2023). However, there has recently been a growing discussion among student communities that many are wrongly accused of AI-related plagiarism. The tendency of some institutions and faculty members to rely on AI-detection tools can penalize hardworking students and discourage grammatically accurate and well-written work. This form of misuse of AI-detection tools is, at best, an increased unnecessary burden on students and, at worst, an infringement of academic integrity on its own. More research on the perceptions of faculty members on LLMs should be conducted, especially on the ways of dealing with such risks.

Limitations

As convenience sampling was adopted, the sampling may not be very representative of the actual student population. This is reflected in the unbalanced institutional make-up of participants (see 2.4). The main scope of this study is to gain in-depth perspectives from participants to bridge future research, and present prelimnary findings, rather than being very conclusive at this stage. Moreover, as this is still a growing topic, future students’ perceptions of LLMs may shift drastically and significantly deviate from the findings of this paper. Moreover, as this is a growing field of research, preprints (e.g., arXiv articles) instead of other scholarly sources are often cited to capture the newest findings.

Conclusion

This study provides insights into the perceptions of Hong Kong students regarding integrating large language models (LLMs) into their educational journey. While most participants have used LLMs, they are also knowledgeable regarding the concerns regarding their learning process and academic integrity posed by LLMs. In particular, a number of participants pointed out that their language and critical thinking capabilities have deteriorated. Some may believe that the benefits of LLMs outweigh the potential adverse effects, seeing them as an effective tool for learning; others argue that the students' learning process is severely compromised. This study hopefully bridges further research on the perceptions of LLMs from a broader range of stakeholders, particularly educators. Looking forward, case studies on Hong Kong students on a larger scale can be conducted to reach a more conclusive result.

Acknowledgement

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Appendix

Survey Questions

Are you a student reading for a degree (bachelor's, master's, or doctorate) or a recent graduate (within two years) who read a degree at a university?
(Please refer to the "eligibility" session if you are not sure.)

Which university are you a student / graduate of?
(Please indicate your most recent affiliation from the list below if you have attended more than one of these institutions.)

What level of degree are you currently pursuing / have you completed?
(If you have completed multiple degrees or studied abroad, please indicate only your latest level of studies in Hong Kong.)

Which category best reflects your area of study?

Have you used LLMs (such as ChatGPT, DeepSeek, etc.) in your learning process?

What have you used LLMs for?

Please elaborate and provide the relevant details based on the above response.
(Fill in N/A if you have not used LLMs in your learning process.)

To what degree do you consider LLMs to be reliable regarding accuracy and the quality of their outputs?
(With 1 being completely unreliable and 5 being completely reliable.)

Please elaborate and provide the relevant details based on the above response.

What potential negative impacts do you think the use of LLMs could have on your learning experience or that of your peers?

What are your opinions on academic integrity concerning LLM usage? Do you feel that they create potential risks for plagiarism, like neglecting to credit the right sources?

How do you view the role of large language models (LLMs) in education? In your opinion, do the potential benefits of LLMs outweigh the challenges and negative impacts associated with their use?

Any closing thoughts?

Bonsai Fridays: Cultivating Long-Term Skills Beyond Challenge-Based Learning Cycles

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Official Conference Proceedings

Abstract

This paper addresses a recurring issue when applying Challenge-Based Learning (CBL) in the development of digital products: the limited lifespan of solutions developed during the "Act" phase precludes students from developing a broader range of competencies that require longer sustained effort and iteration. To address this, we propose and evaluate "Bonsai Fridays," a novel pedagogical approach in which students revisit and iterate on past CBL solutions. This study investigates whether sustained engagement with the output of previous challenges can extend the impact of the "Act" phase, enhance student ownership of their work, and foster long-term skill development. Drawing on established CBL principles (emphasizing real-world problem-solving and action-oriented learning), this study examines how "Bonsai Fridays" promotes the development of student competencies in areas such as marketing, coding, design, and process, that would demand long CBL cycles. It further explores whether this approach increases students' accountability for their solutions by incorporating iterative improvements such as debugging, optimization, and marketing strategies, within a context of active learning and spaced practice for skill retention. The methodology used in this study includes a literature review of CBL in higher education and an evaluation of "Bonsai Fridays" through case studies involving 8 student-developed applications revisited by 40 students over 10 weeks. Findings highlight the benefits and challenges of this extended CBL approach, including its potential to deepen learning outcomes and sustain student engagement. The paper concludes with recommendations towards maximizing educational impact and preparing students for real-world challenges.

Keywords: challenge-based learning, active learning, higher learning, spaced practice

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Introduction

Higher education is a domain that is continuously evolving and demanding of pedagogical innovations, which is especially true in today's challenging, complex landscape. One of these innovations is challenge-based learning (CBL), an active learning framework that focuses on problem solving through real-world challenges systematically presented to learners (Galdames-Calderón et al., 2024).

CBL is a collaborative and multidisciplinary approach characterized by experiential and action-oriented aspects, and enhances skills such as teamwork, communication, negotiation, creativity, digital literacy, and more. The CBL framework, introduced by Apple, Inc. in 2008 (Nichols et al., 2016), is composed of challenge cycles with three stages: Engage, Investigate, and Act (Figure 1), driven by an overarching "Big Idea," a broad concept that serves as a starting point for the CBL process and should be explored in ways that are relevant to the learners and the larger community. At the first stage, "Engage," learners move from this concept to a more concrete and actionable challenge. During "Investigate," they refine their understanding of the deeper real-world issues involved with the challenge. Finally, the "Act" phase allows them the opportunity to put the previous stages into practice, by developing a solution concept and actually building a solution prototype (Cardador et al., 2023). Throughout this process, learners develop a range of skills such as research, planning, design, coding, marketing, and project management (process).

Figure 1
Challenge Based Learning Framework



Source: Nichols et al., 2016, p. 11

According to Nichols et al. (2016), the duration of CBL stages is highly flexible and adaptable to a wide variety of learning environments. Challenges may last from just a few days to several weeks, or even several months.

The goal of the "Act" phase is to develop and implement solutions in authentic settings, acting on the knowledge and skills gained, and gathering feedback. This phase includes the development, implementation, and evaluation of the solution, which is often a digital product such as a smartphone or tablet application (although it could take many forms, since CBL is intentionally flexible). Learners are encouraged to be creative in designing their solutions; prototype testing and development may lead them to cycle back to the investigation phase until a solution is ready (Nichols et al., 2016). Typically, once the "Act" phase is completed and the CBL cycle concludes, solutions are not actively maintained or even further developed, as learners shift their focus to exploring new big ideas, challenges, prototypes, and solutions.

This study investigates the possibility of maintaining solutions beyond the "Act" phase. This investigation allows us to examine whether this approach, or a similar one, may accomplish educational goals such as (1) providing learners with opportunities to develop competencies that require longer sustained effort and iterations, beyond the typical challenge durations of a few days to a few months, without having to extend a full CBL cycle over the course of several months; (2) deepening student ownership and accountability for their solution beyond the end of the CBL cycle; (3) extending the impact of CBL beyond isolated cycles; and (4) expanding the educational value of CBL pedagogies. Since our learners are all undergraduate students, we focused this study on higher education.

Literature Review

CBL is a multidisciplinary approach and is analyzed from different perspectives in published literature. Snyder (2019) observes that a semi-systematic review approach is beneficial when researching diverse disciplines and can be useful for detecting themes, theoretical perspectives, or common issues.

Table 1
Databases, Advanced Search Queries and Number of Results

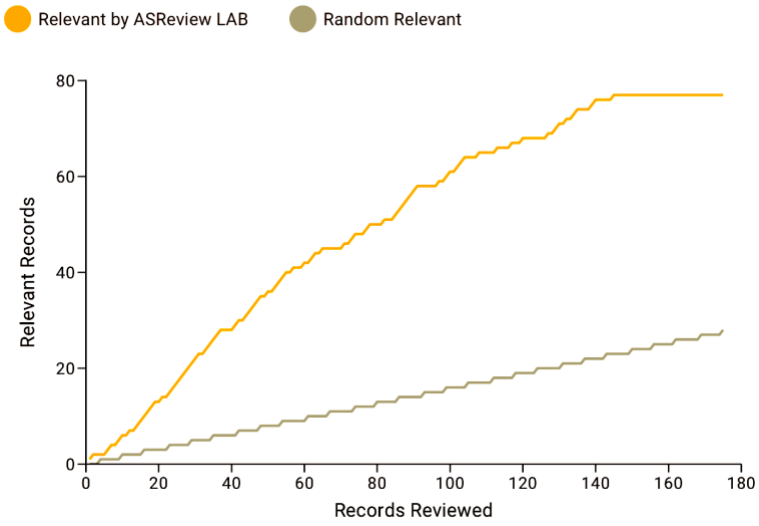
Database	Advanced Search Query	Results
ACM Digital Library	[Full Text: "challenge based learning"] AND [[Full Text: "higher learning"] OR [Full Text: "university"]] AND [E-Publication Date: (01/01/2015 TO 12/31/2025)]	269 (39.2%)
IEEE Digital Library	(("Full Text & Metadata":"challenge based learning") AND (("Full Text & Metadata":"higher learning") OR ("Full Text & Metadata":"university")))	250 (36.4%)
ScienceDirect	("challenge based learning") AND ("higher learning" OR "university")	136 (19.8%)
Scopus	(TITLE-ABS-KEY ("challenge based learning") AND (TITLE-ABS-KEY ("higher learning") OR TITLE-ABS-KEY ("university")))	31 (4.5%)
Total		686

A comprehensive literature review of CBL was conducted to determine whether this extended engagement with a CBL cycle had already been addressed. Four pertinent databases were selected: ACM Digital Library, IEEE Digital Library, ScienceDirect, and Scopus, to locate publications from 2015 to 2025. The search queries (Table 1) were intentionally broad, aiming to find any publication related to CBL and higher education.

From these results, 198 duplicates were removed, resulting in a total of 488 records to be screened. To expedite the screening process, an AI tool, ASReview LAB (V. 2.1.1) was used (Van de Schoot et al., 2020). As per van Dijk et al. (2023, p. 2), this tool uses titles and abstracts, and an "an active researcher-in-the-loop machine learning algorithm to rank the articles [...] probability of eligibility for inclusion." Essentially, the tool is trained with relevant and irrelevant articles, iteratively improving its ability to identify relevant articles. A stopping criterion is set by the user (for example, finalizing the review after a certain number of consecutive irrelevant articles are displayed). Ideally, the optimal criterion would be the moment past which no more relevant articles are identified. Our stopping criterion was 10 irrelevant articles; however, since we were testing the tool, we extended the review to include another 30 articles, confirming that no new relevant articles surfaced. Figure 2 shows the Progress Recall chart, comparing relevant records found against a random approach, showcasing the efficacy of the methodology.

Figure 2

Progress Recall Chart From ASReview LAB



The criteria for screening relevant articles were: (1) relating to CBL and/or another active learning framework; (2) relating to higher education; and (3) analyzing empirical data. A total of 178 articles (titles and abstracts) were manually analyzed until the extended stopping criterion was reached. This resulted in a total of 98 articles marked as not relevant, 77 as relevant, and 314 unlabeled and assumed not relevant.

Out of the 77 remaining articles, the full text of each was analyzed, and the following exclusion criteria were applied: (1) article language not in English (n = 2); (2) not directly related to CBL (n = 8); (3) no empirical data analysis (n = 7); (4) total CBL cycle duration under 8 weeks or not disclosed (n = 24); and (5) full article text not available through the authors' institution (n = 15). This resulted in a total of 53 records excluded. The final number of included records was 24, which were further analyzed in full. Of these, 10 were deemed to actually address extended CBL engagements or longer CBL cycles, as listed in Table 2.

Although the 10 final selected studies addressed longer CBL cycles, none reported focusing on the specific skills related to the extended CBL cycle length. Our conclusion is that, while several studies address extended engagement in CBL, none focus solely on the development of skills that necessarily require longer timeframes and iterations. Moreover, we found no

study systematically extending engagement with a solution from a previous CBL cycle beyond the "Act" phase.

Table 2
Articles Selected for Longer CBL Engagements (n = 10)

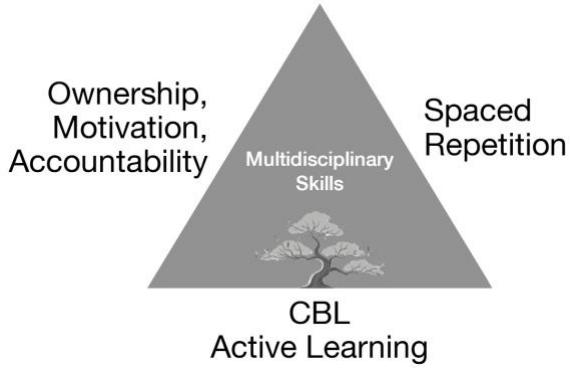
Reference	Length
Binder et al. (2020)	2.5 years, 2 cycles, each 8+ weeks
Colombelli et al. (2021)	11 cycles, each 14 weeks
Colombelli et al. (2022)	11 cycles, each 14 weeks
Gonzalez-Hernandez et al. (2020)	4 semesters, each 19 weeks
Mora-Salinas et al. (2019)	2 cycles, each 18 weeks
Oliveira et al. (2024)	Two-year program and one-semester course; multiple cycles, up to 18 months
Romero-Yesa et al. (2023)	1 cycle, 14 weeks
Sanchez and Lamo (2024)	4 annual cycles, each subject 16+ weeks
Santos et al. (2018)	1 year
Zavala et al. (2023)	9 semesters; multiple cycles; each 16 weeks

Methodology

We conducted an experiment with a cohort of 40 learners over 10 weeks. Each week (the "Bonsai Friday") was dedicated *not* to their current ongoing CBL cycle, but rather to iterative improvements of a solution produced during a previous CBL cycle. At the beginning of the experiment, learners were given the opportunity to select a solution from a previous challenge (approximately two months long) regardless of whether they had not originally been part of the group that developed it. Ultimately, eight student-developed solutions were selected.

Our hypothesis is that this once-a-week approach may provide learners with opportunities to develop skills not typically cultivated during traditional CBL cycles. Figure 3 illustrates the Bonsai pedagogical approach, which integrates CBL with spaced repetition (Kang, 2016) and extends ownership, motivation, and accountability over a longer timeframe to foster multidisciplinary skills.

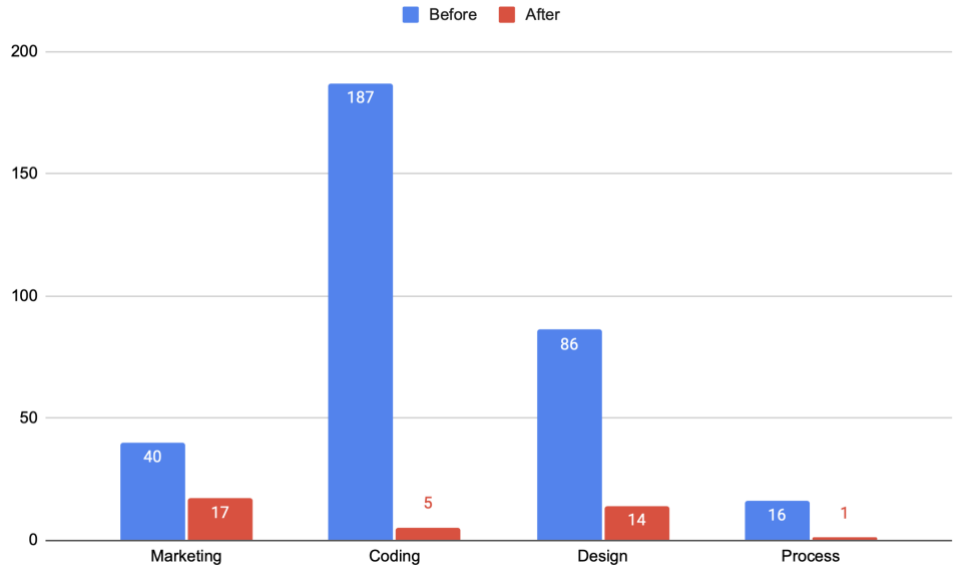
Figure 3
Pedagogical Triangle Illustrating the Integration of CBL and the Bonsai Approach. Each Side of the Triangle Represents a Core Component Contributing to Holistic Skill Development in Learners



To assess this, we used an internal list of skills covering several learning objectives. A panel of researchers ranked these skills, and those related to competencies requiring longer sustained effort (n = 37) were then used to create a questionnaire intended to assess learners' perceptions of their development in these skills. The skill categories were: Marketing (e.g., product management), Process (e.g., project management), Coding (e.g., working with developer tools), and Design (e.g., creating prototypes). Figure 4 shows a before-and-after ranking chart of skills by category, demonstrating that more Marketing and Design skills were deemed to require longer sustained effort.

Figure 4

Before-and-After Ranking of Skills by Category, Illustrating the Proportional Increase in Marketing and Design Skills Identified As Requiring Longer Sustained Effort



The questionnaire, based on the list of 37 skills, included 29 Likert-scale questions as well as open-ended questions. Table 3 presents some examples and responses. Related questions were grouped into the following sections: (1) general/introduction, (2) design patterns, (3) visual consistency and design, (4) developer tools, (5) entrepreneurship, (6) inclusivity and accessibility, (7) product management, (8) engagement, and (9) revisiting a past CBL solution. Each section was introduced by a reflective question with an open-ended response, intended not only to gather qualitative answers but also to prime respondents, allowing them to answer the questions more thoughtfully and with less influence from environmental contexts (Smith & Vela, 2001).

Table 3

Examples of Questionnaire Questions and Possible Answers

Question	Answers (Likert scale)
I'm more effective at communicating through postings, presentations, marketing materials	Completely Disagree (1), Disagree (2), Neutral (3), Agree (4), Completely Agree (5), Not Applicable (6)
I'm better at applying best practices in app development.	Completely Disagree (1), Disagree (2), Neutral (3), Agree (4), Completely Agree (5), Not Applicable (6)
I'm better at detecting logic flaws, interface issues and performance issues using an IDE.	Completely Disagree (1), Disagree (2), Neutral (3), Agree (4), Completely Agree (5), Not Applicable (6)
I'm better at implementing accessibility resources in my apps.	Completely Disagree (1), Disagree (2), Neutral (3), Agree (4), Completely Agree (5), Not Applicable (6)
I'm better at defending user's needs based on research and user feedback.	Completely Disagree (1), Disagree (2), Neutral (3), Agree (4), Completely Agree (5), Not Applicable (6)
How would you rate your overall satisfaction with the opportunity to revisit a project from a previous CBL cycle?	Very dissatisfied (1), Somewhat dissatisfied (2), Neutral (3), Satisfied (4), Very satisfied (5)
Describe moments when you participated in making important decisions related to visual consistency or brand identity.	Open-ended

From a quantitative standpoint, the median value for most questions was 4 or higher on the Likert scale, indicating overall net positive results. Notable exceptions were the questions listed (paraphrased for brevity) in Table 4, which included three neutral results and two very positive results. The neutral results addressed accessibility, privacy, and the sustainability tripod (i.e., the economic, social, and environmental pillars for organizations that seek sustainable development practices). Although all these areas are extremely relevant, it is understandable that they are not generally priorities when building prototype solutions. The two most positive results were associated with ownership, accountability, and autonomy. Although Marketing and Design skills were previously identified as most likely to require longer sustained effort for improvement, they did not emerge as outliers.

Table 4

Selected Questionnaire Items With Outlier Median Likert Scale Responses

Question	Median (Likert scale)
Implementing accessibility features	3.5
Implementing user privacy protection features	3
Regarding the concepts of the "sustainability tripod"	3
Having autonomy to make decisions and propose ideas	5
Assuming responsibility for the project's results even when not directly requested	4.5

Some of the notable responses, including open-ended ones, indicated that learners faced several significant challenges and learning opportunities, such as: "selling" their solutions to real potential customers or investors; revisiting and refactoring existing codebases, particularly when team members changed; setting priorities, adjusting roadmaps, and coordinating communication and work within their teams, especially given the need to balance short timeframes (one day per week) with ambitious goals; and switching to a different project at the end of a work week.

Recommendations

Based on questionnaire data collected and our direct observations, we propose the following recommendations to enhance the effectiveness of the Bonsai approach:

(1) Project selection directly affects continuity and efficiency. We recommend choosing projects in which at least one team member has prior knowledge or previous involvement, in order to facilitate onboarding, ensure continuity, and avoid refactoring. Furthermore, switching teams between cycles should be strongly discouraged.
(2) Refactoring or rebuilding is often favored over pursuing incremental improvements. Prioritize targeted enhancements, novel features, and user-driven refinements, reserving complete rebuilds for situations where they are essential and directly support project goals or long-term maintainability.
(3) Focus on achievable goals within the available time (one day per week). Prioritize tasks and concentrate on the most impactful bugs, usability issues, or feature requests.
(4) Involve real users, industry partners, or community members in feedback and validation processes. Encourage teams to test their solutions with actual users and iterate based on real-world feedback, not just theoretical improvements. However, given the limitation of working on the project only once a week, scheduling user testing may be challenging.

Conclusions, Limitations, and Future Work

Based on our direct experience and questionnaire responses, we conclude that the Bonsai approach did provide learners with opportunities to develop a distinct set of competencies, particularly in relation to learners' ownership and accountability for their proposed solutions, beyond merely delivering them at the end of a traditional CBL cycle. Moreover, we measured an overall positive impact across all skillset categories, which supports the hypothesis that the impact of the CBL methodology can be intentionally extended beyond its cycle.

These findings suggest that the Bonsai approach does, indeed, expand the educational value of CBL and enables the development of a distinct set of competencies with reduced overall time investment, while emulating some of the complexities found in real-world professional environments.

Our experiment was conducted with a cohort of 40 learners over 10 weeks. A larger sample size and varied timeframes would likely yield more robust conclusions. Moreover, as this represents the initial phase of an ongoing experiment, the results cannot be generalized. It is also important to observe that the authors are directly involved with the learners and the application of the CBL approach, which may introduce researcher bias.

For future work, we are conducting two additional interventions during CBL cycles and introducing modifications. Previous observations indicated that holding sessions late in the week can reduce focus and productivity due to fatigue; therefore, we are currently experimenting with Mondays instead of Fridays. The new "Bonsai Mondays" ate intended to help prevent diminished outcomes. We plan to run two CBL cycles in parallel with Bonsai Mondays, one lasting 12 weeks and the other 8 weeks, with results again assessed by questionnaires. Additionally, we are seeking other cohorts willing to adopt this approach, in order to expand the sample size and enable more robust conclusions.

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

This paper acknowledges the use of AI-assisted technologies in the writing process. These tools have been utilized to enhance the language and clarity of the manuscript, as well as to provide translations related to the questionnaire applied during the research, which was done in Portuguese. AI was also used in the literature review to make the process more efficient by using machine learning through ASReview LAB, an academic tool built for such purpose and validated by van Dijk et al. (2023), as explained in the methodology. The authors strongly reiterate their complete control over and responsibility for the final content presented in the manuscript. All use of such technologies has been done with ethical care to make sure any tools or methods complement and support the scholarly rigor that a research process requires.

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Challenging International Social Mobility Narratives: The Emergence of the "Digipolitan"

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Abstract

Traditionally, social mobility has been cultivated through elite educational institutions such as boarding schools and private academies. These physical spaces are embedded within national and class-based hierarchies all around the world. However, the rapid expansion of online schooling in a post-COVID-19 world has begun to disrupt these established pathways. This paper theorizes the emergence of a new form of transnational subjectivity. This is termed as *digipolitanism*, enabled by the digitization of education. As access to physical migration through education becomes increasingly restricted due to rising financial barriers (e.g., heightened VAT in the UK's private education sector), families and students are turning to digital alternatives. British online schools now act as virtual conduits of cultural capital, allowing students to accrue the social and academic credentials associated with British education without territorial relocation. Attached capital rather than pure knowledge gained becomes more of a currency for the new socially mobile class looking abroad. Rather than mere substitutes, these online platforms may be constructing an emergent globally mobile class whose identity and aspirations are forged in digital rather than purely geographic space.

Keywords: cosmopolitanism, social mobility, education, online schooling, digipolitanism

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Introduction

Social mobility has long been defined as being a structural proposition. Individuals are kept in or out of a specific hierarchy of social classes dependant on various factors.[1] Cosmopolitanism has been developed hand in hand with elitist, socially mobile classes. This study proposes the introduction to the theory behind the conception of *digipolitanism,* intent on highlighting a new path[2] of mobility that is now emergent via online modes of private schooling which have sprung up within the past decade in the United Kingdom. These schools, catering predominantly to an international demographic, facilitate upward social mobility and transmission of British cultural milieu without the need for a student to be physically mobile. The advent of the digital opens up an entirely new route of mobility, with digipolitanism becoming a new milieu to be socially constructed and transmitted, and the digipolitan the newly socially mobile class of young people.

The study of social mobility in the United Kingdom has a long history of looking at quite traditional variables in assessing the extent to which social mobility is possible, as well as what individuals can do to propel themselves forward (Savage & Egerton, 1997) in the rat race up the social ladder. Education has long served as the main transportation system for individuals from one social class to another, with private education for decades holding the biggest sway on factors of upwards mobility, even controlling for other factors (Neelsen, 1975; Savage & Egerton, 1997). Similar to the historical continuation of social mobility, cosmopolitanism too has a historical "traditional" connotation steeped in upper class customs and an out-of-touch feel that makes it unrelatable to many individuals. Cosmopolitanism is something which we must seek to define; *Cosmopolitanism is an ideology which seeks to build a universal political and social community based on values of internationalism, humanism and universality to create a common global society which celebrates local and international attachments/differences.*

This definition of cosmopolitanism assists in grounding the "type" of cosmopolitanism that this proceeding is referring to out of the multitude of cosmopolitanisms that have been identified in scholarly literature and theorised in the plural (Pollock et al., 2000). Cosmopolitanism by nature is Janus-faced. Digipolitanism, therefore, is one of many faces. This proceeding is specified to serve as an introduction to the interrelationships between social mobility and cosmopolitanism, and how this interrelationship is the precipice for the emergence of a new, disruptive theory in the form of digipolitanism.

Literature Review

Social mobility and cosmopolitanism have spent significant amounts of time building well fortified traditional routes. The largest debate relevant to this discussion is the longstanding sociological split between whether one's social status is *ascribed* or if it is *achieved*. In the study of social mobility in the UK, the general consensus has been that structural factors determine if a person is able to climb the social ladder or stay stagnant (Savage & Egerton,

[1] Factors dependent on specific study, from Blau and Duncan (1967); Goldthorpe et al. (1980); Savage and Egerton (1997); Neelsen (1975) etc. factors are dependent on the scope of the study, whether they are intergenerational or not, etc.

[2] Digipolitanism and the proposition of this proceeding are to not convince that online schooling or the concepts presented are not based in sociology of the elite, but that there is a new route available with online education and digital options which lower barriers to entry for private education, simultaneously making it a more accessible option.

1997). In comparison, scholarship in the United States has leaned much further into the consensus that it is individualised factors that determine a person's ability or circumstance to overcome their social status (Neelsen, 1975). With the turn of the 21st century, UK scholarship has begun to also swing towards individualist analysis, and therefore landing most of western sociological scholarship firmly in the status is *achieved* school of thought. This is not to say that they ignore structural factors, but moreso that individuals have a certain degree of agency and ability based on individual characteristics (ibid.). This championing of meritocracy has resulted in decades of UK social policies being based on trying to boost the factors of certain social classes to allow them to better climb this "ladder". However, this system is stagnating. There is a continuous strain between expectations of social climbers and the reality of the economic opportunities available in reality after summiting the next peak of the social climb. This disillusions social climbers, resulting in a "social congestion" where the skills individuals obtain, through education or other means, are not enough to fulfil their aspirational expectations (Brown, 2017). The structural bond between lower social classes' social status increasing due to achieving placement in university is now breaking down (ibid.). The ladder can no longer handle the weight on its own, as global society enters a "war for talent" (ibid.) determined to keep the traditional mobility system afloat while simultaneously stretching beyond social class capacities.

The social ladder exists in a myriad of different dimensions. Social mobility can also be analysed through the lens of cosmopolitanism, where the individual is not necessarily territorially bound (Beck, 2017). Mobility becomes more of a fluid notion, opening up the possibility to analyse mobility through different temporal realities, such as the digital. Cosmopolitanism is no stranger to the advent of the internet. Zuckerman (2013) first proposed the idea of *digital cosmopolitanism* and, with it, the drawbacks of how humanity is "failing" to utilise the global connectivity unlocked by digital means to its fullest potential. Online means of communication connect us with ease to those around us, with numerous people of diverse social backgrounds having basic access to a means to connect. This "everydayness" of digital cosmopolitanism results in a banality towards opportunity, as digital connectivity is seen as the new norm (Ponzanesi, 2020; Zuckerman, 2013). The creation of the new cosmopolitan is argued to be happening in the site of the digital. Traditionally, much like social mobility, cosmopolitanism has been transmitted through the same traditional structures as class mobility, i.e. elite education. It is through the passing directly of high levels of cultural and economic capital that elite social classes are able to remain elite (Neelsen, 1975). The concept of Kantian cosmopolitanism we can argue is a part of higher classes cultural milieu that is transmitted through the hallowed halls of British boarding schools and universities. Individuals absorb and "learn" how to be a "global citizen" through these sites of transmission, continuously reproducing the Kantian cosmopolitan as a locked, elite ideal, inaccessible to common man. Therefore, with the breaking down of the traditional social mobility system, there begins to be an opening in how cosmopolitanist ideals are situated, condensed, transformed, and transmitted. New cosmopolitanisms, in the plural, spring up internationally and in local contextualities (Appiah, 1997; Pollock et al., 2000). With new cosmopolitanisms comes new "rooted and routed" methods of being cosmopolitan (Ponzanesi, 2020) resulting in the cosmopolitan being able to be produced and transmitted outside of traditional elite institutions, breaking the nexus of education -> cultural and economic capital -> higher social class milieu and mobility.

The connecting factor between social mobility and cosmopolitanism is elite educational institutions as a site of transmission. Elite institutions, specifically in the UK context, can be further specified to the boarding school model of education. Students, domestic and

international, are in the prime context for socially mobile opportunities. Or, at least, they are supposed to be. The cultural milieu transmitted through boarding schools is that of the higher British social classes. Boarding schools have therefore been the pinnacle of social mobility in the UK for domestic and international students, with the meritocratic system promising a new *achieved* status upon graduation from their school, namely, to a globally ranked higher educational institution. Yet, this is the same traditional method which is argued to be breaking down. What is filling its place? *Digipolitanism.*

Social Mobility, Cosmopolitanism & Creating Digipolitanism

Given the definition of cosmopolitanism attributed in this study, it is possible to combine this theory with known concepts of social mobility in the context of the United Kingdom and in comparative contexts. Education breeds cosmopolitanism (Howard & Maxwell, 2020), which creates a reproduction of cultural and economic capital. Private education has served as the main mode of "creating" the cosmopolitan since the time of Kant (Howard & Maxwell, 2020) when this role was largely confined to an upper-class elite seeking to expand their knowledge to become more global, and continuing today as a more grounded and accessible phenomenon (Appiah, 1997; Hannerz, 2007; Holton, 2002; Ponzanesi, 2020). Schools within the elite context create a milieu specifically needed to succeed in higher echelons of British society (Neelsen, 1975; Savage & Egerton, 1997) which has occurred and reproduced in this cycle for decades. This cycle has also enabled and invited elites internationally to the United Kingdom through physical migration pathways, such as boarding schools, which take in international students and cycle them through this process of cosmopolitanizing elite education. Elite mobility in this way has been confined and refined to be a physical process, relocating oneself or entire family to a new, cosmopolitanist city with a constructed symbolic appeal. Schools cannot be physically picked up and relocated, forcing international participants to come to them, rather than going to them.[3]

However, there is a new factor emerging in today's society: the digital. Social mobility is no longer constricted to be bred and reproduced solely through the hallowed halls of elite educational institutions in a singular location. Since the COVID-19 pandemic in 2020, there has been a new, disruptive educational player emerging: online schools. The digitisation of education enables international students globally to access a British education through entirely online private schools. British online schools now act as virtual conduits of cultural capital, allowing students to accrue the social and academic credentials associated with British education without territorial relocation. This creates a disruption to the elite mobility confined to physical boarding school-esque institution and leads to the emergence of an entirely new figure of cosmopolitan production: the *digipolitan.*

The figure of the digipolitan alludes to a new type of cosmopolitanism all together; *digipolitanism*. Cosmopolitanism is a plural concept (Appiah, 1997; Holton, 2002) and has many branches and therefore many figures which embody the definition of cosmopolitanism. Enabled through the globalization of the digital, the digipolitan is able to gain cultural capital through entirely online means. Online schools purposefully circumvent many of the barriers to entry that are seen in private British schools, with high tuition costs being the most glaringly socioeconomically bound factor. International families are now able to look at

[3] It's important to note that also within the last decade many elite institutions have been opening up "satellite" campuses in other countries for specifically the stated reason they have not done "going to them [internationals]" to create more opportunity for those unable to physically immigrate to the UK, i.e. Haileybury school in Kazakhstan.

alternative options to access elite education. This opens up a whole new world, and numerous new pathways of social mobility which skirt the traditionally held and guarded pathways of British elite schools. The digipolitan is new, *global*, and disruptive.

Digipolitan/ism

Digipolitanism is proposed as the newly emergent branch on the tree of social mobility. Digipolitanism is not argued to be a complete takeover of the traditional methods of social mobility, but a new option that is made possible by the advent and the development of the digital. The digipolitan is emerging, but it's also already here. Just as Zuckerman[4] proposed digital cosmopolitanism(s) all the way in 2013, over a decade ago, the concept of digipolitanism has been growing. To seek out a definition of digipolitanism, it can be tentatively defined as *a cosmopolitanism centred in the digital.* In seeking to place a definition without using cosmopolitanism as a defining word, we can tentatively define it as *a concept rooted in human connectivity, opportunity and social production through digital means.*

This places digipolitanism as a solidly sociologically based conception, yet suspended in a temporality, much like traditional cosmopolitanism. However, digipolitanism is specifically a disruption to the traditionalist definition of cosmopolitanism, as the digipolitan is arguably solidly anti-Kantian. The Kantian[5] definition of cosmopolitanism is centred around Kant's original conception presented in *Idea for a Universal History from a Cosmopolitan Point of View* and *Perpetual Peace*. Kant's cosmopolitan however is defined by the historical context of him and his cultural milieu, namely a heavily colonialist notion. This has tainted the definition and conversation around cosmopolitanism as a colonial project and the cosmopolitan as a colonial figure. Yes, Kant's cosmopolitan is the pinnacle of the colonial figure: white, male, wealthy, Kant's cosmopolitan was able to navigate the many vestiges of the British Empire with ease of affordability based on his race and his class. This is not to negate that Kant's definition has not bled into modern conversations and definitions of cosmopolitanism, but just the opposite. Today's society has multiplied and multicultural-ised beyond's Kant's deepest nightmares.[6] Digipolitanism is situated simultaneously as a disruption to cosmopolitan thought and traditional social mobility, but it is also a clear inheritor of the elite milieu that precedes it.

In introducing digipolitanism as a concept, we must also introduce who is the *digipolitan*. By definition, anyone can be a digipolitan, if they are actively taking part in socially mobile options and utilising the digital for means of migration and mobility, we could call them a digipolitan. Digipolitans look at the conceived banality of digital connectivity as a web of opportunity. Digipolitans can be simply defined as *individuals of an international demographic who are socially mobile through digital means and able to access private methods of mobility.* "Private methods of mobility" we can pinpoint to private education or training that might be found in the traditional collection of social mobility tools. Uniquely digital jobs have also become available which are a generational hallmark not found in preceding studies of intergenerational mobility. Digital jobs, such as the influencer, allow a

[4] Digipolitanism is not equivalent with Zuckerman's (2013) digital cosmopolitanism, but again a branch on the populous tree of cosmopolitanisms.
[5] Translation and edition of Kantian corpus is 1991's *Kant Political Writings*. Second Ed. Cambridge University Press.
[6] Ponzanesi 2020 offers a comprehensive "list" of the "types" of cosmopolitanisms which have emerged in recent social thought, including Zuckerman's 2013 digital cosmopolitanism.

specific kind of social mobility and construction of social class (Mamba & Beharry-Ramraj, 2022; Polson, 2019).

As a critique of this, the "digital nomad" may be conceived as a digipolitan. Arguably, the digital nomad is an extension more of the Kantian conception than anything just argued as the digipolitan. However, the conversation of cosmopolitanism is continuously suspended in its historical connection and complicity in colonialism (Ponzanesi, 2020). Digipolitanism is meant to be a disruptive revision to this, offering a more mediated, postmodern approach to the ongoing discussion of cosmopolitan thought. Cosmopolitanism in itself is not a dirty, colonial word. Digipolitans are not Kantian cosmopolitans, they are the inheritors here to change this outdated perception. Digipolitanism represents the extension of cosmopolitan thought into a more diverse future, where more individuals, who explicitly do not meet the Kantian ideal, are able to access formerly "elite" measures of mobility such as private education. It is through the digital that cosmopolitanism finds this grounding to be able to expand outwardly and more accessibly, rather than simply touting the traditionalist line.

Emergence of Online School as a Digitised Version of the Educational Factor of Social Mobility

In seeking to define digipolitanism and the digipolitan, we can also offer a site in which we might find this as a normative concept in action. Traditional methods are now starting to fail (or arguably, always were) to produce the next generation of cosmopolitanists. International students must seek alternative pathways to fulfil and overcome the global war for talent and simultaneous constraints placed on them by ethnonationalist policies and parties which are springing up across Europe and the United States (Brown, 2017; Ponzanesi, 2020). This has arguably led to the necessity of alternative pathways of mobility having to emerge as traditional routes are continuously constricted. This has led to the digitalisation of educational mobility pathways, with online schools cropping up via a multitude of national educational qualifications (US based, British based, etc.).

A site in which we can find digipolitanism in action is in online schooling. Online schooling has astonishingly little literature or scholarly attention, even as it is a phenomena emerging since the advent of the internet in some cases.[7] However, online schooling as a sector within the educational field is mostly attributed to solutions derived from necessity during the COVID19 pandemic in 2020. With traditional schools unable to operate, education took to the digital as a solution to continuity of learning without physical space. Families in the United Kingdom and abroad were able to access British education without having to deal with the demand of physically attending a school. Particularly for internationals, this opens the opportunity to receive and obtain a British qualification without having to physically relocate to the United Kingdom. Physical migration and mobility has also been further stifled by post-2020 economic constraints, from a shrinking global economy to financial constraints now placed on elite schools in the United Kingdom, with a 20% VAT levied on all private education schools. This cost, passed on to the consumer, limits a specific socioeconomic class which is now iced out financially from being able to access private education. Online schooling, in contrast, mitigates the majority of costs that are incurred through the traditional educational mobility route. This is where we are able to locate the notion of accessibility in online schooling and this new route of mobility. There is a cost reduction in tuition fees, and

[7] Certain charter and private schools, such as Connections Academy, in the United States have utilised online means of schooling since Skype in the early 2000s.

no costs associated with physical migration (visas, flights, accommodation, etc.). This primes online schooling as a viable and highly desirable alternative to traditional elite education for ambitious, socially mobile international students and their families.[8] These schools are able to manufacture a new type of attached capital to the UK schooling system, making it an attractive status symbol with international appeal. The context in which knowledge is gained becomes more of a currency for this newly socially mobile class, the digipolitan. Rather than simply being substitutes of elite, traditionalist education, online schools are constructing and forming an emergent globally mobile class whose identity and aspirations are forged through replicated forms of the traditional cultural milieu with a different route of transmission. Aspirations of mobility are able to be forged in the digital rather than purely geographic space, circumventing another long-standing notion of elite mobility attached to "cosmopolitan" cities[9] and physical location. The digipolitan has no geographic constraints, as they are able to access their mobile means anywhere in the world simply through an internet connection. The digipolitan is quite literally everywhere.

Implications and Conclusion

As the world continues to digitally globalise, the implication of the digipolitan and subsequent digipolitanism is to reevaluate what it means to be a social climber from a ground up perspective. International students are adapting to a crumbling system and creating something new through the routes that are afforded to them. There is a critique on where or not these digital methods are "better" or as substantial as the traditional routes.[10] Yet, the reality is the "traditional" pathway is becoming more and more of a phantom of social mobility. Unless there is radical change in policy in both social and educational forms, the digital is where flocks of social climbers will turn to.

Digipolitanism is not proclaiming to be anything "new", but does offer a new lens and dimension of understanding to what sociology can consider in the fields of cosmopolitanisms (Pollock et al., 2000; Zuckerman, 2013). Digipoiltanism is new in the normative sense, that there is a new, pinpointable route of mobility that is now able to be identified. Going forward, in the sociology of education urgent attention is needed in the analysis of online schooling. As an emergent sector, it is an amalgamous force reckoning with the educational routes and definitions that digipolitanism seeks to disrupt with its temporal modality. There are many things unable to be stretched, stress tested, and argued in the confines of this proceeding regarding digipolitanism, an acknowledged limitation. The theory of digipolitanism is now to be field tested and further defined, post its introduction to scholarship.

Digipolitanism is here to stay, and it is the future of the cosmopolitan tradition.

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[8] A Benton is currently researching a qualitative research paper on British online schools. Forthcoming.
[9] London is the central example in this case, but also can be applied to other "western" capitals that have a socially constructed status symbolism attached to them, such as Berlin, Paris, New York, Los Angeles, etc.
[10] There is social commentary and critique on if online school is a detriment or the future of the educational sector, yet little literature on the topic. Benton (forthcoming) on online schools and creating digipolitanism is creating a foray into study of this sector of online schools.

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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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As Fire Burns Both Here and in Persia: The Internationalisation of Legal Education as a Cosmopolitan Educational Paradigm

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Abstract

The discipline of law has to rediscover its original universal educational configuration. The subject of law with its roots lost in the passage of time, from the study of justice, fairness and equity in Greek philosophy to Gaius's Institutes in the second Century AD and the Institutes of the Justinian codification in the sixth Century AD, is one that was once deemed rather universal in its educational configuration and philosophical outlook. The revival of the study of law otherwise occurred in Bologna in the eleventh Century AD and the subject grew significantly post the 1648 Westphalian paradigm, which marked a new era for the discipline of law altogether: the rise of the modern nation state and, by extension, the legal codifications movement. The paper, taking into account all these developments, posits that the subject of law was once international in and of itself; so were many of its educational aspects. It further posits that law as a discipline has to rediscover its traditional spirit of universality in furtherance of a more cosmopolitan educational paradigm. The paper concludes with an overview of its main findings.

Keywords: internationalisation, legal education, cosmopolitanism, education, law, 1648, Treaties of Westphalia, Peace of Westphalia, comparative law, international law

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Introduction

The paper explores the connection between the concept of internationalisation of legal education and the creation of a cosmopolitan paradigm in the area. In furtherance of its analytical goals, the paper draws a parallel with the universal character of Aristotelian justice, as prescribed in *Nicomachean Ethics*. The contribution concedes that law as an academic subject presents us with a highly divided discipline but it is also posited that law ought to rediscover what the author would call its original educational configuration which perceived the study of law as rather universal matter. The sophistication of modern societies and the departure of the world's modern legal systems from natural law understandings continues to make law a highly fragmented discipline at the world level, as law still comes with a strong national flavour; so do the world's legal educational systems. One would, therefore, be plausibly reminded that law is to this day the toy of the nation state. Nonetheless, law's almost natural adherence to the nation state due to the 1648 Westphalian paradigm has had considerable implications for legal education. The 1648 paradigm (see the two Treaties of Westphalia and the effective rise of the modern nation state) has defined the modern discipline of law but it would be key to rediscover law's universal spirit in legal educational terms for the benefit of the societies of the future.

Methodological Considerations and Hypothesis

When it comes to the paper's methodology, this contribution uses legal historical and legal theoretical matter to promote its key tenets and findings. The paper practically falls in the wider field of legal theory and comparative law vis-à-vis legal education. The working hypothesis of the paper is that a more internationalised type of legal education would effectively result in a more cosmopolitan educational paradigm benefiting both the discipline itself and students of law. It is taken that internationalised legal education would stand for a more open-ended type of legal education which would not concentrate on domestic legal matter to a very significant extent, as seems to currently be the case, but would be one that would balance between such matter, i.e. domestic matter, and forms of law that would create global jurists and so on.

Aristotelian Justice and Cosmopolitan Legal Education

> Some people think that all rules of justice are merely conventional, because whereas a law of nature is immutable and has the same validity everywhere, as fire burns both here and in Persia, rules of justice are seen to vary. (Aristot. Nic. Eth. 5.7.2)

A parallel as to the possibility of a more cosmopolitan type of legal education for our future graduates could be drawn with Aristotle's classic position on the perception of justice around the world. This is not a paper about Aristotle's perception of ethics and justice but, for the benefit of the reader, Aristotle's quote (Aristot. Nic. Eth. 5.7.2) tell us this at the very least: natural justice is universal, while justice based on domestic positive instruments of law would be conventional and, potentially, particular and specific. There are lessons to be learnt for legal educationists in this respect. If Aristotle was right, i.e. if justice could have both a universal and a more particular character to it, legal education too could be perceived as one that has a specific domestic essence e.g. emanating from specific positive instruments from the domestic sphere and a more international essence e.g. one pointing to a more universal type of essence for the international sphere and/or from natural law. As expected, most jurists would not object to such a distinction but would beg to differ when it comes to the semantics

behind such distinction; also, jurists (international lawyers included) would readily remind us that even international law is not as universal as one would normally expect. For instance, an American lawyer, whilst respectful of the essence and the value of international law, could speak of American exceptionalism in the sphere of international law by justifying their view through the supremacy of the American constitution in the US legal order. A Chinese law professor's view of international law would not always be agreeable to the views of an international law professor from France or the United Kingdom and so on. Yet the point remains: there is a more specific domestic essence to law and a more universal one to it. Drawing on this distinction, a legal educator should consider law's tendency (as in the academic subject's tendency) to currently emphasise and focus on domestic law considerably more than a type of study of law that would move beyond the domestic. The same educator would ideally have to move beyond the domestic, after a certain point, and they would do so not just for the benefit of the discipline of law but also for the benefit of the student body. Of course, the pragmatic argument here would suggest that there are utilitarian reasons behind law's current domestic-oriented tendencies but the counter-argument would be that the emphasis on a domestic perception of law would actually seem to favour the production of future practitioners (or students who would have future legal practice in mind) rather than the production of future jurists.

Historical Origins of the Modern Discipline of Law

It would otherwise be close-to-impossible to precisely identify the roots of law as an educational reality under current sources. The names of Code of Ur-Nammu from the 21st Century BC; the Code of Lipit-Ishtar and the Code of Eshnunna both from the 20th Century BC and the Code of Hammurabi from the 18th Century BC would ring bells to legal scholars and would be revealing of the value of law in ancient Mesopotamia. Archaeologists, jurists and historians would, of course, argue as to whether these "codes" were legislative instruments *per se*, compilations of past cases in abstract form or jurisprudential works. Kraus (1960, p. 283ff), for instance, argued that the Code of Hammurabi was a jurisprudential work. If so, it could be taught, taken into account in judgments and, generally, act as something that could be transmitted through instruction. As such, Mesopotamia could be taken to be a serious candidate as to where law was first "taught" and transmitted. Moreover, law seems to have started educationally as a rhetorical and philosophical exercise in Greece. Much of modern law's philosophical outlook and educational configuration, especially when it comes to questions of morality and a virtuous type of living, seems to be traceable in ancient Greece. Candidates in this respect, when it comes to the roots of the modern subject of law as an educational artefact would historically range from the sophists and Socrates in the 5th Century BC to Plato and Aristotle's teachings and writings in the 4th of Century BC. Sophists, for instance, would be intellectuals that would teach rhetoric, amongst other subjects, for a living. Rhetoric at the time would be what we could call nowadays advocacy skills and the related. Of course, the two terms "advocacy" and "rhetoric" are not identical, yet they are synonyms. In China, from the 5th Century BC onwards, one observes the rise of what has been anachronistically and conventionally known as the School of Legalism (*fa*), but it would seem that the particular school would include elements both from the school of law and administrative science, so to speak. Cicero in the 1st Century BC with his famous *ius gentium* theory spoke of the universality of law through the law of nations, the particular law being applicable to all humanity, thereby at least implying that the subject of law is international in and of itself in the central area of law defining moral obligations for diverse peoples and nations. Later at Rome, once again, in 2nd Century AD, one observes with Gaius' Institutes, the first systematic and elementary study of Roman law in a single treatise

when it comes to a particularly extensive area of law, that of Roman private law. In the Eastern Roman Empire, in the 5th Century AD, one notes the Justinian Codification (*Corpus Iuris Civilis*), which for legal educators and students of law contained the Institutions (*Institutiones*), a student law textbook *mutatis mutandis*, based to a significant degree on Gaius' Institutes. In 11th Century AD, we observe the revival of the systematic study of the subject of law at the University of Bologna, which was established in AD 1088 and which to most scholars would be taken to be the first modern university. Others argue, however, that it was Al-Qarawiyyin in what is modern Morocco that acted as the world's first modern university, it having been established as a mosque in AD 857. It acted as a leading centre of the Islamic Golden age and it was down to Islamic scholars that Aristotle's works were salvaged for the West. In any case, moving on, one reaches 1648, which stands for the Treaties of Westphalia, the conventional point of time signifying the rise of the modern nation State. The Peace of Westphalia has had major implications for the rise of nations in Europe and around the world. Finally, the national codifications movement took nations, the legal and the political world and legal educators around the world by storm, especially in the 18th and the 19th centuries AD, the first modern codified texts being the Statutes of Lithuania from the 16th Century AD, the Constitution of Corsica of 1755 and the Constitution of the United States of 1789. However, the most well-known examples of modern codifications are -by far- those of the Code Napoleon of 1804 and the German Civil Code of 1900. These were and are codes which did not only affect whole nations and legal systems but legal education too.

1648

For lawyers, 1648 is a landmark year for the rise of the more modern study of law. This is the year in which the Treaties of Westphalia were concluded. The treaties have been celebrated and known as the Peace of Westphalia. In any case, these two treaties have had major impact on the world of modernity, the particular treaties effectively giving effect to the modern state. As such, not only would certain new nations be formally recognised through these treaties but the principle of sovereignty would also be established. By extension, the principle of non-intervention on the internal affairs of other States was also recognised (e.g. Grote, 2006). As such, the same instruments would lay the foundations for the modern international system, even though Grotius would have laid somewhat earlier than the Peace of Westphalia certain key theoretical and jurisprudential foundations of modern international law through his work *On the Law of War and Peace*. To this day, the modern international system revolves around the Treaties of Westphalia, even though certain scholars would object in relation to the existence of the Westphalian system and its importance (e.g. Osiander, 2001). For most scholars of international law and history, however, international law still effectively revolves around the Westphalian system in one way or another (e.g. Nathan, 2002). The rise of the modern nation state did not simultaneously come about with the rise of modern nationalisms. However, the overconcentration of certain modern nation states on the idea of the nation eventually led to the rise of nationalisms in late 18th and early 19th Century (e.g. Kohn, 1939, pp. 1015-1016). Yet, it would be a mistake to blame the rise of nationalisms on the Treaties of Westphalia and the Westphalian paradigm. Nonetheless, the Treaties of Westphalia and certain of the aspects with which they came, created one of the conditions precedent (modern nation State per se in Europe and the world) for the eventual explosion of nationalisms in the 19th and 20th Century and so on.

Law as a Predominantly Domestic Subject

By all means, law around the world as a taught subject is a domestic or a predominantly domestic subject. What modern legal educationists face is effectively a situation where law is still perceived as a predominantly domestic type of study, because law is perceived as predominantly domestic matter post the 1648 paradigm. Of course, comparative lawyers would tell us that most of "national" or "domestic" laws are on many occasions not the result of domestic genius but rather the result of attentive or not so attentive comparative legislative and judicial exercises. The situation in law is so peculiar that not even the subject of international law, while universal formally (Scoville & Marcovic, 2016, p. 119), is that international, for one has it that the perceptions of international law around the world are not quite exactly the same (Roberts 2017, pp. 1-18) or cosmopolitan (Scoville & Marcovic, 2016, p. 135). Law, the toy of the nation state, has had to follow suit in legal educational terms, legal education being a by and large national exercise (*Landesjurisprudenz*). Major exceptions to the study of law as a predominantly oriented subject toward the domestic sphere, would be the study of comparative and international law subjects. The more domestic character of the subject of law as a taught subject still somewhat prevails in legal education. Nonetheless, it should be reiterated that there are positive developments in the sector, making the subject of law somewhat more open-ended, international and less parochial in its outlook. For instance, the comparative law/legal historical approach in any subject of law would make our subject more outward-looking and, by extension, more internationalised and cosmopolitan.

Three Schools of Thought in Modern Legal Education

We, in law, operate in environments of legal education that are largely designed for the national sphere. Exception to this is the delivery of more "international" subjects e.g. international and comparative law. However, even in these subjects there would be national predispositions in the way these subjects would be delivered. The classic example here would be the teaching of a legal doctrine, which could have never been identified its roots, its sources or its origins, when delivered to the law students of hypothetical legal system X. It would be simply delivered as national legal matter. Moreover, while law leads amongst the theoretical disciplines, it is deemed to be rather peculiar in epistemological terms. Here's why: "[t]here is no such thing as 'German' physics or 'British' microbiology or 'Canadian' geology" (Zweigert & Kötz, 1998, p. 75). As things stand, law is otherwise defined by three schools of thought when it comes to its theoretical orientation and, by extension, when it comes to legal education (see Figure 1 below). The author posits that the following three schools are the leading schools of law in contemporaneity:

Figure 1

The Division of Scholars in Law and Legal Education



The legal Westphalians would be nation-oriented, pro-sovereignty and, under this school of thought, there would be a clear, if not a celebrated, tendency towards the theme of law and authoritarianism. According to them, most modern law seems to be still based on the Westphalian paradigm and modern law would still be a largely authoritarian device. However, in our interconnected and globalised world, these folks are losing ground: the nation and national law are important but not as important as they once were. Also, while the scholars subscribing to this school of thought would not be legal nationalists, legal nationalists would more comfortably sit in this school and many could mistake legal Westphalians for legal nationalists. Moreover, the legal Westphalians would practically oppose liberal cosmopolitanism and liberal constitutionalism. Indicative representatives of the legal Westphalians would be Thomas Hobbes and Carl Schmitt. The legal universalists, on the other hand, would effectively stand for law's more pro-cosmopolitan and pro-internationalisation scholars. They would normally question law's "traditional" authoritarianism and inward-looking tendencies and would be sceptical of the centrality of the nation in modern law and, by extension, in modern legal education. Indicative representatives in the area would be William Twining and the late Basil Markesinis. Last but not least, one would observe the school of legal conservatives. These folks are practically the status quo in many law schools around the world. They generally do not react to external stimuli e.g. from other disciplines and most of them do not come with any special legal flavour or original ideas in their thinking, as they are generally characterised by apathetic and subject-conservative tendencies. Representing an intellectual stream of compromises at best, they do not seem to favour any significant reform in the subject of law and established forms of legal education, unless absolutely necessary. As stated, they are the status quo in many places around the world, practically making the conservative subject of law, even more conservative than already is: even the legal Westphalians might once looked like mavericks when compared to the more conservative colleagues in the discipline of law.

Cosmopolitanism

Cosmopolitanism, on the other hand, has to do with the creation of world-class citizenry (Platsas, 2015, p. 156). In pure epistemological terms, most other academic subjects tend to come with a universal essence to them, while the situation in law could be described as one that comes closer to domestic realities. However, even the subject of law, especially in the last 80 years+ seems to slowly but steadily appreciate the value of a more extrovert approach in its delivery and study. In any case, cosmopolitanism, a largely unknown idea in the modern school of law, relates to a moral commitment to the universal human community (Flood and Lederer, 2012, p. 2514). This idea has conquered the developed world, in that the most developed of legal systems and societies are and would like to perceive themselves as more cosmopolitan than not. A true cosmopolitan always appreciates the diverse but never belongs or subscribes to a given locality. Cosmopolitanism is a "personal tendency to orient oneself beyond the boundaries of the community one belongs to" (Merton, 1957, p. 387ff). It is an idea that hovers between culturalism and universalism. In law, the legal cosmopolitans would need at the very least "a language of legal theory that could transcend legal cultures" (Bradley, 2000, p. 465, on Twining). So what is the point of the cosmopolitan exercise exactly? What is the point of cosmopolitanism for lawyers? Can the idea of cosmopolitanism through the greater internationalisation of our subject result in the production of better law graduates in the future? The answer is in the affirmative. Here's why:

- **Educational benefit**: a cosmopolitan type of legal education would amount to world academic citizenry for our future law graduates (as opposed to acquiring national academic citizenry in a given domestic law).

- **Discipline benefit**: over-fragmentation in law itself as well as in the ways law is taught does not seem to have benefited the discipline, which does not come with a universal essence that one would typically observe in almost all academic disciplines. Law can, therefore, come with more cosmopolitan and internationalised educational models, which would benefit it as a universal type of study.
- **Practical utility**: in an increasingly interconnected world, the need for global lawyers becomes ever more relevant. A more internationalised type of legal education would not only prepare better law graduates but also future global lawyers and jurists.
- **Epistemological benefit**: the discipline of law will become more coherent and will come somewhat closer to the universal character of the majority of disciplines.

Cosmopolitan Legal Education Through the Internationalisation of the Subject of Law

As the world goes, the subject of law is relatively inward-looking and nation-oriented in the main. The subject of law is a by and large domestic subject. This being the case, it is posited that the subject can become more extrovert and certainly more outward-looking by moving to more internationalised forms of education. Such forms of legal education would *mutatis mutandis* amount to a more cosmopolitan type of legal education. Cosmopolitan legal education is the future in a world which is already interconnected and where international trade becomes ever more relevant. Here, in this form of legal education, the fine and attentive immersion of law students in the study of comparative law and international law studies would be a *sine qua non*. Our students tend to receive their legal education on domestic matter with only a fraction of their studies dedicated to most elegant subjects such as legal theory, legal history, international law, comparative law and legal sociology. Of course, it is not automatic that all of these subjects will be found to be appealing to most of our law students. Nonetheless, law degrees devoid of these subjects would miss out on so much; so would the law graduates that would never have had the opportunity to even elect these subjects. For many of our students, the undergraduate law degree in Europe and many parts around the world would be their first and their last chance to study the subject of law in their life. What would our response be to these students, if they never had the chance to choose any of the above? What would our responsibility be as academic scholars, if these students would have had a single chance to study the more extrovert subjects in the discipline of law and yet we would not have offered them such opportunity? One cannot expect to create cosmopolitan law graduates or jurists without minimum but sufficient exposure to the magnificent beauty of the aforementioned subjects (the list is not exhaustive). In our efforts to prepare students for domestic legal markets and the job market, we may be missing the overall picture, the overall picture spanning to many more legal subjects than domestic legal subjects. The study of domestic legal matter should not be neglected but would have to be refined. Even domestic subjects can become more “international” through the eclectic and careful incorporation of comparative legal elements in their delivery, elements which students tend to find of great interest, not least because these elements intrigue their academic curiosity. Suppose one had the choice between creating law degrees with exclusively domestic subjects and degrees with certain domestic subjects and subjects that would cultivate a more internationalised type of legal education. What would the students choose between the two? Whereas one could have highly motivated and focused students on domestic law, the chances are that most of our law students would wish to be able to elect subjects and law degrees that would trigger their legal imagination and would expand their intellectual horizons beyond the domestic sphere, in which case the choice in favour of more internationalised, more open-ended, more cosmopolitan degrees and studies would be an obvious one. The future lies in more cosmopolitan legal studies or what the world calls

"internationalised" law degrees. And the future is now: it is one thing to have a degree that would allow you to navigate domestic law and quite another if your degree would allow you to do so but also prepare you to become a jurist or even a global lawyer.

A More Cosmopolitan Discipline of Law

Surely, when Aristotle posited his famous universal concept of natural justice (Aristot. Nic. Eth. 5.7.2) and the fact that, while there are differences of government from country to country but only one form of government which is the "best" (Aristot. Nic. Eth. 5.7.5), his call was a universalist one. In law, due to the Westphalian paradigm, that old traditional position is not as prevalent as it once was and this should come with wide-ranging connotations for legal education in the future. The subject needs to rediscover the idea of cosmopolitanism and its universal essence, as it may eventually deteriorate to a highly provincial exercise, when law can be expansive, fascinating and outward-looking. Thus, the point to be made is that despite conventional differences from legal system to legal system, there is value in seeking the universal in educational terms, because there is a considerable element of universality in certain of the things we do in law. In this respect, Twining reminds us that "a more cosmopolitan discipline of law needs to engage with problems of constructing just and workable supra-national institutions and practices" (Twining's Oxford Law Faculty webpage – accessed July 2025). In a globalised world, local legal problems are normally dealt with by way of local legal solutions but, as the author has maintained elsewhere, international problems are axiomatically best dealt with by way of international legal solutions (Platsas, 2017, p. 14). For our future lawyers to deal with such international matters, one must start preparing them as law students from their first law degree already, and the way forward here would be to create more cosmopolitan/internationalised forms of legal education in the first place.

Conclusion & Recommendations

Ultimately, the question is not whether more internationalised forms of legal education, generating cosmopolitan law graduates in the future, should be the case. The question would be how one would achieve this. A number of recommendations would be made in this respect. First, one would need to create a common language of legal theory, one that would be intelligible to legal scholars around the world. Second, as opposed to examining the particular in law mainly, one should proceed with the examination of both the particular and the universal in law: more balanced legal education models between the domestic and the international sphere should be on offer to our future cohorts of law students. Third, as opposed to examining the domestic side predominantly, future law degrees ought to explore in greater depth the value of harmonisation of laws, something that would come in agreement with the interconnectedness of economies in our globalised world. Fourth, legal educators ought to also cultivate the study of the relationship between local and global law. Moreover, the exploration of more comparative law, international law, legal theory, legal history and socio-legal subjects in the curriculum should be the case. A need for a cosmopolitan paradigm in the modern law school becomes ever more apparent. Internationalising the subject ought to create better academic citizens and, by extension, better lawyers. A more internationalised type of legal education ought to create this cosmopolitan paradigm: it would allow our students to more thoroughly appreciate diversity but also universality. World-class law graduates would be created (as opposed to *homines speciales* that mainly specialise in the law of a given locality). The subject would come closer to international law's innate cosmopolitanism (Gordon, 2013, p. 906), while our future lawyers would be able to deal

"with people from different countries, different cultures, with different world views […]" (Martini & Susler, 2011). A more cosmopolitan agenda in the modern law school could also accommodate globalisation as a theme, in that cosmopolitanism can, in principle, make allowance not just for the cultural appreciation of legal matter but also allowance for the appreciation of legal universals which globalisation generates. To conclude, Aristotle's fire still burns all over the world, when it comes to justice and the perception thereof. One would hope that this universal fire will also be kindled in the field of legal education for the benefit of the subject, students of law and the societies of the future.

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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Integrating AI Into Engineering Education: Practical Use Cases for Teaching and Learning

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Abstract

As Artificial Intelligence (AI) continues to transform industries, its integration into higher education offers new opportunities to enhance teaching and learning. This paper presents practical use cases of AI in undergraduate computer engineering courses, focusing on how AI can support instructors and improve students' learning experience in a rapidly evolving technological environment. My experience using AI tools to streamline and enrich various aspects of course design and delivery are shared. These include generating quiz and exam questions from lecture notes, creating multiple variations of assessment items, drafting lab manual templates, designing analytical rubrics for lab evaluations, and developing lesson plans and motivational lecture slides. I also used AI to analyze open-ended responses from anonymous mid-semester surveys to identify common themes for a timely and responsive course adjustments. Additionally, to support students' AI literacy and readiness for industry practices, I designed AI-integrated assignments where students used AI tools to develop codes for a given digital design problem, simulate the outcomes, and critically reflect on the AI-generated solutions. Across all these applications, using well-crafted prompts and moderator strategies significantly improved the quality and efficiency of AI outputs. This paper highlights how AI can be effectively incorporated to enhance instructional design, raise student engagement, and support a more responsive and inclusive approach to teaching.

Keywords: artificial intelligence (AI), computer engineering, ChatGPT

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Introduction

AI has rapidly emerged as a transformative force across industries, reshaping processes, decision-making, and innovation. In higher education, AI's integration has generated both enthusiasm and concern, prompting scholars and practitioners to explore its potential to enhance teaching, learning, and assessment (Groothuijsen et al., 2024; Qadir, 2023; Walter 2024; Vierhauser et al., 2024). Engineering education, with its emphasis on problem-solving, design, and hands-on experience, stands to benefit significantly from AI tools that can provide personalized learning, automate assessment, and support interactive and experiential learning environments (Liu et al., 2025; Walter, 2024; Yelamarthi et al., 2024).

The release of large language models such as ChatGPT in late 2022 has accelerated this discourse by making advanced natural language generation widely accessible (Liu et al., 2025, Neumann et al., 2023). These models can generate code, summarize literature, create instructional materials, and facilitate formative assessment, offering instructors novel ways to streamline preparation and engage students (Yelamarthi et al., 2024). However, their adoption has also raised pedagogical and ethical questions, including risks of over-reliance, internalizing mistakes by students due to unsupervised use of AI, academic integrity concerns, privacy issues and the need to develop guidelines that define acceptable use in educational contexts (Daun et al., 2023; Liu et al., 2025; Neumann et al., 2023; Vierhauser et al., 2024).

Recent literature on AI in programming education further emphasizes that students' outcomes depend heavily on their ability to critically evaluate and refine AI outputs (Choudhuri et al., 2025; Neumann et al., 2023; Qadir, 2023). Moreover, research highlights the importance of aligning AI integration with course level and learning objectives, as early-stage learners may lack the foundational knowledge required to assess AI-generated solutions effectively (Choudhuri et al., 2025).

While the literature has begun to map AI's capabilities and implications, there remains a notable gap in how these tools can be systematically integrated into instructional tasks—such as lesson planning, activity design, formative feedback, and curriculum development—particularly in engineering contexts. Most studies focus on theoretical affordances or isolated use cases, leaving limited guidance on practical, course-level strategies that address both pedagogical opportunities and challenges.

In this context, the present paper offers a practitioner's perspective on the practical integration of AI into undergraduate computer engineering courses. Drawing from direct teaching experience in large-enrollment courses with substantial laboratory components, it examines specific use cases—including AI-assisted question generation, rubric design, survey analysis, and AI-integrated assignments—that illustrate both the promise and pitfalls of these tools. The goal is to provide actionable insights into how AI can be purposefully embedded into engineering education to enhance instructional design, increase student engagement, and support a more inclusive and responsive learning environment, while maintaining academic rigor and fostering critical AI literacy.

The paper is structured as follows. Next section outlines the teaching context in which these practices have been implemented, including course characteristics, class sizes, and instructional formats. The method section details the AI-enhanced teaching practices adopted, while next section presents concrete use cases that demonstrate the application of AI in lesson

planning, assessment design, student engagement, and reflective learning activities. Finally, last section offers concluding remarks and recommendations for effectively and responsibly integrating AI into engineering education.

The Context

The practices described in this section have been implemented in the teaching of computer systems engineering courses at Carleton University, Ottawa, Canada. Specifically, these methods have been applied in Digital Systems Design (SYSC2310, second-year course), Computer Systems Design (SYSC3320, third-year course), and Computer Systems Architecture (SYSC4310, fourth-year course). These are relatively large courses, with over 100 students enrolled in SYSC2310, and approximately 80 students in each of SYSC3320 and SYSC4310. All three courses include experiential learning components, primarily delivered through bi-weekly lab sessions lasting two and a half hours. Given the large enrollment numbers, it is essential to develop engaging instructional materials and provide ample opportunities for self-assessment. In the following section, I describe how I plan to enhance my current teaching practices in these courses. Notably, I have mostly utilized the paid version of ChatGPT as a support tool in this process unless otherwise is specified.

Methods

In this section, I describe my experience using generative AI, specifically ChatGPT, to enhance the effectiveness of my teaching practices. These practices span several core instructional activities in my computer systems engineering courses and include:

- Creating lab manual templates
- Generating quiz questions and variations for real-time or self-paced feedback and assessment
- Designing motivational slides
- Developing ice-breaking activities
- Leveraging learning analytics
- Interpreting mid-semester teaching evaluation surveys
- Designing AI-integrated assignments to explore both the potential and limitations of AI
- Creating experiments to illustrate AI limitations
- Generating and refining rubrics for lab experiments

Based on my experience, several key factors influence the quality and relevance of AI-generated outputs:

- **Context matters**: ChatGPT tends to make assumptions when insufficient context is provided. These assumptions can lead to irrelevant or overly generic content.
- **Logged-in usage improves relevance**: The responses differ noticeably when logged into a personal account versus using ChatGPT anonymously. When logged in, the model learns from prior prompts, resulting in responses that are more aligned with one's teaching context and subject area.
- **Prompt quality is critical**: Providing detailed prompts—such as background information, course level, expected output format, and number of items—leads to significantly more accurate and useful results.
- **Prompt modifiers enhance interaction**: Although ChatGPT does not ask clarifying questions by default, using explicit instructions like “don’t make assumptions” or “ask me three questions before generating a response” can guide it toward better outcomes.

- **Project workspaces improve consistency**: For topics that require multiple iterations, creating a dedicated "project" in ChatGPT allows for persistent instructions and uploaded reference materials, improving coherence across interactions.

Use Cases in Teaching and Learning

Lesson Plan Creation

One common challenge in developing new lectures is creating a coherent and engaging sequence of topics that incorporates examples and active learning opportunities. Generative AI can be highly effective in drafting initial lesson plans. However, outcomes vary significantly based on prompt specificity. For instance, when I asked ChatGPT to "generate a lesson plan to teach finite state machines" without logging in, the resulting plan targeted senior high school or early college audiences. It included examples such as pattern recognition and vending machines—scenarios less relevant for a university-level Digital Systems Design course. In contrast, when I asked the same question while logged into my account, ChatGPT leveraged my prompt history and assumed an appropriate context: an undergraduate digital design course with prerequisites like logic gates, combinational circuits, and basic Verilog. The revised plan included more relevant tools and platforms such as Logisim, EDA Playground, and FPGA boards, significantly improving the usability of the output.

Quiz Generation and Variations for Feedback and Assessment

In large-enrollment courses, manual assessment is resource-intensive, especially when teaching assistant support is limited. To address this, I use tools such as PollEverywhere and Wooclap to deliver real-time or asynchronous self-assessment quizzes. These serve as formative feedback mechanisms that benefit both students and instructors. ChatGPT can assist in generating quiz questions based on lecture content. However, in my experience, generic uploads often yield overly simplistic questions. By specifying the number, format, level of difficulty, and topic focus in the prompt, the generated questions become much more aligned with course expectations. ChatGPT is also useful for producing question variations—though specifying the desired degree of similarity is essential to avoid redundant or overly repetitive items. Careful review remains necessary, as the model can sometimes generate misleading or incorrect combinations of technical concepts (i.e., hallucinations).

Motivational Slides

The first slide of a lecture plays a critical role in capturing students' attention and setting the tone for the session. Connecting course content to real-world applications increases engagement. For example, although SYSC2310 course is generally well-received, the early portion of the course—focusing on Boolean algebra and number representation—can feel abstract and math-heavy. In one lecture on coding schemes (e.g., fixed-point, floating-point, Gray code, and ASCII), I used ChatGPT to generate a motivational slide. It suggested: "Have you ever wondered how your phone stores a text message, or how a calculator displays numbers? That's all possible thanks to codes—structured ways of representing data digitally."

This introductory framing proved highly effective in sparking curiosity and contextualizing the topic, making the lecture more relatable and engaging for students.

Developing Ice-Breaking Activities

One of the effective ways to attract students to the course and build a community is developing ice-breaking activities. With the help of ChatGPT, I could generate a series of interactive question to bring all students to the topic and build an interesting and curios atmosphere. For example, When I asked ChaTGPT to generate ice-breaking questions for my SYSC2310 course, it generated these questions:

- What comes to your mind when you hear "Digital design"?
- Which of these have you used or heard of? Logic Gates, Truth Table, Verilog, Karneough map, FPGA, Boolean Functions
- How many transistors are in a modern CPU in an average PC?

While I previously used ice-breaking activities, I found the ones generated by the ChatGPT much more effective in capturing interest and curiosity, and participation.

Analyzing Teaching-Related Surveys

In order to understand students' learning experience, anonymous pre-course and mid-semester survey is very helpful to get an insight into students' expectations and experience. In pre-course survey, students are often asked about their preferred learning style or anything that can be considered by their instructors to help them succeed in the course. In a mid-semester survey on the other hand, questions normally includes a number of likert questions that measures the effectiveness of different methods or component of the course and two open ended questions that asks "what the students like" and "rooms for improvements". AI can help categorize these comments and prepare an action plan for the rest of the semester or future delivery. This is very helpful to improve the course quality for the students. For this task I used the university provided Co-pilot AI tool that is more secure and does not use or store data for training the models. This is especially helpful for large classes. As an example, an analysis of students' comments from the pre-course survey in SYSC3320 revealed several recurring themes, extracted and grouped using the AI tool Copilot. Many students emphasized the importance of engaging content supported by practical examples and requested that all lecture slides and notes be made available on Brightspace. Others expressed interest in interactive elements such as Wooclap quizzes and suggested incorporating a mix of teaching methods (e.g., chalkboard, whiteboard, iPad) to maintain engagement. Several respondents requested ample practice problems and sample exams to support their preparation, while a few noted accessibility considerations, such as adjusting color schemes for students with color blindness. These insights provide valuable guidance for refining course delivery to better meet students' needs.

Designing AI-Integrated Assignments and Exploring the Potential and Limitations of AI

As AI continues to expand across various sectors, including industry, it is essential that students develop a nuanced understanding of both its potential and its limitations. However, the impact of AI tools on student learning heavily depends on when students use them and how they engage with them.

A recent study (Choudhuri et al., 2025) investigated four phases of AI use in teaching software engineering:

- **L1 (Initial Learning):** Learning new SE concepts from scratch
- **L2 (Incremental Learning):** Deepening or refining existing knowledge

- **I1 (Initial Implementation):** Starting software projects and setting up frameworks
- **I2 (Advanced Implementation):** Optimizing or integrating complex systems

The study found that students perceived AI to be most beneficial during the L1 and I1 phases. Specifically, students highlighted advantages such as personalized support and concept clarification, structured outlines and roadmaps, help with syntax and practice problems, and assistance with brainstorming and initial code scaffolding.

In contrast, students encountered more challenges during the L2 and I2 phases. These included (Choudhuri et al., 2025):

- Misunderstanding generative AI's limitations (C1)
- Difficulty articulating their needs effectively (C2)
- Misalignment with their learning styles or workflows (C3)
- Lack of rationale behind AI-generated outputs (C4)
- Difficulty verifying or adapting AI-generated content (C5)

The root causes of these challenges were identified as (Choudhuri et al., 2025):

- Flawed reasoning (e.g., logical errors, contradictions)
- Poor response quality (e.g., incomplete or inconsistent answers)
- Deceptive outputs (e.g., hallucinations, confirmation bias)
- Context neglect (e.g., failure to consider user preferences or constraints)

In light of this, I have been intentional in how I integrate AI into the computer systems engineering curriculum. For example, I do not recommend the use of AI tools in SYSC2310, a second-year course, as this is a course where lots of initial learning about digital design takes place and students at this stage may lack the foundational knowledge required to critically assess AI-generated content and are more vulnerable to misinformation. However, in upper-year courses such as SYSC3320, I see value in incorporating AI in a structured and reflective way.

One such example is an assignment in SYSC3320, where students are tasked with designing a traffic light controller using AI tools. In addition to completing the design task, students are required to:

- Document the exact prompts they used
- Reflect on their experience using AI

Student reflections varied significantly based on the tools and prompt styles they employed, providing valuable insight into their understanding of both AI's capabilities and its shortcomings. In the SYSC3320 assignment on designing a traffic light controller using AI tools, student reflections revealed a nuanced understanding of AI's capabilities and constraints. Many students appreciated AI's ability to scaffold initial designs, generate structured templates, and clarify Verilog syntax—particularly during the early phases of learning and implementation (L1 and I1). They noted that AI accelerated their workflow, introduced them to new constructs like localparam and case statements, and provided helpful debugging support. However, students also encountered significant limitations, especially during refinement and simulation (L2 and I2). Common issues included syntax errors due to unsupported constructs (e.g., SystemVerilog in Verilog-2001), overcomplicated logic, and a lack of contextual awareness in the generated code. Several students expressed that while AI could produce functional code with the right prompts, it often failed to meet nuanced design requirements without substantial human intervention. Others found that over-reliance on AI

hindered their deeper understanding of state machine design and debugging. Overall, students recognized AI as a valuable assistant for learning, but emphasized the importance of critical thinking, clear prompting, and manual validation to ensure correctness and learning efficacy.

Creating Experiments to Illustrate AI Limitations

While research (Choudhuri et al., 2025) suggests that using AI during the early stages of learning—such as in a course like SYSC2310—may not be beneficial, students may not immediately accept this advice. Therefore, transparency about the reasoning behind this guidance is essential. In future course deliveries, I plan to discuss with students the potential drawbacks and risks of over-relying on AI during the foundational stages of learning, drawing on findings from recent studies.

To make these points more tangible, I have designed hands-on experiments that illustrate situations where AI tools are ineffective or misleading. For instance, I have observed that AI often struggles with simplifying Karnaugh maps (K-maps) for Boolean functions, a topic in SYSC2310, frequently producing suboptimal or non-minimal expressions. I will use this as a classroom demonstration to highlight the limitations of AI. Similarly, AI-generated solutions for finite state machine (FSM) design often include incomplete or incorrect state transitions. This, too, will serve as an illustrative example to help students critically evaluate AI-generated content.

Generating and Refining Rubrics for Lab Experiments

The use of analytic rubrics with detailed evaluation criteria is often recommended to enhance transparency and consistency in assessment (Derahman et al., 2024). However, developing such rubrics can be time-consuming and challenging, particularly for instructors managing large classes where grading efficiency is crucial. To address this, I have leveraged AI tools to design and refine rubrics for grading lab reports. These AI-assisted rubrics are then integrated into the learning management system (LMS), enabling teaching assistants to apply them directly during the evaluation process. This approach not only streamlines grading but also promotes fairness and consistency across sections and markers.

An example of a rubric co-developed with AI is shown in Figure 1. This rubric helped align assessment criteria with learning outcomes while reducing ambiguity in expectations and feedback.

Figure 1

Sample Rubric Designed for One of SYSC4310 Lab Experiments

Criteria	Level 4	Level 3	Level 2	Level 1	Criterion Score
Task 1: Verilog code for cache module	15 points Verilog code is included, its correct and is explained briefly.	10 points Verilog code has minor issues or not explained.	7 points Verilog code has major issues, and/or not explained.	0 points missing this component.	/ 15
Task 2: Top-level design Verilog code	15 points Verilog code is included for the top-level design, its correct and is explained briefly.	10 points Verilog code has minor issues or not explained.	7 points Verilog code has major issues, and/or not explained.	0 points missing this component.	/ 15
Task 4: Simulation	30 points Simulation is complete for all 6 test cases and correct waveform is included, and properly explained.	22 points Simulation has minor issues, or missing some cases, or waveforms are not explained or not clear.	14 points Simulations have major issues.	0 points missing simulation.	/ 30

Criteria	Level 4	Level 3	Level 2	Level 1	Criterion Score
Documentations	10 points Well-organized documentation, includes a conclusion, Names and student ID are included in all codes. Codes are submitted as a separate zip file on Brightspace. waveforms are annotated when needed.	7 points No so well-organized report or missing student name and ID in codes, or not following the submission formats.	4 points Major documentation issues (see level 4)	0 points unacceptable report based on elements outlined in level 4.	/ 10
Checkout in the lab and answering TAs Questions.	10 points checked out and answered any questions if there was any.	7 points not all questions were answered.	4 points most questions were not answered.	0 points did not check out.	/ 10

Total	/ 80

Conclusion

This paper has demonstrated that generative AI tools, when purposefully integrated into the teaching of undergraduate computer engineering courses, can provide substantial benefits for both instructors and students. By streamlining tasks such as lesson plan creation, quiz and exam question generation, rubric development, and survey analysis, AI can reduce administrative workload and allow instructors to focus more on pedagogy and student engagement. Moreover, structured AI-integrated assignments and classroom activities can

enhance students' AI literacy, encouraging them to engage critically with AI outputs, identify errors, and reflect on the technology's capabilities and limitations.

At the same time, the findings reinforce that successful integration requires careful consideration of course level, learning objectives, and students' readiness to work with AI. As shown in both the literature and classroom experience, early-stage learners may be more vulnerable to AI-generated inaccuracies and over-reliance, whereas upper-year students can benefit from structured opportunities to explore AI tools in more complex and reflective ways. The strategic use of prompt engineering, clear guidance, and instructor oversight is therefore essential to maximize the educational value of AI while mitigating risks such as misinformation, flawed reasoning, and reduced independent problem-solving skills.

Looking ahead, the adoption of AI in engineering education should move beyond ad hoc experimentation toward evidence-informed strategies that align with ethical, pedagogical, and disciplinary standards. This includes developing institutional guidelines for AI use in coursework, training instructors and students in critical AI literacy, and building assessment frameworks that value process and understanding alongside final outputs. By combining the efficiency and creative potential of AI with sound instructional design, educators can foster learning environments that are more engaging, inclusive, and responsive—preparing students not only to use AI effectively but also to question, improve, and innovate with it in their future professional practice.

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

The author declares that ChatGPT, was used for proofreading and refining the language used in the manuscript.

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Learning Effects From Decision-Making Processes in a Project-Oriented Teaching Format: Results From a Qualitative Study Using Written Reflections

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Abstract

Project-based teaching methods with teamwork components require various coordination and decision-making processes. This qualitative study looks at these processes and the resulting learning effects for the students exemplified by a community-based research service-learning course. In this course, 15 geography students worked together in several project groups for one year. Written answers from the course participants to specific key questions were used as a methodology for the accompanying research and to stimulate the students' reflection. The following main research questions were addressed: RQ 1 What were the different ways of decision-making and consensus-building in the project? RQ 2 What learning outcomes resulted from the decision-making and participation processes? The written responses were analysed using the qualitative content analysis method, following inductive procedures. It became apparent that various forms of decision-making and consensus-building occurred in the project. These included, in particular, the grouping process of the team, selecting the community partners, the research topic and the tasks. The resulting learning effects are manifold. Particularly noteworthy is the insight gained that everyone should have the opportunity to express their opinion, that the individual strengths of each team member are an advantage, that certain framework conditions should be in place for successful communication, that different forms of participation are conceivable and that different views and ideas offer added value. In conclusion, it can be said that project-based teaching formats with integrated teamwork teach practical and social skills that are valuable for students' future professional lives, including decision-making and coordination processes at work.

Keywords: decision-making, learning effect, learning outcome, community-based research, service-learning, written reflection, qualitative content analysis

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Introduction

Decision-making processes are a frequent area of importance and research interest in the fields of management science and economics, as well as in various other disciplines, such as psychology and statistics (Andreis, 2020). They serve an essential function in the business context and working life, but also in our everyday lives, in negotiation processes in the interpersonal sphere, with the partner, in the family, in decisions that we make as consumers, in setting priorities in everyday obligations and in leisure time, considerations regarding your own further professional development, the professional career, to name just a few areas. In the entrepreneurial context, strategic decisions play a decisive role. These are entrusted to the company's or organisation's leading managers, often a group of people in the top management (Csaszar, 2012) and thus influence the long-term success of the company and the entire organisation and entail a whole series of further decisions at subordinate levels (Harrison, 1996). Ahmed et al. (2014) pointed out, relating to the importance of decision-making processes, referring to Arsham (2010), that "making the right decisions is not only what someone wants to do, but also includes what he has to do. On the one hand, the repercussions of not making a decision could be more severe than making a wrong decision" (p. 80).

However, what exactly does it mean to make a decision? If a decision is made, a choice is made between different possibilities, which are weighed against each other (Andreis, 2020; Churchman, 1968, as cited in Eilon, 1969; Eisenfuhr, 2011, as cited in Lunenburg, 2010; Massie, 1971, as cited in Omarli, 2017; Etlon, 1969; Ofstadt, 1961; Simon, 1968 all three as cited in Harrison, 1996). Another prerequisite for a decision-making process is that there exist a problem that requires a solution (Andreis, 2020; Corcoran-Perry, 1997, as cited in Omarli, 2017). In addition, it is assumed that a decision is made purposefully, i.e. that a specific goal is to be achieved (Churchmann, 1968, as cited in Eilon, 1969; Harrison, 1995 as cited in Harrison, 1996; Massie, 1971, as cited in Omarli, 2017). Andreis (2020) summarised this as follows:

> (…) For a decision to be taken, there must be at least two alternatives available. The decision-making process, therefore, consists of choosing between alternative actions, to which a result corresponds. We can say, however, that the decision-making process cannot begin until the existence of a given problem is explicitely recognized and resolved. (p. 288)

Several people are usually involved in decision-making processes in a corporate or organisational context. Schwarber (2005) mentioned four reasons why it is important for top managers and team leaders to involve other people, team members in the decision-making processes: information gathering, developing solution options, being able to convince and gaining willingness to take action, as well as passing on decision-making knowledge and skills to others.

Given the great importance of decision-making processes in project-related, complex work contexts in the modern working world and for the long-term corporate or organisational development, it follows that it is important in today's modularised bachelor's and master's degree programmes to confront students with these processes in university courses and to make the decision-making and participation processes visible, name them, and reflect on them. According to Des Marais and Farzanehkia (2000), the transfer of decision-making authority and responsibility for decisions made is an important prerequisite for enabling leadership development in service-learning projects. In professional practice, the tasks of the

project manager or team leader often include moderating decision-making processes within the teams.

The motive behind this research study lies precisely here: to make processes that normally take place unconsciously visible. And to consider this in relation to the learning effect and the students' ability to reflect on it. A review of the literature also revealed that this area requires further research, primarily due to the anticipated benefits for students' preparation for their future professional practice and the limited number of studies in the field.

The sub-study presented in this paper specifically examined the following two research questions:

- What were the different ways of decision-making and consensus-building in the project? (RQ 1)
- What learning outcomes resulted from the decision-making and participation processes? (RQ 2)

At this point, I would like to briefly introduce the course in which the research object presented here was examined and explain why this course was particularly suitable for this purpose. For a more detailed description of the teaching format and the characteristics of the participating students, see Bittner (2025), Bittner and Kempchen (2024a) and Bittner and Kempchen (2024b). It should be emphasised that the newly developed course concept attempts to combine elements of two different teaching approaches: service-learning and community-based research, or research-based teaching and learning.

Service-learning as a specific approach to teaching and learning was described by Bringle and Hatcher (1995) as a:

> Course-based, credit-bearing educational experience in which students (a) participate in an organized service activity that meets identified community needs and (b) reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility. (p. 112)

Research-based learning follows the basic idea formulated by Lambert (2009) that "all students benefit from carrying out research" (p. 302). Basically, it can be said that this is an effective educational approach that combines research activities with university or academic learning, making an important contribution to increasing students' research knowledge and their ability to cope with unpredictabiliy and unclear, uncertain situations in science (Wessels et al., 2021), although the scope of the research activities can, of course, vary.

Both approaches share the commonality that students learn through practical experience and reflection on the experience gained, and that holistic development is promoted, which is an advantage in preparing for future careers after graduation. In addition to acquiring specialist knowledge, the acquisition of practical skills, personal development, and social skills also plays an important role.

Table 1 illustrates which elements of the two teaching approaches were included in the course.

Table 1

Characteristics of the Course That can be Assigned to the Teaching Formats Research-Based Teaching and Learning and Service-Learning

Research-Based Teaching and Learning	Service-Learning
▪ collaboration between students in research teams ▪ going through the various phases of the research cycle ▪ development of the research design for a small research study ▪ compilation and analysis of secondary data ▪ applying project management methods ▪ development of data collection instruments ▪ [data collection and analysis]* ▪ preparation of a final report ▪ discussion of the results in a final presentation	▪ collaboration with community partners ▪ addressing issues that are also relevant to the professional practice of employees in the relevant social organisations ▪ applying project management methods ▪ collaboration between students in teams ▪ holistic learning through practical experience ▪ stimulation of reflection processes ▪ appreciative end

Note. * Due to the restrictions imposed by the COVID-19 pandemic and the necessary conversion of the course to a purely online format, the collection and evaluation of primary data could not take place as originally planned.

The course, which lasted for two semesters, addressed the overarching issues of social inequality, poverty, and homelessness. It was organised in collaboration with three social organisations and vulnerable individuals in the case study cities of Bochum and Essen. The students worked on three small research projects, developing research questions that fit into the overarching framework topic. An important component was also working in student teams and learning project management skills in theory and practice.

Compared to other teaching formats, the high proportion of independent, albeit supervised, project work gave students greater freedom and therefore required them to make various decisions. These decisions pertained to the project's further content or specifically to how to address problems that arose. Due to the COVID-19 pandemic outbreak, approximately halfway through the project, the course format was converted to an online format for the remainder of the project. Coordination processes between the members of the individual student teams, and between the course instructor and students, then took place exclusively via digital communication channels. The development of the innovative didactic teaching concept for the course was financially supported by a teaching grant from the Ruhr University Bochum (cf. Ruhr University Bochum, 2020).

Methods

Research Design and Setting

I conducted a qualitative study, utilising written reflections from the students as a data collection method. The participants in the accompanying research study were students enrolled in the community-based research service-learning course during the academic years 2019 and 2020, who completed a written portfolio as a reflection assignment at the end of the course.

Participants

Of the original 16 participants who had chosen the course from various options, 15 students attended until the end and successfully completed the course. Among them were seven male and eight female students, aged between 21 and 27 with a mean value of 22.08. The majority came from North Rhine-Westphalia, where they were born and raised (53%). Two students were foreign-born; the other students were from Germany. The participants in the course, all of whom were advanced bachelor's students in geography, had good basic knowledge of human geography, methods of empirical social research, the application of geographic information systems and statistics relevant to the course.

Data Collection

The data used in this research study were obtained from the students' written reflections. I developed a learning portfolio inspired by the portfolios described by Häcker (2004) for project-based courses with seven reflection-stimulation questions. Reflecting on experiences is also considered an important component of experiential learning approaches (cf. Kolb, 2015). Personally, I found the explanations provided by Hatcher and Bringle (1997) on facilitating and designing reflection activities helpful. They see “reflection as the intentional consideration of an experience in light of particular learning objectives” (Hatcher & Bringle, 1997, p. 153). A portfolio fulfils this function in the form of a question-led written reflection.

The key questions developed in the portfolio related to various topics, including students' ideas about good leadership, successful team project work, risk management, and, in this study, the design of decision-making processes and the resulting learning effects.

One key question in the written reflections related to the qualitative study presented in this paper. It consisted of two sub-questions and was as follows:

- Think in general terms about the possibilities of having a say in the project and decision-making processes. Can you please describe these in more detail? You are also welcome to use examples.
- What have you learned from this?

The students had the opportunity to write their reflections at home or elsewhere, without time pressure, in a relaxed atmosphere. The portfolio was not linked to the final respective examination, which consisted of preparing a research report and a presentation as a team effort and was therefore not graded. The questions in the portfolio were answered by hand in only one case; all other students used a computer to type their thoughts. The handwritten version was converted into a typed version. The students provided answers to the relevant guiding question, which ranged from ¼ to ¾ of a page.

Data Analysis

The qualitative content analysis method, as described by Mayring (2010a, 2010b, 2022a; Mayring & Frenzl, 2019), was employed to analyse the written reflections. The available answers to the key question in the students' written reflections were coded inductively from the text material, which was analysed line by line. The content analysis was carried out using MAXQDA Analytics Pro software, version Release 22.8.0 (cf. Kuckartz, 2010; Rädiker & Kuckartz, 2019), but without the use of AI-supported tools, in accordance with the existing difficulties and limitations in the use of AI-supported data analysis technology, which

Mayring (2025) pointed out. The available text material was searched for concrete statements on possibilities, different forms of decision-making and consensus-building in the project and the resulting learning outcomes. New categories were formed step by step inductively while remaining close to the text. The content analytical units, evaluation unit, coding unit and context unit were defined at the beginning. The clear meaning component was defined as the smallest unit that may be coded, the coding unit. For quality assurance purposes, a second pass of the material was carried out by the same coder after an appropriate time interval. No major changes were made.

Results

The main findings of this research study are presented in the following chapter. The presentation of the results comprises two parts, each corresponding to one of the two research questions examined. Despite the small number of cases analysed, the usual form of result presentation used when conducting a qualitative content analysis, according to Mayring's (2010a, 2010b, 2022a) approach, is adhered to. This also means that the frequencies with which the individual categories occur are indicated. The reference value here is the documents that are analysed. In addition, to make the coding process somewhat more transparent, an example quote is given for each of the categories inductively derived from the analysed text material. It should be noted that the example quotations shown in the three tables may be longer than the actual coded text passage to make the content easier to understand for the reader of this paper.

Different Ways of Decision-Making and Consensus-Building in the Project

Table 2 summarises the key findings of RQ 1, which concerns the different forms of decision-making and consensus-building that occurred during the project work. Nine main categories were formed based on inductive category formation. These are listed in Table 2. The most common occurrences based on case-related frequencies are the three categories: tasks to be completed and to-do's, selecting a research topic and selecting the community partner (each category, 4 out of 10 documents). Looking at the frequencies, the category grouping of the team follows in descending order of category frequency (2 out of 10 documents). Other categories that were only mentioned once are views on the work in the project, choice/selection of the study module, plans to achieve the research objective, structure and content of the final report, problems and questions.

Table 2

Frequencies of Main Categories (Documents With Codes) – Different Ways of Decision-Making and Consensus-Building

	Documents	Percentage	Percentage (valid)
Tasks to be Completed and To-Do's	4	26.7	40.0
Selecting the Research Topic	4	26.7	40.0
Selecting the Community Partner	4	26.7	40.0
Grouping of the Team	2	13.3	20.0
Views on the Work in the Project	1	6.7	10.0
Choice/Selection of the Study Module	1	6.7	10.0
Plans to Achieve the Research Objective	1	6.7	10.0
Structure and Content of the Final Report	1	6.7	10.0
Problems and Questions	1	6.7	10.0
DOCUMENTS with code(s)	10	66.7	100.0
DOCUMENTS without code(s)	5	33.3	-
ANALYSED DOCUMENTS	15	100.0	-

Table 3 presents the categories developed for RQ 1, each illustrated by an example quote from students' written reflections as evidence.

Table 3

Category System with Sample Quotes – Different Ways of Decision-Making and Consensus-Building

- **Tasks to be Completed and To-Do's**
  Sample Quote: "The day was about redistributing the tasks and bringing the members up to date with the latest knowledge. When it came to allocating tasks, I thought it was very good that it wasn't said: "You do this and you do that, ok?" Instead, we were asked which tasks we wanted to take on and which we were confident about." (*Paolo Blümel, male, age: unknown)*
- **Selecting the Research Topic**
  Sample Quote: "Especially in the first semester of the project, for example when we were finding topics, we students were given the opportunity to choose the topics that interested us. As long as the topics matched the overall theme of the study project. We were also always able to contribute our ideas in discussions with the course instructor and then received feedback on which ideas were feasible and which were not. " *(Enno Roskoth, male, age: 21)*
- **Selecting the Community Partner**
  Sample Quote: "We were also able to choose the engagement partners ourselves from those available."(*Nico Gunf, male, age: 24)*
- **Grouping of the Team**
  Sample Quote: "Another decision was made in the choice of team, where each student had the right to choose their team members according to their own interests." (*Carmen Spieß, female, age: 27)*
- **Views on the Work in the Project**
  Sample Quote: "This also applied within the team. Here, views and comments on the work in the project were expressed and discussed." *(Enno Roskoth, male, age: 21)*
- **Choice/Selection of the Study Module**
  Sample Quote: "At the beginning there is the decision to choose the module, which each student has chosen based on individual motivation. This is linked to the participation in the module itself, the conscientious fulfillment of the tasks and requirements. " (*Carmen Spieß*, female, age: 27)
- **Plans to Achieve the Research Objective**
  Sample Quote: "In the team, each member had the opportunity and also the duty to participate in the decision-making process of tasks and plans for the realisation of our research project and goal." *(Alfons Eberth, male, age: 21)*
- **Structure and Content of the Final Report**
  Sample Quote: "The same was applied to decision-making processes, which often concerned the structure and content of the final report."*(Wolfram Wagner, male, age: 21)*
- **Problems and Questions**
  Sample Quote: "These were then evaluated in the next meeting and any problems or questions were dealt with." *(Wolfram Wagner, male, age: 21)*

Learning Outcomes From Decision-Making and Consensus-Building Processes in the Project

The results for RQ 2 will now be presented in this section. The students named a large number of different learning outcomes. The following categories occur several times (unit of analysis: documents): everyone should be able to express their opinion (3 out of 12 documents), importance of communication in the team, individual strengths of the team members are an advantage, dealing with opposing ideas and opininions is seen as positive and pro & con list as an important tool (each category, 2 out of 12 documents). The following categories appeared once: Q & A session is an important tool, brainstorming as an opportunity for participation, processes should be moderated, dealing efficiently with the covered topics, getting to know your interests better, active and passive participation opportunities, decision-making is not a straightforward process, personal involvement increases motivation, a relaxed atmosphere for discussion is important, appreciation of diverse ideas, assignment of tasks according to knowledge and preferences, first decision should lie with the team leader and group size affects decision-making processes.

Tables 4 and 5 illustrate the developed category system. For each category relating to RQ2, an example quote from the written reflections is provided.

Table 4

Category System With Sample Quotes – Learning Effects From Decision-Making and Participation Processes

- **Everyone Should be Able to Express Their Opinion**
  Sample Quote: "A say in the project can only be achieved if all members have a voice."
  (Ludmila Mude, female, age: 21)
- **Importance of Communication in the Team**
  Sample Quote: "This teaches us that communication within a team is extremely important."
  (Maria-Luise Haase, female, age: 22)
- **Individual Strengths of the Team Members are an Advantage**
  Sample Quote: "The individual strengths of each person are particularly helpful in this regard."
  (Wolfram Wagner, male, age: 21)
- **Dealing With Opposing Ideas and Opinions is Seen as Positive**
  Sample Quote: "Since everyone has their own opinion and should be able to express it, it can happen in groups that not everyone agrees. In some cases, it would not be good if everyone had the same opinion. Different opinions allow you to see things in a different light than you did at first."
  (Berta Schleich, female, age: 22)
- **Pro & Con List as an Important Tool**
  Sample Quote: "The pros and cons list is also worth mentioning. In my opinion, it is an important tool for decision-making, alongside gut instinct. There are countless templates available online. They can be very simple or very detailed. The advantage is that they can be implemented quickly. They can also be created as group work in team meetings, giving you a much broader view of the pros and cons of various solutions."
  (Amelie Scheibe, female, age: 21)
- **Q&A Session as an Opportunity for Participation**
  Sample Quote: "Possible ways of participating could include an open Q&A session or brainstorming.This allows each team member to express ideas, wishes, comments, suggestions and problems." *(Ludmila Mude, female, age: 21)*
- **Brainstorming as an Opportunity for Participation**
  Sample Quote: "Possible ways of participating could include an open Q&A session or brainstorming. This allows each team member to express ideas, wishes, comments, suggestions and problems."
  (Ludmila Mude, female, age: 21)
- **Processes Should be Moderated**
  Sample Quote: "A say in the project can only be achieved if all members have a voice. For this reason, one person should moderate these processes." *(Ludmila Mude, female, age: 21)*

- **Dealing Efficiently with the Covered Topics is Important**
  Sample Quote: "and [I] dealt with the topics covered efficiently." *(Nico Gunf, male, age: 24)*
- **Getting to Know Your Own Interests Better**
  Sample Quote: "Ultimately, we had a great deal of freedom to make decisions and gradually focused more and more on our individual areas of interest. This allowed me to get to know my interests better."*(Nico Gunf, male, age: 24)*
- **Active and Passive Participation Opportunities**
  Sample Quote: "There are many different ways to have a say in a project and decision-making processes. Members can participate actively and passively."*(Berta Schleich, female, age: 22)*
- **Decision-Making is not a Straightforward Process**
  Sample Quote: "It can also happen that you make the wrong decision at first and only realise during the course of the project that other decisions might have been better. For example, defining the research question proved more difficult than originally thought. Everyone had different ideas and shared them. We then decided on one idea, but realised during the course of the project that we needed to change the research question due to various changes. This brought the other ideas back to the surface." *(Berta Schleich, female, age: 22)*
- **Personal Involvement Increases Motivation**
  Sample Quote: "The opportunity to contribute their own ideas made people feel more involved in the project, which also increased motivation."*(Enno Roskoth, male, age: 21)*

Table 5

Continuation – Category System With Sample Quotes – Learning Effects From Decision-Making and Participation Processes

- **Relaxed Atmosphere for Discussion is Important**
  Sample Quote: "That's why I think it's very important to sit down together in a relaxed atmosphere and give everyone the opportunity to present and explain their views."
  (Amelie Scheibe, female, age: 21)
- **Appreciation of Diverse Ideas is Important**
  Sample Quote: "In a team, it is common and normal for different ideas and opinions to exist. That is why it is important to acknowledge this first." *(Carmen Spieß, female, age: 27)*
- **Assignment of Tasks According to Knowledge and Preferences**
  Sample Quote: "If I have understood the question correctly, one example would be the first meeting of the new large team C & D. That day was about redistributing the tasks and bringing the members up to date with the latest knowledge. When it came to allocating tasks, I thought it was very good that they didn't say: "You do this and you do that, ok?", but asked which tasks we wanted to take on and which we were confident about." *(Paolo Blümel, male, age: unknown)*
- **First Decision Should Lie With the Team Leader**
  Sample Quote: "Through this type of decision-making, I have learned that it works best in a project team if decisions are first evaluated and weighed up by a team leader, but are still presented to the team and reconsidered if necessary." *(Alfons Eberth, male, age: 21)*
- **Group Size Influences Decision-Making Processes**
  Sample Quote: "Due to the size of the group, there were difficulties in arranging appointments. Very often, at least one of us was not present and this led to delays in important decision-making processes."
  (Norma Girschner, female, age: 22)
- **No Concrete Learning Effects can be Named**
  Sample Quote: "Looking back, there were never any problems with decision-making, so I don't think there was much of a learning effect. I can't think of any specific examples."
  (Hans Jörg Lange-Pölitz, male, age: unknown)

Summary

In summary, the most important results of the study can be summarised as follows:

Based on the available answers in the written reflections, it could be demonstrated that students were able to recognise and describe various decision-making processes that took place during the project work in the community-based research service-learning course. Both

strategic decisions and normal decisions with less far-reaching consequences that had to be made during the project work were listed.

Students' learning outcomes identified from the decision-making processes are diverse, but can be roughly divided into learning effects relating to the design of communication processes, helpful methods that can be used in decision-making and coordination processes in the team, learning effects relating to the general organisation or design of processes that address the duties of the team leader or the responsible manager in particular, the special role of the team leader in the decision-making processes, the general value of individual participation in decision-making and coordination processes, influencing framework conditions and a general view of the decision-making process as a non-straightforward process.

Strengths and Limitations

The study has important limitations which should be named. The number of study participants was small, and although the answers given in the written reflections varied in length, they were shorter in comparison to the answers given in qualitative interviews. This causes problems in two respects.

Both the number of cases and the selection of cases play a role in deriving conclusions that go beyond the actual results obtained from the data, as is often the case in qualitative research. Even if there are differing views on the importance and necessity of generalising the results of qualitative research according to the scientific theoretical position taken (cf. as an overview Mayring, 2007) it should be pointed out that this is usually the aim of content analysis (Mayring, 2022b).

In the context of the accompanying research, the case selection was determined in advance by the necessary focus on the participating students in the community-based research service-learning course, with whom the principal investigator had contact as the responsible lecturer, as well as the university funding received for the course. The number of cases then resulted from the number of students who voluntarily agreed to participate in the accompanying research study. The possibilities of deriving more general conclusions from the study results are therefore limited and should be approached with necessary caution.

The necessary depth of the analysis naturally also depends on the available data material on the individual cases. The use of written reflections as response texts to predefined key questions offers the advantage that students can prepare these independently, undisturbed, and at their own flexible pace. However, there is no direct interaction between the researcher and study participants and therefore no opportunity for the researcher to initiate a longer, more detailed narrative or to clarify ambiguities through more specific follow-up questions, as is the case with qualitative interviews. This leads to limitations in the depth of the analysis.

Conclusion

In summary, the qualitative research study demonstrates that project-based learning formats with integrated teamwork and increased freedom for student work require very different decision-making and consensus-building processes. Students need to make their own decisions, agree on a course of action in a team and agree on the next steps, much more than in conventional instructional learning formats. On the one hand, this places high demands on

the students, but in the protected framework of a university course, they practice self-organisation, clear identification of the problem or the desired goal, communication skills, openness to the views of others, and they take part in moderated processes for consensus and decision-making in a team and have to take responsibility for decisions made and actions taken. The findings also support the conclusion that practising such decision-making processes in a team is highly valuable for students and sets various learning processes in motion, which can be made conscious through stimulated reflection processes. This provides students with advantages for their future professional practice.

Reflections in the present form, as question-driven written assignments, have proven to be a useful tool for encouraging students to engage critically and in-depth with specific topics related to the overarching learning objectives of the course, to review their own experience and to view them from a meta-perspective. In the future, it would be beneficial to incorporate the findings of the empirical study by Hatcher et al. (2004) more closely into the design of experiential learning experiences, as they demonstrate that effective reflections are linked with the classification of a course as a good learning environment. Good reflections are characterised by regularity, structure, and a connection to the students' values (Hatcher et al., 2004). Ideally, reflection should occur at various points throughout the course. In the community-based research service-learning course presented here, this took the form of an oral exchange with the students, but the written reflection based on questions was limited to the end of the course.

It appears valuable to undertake further investigation to explore the different forms of decision-making processes in project-based teaching formats and the resulting learning effects on students. It is recommended to have a larger number of study participants, for example, by extending the study to several courses with a similar structure, the same didactic concept, and the same teaching methods used.

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Integrating the Sustainable Development Goals Into Croatian Higher Education: A Content Analysis of University Strategic Documents

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Abstract

The integration of the Sustainable Development Goals (SDGs) into higher education policy is an important step towards fostering a responsible, transformative academic environment. This study focuses on a content analysis of Croatian universities' strategic documents to understand how the contribution to the implementation of the SDGs is addressed. A content analysis protocol was created to code all points of the strategic documents that address the facilitation of the realization of the SDGs within the core academic activities (in research, teaching, management and community engagement). The analysis shows that while universities emphasize the importance of their own societal impact and sustainable development in general, the integration of the SDGs and SD remains uneven in both scope and depth across institutions. The strategic documents are generally aligned with the SDGs, such as Quality Education (SDG 4), Industry, Innovation and Infrastructure (SDG 9) and Sustainable Cities and Communities (SDG 11), but detailed frameworks for how academic staff can contribute to these goals are not clearly outlined.

Keywords: higher education institutions, sustainable development, sustainable development goals, university strategies

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Introduction

Contemporary society is confronted with a range of complex challenges that stem largely from human activity. This is primarily manifested in a large number of global inequalities and disparities among individuals and communities, and a general imbalance between human needs and the exploitation of available natural resources. Accelerated technological advancements are transforming numerous aspects of daily life, and yet such progress is frequently insufficiently directed toward ensuring equality, democratic participation and social inclusion (UNESCO, 2021). Addressing these multifaceted issues, alongside the demands of modern living, require creative, adaptive, and self-organized action (Bai et al., 2016). In this context, the Sustainable Development Goals (SDGs) were adopted by the United Nations member states at the United Nations Sustainable Development Summit as part of the 2030 Agenda for Sustainable Development. The stated goals are aimed at eradicating poverty, fighting against inequality and injustice, and addressing the climate change by 2030 (United Nations, 2015). In the Agenda 2030, particular emphasis is placed on education, which is regarded not only as a means of advancing all 17 SDGs, but also as a distinct objective in its own right. Specifically, SDG 4 underscores the need to promote and ensure inclusive and high-quality education (UNESCO, 2017).

The Role of Universities in Shaping a Sustainable Future

The role of educational systems in shaping a sustainable future is often emphasized and widely acknowledged, with higher education institutions, especially universities, holding a distinctive position in this process (Prior et al., 2025). Universities are increasingly perceived as key agents, capable of steering society towards more sustainable trajectories (Berchin et al., 2021). This role has been conceptualized through various models emphasizing the multidimensional integration of sustainability across key domains of university functioning: teaching and learning, research, campus operations and governance (management), and community engagement (Findler et al., 2019; Henderson et al., 2017; Lozano & von Haartman, 2018). According to these models, transformative sustainability integration requires not only the adoption of sustainability principles in strategic documents but also their operationalization through measurable targets, concrete action plans, and monitoring mechanisms. Without such operationalization, sustainability risks being reduced to rhetorical commitment rather than institutional practice (Leal Filho et al., 2023).

In recent years, sustainability has emerged as a central pillar of strategic planning within higher education institutions (Duarte et al., 2023). Well-designed higher education institutions' strategic plans encompass environmental, social, and economic dimensions, thereby aligning institutional objectives with global sustainability commitments (Franco et al., 2019). While insufficient on its own, the integration of the SDGs into higher education policy is recognized as an essential initial step towards fostering a responsible and transformative academic environment (Leal Filho et al., 2023). Nevertheless, the representation of the SDGs in university strategies often remains limited, and discrepancies between formal strategic documents and actual institutional practices can be found (e.g., Blasco et al., 2020; Duarte et al., 2023; Sanches et al., 2023). Such inconsistencies indicate the need for coherent coordination and robust monitoring mechanisms.

Despite the growing body of international literature addressing the integration of the SDGs into higher education policies and strategic planning (e.g., Leal Filho et al., 2023; 2024; Prior et al., 2025; Sanches et al., 2023), empirical evidence from the Croatian context remains

scarce. This lack of systematic investigation limits insights into the extent to which Croatian universities align with global sustainability agendas and adapt them to local socio-economic and policy conditions. Therefore, the aim of this study was to examine the extent and manner in which SDGs are integrated into the strategic frameworks of Croatian universities.

Methodology

This study employed a qualitative content analysis of 7 Croatian universities' strategic documents (University of Zagreb, Split, Rijeka, Zadar, Dubrovnik, Juraj Dobrila University of Pula, Josip Juraj Strossmayer University of Osijek). The units of analysis were the official strategic plans of each Croatian university, as publicly available on their institutional website. Strategic documents were collected in their most recent versions.

The content analysis proceeded in several steps. First, a protocol was created to code all points of the strategic documents that address the facilitation of the realization of the SDGs within the core academic activities (in research, teaching, management and community engagement). The coding framework was based on the 17 SDGs and the corresponding targets. The framework was adapted to allow for the identification of both explicit references to the SDGs (e.g., the Agenda 2030, direct mention of a specific SDG, etc.) and implicit alignments (e.g., references to sustainability related concepts such as climate action, social equity, or inclusiveness). Second, the strategic documents were systematically reviewed and coded using a coding framework. For each document, occurrences of SDG related content were recorded and categorized under the following dimensions: (I) general orientation towards SD/SDGs, (II) integration of SD/SDGs in teaching strategies, (III) integration of SD/SDGs in research agendas, (IV) community engagement in line with SD principles or SDGs, (V) institutional governance and management plans promoting sustainability and SDGs. Coding was conducted manually using MAXQDA software.

Results and Discussion

Different Levels of SD and SDGs Integration

The analysis reveals three distinct levels of integration of SD and the SDGs within the strategic documents of Croatian universities:

(I) *Minimal or no mention of SD/SDGs* – The focus on universal themes of sustainable development is recognized, but without explicit reference to the SDG framework.

(II) *Explicit reference to SD/SDG principles without a clear operational framework or implementation plan* – The strategies in this category mention specific SDGs or SD principles, but there is no clear action plan to achieve them. Here, the SD/SDGs are stated as general principles on which the strategies are based rather than as operationalized objectives. Most universities fall into this category.

(III) *Comprehensive integration of SDGs/SD across academic functions supported by specific action plans* – This level, which entails full alignment of teaching, research, management, and community engagement with the SDGs, is rarely observed in the national academic context.

An interesting finding is that smaller universities, such as the University of Dubrovnik, tend to demonstrate greater commitment to SD/SDGs and are more inclined to develop detailed implementation plans to achieve the SDGs and SDs compared to larger and older universities such as the University of Zagreb.

Focus on Specific SDGs

Among the SDGs, SDG 4 (Quality education) emerges as the most prominent, appearing in all analyzed strategies, even those that do not directly mention sustainability. Particular emphasis is placed on the development of new study programs, curricula, and lifelong learning initiatives tailored to diverse student profiles, as well as the introduction of interdisciplinary programs. Other than SDG4, which appears in all strategies, SDG17 (Partnerships for the goals) is also frequently represented, mostly through activities such as networking with European education and research initiatives (e.g., SEA-EU, YUFE). Goals that can also be identified as priorities in university strategies are SDG5 (Gender equality) and SDG10 (reducing inequality). Universities mainly focus on ensuring equal opportunities for all, caring for vulnerable and underrepresented groups, and improving educational accessibility. SDG 9 (Industry, innovation and infrastructure) is also present in strategies through plans to develop transdisciplinary research centers and promote technological innovations, while SDG 13 (climate action) is reflected in green campus initiatives, green practices, energy efficiency measures and climate adaptation strategies.

SDGs in Core Academic Activities

The last aspect of the strategy analysis is focused on the analysis of SD and SDGs representation in core academic activities.

Teaching is the domain where the strongest alignment with SD and the SDGs can be observed. Strategic documents frequently emphasize fostering "competencies of the future". In this sense, democratic competences, the development of critical thinking, active citizenship, system thinking are mentioned, all of which are key topics in the Education for sustainable development and aspects of sustainability competencies (e.g., Adomßent & Hoffmann, 2013; Bianchi, 2020; Bianchi et al., 2022; Redman & Wiek, 2021; Rieckmann, 2018; Wiek et al., 2011, 2016). Nonetheless, the introduction of new study programs based on the SDGs or similar initiatives is mentioned to a lesser extent.

When it comes to *research*, there is no explicit link to the SDGs and SDGs. The greatest focus is placed on quantitative indicators, such as the number of funded projects, publication indexed in the Web of Sciences and Scopus, and the establishment of research groups, etc. Any connection between these research activities and the SDGs is largely implicit and infrequent.

Least addressed domain in universities strategies is *management*, both in respect to the SDGs/SD and in general. In universities' strategic documents sustainability mainly appears through green campus initiatives, rather than being integrated into governance structures. Although management (or governance) is considered a key aspect of fostering sustainability in higher education institutions (Leal Filho et al., 2023), in the Croatian academic context, focus is rarely placed on connecting this core academic activity with SD/SDGs.

Community engagement is frequently mentioned in universities strategies, though seldom explicitly linked to the SD/SDGs. Universities contribution to the realization of the SDGs in this core academic activity is primarily framed in terms of knowledge transfer and the fulfilment of universities' social responsibility.

Conclusion

Although the SDGs are institutionally embedded in the strategic frameworks of most Croatian universities, their integration remains uneven in both breadth and depth across institutions. The majority of SDG references are related to the quality of education, innovation, and the green transition. While detailed implementation plans exist in some universities, a comprehensive integration of the SDGs as a strategic framework is still lacking.

To better align Croatian higher education with global sustainability efforts, it is necessary first of all to formally embed the SDG framework in strategic documents. More specifically, all universities should explicitly link their institutional goals to the SDGs. Universities that have already integrated the principles of SD and SDGs into their strategies and activities, such as the University of Dubrovnik, can serve as an example of good practice. In addition, what is missing from most of the analyzed universities are detailed action plans of work on SD/SDGs. Berchin et al. (2021) also find that in promoting sustainability by higher education institutions, it is most important to set clear goals whose achievement will be monitored and measured through various tools. Finally, it is important to put greater emphasis on management as core academic activity, which in the context of sustainability has been neglected in most of the analyzed strategies.

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

The author declares that Instatext, 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 Instatext, 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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